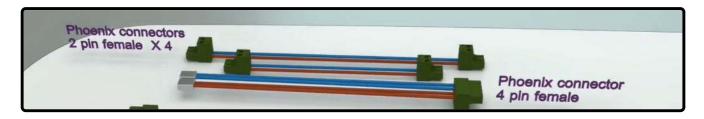


Tester AMT105 Manual

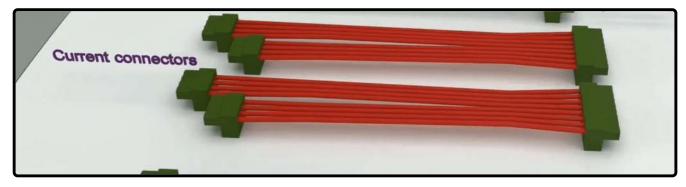
1 : ASSEMBLYING STAGES OF AMT105 TESTER



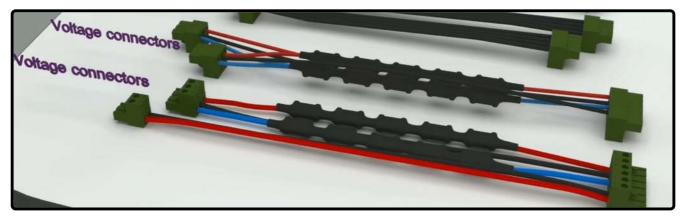
Four wires with 4 pin female Phoenix connectors



Current connectors



Voltage connectors



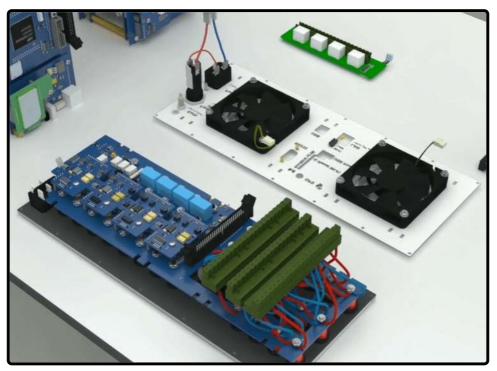
Ribbon cables



Neutrik board

Back panel

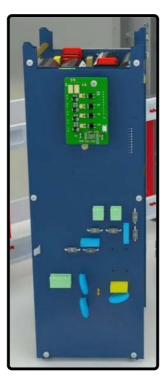
Front panel



Switching module Complete side of switching module



Incomplete side of switching module



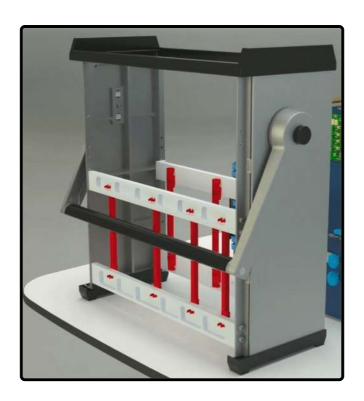
Amplifier module Complete side of amplifier module



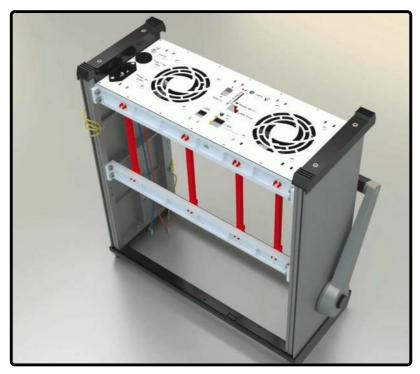
Incomplete side of amplifier module

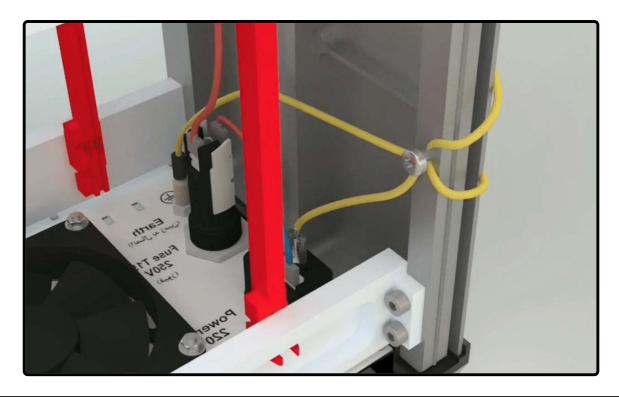


Case



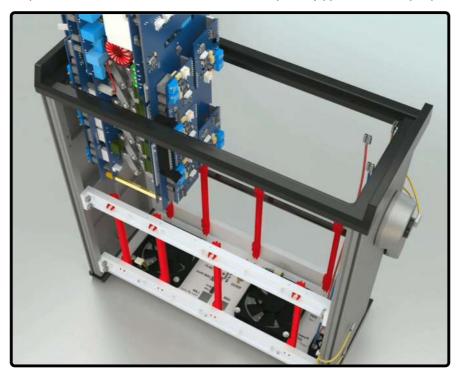
To assemble the device, you must first install the back panel on the case. Stand the case in front of you, in a way that the power socket is on your right side. Connect one of the earth wires to the power socket and the other one to the earth socket.





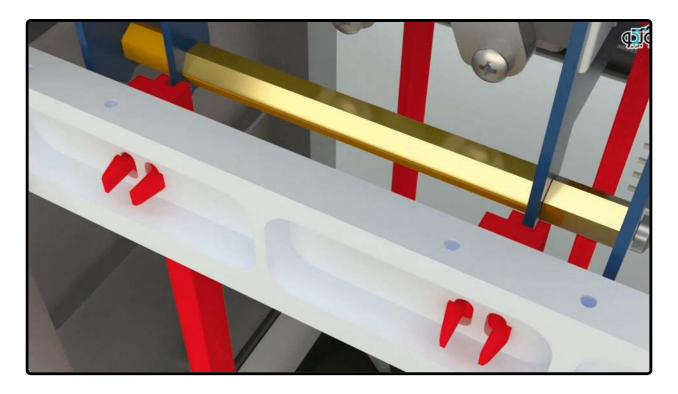
Placing the amplifier module in the case

The amplifier module is placed into the case where the racks are less spaced (opposite to the input power socket).



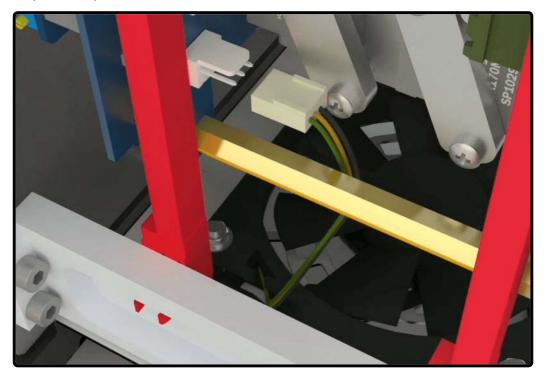
Position of amplifier module inside the case

The complete side of the amplifier goes to the case wall. The edges of the module should be placed inside the 4 racks.



Connecting the socket of fan to the amplifier module

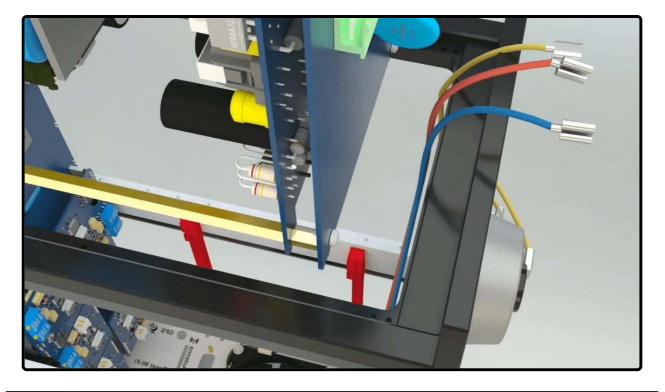
Insert the module up to 5 cm to the end of the case, then take the fan wire from the back of the Spacer and connect the socket to the amplifier then push the module to the bottom of the case.



Note: make sure that the fan wire is not under any modules or inside the fan.

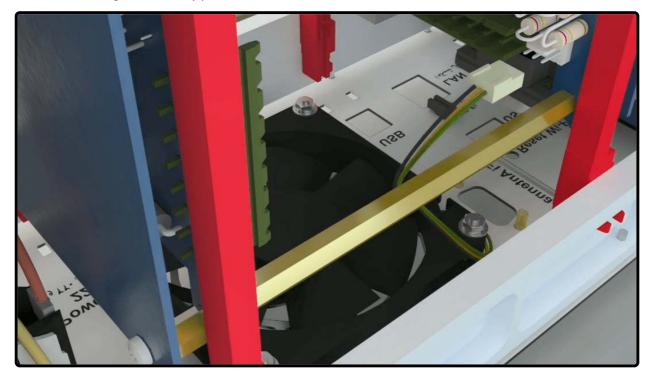
Position of amplifier module inside the case

The incomplete side of the switching module (the one that only has a command board) should be on the side of the case's wall, so that the Ethernet, USB, RS232, Wi-Fi and GPS ports are downward and placed in the rear panel.



Connecting the socket of fan to the switching module

Insert the module up to 5 cm to the end of the case, then take the fan wire from the back of the Spacer and connect the socket to the switching module finally push the module to the bottom of the case.

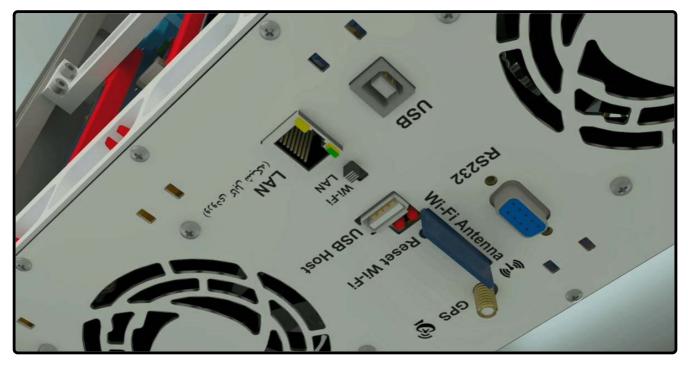


Complete fitting of the switching module

By shaking the GPS port, the switching module must be fully placed at the bottom of the case.



Ethernet and USB socket must be 1 to 2 mm away from the back of the case. If the socket of the Ethernet and USB are stuck, In case ports are stuck shaking them allows them to come out from the back panel.



Note: make sure that the fan wire is not under any modules or inside the fan.

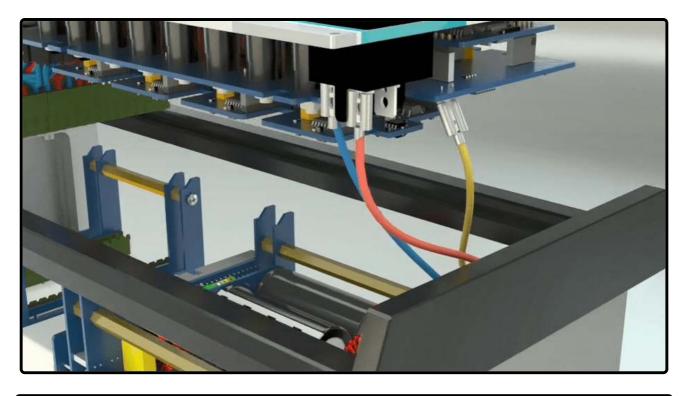
Installing the front panel

Before installing the front panel, check that the varnished wire connected to the back panel is completely straight.

Connecting the input power cable (varnished tube)

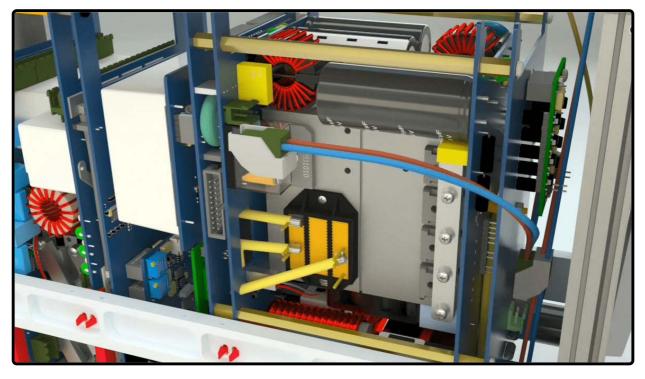
Connect the two heads of wires that come from the back panel to the zero side of the power switch on the panel.

The guards must be faced outwards so that they can be easily opened.



Connecting four 2 pin Phoenix connectors

First, connect two 2 pin female Phoenix connectors to the incomplete board of the switching modules. Connect the other side to the switching modules.

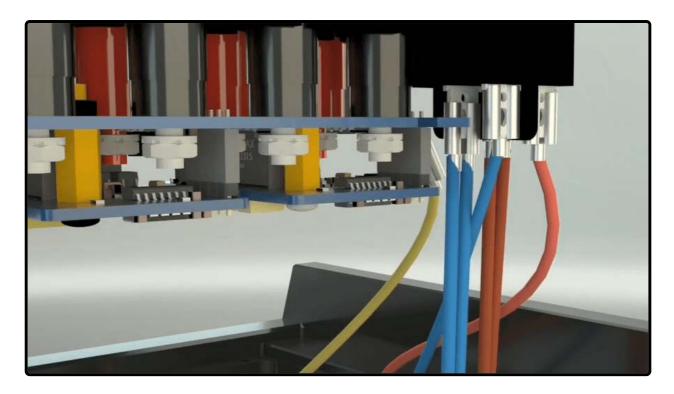


Connecting a 4 pin Phoenix connector

Connect one side of the corresponding power cord to 1 key and connect the Phoenix side to the incomplete switching switchboard.

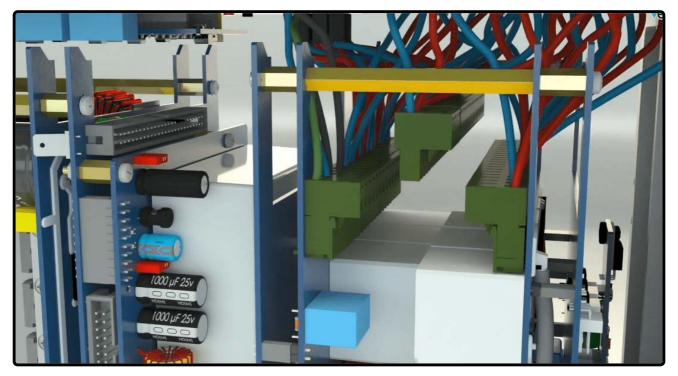






Connecting the Phoenix Connectors of the Front Panel

First, on the left side, connect the corresponding Phoenixes to the amplifier. You should first connect the two 16 pin Phoenixes and then connect the two 5 pin Phoenixes.

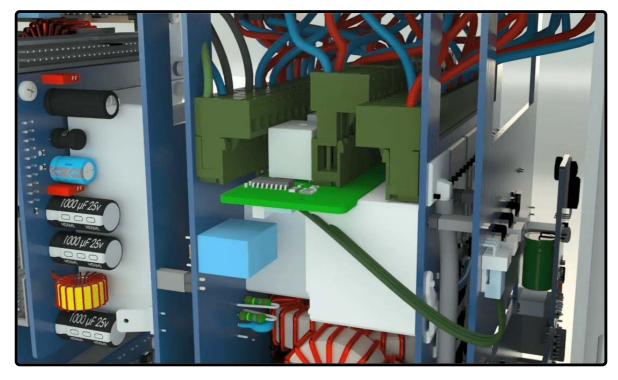


Then install the appropriate phoenixes to the right side of the amplifier.



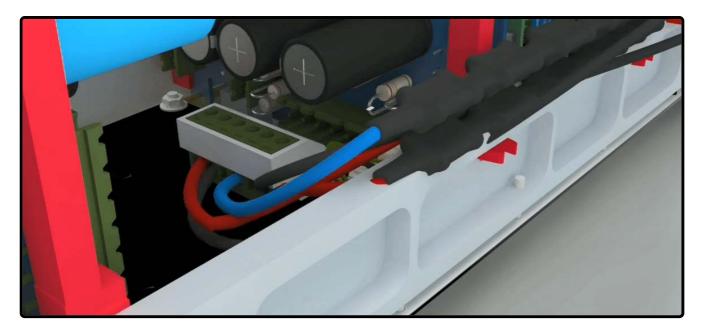
Connecting the Neutrik Board

First, turn the device in a way that its socket is to your left and the Neutrik board is placed between the amplifier phoenixes so that its socket is to your right. The socket connects to the complete board of amplifier.



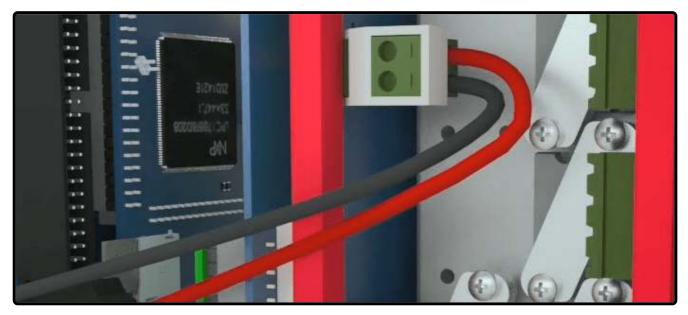
Complete Installing at front panel

The holder is placed half way on the 6 pin Phoenix voltage connectors. Connecting the voltage 6 pin Phoenix on which the holder is placed to the switching and put the holder in place.

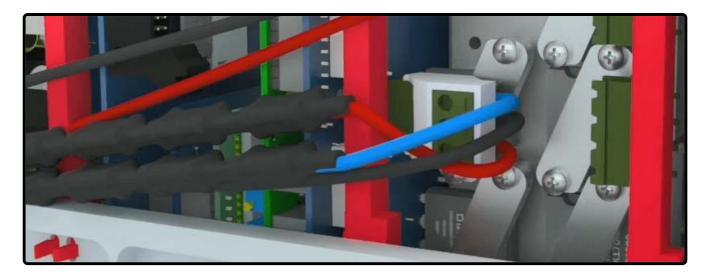


Connecting the voltage connectors to the incomplete side of amplifier

2 pin female Phoenix connectors with shorter wires (red and black) should be connected to the upper 2 pin male Phoenix connectors.

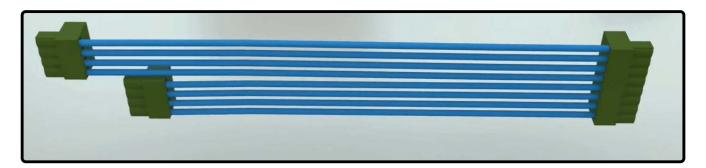


3 pin female Phoenix connectors with shorter wires (red, black and blue) should be connected to the lower 3 pin male Phoenix connectors.

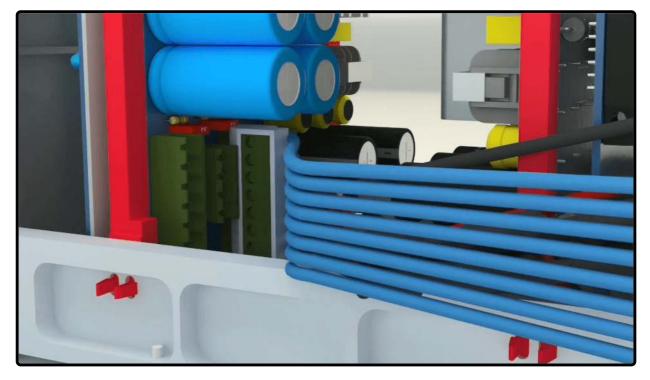


Tip: Before placing the phoenixes on the amplifier, place the corresponding holders on phoenixes.

Connecting the current connectors to the incomplete side of switching



First, put a holder on the 8 pin current Phoenix (blue wire) and connect the internal 8 pin Phoenix to the incomplete switching board.



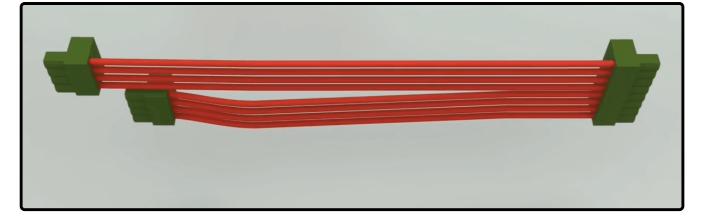
Connect the 4 pin blue longer Phoenix holder to the second male Phoenix from the bottom. Connect the 4 pin blue shorter Phoenix holder to the first male Phoenix from the bottom.



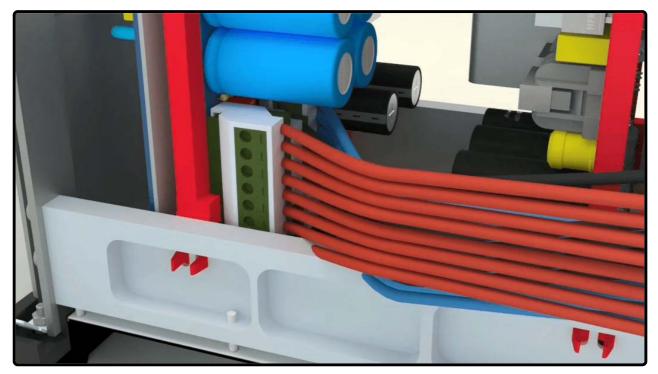
Put a holder on the 4 pin current Phoenix (black wire) and connect it to the incomplete switching board. Connect the 4 pin black male Phoenix to the first male Phoenix from the top.

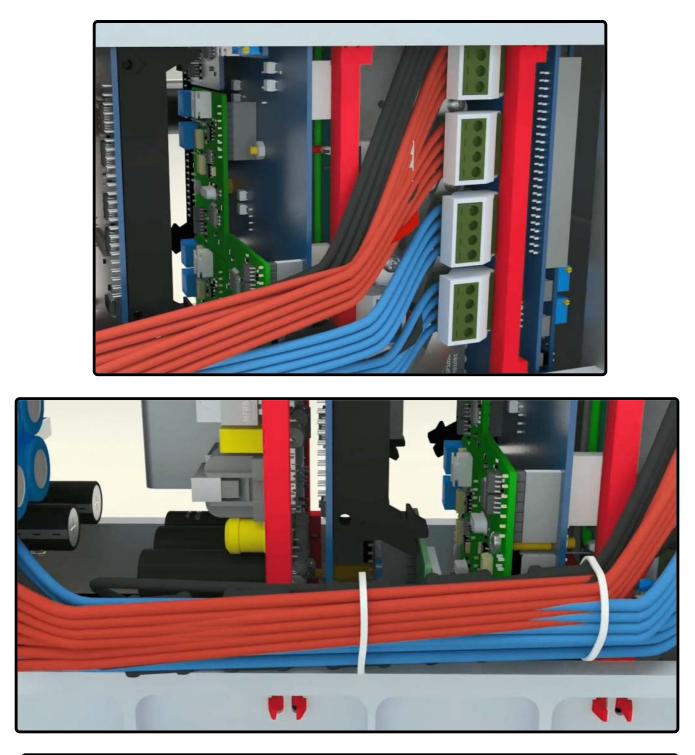


Put an 8 pin Phoenix (red wire) current and connect it to the 8 pin male Phoenix of the incomplete switching board.



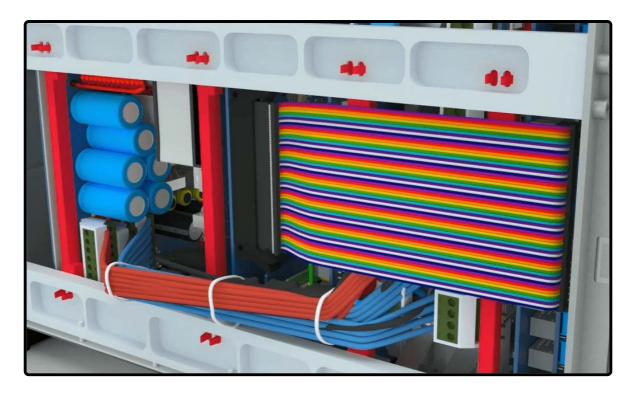
Connect the 4 pin female Phoenix with longer red wire holder to the second male Phoenix from the top. Connect the 4 pin female Phoenix with a shorter red wire holder to the third male Phoenix from the top. Then assemble all the current and voltage wires with a cable tie wrap.





Closing a 16 cm 25 * 2 ribbon cable (both sides without a guard)

This ribbon cable connects the entire side of the switching range to the full range of the amplifier.

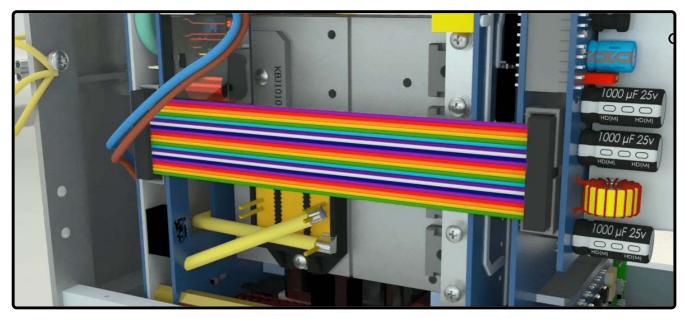


Install a short legged IDC holder on the side of the amplifier module attached to the wall case.

Connect the holder from one side to the IDC and connect it to the IDC by using a screwdriver or one forceps.

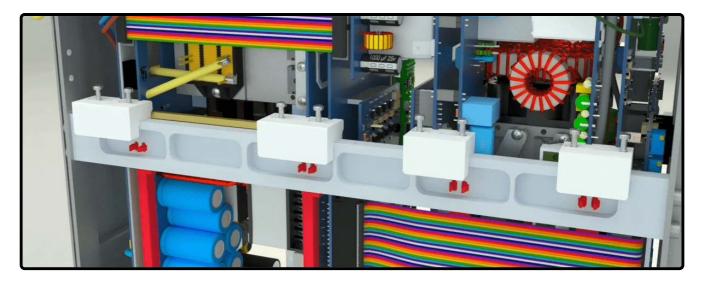
Connecting a 15 cm 2*10 Ribbon Cable

Connect the incomplete cable to the complete side of the switching module.



Installation of two amplifier holders and two switching holders on the middle rails of the case

Holders must be placed on the rails and the two slots embedded on them should be placed on the module and the original board. Each holder is closed and tightened by 2 screws 16.5×2 soaked in a special screw along with a ribbon gasket on the holder and middle rails.



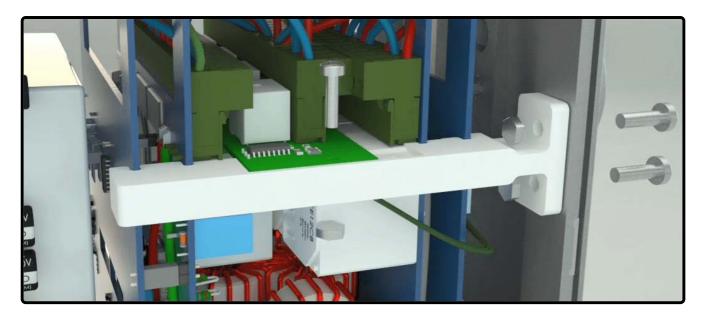
Placing the Micro Holder

Place the micro holder on the middle rail on the one side and its two pins must be placed on the lower rails of the case on the other side.



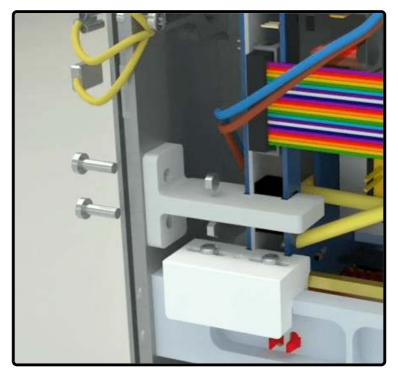
Placing the amplifier holder and Neutrik board

This holder is connected to the body of the case from one side using bolts, nuts and 8×4 flat washers. The slots embedded on this holder, on the other side, are connected to the amplifier and the neutrik board. The neutrik board on this holder is fastened by a special glued 8×3nut to a bolt and a spring washer.



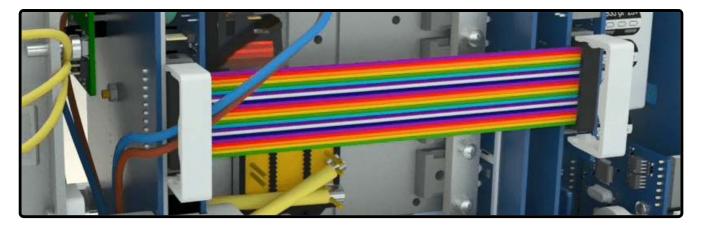
Installing the holder of the module board and main switching

This holder is connected to the wall of the case on one side and connected to the body of the case using bolts, screw washers, and a 8×4 flat. The other side is connected to the module and main switching.



Installation of 10 * 2 IDC holders of 10 * 2 15 cm ribbon cable

Place the 2*10 holder on a ribbon cable and push it slightly towards the IDC.

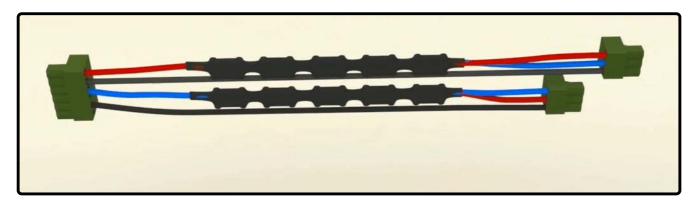


Connecting the Earth wires

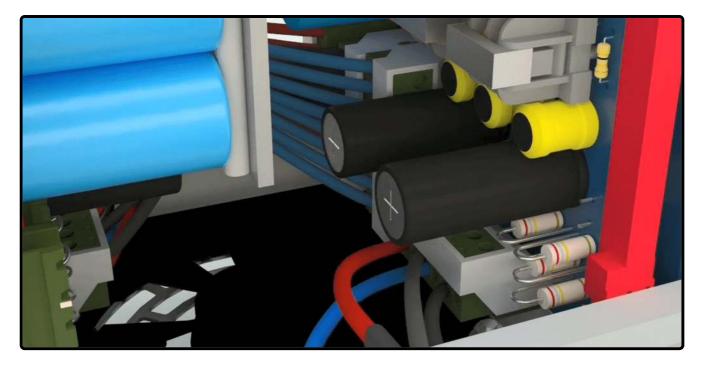
The 2 connected wires to the case must be connected to the complete switching module and the incomplete side of the amplifier module.



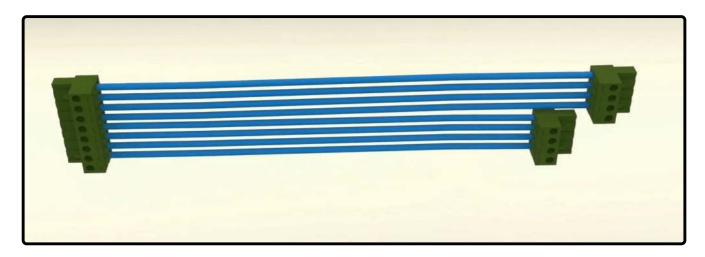
Connecting the voltage connectors to the incomplete side of switching



Connect the 6 pin Phoenix voltage cable on the holder to the switching module and put the holder in its place.

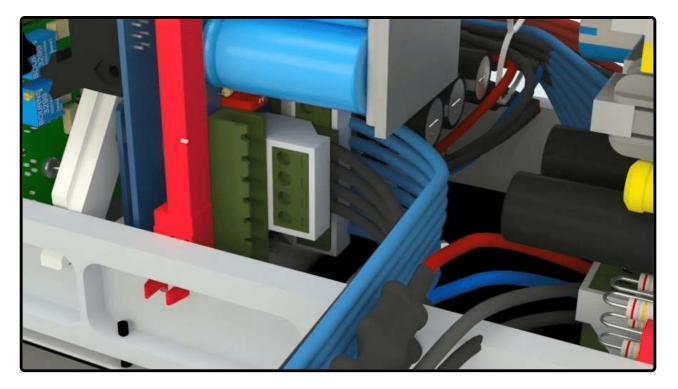


Connecting the current connectors to the complete side of switching

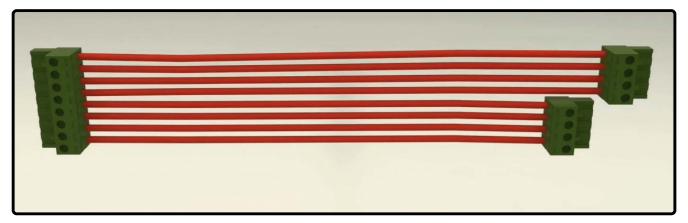


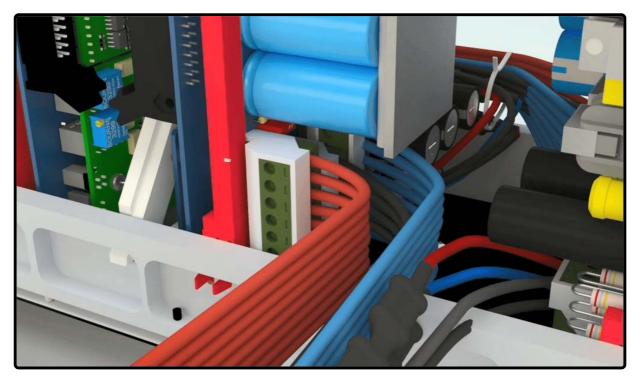
First, connect the 8 pin black Phoenix wire with its holder to the complete switching module.

Then connect the 4 pin black Phoenix wire with its holder to the complete switching module.



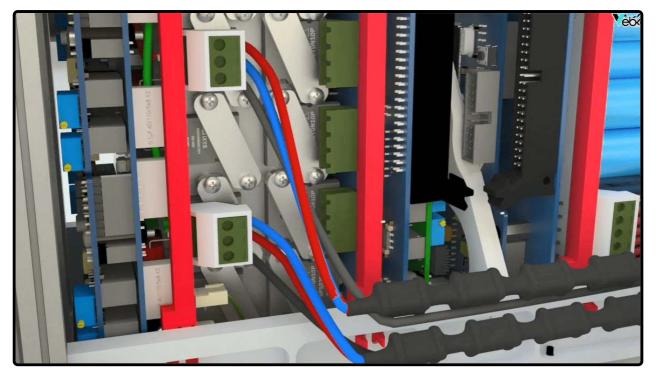
In the end, connect the 8 pin red Phoenix wire with its holder to the complete switching module.





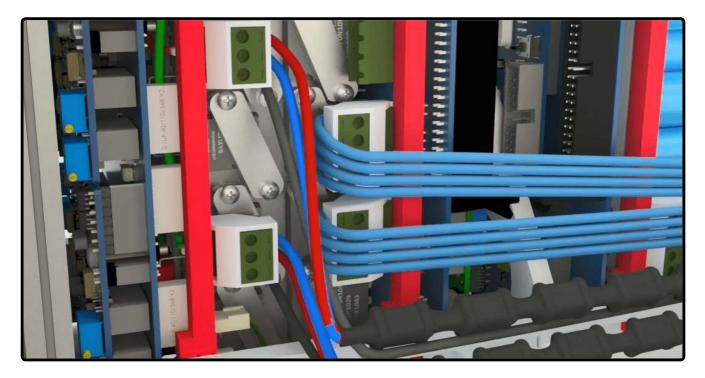
Connecting the voltage connectors of the complete side of amplifier modual

The female Phoenix connector with a shorter wire on the holder should be connected to the lower 3 pin male Phoenix connector. The female Phoenix connector with a longer wire on the holder should be connected to the upper 3 pin male Phoenix connector.

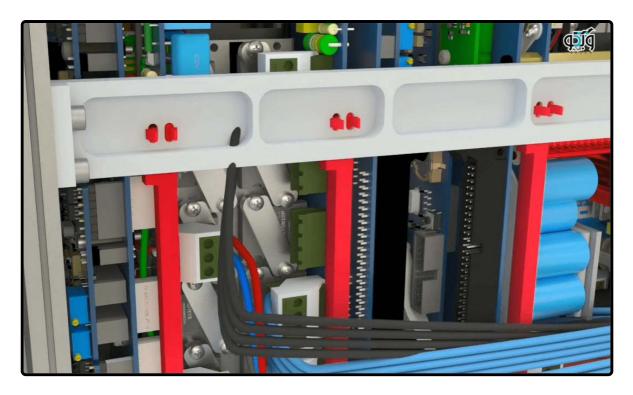


Connecting the current connectors to the incomplete side of amplifier modual

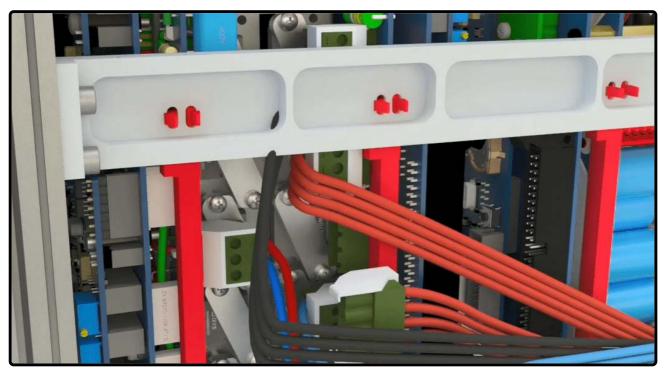
First, connect the 4 pin blue female Phoenix with longer wire on the holder to the second 4 pin male Phoenix connector from the bottom. Connect the 4 pin blue female Phoenix with shorter wire on the holder to the first 4 pin male Phoenix connector from the bottom.



Connect the 4 pin black female Phoenix with shorter wire on the holder to the first 4 pin male Phoenix connector from the top. Connect the 4 pin red female Phoenix connector with longer wire on the holder to the second 4 pin male Phoenix connector from the top.

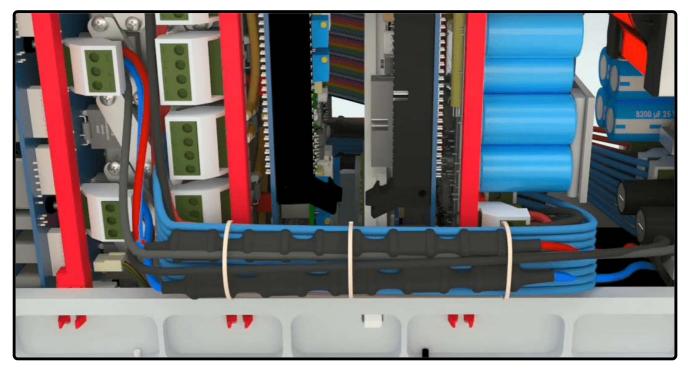


Connect the 4 pin red female Phoenix connector with shorter wire on the holder to the third 4 pin male Phoenix connector from the top.



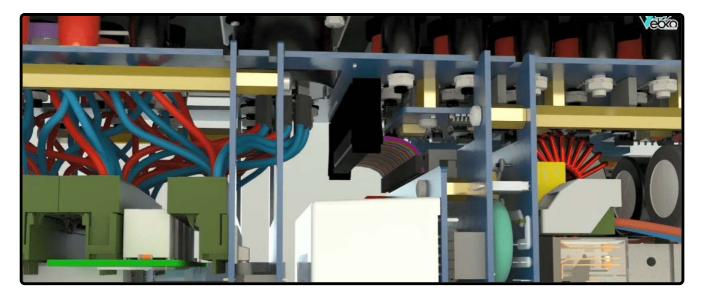


Then assemble all the current and voltage wires with a tie wrap.



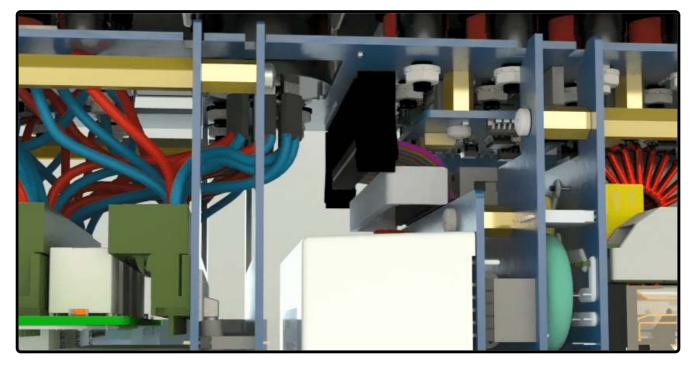
Connecting a 3.7 cm 25 * 2 ribbon cable of the front panel (one side without the guard and the other side of the guard)

The connector of this cable is approximately in the middle and below the front panel. First, connect the switching side to the switching module, then attach the uncompressed part to the IDC Latch on the panel and close the guards.



How to connect the IDC flat cable holder to the front panel cable

On IDC connected to the switching module, install a high legged holder IDC and connect the two sides of the holder base to both sides of the IDC.



When connecting the ribbon cable, pay attention to the IDC cable and the groove on the IDC modules.

Closing a 5 cm 25 * 2 ribbon cable (two sides without toggle)

This flange cable connects the full side of the switching module to the incomplete amplifier module.



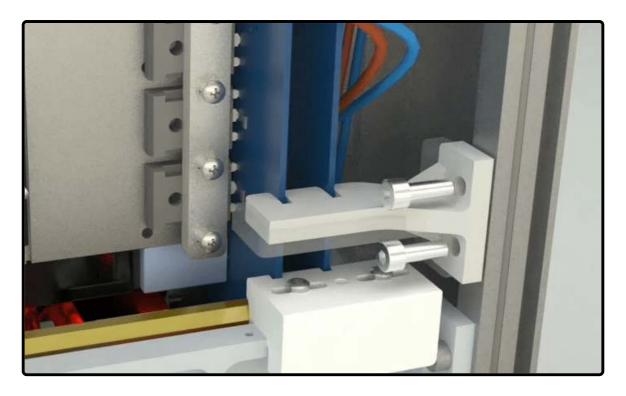
Installation of two amplifier holder and two switching holders on the middle rails of the case

Holders must be placed on the rails and the two slots embedded on them should be placed on the module and the original board. Each holder is closed and tightened by 2 screws 16.5×2 soaked in a special screw glue along with a flat washer on the holder and middle rails.



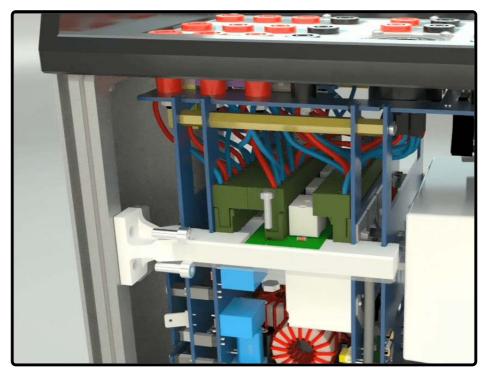
Installing the holder of the module board and main switching

This holder is connected to the wall of the case on one side and connected to the body of the case using bolts, screw and flat washers and an 8×4 flat. The other side is connected to the module and main switching.

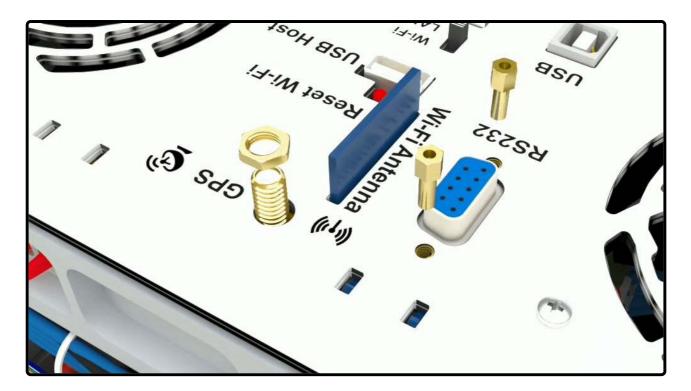


Placing the amplifier holder and neutrik board

This holder is connected to the body of the case from one side using bolts, nuts and 8×4 flat washers. The slots embedded on this holder, on the other side, are connected to the amplifier and the neutrik board. The neutrik board on this holder is fastened by a special glued 8×3 nut to a bolt and a spring washer. Turnover the device on in a way that the back panel is facing upwards.



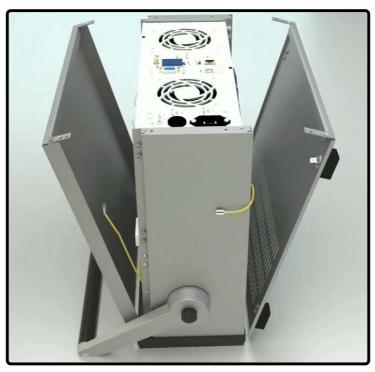
Fasten two screws on RS232 socket



Fasten an internal tooth lock washer and a golden nut on GPS antenna of the socket

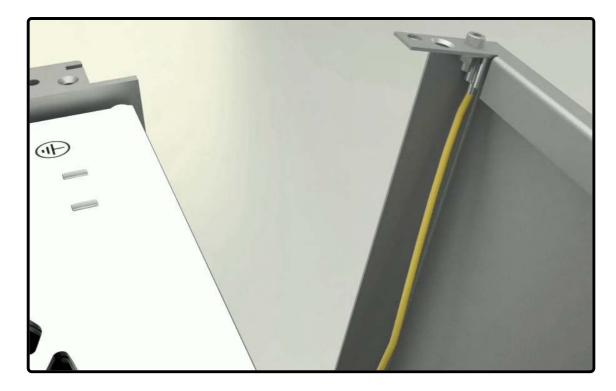
Closing Doors

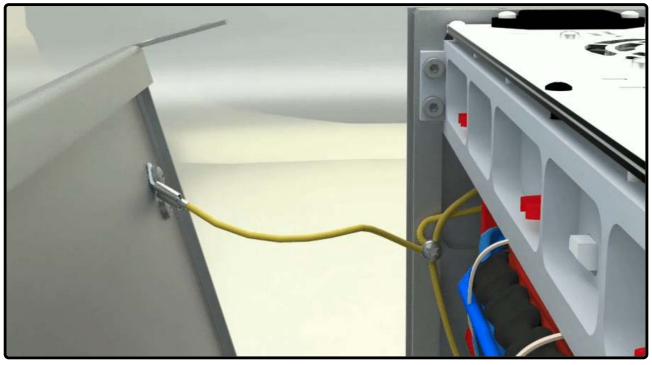
The door with four legs must be installed underneath the device and the leg-less door is installed on the top. Place the walls in the lower grooves (grooves are on the front panel frame).



Connecting the earth wires to the doors of the device

On both sides of the case, two long earth wires have been attached to the body. Connect each side to its door, pull the wire a little with a small force to make sure that they are tight and steady.





Close the doors completely

Place the doors and install the legs in place; two star screws must be tightened on each side. You need a star screwdriver to tighten the screws.



2 : INTRODUCING THE DEVICE AND EQUIPMENT

In order to remove the device from the suitcase, by pressing the push button, the handle of the device should be placed in a 45 degree angle and taken out of the case.



To change the status of handle of the device, it is necessary to press the side buttons of the device simultaneously and then the status should be changed. Once the device is positioned on the intended surface, the handle of the device can be put on the device by pressing the push button.



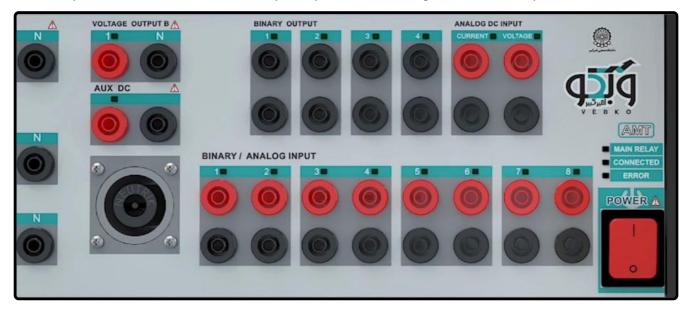
Also, it is possible for the handle to be positioned beneath the device so it could be used as a stand for the device. In addition, the bases that are installed under the device can be used for this purpose.



At the bottom of the device are the air conditioning grooves and it is crucial to consider that, while positioning the device, these grooves must not be blocked under any circumstances.



The front panel of the device consists of the outputs, inputs, device status lights, and the on/off power button.



If the green light of the main relay is on, it means that all main switches of the device are on.



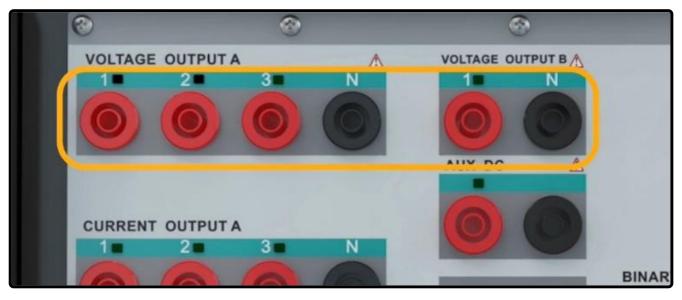
If the green light of "CONNECTED" is on, it means that the device is correctly connected to the software via PC or mobile phone.



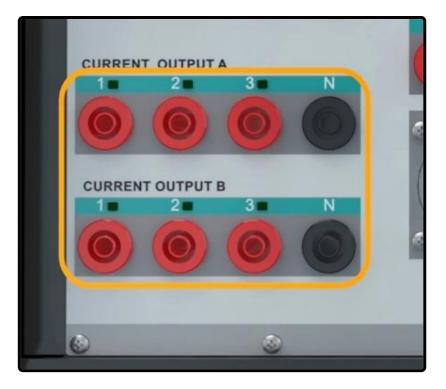
If the red light of "ERROR" is on, it means that there is a problem with the device and it has stopped working. As long as the problem is not resolved, this light will remain on and the device will not work.



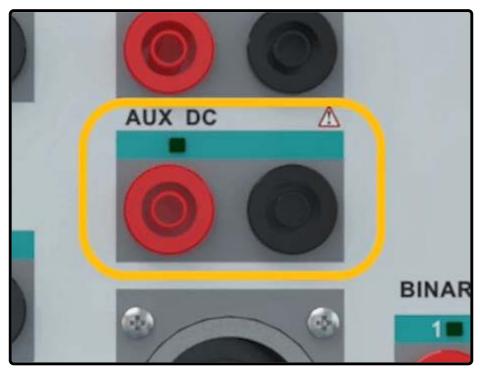
The two voltage groups A and B allow the user to receive up to 150^{V} AC and 212V DC in all four phases simultaneously with a precision of 10^{mV} with a maximum current of 0.4^{A} AC and 0.6^{A} DC as well as up to 2^{A} in transient mode. By changing the wiring, it is possible to receive up to 450^{V} single-phase AC from the device. Also, it is possible to increase the output voltage and provide the user with a 150^{V} AC with a maximum current of 0.8^{A} by changing the wiring and paralleling the two current sources.



The two current groups A and B allow the user to receive up to 32^A in all six phases simultaneously or three-phase 64^A. Moreover, by changing the wiring, it is possible to receive up to 128 single-phase amperes from the device.

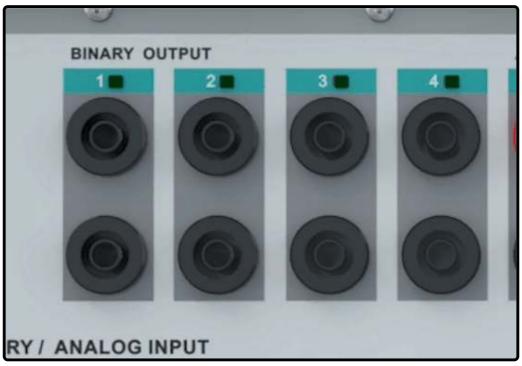


At the "Auxiliary DC" output, a DC voltage as high as 0 to 212^{V} is permanently adjustable. This voltage is independent of the test and can be used to switch on other devices such as relays.

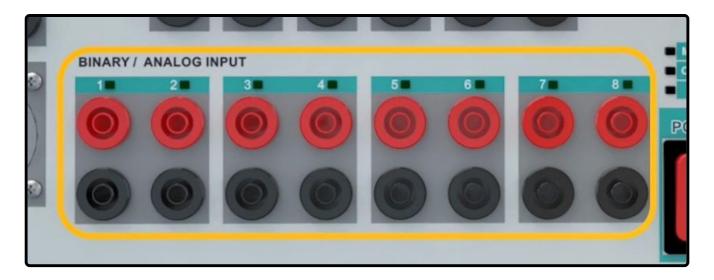


This is where the integrated cable is connected. The amount of the current and the output voltage of this port are the same as the amounts of the current and voltage ports that have been described earlier.





The analog inputs of the device are capable of receiving both analog and digital signals. All 8 inputs can be active simultaneously. Other than reading them, these inputs can show the waveform of voltage in three voltage levels of 4.5, 30 and 188^{V} with the precision of 1, 3 and 10^{mV} .



The "Analog DC Input" section is capable of measuring voltages up to 200^{mV} with a precision of $50^{\mu V}$ and current up to 500^{mA} with a precision of $50^{\mu A}$.



Generally, the back of the device consists of various components including:

Earth port Fuse Power supply RS232 port USB port type A GPS USB port type B LAN and Wi-Fi switches Ethernet port

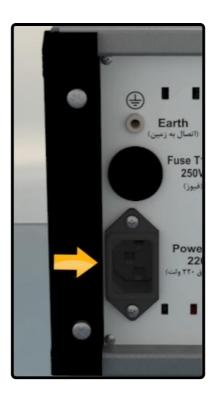
This port is used to protect the earth connection and the earth cable of the device is connected to this port.



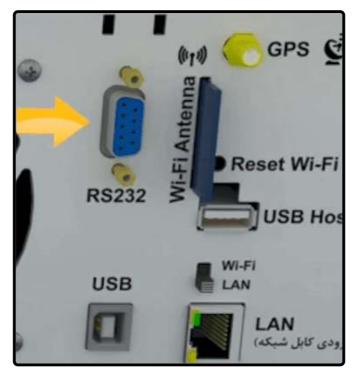
In this section, in order to protect the device, a 15A and 250V fuse is used.



The power supply port is located here. The power cord of the device is plugged to this port.



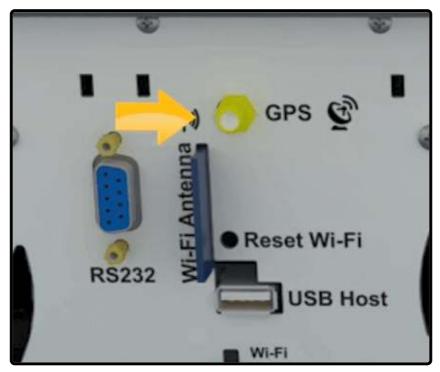
The RS232 port is mainly used for resetting the IP and updating the firmware. To do this, the RS232 dongle, which is a part of the equipment of the device, needs to be connected to this port. Then, the necessary operation, described in the following animations, needs to be performed.



In this section, by using the switch, the communication protocol between the device and laptop is selected. If the switch is up, the connection is via LAN. The LAN port located under this switch is used for the mentioned communication. The laptop settings for connecting a laptop to the device are described in the following animations.



The GPS antenna, which is used for time synchronization of two devices for performing a longitudinal test, is connected to this part.



Inside the black bag comes with a one-way wire-to-female connection, a lizard clip, a 30 cm test wire, a 10 cm test wire and a 4 mm test socket, and a belt clamp and a test socket 4 mm in diameter.

Other pieces of equipment that come with the device are communication cables which are used for communicating with the relay and injecting voltage or current. This side of the cable which has a fixed head is connected to the device and the head on the other side which has a dynamic plastic guard is connected to the equipment.

LAN cable

The blue cable, shown, is used to connect the device to a laptop.

Earth cable

The cable is the ground (earth) wire where its place of connection to the device was shown earlier. While one side of this cable is connected to the device, the other side, where the crocodile clip is attached, is connected to the location of the ground connection.

The black cable on the right is the power cable and the one on the left is the GPS antenna cable. This antenna is used for End to End tests. The GPS antenna is used for time synchronization of two devices to performe a longitudinal test.

Serial Dongle:

This dongle is used to reset the device. The 2nd and 3rd pins of this dongle are interconnected, so if the dongle cannot be accessed, the device can be reset by connecting the 2nd and 3rd pins to the RS232 port located on the back of the device.

Capacitor box

In this capacitor set, there are 3 capacitors $(10000\mu F)$ which are used as a filter in equipment tests.

Integrated or Neutrik cable

This cable has 6 output wires on one end and a single part on the other which is connected to the device. To plug this cable, first insert the tab of the combination cable as it is shown in the image. Then, after the Neutrik cable is inserted, spin it to the right until the metal pin fits into its place. To unplug the Neutrik cable, pull the tab and spin it to the left. After the spin is complete, it can be removed.

There are several labels attached to the sides of the device. The first label includes contact information for device support.

The second label includes the serial number and technical information of the device.

Soft bag/ Backpack

This case is designed for convenient transportation of the device.

To place it inside the case, the device must be standing perpendicular to the surface. Then it can be placed in the case and after that, the case can be closed.

At the front and back of the case, there are pockets where the equipment of the device can be placed.

Inside the backpack, along with the device, there are three 7-meter cables and 8 clamps for testing transformers and circuit breakers, as well as several clamps to hold the connection between the cables.

3 : SOFTWARE INSTALLATION

Vebko company's software comes in two versions of "Stable" and "Test". All the latest changes of the software are added to this version and, as the title suggests, it is a test version and may contain software bugs. Once these bugs are fixed, a stable version is released in which all the software issues are solved and it can be easily used. It, also, may not contain all features of the test version. Note that you can install both test and stable versions at the same time without facing any problem. To download the latest test or stable versions, you can visit the software section at <u>www.vebko.ir</u>.

It should be noted that, before installing the software, if an older version of the software is already installed on the currently being used system, to install a newer version, there is no need to uninstall the old version and the newer version will automatically replace the old one. To install the software, run the "Test.exe" file. Then, to continue, select "Next". It is necessary to install the "WinPcap" software before trying to install the Vebko software.

ایرادات را	آموزش	نرم افزار	شرايط فروش	تاريخچه	کاتالوگ	نفحه اصلى	0
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دانلود	ىخە	tu ا	نوع		عنوان	0	
*	97.16	٨	Stable	Windo	ws (XP, V, A,	۱۰)	1
*	99.08	00.01	Test	Windo	ws (XP, V, A,	۱۰)	٢
*	۹۷.۰۵.	15.01	Stable		Android		٣



Click on "Next" option again. Then the WinPcap 4.1.3 Setup message will pop up which means that this software has been installed before and if it is necessary to reinstall it, select "Ok"; otherwise you can select "Cancel" to continue. If the software has not been installed on the currently being used system, the "Install" option will be available to install the WinPcap software. Now, in the opened window, check the "I agree" option and click on "Install". Installing the AMPro Test software takes a few seconds. Now you can run the software by clicking on the "Run" option. In the "Security" section on the main page of the software, by clicking on "Open Source Location", the location where the software is installed will be opened. On this page, right-click on the "AMPro Application.exe" file and select "Properties". Now, in the "Compatibility" tab, check the "Run this program as an administrator" option. Then, you need to repeat the same process for the "AMPro APP Launcher.exe" file.



]	Other Version 99.03.05.01-Test
	Preferences
	Information Clear cache
)	Help Solution Help Help Help Help Help Help Help Help

AdornedControl.	dll 5/25/2020 10:55 AM Applie	ation exten
All Projects	12/1/2019 11:28 AM Text D	ocument
	Change settings for all users	
	OK Cancel Apply	=

After doing so, installation software process is finished and it can be use it for testing.

	شرکت واپایت شدیم روب ر داری کیفت بر تاریون الم رک بیر	
General Test	Special Test	Other Version 99.03.05.01-Test
Relay Test AMT Overcurrent AMT VI Starting AMT VI Starting AMT Distance AMT Differential AMT Diff Harmonics AMT Meter AMT Transducer AMT Synchronizer	Overcurrent Quick Test Under Over Voltage Test Instrument Test Current Transformer(CT) Circuit Breaker(CB) Capacitor Voltage Transformer(CVT) Transformer Resistance RED	Preferences Setting Security Information Contact us About Help Help Help Remote Recovery
Vebko Control Center	Vebko Relay	MT Disconnected

4 : HOW TO CONNECT TO AMT105

In order to be able to perform various tests with the device, it is necessary to connect to it via a laptop or computer. Before starting the device, the earth wire from the back of the device needs to be connected. Note that if the outlet is grounded, there is no need to connect the ground wire from the back of the device. Then, the power cord is connected to the specified location on the back of the device. After connecting the power cord, the power button on the front of the device is pressed and the device turns on. As the device turns on, 8 binary input lights (on the bottom row) and 2 analog DC input lights (on the top right) turn on.

There are two ways to connect to the device: Wi-Fi and LAN. The switch on the back of the device is adjusted according to the connection type. To switch the LAN connection, one end of the LAN cable is connected to the device and the other end is connected to the laptop. When the device and the laptop are properly connected and the switch is changed from Wi-Fi to LAN, the LAN port light of the device and the laptop turn on. The setting for the connection of the LAN port is set only once for each computer before the first connection. To set these settings, go to the "Control Panel" and open "Network and Sharing Center".



On this window, by clicking on "Change Adapter Setting" another window opens. There are several sections on this window. To change the LAN settings, double click on "Ethernet". Click on "Internet Protocol Version 4" in the opened window. On this window, enter 192.168.1.20 in the "IP Address" field and then close the window. Then, open the "AMPRO" software. By clicking on "Setting" on the start page of the software, a new window opens.

anize 👻 🛛 Disable this network device	Diagnose this connecti	ion Rename t	his connection	View status of this connection	Change s	ettings of this co	nnection	1	
Ethernet Properties	X	unplugged		thernet 3 letwork cable unplugged		/i-Fi ebko Tolid			
Connect using:		Adapter V9	× × s	peedify Virtual Adapter		ualcomm Athero	os QCA9377	Wir	
👮 Realtek PCIe GbE Family Controller									
	Configure								
This connection uses the following items:									
Client for Microsoft Networks	^								
🗹 🕎 File and Printer Sharing for Microsoft N	letworks								
 ✓ File and Printer Sharing for Microsoft N ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ <p< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></p<>									
File and Printer Sharing for Microsoft N GoS Packet Scheduler Internet Protocol Version 4 (TCP/IPv4))								
File and Printer Sharing for Microsoft N GoS Packet Scheduler Internet Protocol Version 4 (TCP/IPv4 Microsoft Network Adapter Multiplexor)								
File and Printer Sharing for Microsoft N GoS Packet Scheduler Internet Protocol Version 4 (TCP/IPv4) Microsoft Network Adapter Multiplexor)								
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File and Printer Sharing for Microsoft N GoS Packet Scheduler Internet Protocol Version 4 (TCP/IPv4 Microsoft Network Adapter Multiplexon PROFINET IO protocol (DCP/LLDP) Microsoft LLDP Protocol Driver <) Protocol								
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File and Pinter Sharing for Microsoft N GoS Packet Scheduler Internet Protocol Version 4 (TCP/IPv4) Microsoft Network Adapter Multiplexon PROFINET IO protocol (DCP/LLDP) Microsoft LLDP Protocol Driver Install Uninstall Description Allows your computer to access resources or) Protocol								

On this window, enter the last three digits of the serial number of the device in the fourth part of the IP field. To connect to the device, click on "CONNECT". If a new version is connected to the device, the "Firmware" of the device will be updated once and after the green bar is filled, the device will be connected in a few seconds. To connect via Wi-Fi, the switch on the back of the device needs to be set on "Wi-Fi". Then, from the "Wi-Fi" in quick launch bar on the laptop, find and select the Wi-Fi connection of the device. The password for this connection is the serial number available from the label attached to the side of the device. Once the connection is complete, click on "Setting" on the start page of the software. On this page, enter the last two digits of the serial number of the device in the fourth part of the "I" field. To connect to the device, click on "CONNECT".

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Control Panel Home	View your basic network informat	ion and set up connections			Vecko
Change adapter settings Change edvanced sharing sattings Media streaming options	View your active network: vebito Tolisi Public network	Access type Internet Connections: will Wi-Fi (vesko Tolid)			
	Unidentified network Public network	Access type No network access Connections: U Ethemat			
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	Change your networking settings		letwork Connections	Ψ (b) Search Ne., P	
	Set up a new connection or no Set up a broadbanit, dial-up, c (Immune - Dirabla this natural classes - Dirabla this cores	ection Reneme this connection View status of this connect	an Change settings of this connection 🚁 📲 🔕	
	Teableshoot problem Diagnose and repair network	Dhenot Properties X Networking Staring	ble unplugged ble unplugged Speed 2 Speed 2 Visual Adapter	Wi-Fi vebion Total Qualcomm Advance QCA0377 Wis	
		Comment Protocol Version 4 (TCP/IPv4) Properties	×	The Quantity dense dense and	
		General			
			scorts		
		The You can get IP settings assigned automatically if your network s this capability. Otherwise, you need to ask your network admini- to the appropriate IP settings.	atata"		
		5 0 Cottain an IP address sutometrolly			
		B Use the following P address			
		6 IP addressi 292 - 369 - 1 - 20			
		Bubnet riveski Default gatewayi	-		
		and the second se			
		Obtain DNS server address automatically (ii) Lise the following DNS server addresses:			
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		Alternate DPG server:			
			anced		
		D OK	Cancel		
	4	tons 1 item selected		() i (e)	
Sez also Internet Options					
Windows Defender Firewall					

	t Room Directory	Port Subnet Mask	Gateway	DNS	Serial Number	Firmware Version	Firmware Minimum Version	Mac Address	
		1001 255.255.255.0			3313541343434744754242	99030300		1E:30:6C:A2:45:5E	
	re Hardware Available D	evices Log					No E	rror	
МТ]	Connect	Update Firm	ware I	Jpdate Firmware in	Flash Mode			
P ;	192.168.1.30	Refresh Connection							
ort :	1001	Disconnect	Progress :						
ubnet Mask :	255.255.255.0	Set to AMT							
iateway :	192.168.1.1	Ping Entered IP							
NS :	192.168.1.1	Ping Wi-Fi							
erial Number:	230								
ersion :	99030300								
finimum Version:	96102900								
AC Address :	1E:30:6C:A2:45:5E								
Enable Update (Connection Data by Device								
									*

5 : SIMULTANEOUS CONNECTION OF SEVERAL TESTERS

The user can view all devices that are, through different protocols, connected to the laptop on the "Available Devices" tab on the "Preferences" page. By clicking on "Start Search", after a few seconds, the list of network adaptor options of the system will appear in the "Interfaces" slider.

est Ob	ject	Roon	n E	Directo	ory	Cad	che		
	Na	ame	IP	Port	Su	ubnet	Mask	Gateway	DNS
▶1	AM	T1	192	1001	00	0.000	.000.0(000.000.00	000.00
2	AM	T2	192	1001	00	0.000	.000.00	000.000.00	000.00

By clicking on any network adaptor, the list of devices connected to the laptop, as well as all their connection information, will be displayed. If the user does not know the name of their network adaptor, they should go to the "Control Panel" page and click on "Network and Sharing Center". Then, on the left side of this page, they should click on "Change Adapter Setting". If the connection cable of the device that is connected to the laptop is unstable, this instability is indicated by the connection's getting activated and deactivated on the "Network Adaptor" page.

Connection &	Firmware Hardware	Available Devices	Log
Interfaces :	Ethernet		
IP : 192.168	1.1.199, Port : 1001, Su	bnet Mask : 255.255	5.255.0, Status : Disconnected, Last Seen : 12:54:09



Upon returning to the "Available Devices" page, by clicking on the currently being used "Network Adaptor", the name and IP of the device will be displayed along with its other connection information. If the user does not have access to the IP of the device, they can find it by following these steps and it will no longer be necessary for them to reset the IP of the device.

Interfaces : Ethemet
IP : 192.168.1.199, Port : 1001, Subnet Mask : 255.255.255.0, Status : Disconnected, Last S

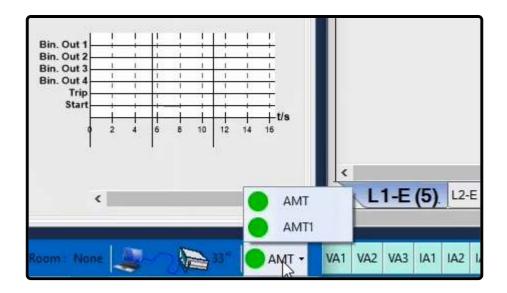
On the "Connection & Firmware" tab, the settings for the device connection, changing the IP and updating the firmware can be set. One of the features of this software is connecting to multiple devices at the same time. To do so, by clicking on the green plus button on the "AMT" tab, a new row is added to this table. On each row is the connection information which should be different from other connections.

J	💀 Settin	g				
Ľ.	Т	est Obj	ect	Roo	m	D
	ſ		1	lame	IF	2
		▶1	A	MT1	19	2
		2	A	MT2	19	12

In the case of connecting to multiple devices through one software, it should be noted that while connecting through a network adaptor", each connection must have a unique "Mac" and "IP" Address. To do this, first, you need to connect to the first device by entering its IP. Then, by clicking on the second row and entering the IP of the second device connect to it and if the "Mac" addresses are the same, make a small change in them and by clicking on "Set to AMT" apply the changes.

MT1	
P :	192.168.1.26
Port :	1001
Subnet Mask :	000.000.000.000
Gateway :	000.000.000.000
DNS :	000.000.000.000
Serial Number:	0
Version :	0
Minimum Version:	0
MAC Address :	00:00:00:00:00

After properly connecting to multiple devices, by using them, multiple tests can be performed simultaneously. For example, if the two rooms of "AMT Sequencer" and "AMT Distance" are opened, by selecting the "AMT" connection in the "AMT Sequencer" room and "AMT1" in the "AMT Distance" room, by using two devices, two tests can be performed at the same time and two relays can be tested simultaneously.



6 : RESETTING IP ADDRESS

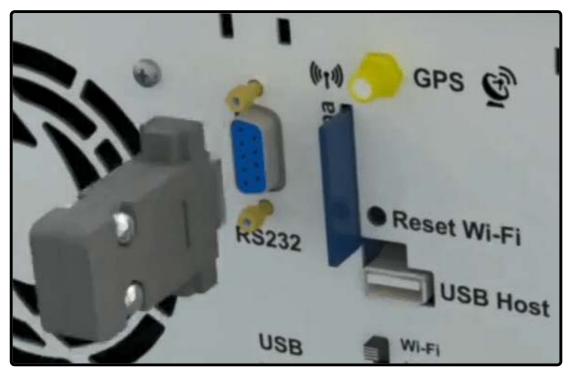
When the LEDs of all binaries are on or you do not connect to the device according to the relevant settings, you must reset the device IP using the dongle. Before resetting the device's IP address, it is necessary to make sure that the device is turned off. Then, the RS232 dongle is connected to its specific port on the back of the device.



Upon turning on the device, you can see that, the error lights of the device will start blinking



After blinking several times, there is a pause and then the device will start blinking again. After this process is repeated for the third time, the user should turn off the device and disconnect the RS232 dongle from the back of the device



Now, the IP address of the device is reset and its serial for connecting via Wi-Fi is changed to 199. After turning on the device, to establish the connection between the device and the laptop, enter "199" in the fourth part of the IP field on the "Setting" page.

AMT	
IP :	192.168.1.199
Port :	1001
Subnet Mask :	000.000.000.000
Gateway :	000.000.000.000
DNS :	000.000.000.000
Serial Number:	0
Version :	0
Minimum Version:	0
MAC Address :	00:00:00:00:00:00

Note that if you do not have a dongle or even an RS232 port, you can use a thin wire to do it. As can be seen, it is enough to connect pins 2 and 3 with a thin wire.

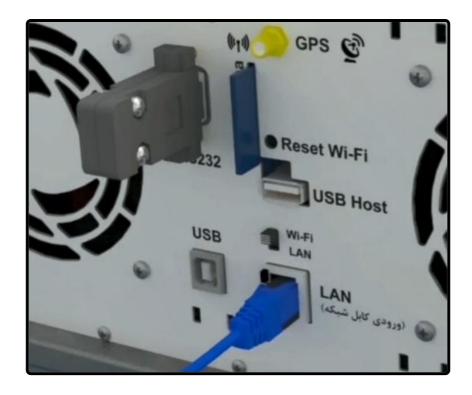
7 : UPDATING FIRMWARE OF DEVICE MANUALLY

To update the "Firmware" manually, first, it is necessary for the device to be turned off.

Then click on "Disconnect" in the "Preferences" screen, so that the software will not send ping to device after the device is turned on.

AMT		Connect
IP :	192.168.1.76	Refresh Connection
Port :	1001	Disconnect
Subnet Mask :	000.000.000.000	Set to AMT
Gateway :	000.000.000.000	Ping Entered IP
DNS :	000.000.000	Ping Wi-Fi
Serial Number:	0	
Version :	0	
Minimum Version:	0	
MAC Address :	00:00:00:00:00	

To get started, the RS232 dongle needs to be connected to its specific port on the back of the device Also, the device and the laptop must be connected via LAN cable.



It can be seen that, after the device turns on, the "ERROR" light in the front panel of the device starts blinking.



On the main page of the software, click on "Update Firmware in Flash Mode."

Then, you have to wait for the green bar to get filled. After that, a message will be displayed. By clicking on "OK", you can finish updating the "Firmware".

Connection & Firmv	vare Hardware Available [Devices Log		
r Details	11			
AMT		Connect	Update Firmware	Update Rimware in Flash Mode
IP :	192.168.1.76	Refresh Connection		
Port :	1001	Disconnect	Progress :	
Subnet Mask :	000.000.000	Set to AMT		
Catanana	000 000 000 000	Ping Entered IP		

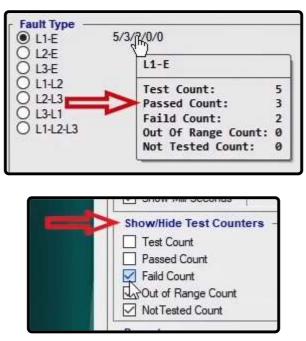
Turn off the device and unplug the RS232 dongle.

8 : GENERAL SETTING OF ROOMS

There are four main tabs in the software "setting" page. The "Room" tab provides a number of features for different rooms. In the "Date-Time" section, you can select "Persian" or "Christian" as the type of the date used in the output report. By using the other three options in this section, it is possible to show the name of the month and week and milliseconds in the report.

	💀 Setting
10	Test Object Room Directory Cache
	Persian V
=	Date / Time
	Type : Persian ✓ Show M Constian
	 ✓ Show Day of Week ✓ Show Mili Seconds ✓ Show Mili Seconds

In rooms such as "AMT-Distance" and "AMT-Overcurrent", next to each of the "Fault Types" are written numbers which show the test points, the number of passed test points, the number of failed test points, the number of test points that are outside the range of the device and the number of untested test points respectively. With this explanation, unchecking each of these options in the "Show/Hide Test Counters" will cause the number of points associated with that option not to be displayed.



In the "Report Refresh Interval" field of the "Report" section, the update time for the report is specified. In the "Report Package" section, the default settings for the "Reports" are adjusted. In the "Extra Tools" section, clicking on the "Template

Report Generator", opens the "PDF Report Creator" page where the desired test files can be imported to get a report. By

clicking on "Remove Signature", the "Remove Signature from Report" page opens where, without needing to open the test files, the added signatures to the reports can be removed. In the "Template" section, the settings of the "Test Object" of the device as well as the settings related to displaying numbers in the "Decimal Places" are adjusted.

_	Report	-	
	 Report Refresh Interva 	t: 📔	2.000 s
	Template Report Pack	age :	Settings
н,	Extra Tools		
	Report Genrator	Remove Signature	

By checking the "Auto Save" option, the software saves the last changes made to the test page according to the time specified in the "Interval" field. These files are also saved in the location specified in the "Directory" box in "History" section. The maximum reserved size for these files and the maximum duration of time that these files are kept in the system is specified in the "Max Size" and "Max Time" filed, respectively, and the user is able to change these values. By unchecking

any of these options, the limitation is removed as well. By doing this, if the software crashes for any reason, the test page

and the user information will remain safe.

~	Interval:	්රි <u>30.00 s</u>
	Directory C:\Users\p	q\Document
	Max Size	1.000 GB
	Max Time	365 day

In the "Alert-Tone on Hardware Error" dropdown field, you can select an alert sound for when there is a hardware error in the device. The settings for specifying and changing the sizes of the tables of the rooms such as "Distance" and "Differential" are adjusted in the "Styles of Tables" section. You can customize the "Key Setting" section to be able to use the "Enter" key and the arrow keys to move in the cells of a table. In the "Communication Mode" section, you can choose between "Service System" and "Integrated System" for the connection between different rooms and pages of the software. "Appearance Setting of Groupbox" is designed for personalizing user interface. This setting is divided to two categories of "text" and "border", which are used to personalizing the borders , color and text's fonts. In the following tutorials, all of the above will be stated in detail as well as how to adjust the settings.

		1.000 GD
- چهارشنبه - 7	Max Time	365 day
09.735	Alert Tone on Hard	ware Error ——
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	None	-
	Alert (1).wav	
	Alert (2).wav	
	Alert (3).wav	
	Alert (4).wav	~
	Alert (5).wav	
	Alert (6).wav	
	Alert (7).wav	px
	Alert (8).wav	
2.000 s		
Calling	Alert (10).wav	
Settings	Alert (11).wav	
	Alert (12).wav	
1	Alert (13).wav	
	Alert (14).wav	
-		
	Service System	
	O Integrated System	
	C mogratos ofotom	

- چهارشنبه -	Max Time	365 day
9.735	Alert Tone on Hardward	e Error
	None	~
Ĩ	Style of Tables	nual
	AllCells	~
	Height of Table Cells:	15 px
2.000 s Settings	Key Settings	

	AllCells	~
	Height of Table Cells:	15 px
Settings	Key Settings	
ature Decimal Places	Communication Mode - Service System O Integrated System	

20.00	Appearance Setting of Group	Telescolo -
30.00 s	Border Color:	
\Document	Enable Setting of Text	
1.000 GB	Font Setting: Fon	ıt
365 day	Text Color:	
1245	Text Back Color:	

9 : DEFAULT SETTING FOR "REPORT"

In the "Room" tab and in the "Report" section, the time of updating the reports in the rooms, if any changes happen, it indicates in the "Report Refresh Interval" field. For example, the test information is checked every five seconds and if there is any change the report is updated. In this section, by clicking on the "Setting" button a new window named "Report Setting" is opened. In "Item Type" the default settings can be specified to get the report from a specific room or screen.

eport Refresh Inter	val:	2.000 s
emplate Report Pa	ckage :	Settings
Extra Tools —		
Report Genrator	Remove Signature	

Report	
Report Refresh Interval:	5 s
Template Report Package :	Settings

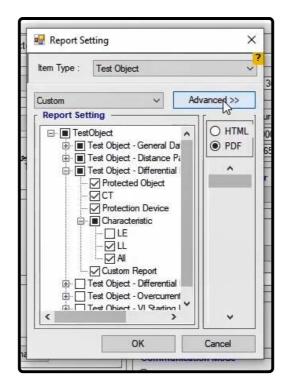
Item Type : Test Object	×			
Long V Adv	vanced <<	Export Settings	Import Settings	Reset to Default
Report Setting	HTML	Load from Tem	plate Sav	ve to Template
🗄 🔳 Test Object - General Data	O PDF	General Setting	1	
 ■ Test Object - Distance Paran Test Object - Differential Non Test Object - Differential Han Test Object - Overcurrent Pa Test Object - VI Starting Para 		Font Setting		
		Images Setting	- 	
		Margins Setting	1	
		Document Sett	ing	
		Header/Footer Setting		
		Extra Setting		

The elements that can be added to the report by the user are located in the "Report Setting" section of this window. By checking the main option, the user can add all the subsets to their output report. If the user chooses only some of the subsets of the main option, the square sign next to the main option will be displayed as a half-filled square. In the column next to the "Report Setting" section, the user can select HTML or PDF as the format of the report preview.

Item Type	: Test Ol	oject	
Long	N	~	Ad
	estObject Test Obje	ct - General E ct - Distance ct - Differentia ct - Differentia ct - Overcurre ct - VI Starting	Paran al Non al Han ent Pa

Ad	vanced <<	E
neral Data tance Paran erential Non oject evice	HTML PDF ^	

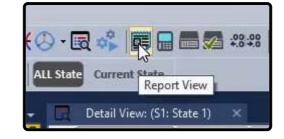
By clicking on the "Advance" button, the screen is displayed more extensively, and more settings can be applied to the report. By checking each of these categories, their subcategory is opened and the needed settings can be applied. At the top of this screen, there are options used for saving the applied settings and using them again later.

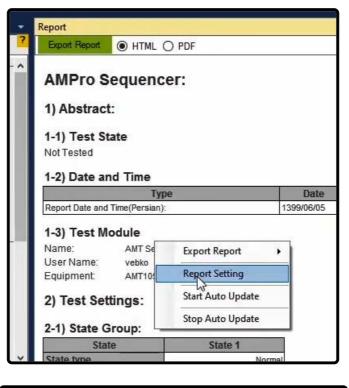


For instance, if "Sequencer" is selected in the "Item Type" and some specific settings are set at default and confirmed, after entering the "Sequencer" room, selecting the "Report View" option from "View" menu and reviewing the "Report Setting" section and then selecting "Load from Template" option, you will see that the same settings are set at default for this section as well. In the "Extra Tools" section, the user is allowed to click on the "Report Generator" button and get a report on the saved test files without needing to open them. After clicking on this button, a screen called "PDF Report Creator" opens. On this screen, the user can select their test files to get a report on by clicking on the "Select Input Files" button. For example, the first two files are selected. The user can, also, by clicking on the "Select Input Folders", select a folder including several test files. and insert them into the "Files" section. For example, "Vebko Test Files" folder is selected. By clicking on the "Clear" button, the files inserted for getting a report can be removed from the list.

tem Type :	Test Object	~
	Test Object	
Custom	Hardware Config Pause	
Report Set		
Report Set	Differential	
🖃 🔳 Test	d Differential (Harmonics)	
÷. 🔳	TOvercurrent	
÷. ا	T Sequencer	
÷. 🔳	Current Transformer	
TH	Capacitor Voltage Transformer	
	Transformer	
	Resistance	
	RTD	
	Test Template	
	Function Test	
	Overcurrent Quick Test	
	UV Voltage	
	Meter	
ф. —	Transducer	
	VI Starting	

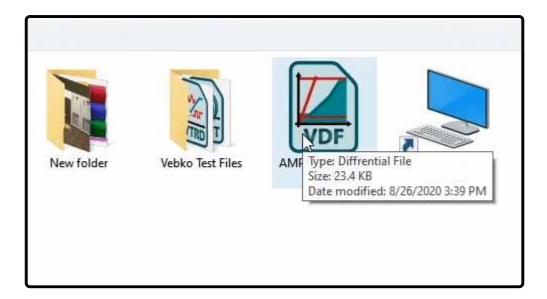
Adv	ranced <<	Export Settings	Import Settings	Reset to Default
]	O HTML	Load from Tem	plate	Save to Template
Data e Paran	PDF	General Setting	1	
tial Non		Font Setting		
e		Images Setting		





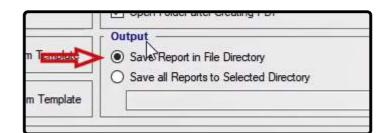
Report	
Report Refresh Interval:	5.000
Template Report Package :	Settings
Extra Tools	
Report Genrator Remove	Signature

PDF Rep	ort Creator		- 🗆 X
Files :	State Type	File Path	Select Input Files Select Input Folder
			Clear



By selecting the "Open Folder after Creating PDF" option in the "Other Setting" section, the folder where the file is saved will be displayed right after the report is made. In the "Output" section, by selecting the "Save Report in File Directory" option, the report files can be saved at the same directory as where the files are imported from. If the "Save all Report to Selected Directory" option is selected, the user can select a specific directory and save all their reports in that directory.

PDFs	Other Setting
	Output
ng from Template	Save Report in File Directory
	O Save all Reports to Selected Directory
ng from Template	



S	Open Folder after Creating PDF
	Output
om Template	Save Report in File Directory
	Save all Reports to Selected Directory
om Template	6

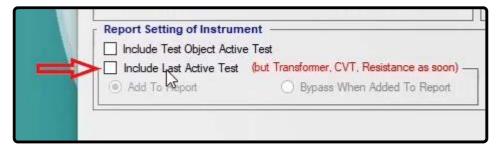
There are two options available in the "Overwrite File" section. In order to clarify this issue with an example, a file is imported for getting a report. By selecting the "Bypass Existing PDFs" option, if they're already exists a report on a file in the selected directory, the software does not make another report on that file. The appearance of this screen is due to the prior selection of the "Open Folder after Creating PDF" option which can be disabled. By selecting the "Overwrite Existing PDFs", the new report replaces the previous one.



In the "Report Setting" section, by selecting the "Load Report Setting from File" option, it is specified that for making the reports, the setting from the loaded files should be used. By selecting the "Load Report Setting From Template" option, the settings which are saved in the Template file will be used for making the reports. In the "Device Setting" section, by selecting the "Load Device Setting from File" option, it is specified that for making the reports, the Device setting from the loaded files will be used, while in the same section, by selecting the "Load Device Setting from Template" option the settings which are saved in the Template file will be used for making the reports. By selecting the "Include Test Object" Active Test" option in the "Report Setting of Instrument" section, if a report is made on the Instrument test files, the information existing in the "Test Object" tab will be included in the report under any circumstances.

	- Device Setting - LY
Γ	Report Setting
	Load Report Setting from Template
Г	Device Setting
	(a) Land Davies Course from File () Land Davies Course from Tomolate (
	Device Setting
1	Device Setting Setting O Load Device Setting from File
=	
=	> Load Device Selang from File O Load Device Setting from Template
	Load Device Se ng from File O Load Device Setting from Template Peport Setting of Instrument
	Load Device Setting from File O Load Device Setting from Template Peport Setting of Instrument Report Setting of Instrument
=	Load Device Set ing from File O Load Device Setting from Template Report Setting of Instrument Include Test Object Active Test
==	Load Device Setting from File O Load Device Setting from Template Peport Setting of Instrument Report Setting of Instrument

By selecting "Include Last Active Test" option, the previously saved equipment test files and the last performed test which has not been cleared by the user, by selecting "Add to Report" radio-button the report of that test is added to the report as well but if the user has added the test result to the output report, by selecting "Bypass When Added To Report" radio-button, the software does not add the test result to the output report again.



	Report Setting of Instrum	ent —
X	Include Test Object Active	e Test
	□ Include Last Active Test	(but Tr
	Add To Report	4

By clicking on the "Remove Signature" button in the "Extra Tools" section on the "Preferences" screen, a new screen named "Remove Signature from Report" appears in which the user can remove the existing signatures from the reports on their desired files. On this screen, by clicking on the "Select Input Files" button, the user selects their files for removing the signature. By clicking on the "Select Input Folder" button, the user can select a folder containing several report files and import all of these files into this list altogether. After the report files have been added to the list, by clicking on the "Modify" button, the existing signatures in the report will be deleted along with the framework around the report as well as the added names to the signature.

Report		
Report Refresh Interva	l: [5.000 s
Template Report Pack	age :	Settings
Extra Tools		
Report Genrator	Remove Signature	~

💀 Remove	e Signature from Report			- 🗆 X
Files :	State Type	File Path		Select Input Files Select Input Folder Clear
			Stop	Modify Close

Name		Date modified	Туре	Sīze
AMProDistance.vadt		8/26/2020 3:32 PM	Distance File	391 KB
Meter.vseq	3	8/10/2020 10:07 PM	StateSequencer File	1,922 KB
		Type: Distance File Size: 390 KB Date modified: 8/26/2020 3:32 PM		

le Path	Select Input Files
Browse For Folder	× Select Input Folder
	Clear
Desites	
Desktop	
> & vebko	
V This PC	
> 3D Objects	
V Desktop	
> New folder	Modify Close
Vebko Test Files	
> Documents Date created: 8/2	5 (2020 2-20 PMA)
> Unite Created: 6/2	0/2020 5:56 PW
> h Music	
> Pictures	
	M N

10 : GENERAL SETTING OF ROOMS, PART2

In the "Templates" section, by clicking on the "Device" button, a new screen named "Device Settings" appears in which the default settings for the Device are set. If changes are made to this section, clicking on the "Save to Template" button will save these changes as a template. After confirming the setting, The user can reset the settings saved as the template, by visiting the "General Test Object" in any of the rooms and clicking on "Load Template" in "Device Setting" screen.

Template Report Pack	age :	Settings	⊡ Ente
Report Genrator	Remove Signature		Comn
Templates		Decimal Places	Ser
		Decimarriados	

Clicking on the "Decimal Places" button opens a screen named "Number of Decimal Places Settings" where the accuracy of the numbers and the number of digits visible for every parameter are determined. In the "Item Type" field, the desired section or room is selected and in the "Sample Value" field a number has been inserted as an example. The name and unit of the parameter are seen in the "Parameter Name" and "Absolute Unit" columns respectively. In the "Absolute Eng. Factor" column, the number of digits displayed is specified. For example, if number 7 is entered in this column, 7 digits of the number entered in the "Sample Value" are displayed.

All changes made on this screen are considered as default for this section in the software and applied to different rooms. For example, if "Sequencer" is selected in "Item Type" field, by making and confirming some changes in this screen, via opening "Sequencer" room and checking "Decimal Places", it can be seen that done setting considered as default. There are several audio files available in the "Alert Tone on Hardware Error" section in the "Preferences" screen which can be used as the alarm tone in case of a hardware error.

	Parameter Name	Absolute Unit	Absolute Accuracy	Absolute Eng.Factor	Absolute Display	Relative Unit	Relative Accuracy	Relative Eng.Factor	Relative Display	1
•	Impedance	Ω	8	7	123.4567 Ω					
	Inverselmoedance	U	8	7	123.4567 u					
	ImpedancePercent	%	8	4	123.5 %					
	Inductance	Н	8	4	123.5 H					
	Capacitance	F	8	4	123.5 F					
	Voltage	V	8	4	123.5 V	Vn	3	0	123.457 Vn	
	Current	A	8	4	123.5 A	In	3	0	123.457 In	
	Current Differential	In	3	0	123.457 In					
	Current Overcurrent	Iref	3	0	123.457 Iref					
	Current Prefault Overcurrent	IFault	2	0	123.46 Fault					
	Current Prefault IBias	IBias	2	0	123.46 IBias					
	Anale	•	2	0	123.46 °					
	Percent Dev	%	2	0	123.46 %					
	Percent IHarmonic	%	2	0	123.46 %					
	Percent ForComtradeSignalScale	%	8	4	123.5 %					
	Time	S	8	4	123.5 s	cv	3	0	123.5 s	
	TimeInput	S	3	4	123.5 s	cv	3	0	123.5 s	
	Time Percent	%	2	0	123.46 %					
	Negative Time	1/s	8	4	123.5 1/s	1/cv	3	0	123.5 1/s	
	Minute	min	4	0	123.4567 min					
	Frequency	Hz	4	4	123.5 Hz	fn	3	0	123.457 fn	
	Power S	VA	8	4	123.5 VA	Sn	3	0	123.457 Sn	
	Power P	W	8	4	123.5 W	Pn	3		123.457 Pn	
	Power Q	Var	8	4	123.5 Var	Qn	3		123.457 Qn	
	EneravPQ	VAh	8	4	123.5 VAh					
	EneravP	Wh	8	4	123.5 Wh					
	EnergyO	VARh	8	4	123.5 \/ARh					

7:11.097	Alert Tone on Hardware E	
	None	X
2.000 s Settings	Alert (1).wav Alert (2).wav Alert (3).wav Alert (3).wav Alert (5).wav Alert (5).wav Alert (6).wav Alert (7).wav Alert (8).wav Alert (10).wav Alert (11).wav Alert (11).wav Alert (13).wav Alert (14).wav	
Decimal Places	Service System Integrated System	

By activating the "Automatic" option in the "Style of Tables", dimensions of table cells will be set by the software automatically. By activating the "Manual" option, the user can modify the dimensions of the cells of the tables. In this dropdown list, user chooses how table cells dimensions be set. In the "height of table cells" the height of each cell is adjusted by pixels. For example by selecting and confirming "All Cells", If you visit the "Distance" room and shot several points, you

see the width of each column is equal to the title of its header and due to selecting "Manual" state its dimensions is changeable by the user. In the "Key Setting" section, by activating the "Enter like Tab in Forms" option, the user chooses "Enter" as the "Tab" key to move between the cells. By activating the "Arrow like Tab in Forms" option, the user chooses to move between the cells in the tables by using the arrow keys.

None		~
Style of Ta		Jal
AlCells		~
Height of Tai	ble Cells:	15 px

By selecting "Service System" in the "Communication Mode" section, each of the rooms on the first screen of the software, if opened, will launch as a separate exe file and each window will be used independently from the windows of other rooms which will reduce the use of system resources; however, by selecting the "Integrated System" option, if several rooms are running simultaneously, all of them will be running in the same exe file. In this case, in addition to using more system resources, if a window is running in one of the rooms, the other rooms and screens of the software will not be usable.

	Height of Table Cells: 15 px
2.000 s Settings	Key Settings ✓ Enter Like Tab in Forms ✓ Arrow Like Tab in Forms
ignature Decimal Places	Communication Mode Service System Integrated System

11 : PREFERENCES PAGE "DIRECTORY" & "CASH" TAB

In the "Directory" tab, the default paths for saving files are specified. By clicking on any of the file formats, this default path can be changed. For example, by double-click on "AMPro-Distance Report Files", its path can be changed to desktop. To save the existing report file, open "Report View" in the "Distance" room and click on the "Export Report". It is seen that the saving path is located on the desktop.

Device	Nominal Values -					
Name/Description :	f nom :	50.00 Hz				
Manufacturer :	V nom(secondary) :	110.0 V(L-L)				
Device Type :		63.51 V(L-N)				
Device Address :	V primary :	230.0 kV(L-L)				
Serial/Model Number :		132.8 kV(L-N)				
	I nom(secondary) :	1.000 A				
Additional Information1:	I primary :	1.000 kA				
Additional Information2 :	Residual Voltage/C	urrent Factors —				
Substation	VLN/VN :	1.730				
Name :	IN/I nom	1.000				
Address :	Limits —					
Bay	V max :	132.0 V				
Name :	I max :	64.00 A				
Address :	Debounce/Deglitch	Debounce/Deglitch Filters				
	Debounce Time :	3.000 ms				
	Deglitch Time :	400.0 µs				

By checking the squares in the "Remember Last Location" column, it is specified that if the user chooses another path while storing the file, the software should remember that path. For example, if you open the "Distance" room, and set the report file saving path on drive "C" and save the file and then if you try to save the file again you can see that the saving path has been changed to that folder.

Template Report Package :	Settings Enter Like Tab in Forms
Report Genrator Remove Signatu	Communication would
Templates	Decimat Places

By clicking on the "Restore Selected to Defaults" button in the "Preferences" tab, the changes made to the squares in the "Remember Last Location" column are restored and reset to the default settings. For example if three squares become unchecked and two of them be selected. By clicking on "Restore Selected to Defaults" it's seen that these squares are gotten back to default state.

n Typ		~								
umber	of Decimal Places									
amala	Value: 123.4567									
ampie	123.4567									
	Í.	1				1. 100 March 10 March 1	- Constant - F	1000 AV 40	1247 - 44 - 14 (1993)	
	Parameter Name	Absolute Unit	Absolute Accuracy	Absolute Eng.Factor	Absolute Display	Relative Unit	Relative Accuracy	Relative Eng.Factor	Relative Display	^
	Impedance	Ω	8		123.5 Ω					
	Inverselmpedance	8	8	13 A	123.5 บ					
	ImpedancePercent	%	8	4	123.5 %					
	Inductance	н	8	4	123.5 H					
	Capacitance	F	8	4	123.5 F					
	Voltage	V	8	4	123.5 V	Vn	3	0	123.457 Vn	
	Current	A	8	4	123.5 A	In	3	0	123.457 In	
	Current Differential	In	3	0	123.457 In					
	Current Overcurrent	Iref	3	0	123.457 lref					
	Current Prefault Overcurrent	Fault	2	0	123.46 IFault					
	Current Prefault IBias	IBias	2	0	123.46 IBias					
	Anale	•	2	0	123.46 °					
	Percent Dev	%	2	0	123.46 %					
	Percent Harmonic	%	2		123.46 %					
	Percent ForComtradeSionalScale	%	8		123.5 %					
	Time	S	8		123.5 s	CV	3		123.5 s	
	TimeInput	S	3		123.5 s	cv	3	0	123.5 s	
	Time Percent	%	2		123.46 %					
	Neoative Time	1/s	8		123.5 1/s	1/cv	3	0	123.5 1/s	
	Minute	min	4		123.4567 min					
	Frequency	Hz	4		123.5 Hz	fn	3		123.457 fn	
	Power S	VA	8		123.5 VA	Sn	3		123.457 Sn	
	Power P	W	8		123.5 W	Pn	3		123.457 Pn	
	Power Q	Var	8	4	123.5 Var	Qn	3	0	123.457 Qn	~

By clicking on the "Reset to Default" button, all settings are reset to the default values. It is possible to save the changes made to the settings of this section in a file by clicking on the "Export" button. When necessary, this file can be imported and applied to other screens. Settings related to different sections of the software are saved in the paths stored in the "Cache" tab. In order to prevent software slowdown in the long run, the software cache must be cleared. For clearing the cache of the software, the "Clear" button should be used. The "Open Roaming Directory" button opens the path where the cache is stored. In this folder, cache files can be viewed or cleared. For clearing, select all of the folders then press the delete button on keyboard.

Setting			×
Test Object Room Directory Cache			
Default Language of Help Persian Date / Time Type : Persian ✓ Show Month Name ✓ Show Day of Week 1399/>۲۰۲۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰	Auto Save Interval: 30.00 s History Directory C:\Users\pq\Document Max Size 1.000 GB Max Time 365 day	Appearance Setting of GroupBoxs Enable Setting of Border Color Border Color: Enable Setting: Font Text Color:	
Show Mili Seconds Show/Hide Test Counters Test Count Passed Count Faild Count Out of Range Count Not Tested Count	Alert Tone on Hardware Error None Style of Tables Automatic AlCells Height of Table Cells: 15 px	Text Back Color:	
Report Report Refresh Interval: 2.000 s Template Report Package : Settings Extra Tools Report Genrator Report Genrator Remove Signature Templates Templates	Key Settings Image: Setting form Image: Setting form Image: Setting form Communication Mode Image: Setting form Image: Setting form Image: Setting form Image: Setting form Image: Setting form		

12 : "CONNECTION & FIRMWARE"TAB

In the "Connection & Firmware" tab on the "Setting" page, the settings for the device connection and "Firmware Update" can be adjusted. Also, the settings for the connection can be adjusted in the "Details" section. The "IP" field is used to connect to the device. In the past, the last three digits of the device's serial number were used for the fourth part of this field, but as of 15/07/2019, the last two digits of the device's serial number are used for this purpose. The "DNS", "Gateway", 'Subset Mask" and "Port" fields are used for network connections. Once connected to the device, you can change these elements and then by selecting the "Set to ATM" option the changes can be saved.

Details	are Hardware Available	Devices	Log				
AMT 63			Connect	Update Firmware	Update Firmwa	ire in Flash Mode	
IP :	192.168.1.72	Refre	sh Connection				_
Port :	1001	D	isconnect	Progress :			
Subnet Mask :	000.000.000.000	S	et to AMT				
Gateway :	000.000.000.000	Ping	g Entered IP				
DNS :	000.000.000.000	F	ing Wi-Fi				
Serial Number:	0	Ī					
Version :	0						
Minimum Version:	0	Ī					
MAC Address :	00:00:00:00:00:00						

The "Serial Number" is not changeable by a user and after connecting to the device, the last three digits of the device's serial is written in this part. The "Version" field displays the current version of the device and the "Minimum Version" field displays the minimum version that allows updating the "Firmware". In the "MAC Address" field, users can use the same software to connect to two devices. If the "MAC Address" of both devices is the same, it is necessary to change one of them. "MAC Address" of a device consists of 6 2-character parts. Enabling the "Enable Update Connection Date by Device" option causes the information of this part to be refreshed continually. If the user wishes to make and apply some changes in this section, they should uncheck the mentioned option and by clicking on the "Set to AMT" option, apply the changes.

AMT		Connect	Transfer ages
IP :	192.168.1.72	Refresh Connection	Update Firmware
Port :	1001	Disconnect	Progress :
Subnet Mask :	255.255.225.0	Set to AMT	
Gateway :	192.168.1.5	Ping Entered IP	
DNS :	192.168.1.1	Ping Wi-Fi	
Serial Number:	472		
Version :	99052701		
Minimum Version:	96102900		
MAC Address :	1E:30.6C A2:45:5		
☐ Enable Update (Connection Data by Device	e	

The "Connect" button is used to connect to the device,

IP :	192.168.1.72	Refresh Connection	U
Port :	1001	Disconnect	Pro
Subnet Mask :	255.255.225.0	Set to AMT	
Gateway :	192.168.1.5	Ping Entered IP	
DNS :	192.168.1.1	Ping Wi-Fi	
Serial Number:	472		
Version :	99052701		
Minimum Version:	96102900		
MAC Address :	1E:30:6C:A2:45:5E		
] Enable Update (Connection Data by Device	e	

the "Refresh Connection" button is used to connect and disconnect the device once,

Details		ñ	
AMT		Connect	Update Firmw
IP :	192.168.1.72	Refresh Connection	
Port :	1001	Disconnect	Progress :
Subnet Mask :	255.255.225.0	Set to AMT	
Gateway :	192.168.1.5	Ping Entered IP	
DNS :	192.168.1.1	Ping Wi-Fi	
Serial Number:	472		
Version :	99052701		
Minimum Version:	96102900		
MAC Address :	1E-30-6C-42-45-5E		

the "Disconnect" button is used to disconnect the device,

MT	Connect	
P :	192.168.1.72	Refresh Connection
Port :	1001	Disconnect
Subnet Mask :	255.255.225.0	Set to AMT
ateway :	192.168.1.5	Ping Entered IP
DNS :	192.168.1.1	Ping Wi-Fi
Serial Number:	472	
/ersion :	99052701	
Ainimum Version:	96102900	
AAC Address :	1E:30:6C:A2:45:5E	

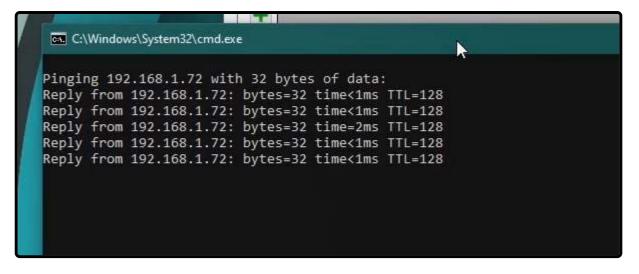
the "Ping Entered IP" button is used to check the authenticity of the connection to the device via LAN.

MT		Connect
Ρ:	192.168.1.72	Refresh Connection
^p ort ;	1001	Disconnect
Subnet Mask :	255.255.225.0	Set to AMT
Gateway :	192.168.1.5	Ping Entered IP
DNS :	192.168.1.1	Ping Wi-Fi
Serial Number:	472	
Version :	99052701	
Minimum Version:	96102900	
MAC Address :	1E:30:6C:A2:45:5E	

and, finally, the "Ping Wi-Fi" botton is used to check the authenticity of the connection to the device via "Wi-Fi".

IP :	192.168.1.72	Refresh Connection
Port :	1001	Disconnect
Subnet Mask :	255.255.225.0	Set to AMT
Gateway :	192.168.1.5	Ping Entered IP
DNS :	192.168.1.1	Ping Wi-Fi
Serial Number:	472	10
Version :	99052701	
Minimum Version:	96102900	
MAC Address :	1E:30:6C:A2:45:5E	

If the connection is made via LAN, by clicking on the "Ping Entered IP", the IP which is entered in this section will be pinged.



If the connection is made via Wi-Fi, by clicking on "Ping Wi-Fi", this IP (192.168.1.1), which is specified for the Wi-Fi of all devices, will be pinged.

C:\Windows\System32\cmd.exe
Pinging 192.168.1.1 with 32 bytes of data: Reply from 185.44.114.209: Destination host unreachable.

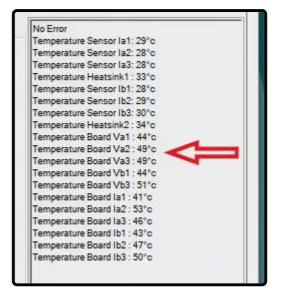
"Update Firmware" is used to update the firmware of the device which is, usually, done automatically after connecting to the device. If it didn't happen automatically, the "Update Firmware in Flash Mode" must be used. How to use this option is explained in the related animation.

Connect	Update Firmware	Update Firmware in Flash Mode
efresh Connection	1	13
Disconnect	Progress :	
Set to AMT		
Ping Entered IP		
Ping Wi-Fi		

13 : DEVICE HARDWARE SETTING

The general settings of the device are adjusted in the "Hardware" tab on the "Preferences" page. In the "Fan mode" section, selecting "Silent" will change the speed of the "Fan" depending on the temperature of the switches or heatsinks of the device which is displayed on this page. But, if the "Max.Power" option is selected, the fan of the device will work at its maximum power constantly.

+
Connection & Firmware Hardware Available Devices Log
► Fan Mode Silent O Max. Power Delay :
Min. Temperature : 45.00 * Max. Temperature
Absolute Voltage : 4000 mV
Absolute Current : 500 mA
r Binary Input Status

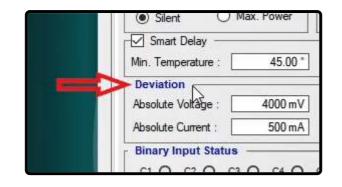


By activating the "Smart Delay" option, if the temperature of the device reaches 55 degrees, in the rooms such as "Distance" and "OverCurrent" where points are used for the test, the test will automatically pause and a message saying "Cooling" will be displayed on the bottom bar of the test screen. The test will not resume until the temperature reaches 45 degrees. The maximum operating temperature of the device is specified in the "Maximum Temperature" section. If the temperature of the device exceeds this value, the device will stop working completely. This value can be changed up to 70 degrees but, except for certain conditions, the user must not set the temperature above 60 degrees.

Connection & Firmware Hardware Av	ailabl
Fan Mode Silent Max. Power	De
MrX: Temperature : 45.00 °	Ma
Absolute Voltage : 4000 mV	Pe

In the "Switch Off After Test" section, the user can specify how many seconds after the test is finished, the current and voltage switches should be opened. This number is set to 5 seconds by default but it can be increased up to 10 seconds. In the "Deviation" section, the reporting conditions for "Other" errors can be specified. By default, it is specified in the software that if there is a difference between actual voltage of the device and value specified in the software exceed 4 volts or the current difference goes over 500 mA, the "Other" error should be displayed. In the "Relative" section, this value is specified as a percentage of the value specified in the test. In the actual operating mode, the device uses the lowest value among these two for the error message.

nection & Firmware	Hardware	Available Devices	Log	
n Mode ——) Silent O	Max. Power	Switch off a Delay :	after Test	t
Smart Delay — . Temperature :	45.00	Max. Tempera	ature :	55.00 °
eviation ———				



In the "Binary Input Status" section, it is specified which binary is connected and which binary is not.

7 BOOLC	voilage .		10001114	Relativ		
Absolute	Current :		500 mA	neiau	ve.	1
Binary Ir			_			
C1 O	C2 ()	C3 Ô	C4 O	C5 ()	Ce O	C7 O
Disable	Error –					

In the "Disable Error" section, a list of possible errors of the device is available and you can disable them.

"Select All Error Other": this error is displayed when the device is unable to produce the current and voltage asked by the user. The cause for this error can be the voltage outputs' short circuting or the current outputs' open-circuting. By opening the drop-down of each errors' fields, any error can be disabled for a number of voltage and current outputs.

"Select All Error Self": every time before running the test, the device checks its internal hardware to determine whether it is capable of generating +50V or -50V of voltage and +5A and -5A of current. If there is a problem, the device displays a "Self" error.

"Error Thermal": this error is displayed when the temperature of the device's sensors is increased. Occasionally, the thermal sensor of one of the switches has a problem, indicating irrational temperatures such as 800 degrees. In this case, in the slider of this section, it is possible to deactivate the thermal error to continue working with the device.

"Error Over Current Binary 9": the binary 9 of the device can measure the current up to 500mA. If the input current of this binary exceeds this value, this error is displayed.

"Select All Error Over Voltage Binary": depending on the duration specified for them, if their input voltage exceeds the specified limit, the binary inputs of the device will display this error. For instance, in the 4.5V mode, if the input voltage of any of the binaries exceeds 4.5V, the device will display this error.

In the "Times For ignoring Over Voltage Binary" field, the maximum time allowed to ignore the "Over Voltage" error of the binary is specified. By default, it is set that if the time for the "Over Voltage" error is not shorter than 100 milliseconds, the device will not display any error about this matter.

Select all Error Other	~
Select all Error Self	~
Error Thermal	~
Error Overcurrent Binary 9	
Select all Error O.V. Binary	~
Times for Ignore OV of Binary	

This should be noted that, since "Thermal Error" and "Error Over Current Binary 9" are among the fatal "Errors" of the device, their deactivation setting will not be saved by the software and will be disabled each time the software is run, then if this "Error" needs to be disabled, the user must do this manually. The "Check RAM" section is used for testing the RAM that is used in the "AMT". In the "Repetition" field, the number of times that a series of data are written in the RAM and erased is specified. This section can be used in case of uncertainty about the performance of the device's RAM. Since the writing and reading operations are performed on the RAM multiple times, eventually, if there is a problem in this process, the error light on the panel of the device will turn on.

	Check RAM	_
5.000 s	Repetition: 1x Check Performance of RAM	AD
	Maximum Temperature	
55.00 °	Maximum Temperature Value: 60.00 *	

In the "Earth" section, it is possible to enable or disable the "Earth" error of the device. If the "Enable" option is checked, it is necessary to connect the "Earth" cable to perform the test. Otherwise, an "Earth" error will be displayed and the device will stop working. This error can be deactivated by unchecking the "Enable" option. But, it is vital to note that, doing so during the test can be lethal and as it is ,also, stated in the displayed message, Vebko company will not be responsible.

55.00 °	Maximum Temperature Value:
30.00 %	Earth Enable
30.00 %	Combination Cable
0 0 0	Voltage O Current

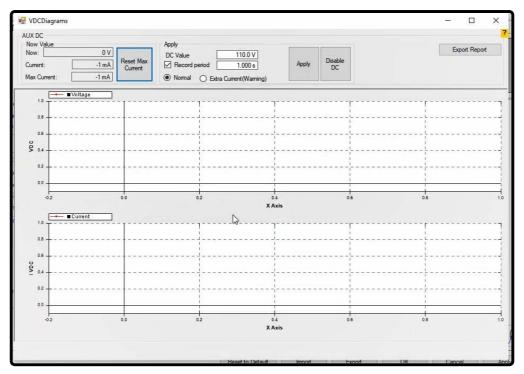
It is possible to activate or deactivate the main hardware switches of the device in the "Switches" section. The switch number 1 is related to the voltages and currents of the group A output. The switch number 2 is related to the voltages and currents of the group B and VDC. By deactivating every switch, all outputs of that switch will be deactivated.

Switches ———	
Enable Switch1	Enable Switch2

In the "Combination Cable" section, if the "Voltage" option is selected, the outputs of the Neutrik cable will include three current and three voltage phases. But if the "Current" option is selected, the output of the cable will consist of two three-phase current groups which are used for various tests such as differential test.

30.00 %	Enable	5
Î	Combination Cable]
0 0 0	0 VDC C #	

The "Open VDC Setting" option is used to enable the DC output voltage of the device. By clicking on this option, the "VCD Diagrams" page opens. On this page, in the "DC Value" field of the "Apply" section, the output DC value of this port is specified. This value can be set up to a maximum of 212V DC. By clicking on the "Apply" option, the "AUX DC" port of the device will inject the amount that is specified in the "DC Value" field. The "AUX DC" output can be disabled by clicking on the "Disable DC" option. By activating the "Record Period" option in the next field, a duration of time is specified for recording the output signal of this port.



In the "Now Value" section, the amount of current and voltage produced by the "AUX DC" port is displayed. The "Max Current" field shows the maximum current pulled from this port. In the following two diagrams, the instantaneous amounts of voltage and DC current of this port are indicated. It is also possible to save the settings set on this page as a PDF file by clicking on the "Export Report" option. To reset and update the amount of the current displayed in the "Max Current" section, you can click on the "Reset Max Current" option.

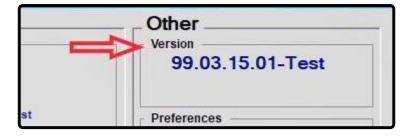
	Now: 43	110 V	
-	Current: [78 m A	Reset Max Current
+	Max Current:	420 mA	

By checking the "Dancing Light" option, the LEDs in front of the device will turn on in a dancing manner. This operation is to test the healthy "LED" binary inputs of the device.



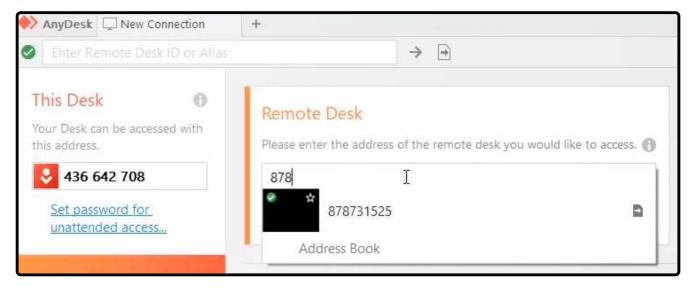
14 : SOFTWARE START PAGE

The "Start" page of the software is the first page that the you face when the software is opened. At the top right is the version name of the software ("Stable", "Test") as well as its version number. If a new version of the software is provided by Vebko, when you are connected to the internet, an option, saying "New Version is Available" will appear at the top right. By clicking on this option, you can download and install the latest version of the software. Clicking on the "What's New" option opens a page in which the fixes or the features added to different versions of the software are displayed. For preparing these versions, first, Vebko experts present the software problems and suggestions to the software group. Then, after evaluating and correcting this group, the new features are displayed in detail on this page.



By clicking on the "Launch Remote Help" option, you can connect to the online software support via one of the two available methods of "AnyDesk" or "Ammy Admin". For using AnyDesk, first, the user needs to give the 9-digit number called AnyDesk ID, which is available at the top left of the "New Connection" page, to the supporter. Then, the supporter will enter the code in the "Remote Desk" section and press "Connect" to connect to the user's "Desktop" page.





Also, by clicking on "Ammy Admin", the "Ammy Admin-Free" page opens. Then, the user needs to give their "ID" and "Password" to the supporter. After that, the supporter will enter this information and connect to the user's desktop.

Ammyy Language Help	Free license (for home use only!)
Client. Wait for session	Operator. Create session
86 766 188	Client ID/ IP
Password	88069198
05081	Desktop - speed 256 Kb - 1 Mb 🗸 🗸
Your IP 192.168.1.20 ~ 192.168.0.88	View only
Start Stop	Connect

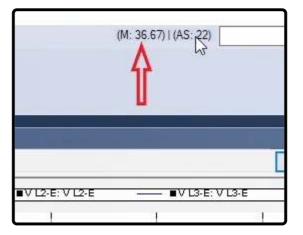
The "Relay Modules" section contains the special software for Vebko's relay. In the "Tester Modules" section, different relay test rooms are on the left while equipment test rooms are on the right.

AMT Synchronizer	RTD
Vebko Control Center	Vebko Relay

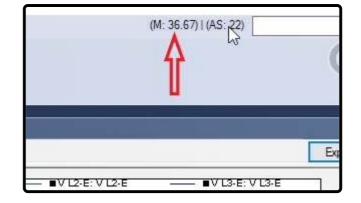
You can adjust the settings for all test pages by clicking on the "Preferences" option. In all rooms, you can see two letters and numbers at the top right of the screen:



1- "M" means that how many megabytes of the ram is occupied by this page.



2- "AS" which is "Auto Save" means that if you make a change to the file, after passing the time that is specified in front of this option, the software automatically saves the status of the file and if there is a previous file, the new file replaces the existing one. After the filed is saved, a message saying "Auto Save Done" will be displayed at the bottom of the page.

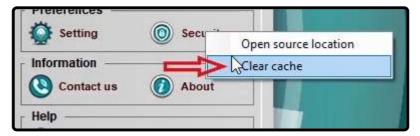


The software repeats this saving process every 30 seconds which can be changed in the "Auto Save" section in the "Room" tab on the "Preferences" page. This saved file is displayed in the "Recovery" option. If the software crashes for any reason, by clicking on the "Recovery" option, you can recover and view the last saved version of your file. This is an advantage for the software because the "Ctrl+Z" key combination recovers the changes based on this 30 seconds and if the software crashes, the test file will not be destroyed.

Active 2
 Recovery Recovery
AMT

Interval:	30.00
History	
Directory C:\Users\p	q\Document
Max Size	1.000 GI
Max Time	365 da
Alert Tone on Hard	ware Error —
None	~
none	
Style of Tables	
	Manual

By clicking on the "Security", two options open. "Clear Cache" option which is used to clear the cache of the software.



When you install the software for the first time, you should click on the "Open Source Location" option to run both "AMPro Application" and "AMPro APP Launcher" files as an administrator. To do this, right-click on the mentioned files, then select

"Properties" and in the "Compatibility" tab, check the "Run this program as an administrator" option. After that, you can close the window.

Preferences	Secu
Information	Open source location
Contact us	About

The "Contact us" option provides you with ways to connect with experts at Vebko.

	Setting	Security	
Ť	Information	About	
ner(CVT)	Help Help	🙆 What's new	

The "About" option, provides the user with information about Vebko company.



By clicking the "Help" option, provides the user with the reference manual and of the tester and the software.



Various tasks are performed in the "AMT" section. You can directly connect or disconnect to the device by holding on the "Control" button and left-clicking on this image. The figure in this section indicates the connection status to the device. By double-clicking on this section, it is possible to enter the "Preferences" page directly. If you want to connect to multiple devices at the same time, right-click on this section and select the device name to connect to it. By doing this, the device name will appear on the left of the screen.



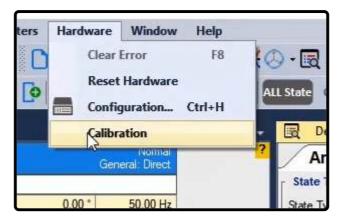
15 : GENERAL TYPES OF ROOMS

Generally, there are two types of testing rooms available on the main page of the software.

The "VCC" room: this room provides you with a place to perform a series of different tests. Also, it is possible to perform several tests from different rooms in a continuous manner in this room.

Nodes	Summery	Window State	Run State	Report State	Process ID	Progress	Inherit XRio	Inherit Hardware Config	Inhe
🖙 💓 🛅 Root						0%			
🔽 🎬 XRio File		ReadyToOpen		Up to date					
		ReadyToOpen		Up to date					
ReportSettingsPackage File									

The other rooms including "AMT Sequencer", "AMT Distance", "AMT Transformer" and "AMT Differential", have the same main page. The only difference is that in these rooms, a few features are made hidden or shown according to the needs. For example, in the "Hardware" section in the "Sequencer" room, there is an option for "Calibration" but in the same section in the "Distance" room, this option is not available and has been made hidden.



All necessary features for performing different tests are available in the "Sequencer" room. "Table View", "Detail View" and "Measurement View" are the important windows of this page while the "Table View" and "Measurement View" are not available in the other rooms. Also, the "Detail View" window in this room is different from the "Detail View" in the other rooms like "Distance".

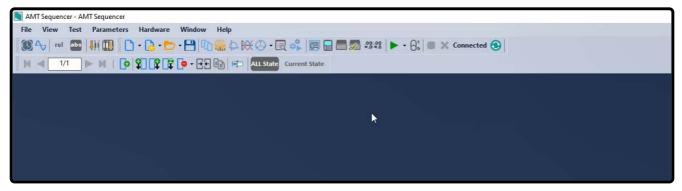
In rooms like "Overcurrent", "Distance" and "Differential", which are also called the "Medium" rooms, the "Table View" and "Measurement View" windows are not available but instead, the "Test View" window is available in these rooms. Generally, the "Test View" window is the same in all "Medium" rooms. In the "Test View", some options are made hidden or shown according to the needs. For example, in the "Differential" room, the "I diff" and "I bias" fields are available, while in the "Distance" room, the "[z,Left:0,Top:0,Right:0,Bottom:0,Scale:50%]" and "phi" fields are available.

Some parts like "Trigger" and "Binary Output" are the same in all rooms because changing their parameters was not deemed to be necessary. Those rooms which are used for testing the equipment are called "State Sequencer" and the windows available in the "Sequencer" rooms are, also, available in these rooms. Moreover, the "Instrument View" window, which is not available in the "Sequencer" rooms, is added to these rooms. Some windows including "Vector View" and "Signal View" are similar in all rooms and have the same structure but it is possible that some of their information is made hidden or shown according to the needs.

16 : TOOLBAR AND STATUS BAR, PART 1

By opening each room, a page which contains several windows opens Along with these windows there is the toolbar and

the status bar. After closing these windows, the explanation of different parts of the menu and the toolbar will be given in the video This toolbar is the same in all sections and the "Sequencer" room has another toolbar which is exclusive to it.



To open a new room, click on "File" and select "New". You can also access the files that have already been saved by selecting "Open". Use "Save" or "Save as" to save a file. Use "Recent" to access the files that have recently been saved.

AM 📳	IT Sequencer - AMT Sequencer	
File	View Test Parameters Hardware Wi	ndow Help
	New Base On System DefaultNew Base On Custom TemplateOpenSaveCtrl+SSave AsCtrl+Shift+SSave As Template	 Contraction Contract
	Recent	1 c:\users\pq\desktop\transformer.vtrs
	Security Export Report	Set Mode and FaultType
	Exit	General: Direct

Use "Security" to encrypt a file the encryption has three levels the first level, full permission, allows users with an encryption code to access the settings, run the test file and save the output.

File	View	Test	Parameters	Hardware	Window	Help
0	New Ba	se On Sy	ystem Default		<u>ت</u> ا •	a 4
	New Ba	se On Ci	ustom Templato	e		
	Open					
8	Save			Ctr	I+S	
	Save As			Ctrl+Shift	t+S	
	Save As	Templa	te		-	
	Recent				•	
	Secu (3)	,				
	Export F	Report	(
	Exit					
-	_	111011110				

In the second level, users cannot change the settings but can only run the test file and save the output in the third level of encryption, users can only view the file.

reate Password		×
Password full permission for this file		
Read-only password with the ability to run the test for this file		
I		
Read-only password without the ability to run the test for this file		
	Ok	Cancel

Use "Export Report" to save the test file as PDF. Use "Exit" to close and exit the test page. Click on "View" and select "Toolbars" to see different modes of the toolbar Add or remove the check mark to show or hide the icons.

File V	iew	Test Parameters	Hardware	Wind	
		Toolbars	↓	~	Standard
M		Status Bar	~	*	Units and Values Tools
100		Units	•		
Ę		Communication Logge	er	Norm I: Dire	
Name V L1-1 V L2-1	5	Table View	Ctrl+Alt+T	0.00	<u>+z</u> 9
V L3-1		Measurment View (trl+Alt+M	0.00	Hz
I L2:	2	Characteristic View	Ctrl+Alt+I	0.00 H	Hz [
Bin. C	>	Vector View	•	1.000	-
Туре 隆	£	Signal View	Ctrl+Alt+S		×
Comm		Report View	Ctrl+Alt+R		
	1	Detail View	Ctrl+Alt+D		
*	8	Start-Condition & Rep	etition		
Bin. li	Ð	Revision History	Ctrl+Alt+H		

Use "Status Bar" to hide or show the status bar at the bottom of the page.



The "Units" option has three parts:

File Vi	ew Test Parameters Hardware	Window Help
8	Toolbars +	B 6 + K 8
M	Status Bar	• - ⊡-: @@ === All
(j)	Units +	Seconds
Name	Communication Logger	Cycles Absolut
V L1- (() V L2-] Table View Ctrl+Alt+T	Relative Secondary
V L3-1	Measurment View Ctrl+Alt+M	Primary
	Characteristic View Ctrl+Alt+I	0.00 Hz 0.00 Hz
Bin. C	Vector View	1.000 s
Туре Ю	Signal View Ctrl+Alt+S	~
Comm		
	Detail View Ctrl+Alt+D	
\$1 \$1	Start-Condition & Repetition	_
Bin. li	Revision History Ctrl+Alt+H	

Choosing time between "Cycles" and "Seconds". By default, time is displayed in terms of seconds while by selecting "Cycles" the time is displayed in terms of cycles. Determine the cycle time in "Test Object", the "Device" block and then in the "f nom" field. If this frequency is changed the time is change accordingly.

General Test Object		10.		···	
File View			~	Tree :	2
😰 😰 🛅 Resize Columns : Auto	• 🖳 🛱 Recalculate Dicab 💀 Device Settings	led Formula(s) 4 Quick	Accese Ok Can	X	
Script Functions	Device Settings				? Formula
RIO Pilor Distance Differential CBConfiguration	Device Name/Description : Manufacturer : Device Type : Device Address : Serial/Model Number : Additional Information 1 : Additional Information 2 : Substation		Nominal Values f nom : V nom(secondary) : V primary : I nom(secondary) : I primary : Residual Voltage/C VLN/VN :	1.730	
	Name : Address :		IN/I nom	1.000	>
Auto Scroll	Bay Name :		V max : I max :	132.0 V 64.00 A	💢 Clear
	Address :		Debounce/Deglitch	100000	
	-		Debounce Time : Deglitch Time :	3.000 ms 400.0 μs	
Proccess Log Error / Warning Formula	F				w/Hide 🗹
	Save to Template Load T	emplate Export	Import	OK Cancel	ancel

Choosing Parameter's values between "Absolute" and "Relative" By default Parameters' values are "Absolute". use "Relative" to see parameters' values dependent to nominal value The nominal values for voltage can be determined in the "Test Object", "Device" and in the "V nom (secondary)" field, for current in the "I nom (secondary)" and for frequency in the (f nom) field.

ile View		~	Tree :	
n no Resize Columns : Auto	- E Pa Recalculate Disabled Form	ula(s) 4 Quick Access Ok Cance		-
	💀 Device Settings		- 🗆 X	-
Script Functions	Device Settings			? Formul
RIO	Device	Nominal Values		
⊕ 👩 Device ⊕ 🥣 Distance	Name/Description :	f nom :	50.00 Hz	
	Manufacturer :	V nom(secondary) :	110.0 V(L-L)	
Overcurrent Overcurrent Overcurrent Overcurrent	Device Type :		63.51 V(L-N)	
	Device Address :	V primary :	230.0 kV(L-L)	
	Serial/Model Number :		132.8 kV(L-N)	
		I nom(secondary) :	1.000 A	
	Additional Information 1 :		1.000 KA	
	and the second second	I primary :		
	Additional Information2 :	Residual Voltage/Cu	irrent Factors	
	Substation	VLN/VN :	1.730	
	Name :	IN/I nom	1.000	
	Address :	Limits		
	r Bay	V max :	132.0 V	-
Auto Scroll	Name :	1 max :	64.00 A	🔀 Cle
	Address :	Debounce/Deglitch	Filtoro	-
	L	Debounce Time :	3.000 ms	
		Deglitch Time :	400.0 µs	_
occess Log Error / Warning Formula F		Degitor finite .	400.0 µS	w/Hide
CCess Log Entry Wathing Formula P				w/ hide

Choosing values between "Primary" and "Secondary. By default, software values are in terms of secondary. To see the values in terms of primary use the "Primary" option these values can be determined in the "Test Object", "Device" block, "V primary" and "I primary" field



The "Communication Logger" option is for the communications of devices and laptops that the Vebko's programmers use. Different windows in the "Sequencer" page including "Vector View" and "Signal View" are shown in this list

File	View	Test Parameter	rs Hardware	Window
0		Toolbars		• 🕒 🗅
M	~	Status Bar		• • • •
10		Units		
Ę		Communication Log	ger	Normal I: Direct
Name VL1- VL2-	m	Table View	Ctrl+Alt+T	1.000 fn 1.000 fn
VL3-		Measurment View	Ctrl+Alt+M	1.000 fn 1.000 fn
1 L2: 1 L3:	Þ.	Chalacteristic View	Ctrl+Alt+I	1.000 fn 1.000 fn
Bin. C Trigge	144	Vector View		0.000 cy
Туре		Signal View	Ctrl+Alt+S	~
Comm	05	Report View	Ctrl+Alt+R	
		Detail View	Ctrl+Alt+D	
	*	Start-Condition & R	epetition	
Bin. li		Revision History	Ctrl+Alt+H	

Use "Revision History" to access all of the files that were saved by the program every 30 seconds. By selecting each file, you can reset them as needed

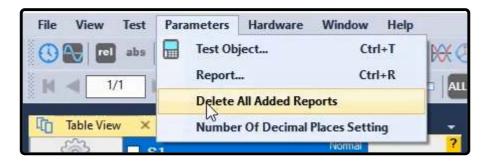
Select "Start/Continue" option in the "Test" menu to run the test. To stop the test use "Stop". Use "Clear" to remove the test results.

File	View	Test	Paramo	eters	Hardware	Window	Help
0	V rel	•	Start	F5	1-0	·8 0	\$
M	< <u>1</u>		Stop	F6		• - • • •	753 IV
ľ'n	Table View	×	Clear	F4			U

In the "Parameter" menu, select "Test Object" to open "General Test Object" page. Select "Report" to open "Report Setting" page.

ente ilbe	11.0	9901 0010	ina ina				1 0100010	nong	
🔚 General Test Object								-12	
File View				×	~		Tree :		?
😨 🛅 🔚 Resize Columns : Auto 🔹	🔏 🚱 Recalcu	late Disabl	ed Formula	(s) 👍 Quick	Access	Ok Canc	el		
	Device - Device								
Script Functions Custom FORU FORU FORU FORU FORU FORU FORU FORU	State	Name	ID	Description	Value	Туре	Min	Max	Formula
Auto Scroll									X Clear
									9
Proccess Log Error / Warning Formula References	Relay Config Log	3							Show/Hide 🗹
							0	ĸ	Cancel

Use "Delete all Added Reports" to remove all of the reports that have been added to the output report using the "Add to Report" option.



Using "Number of Decimal Places Setting" option, depended page opens and you can determine parameter units and determine how to display numbers

ple ^v	/alue: 123.4567									
	Parameter Name	Absolute Unit	Absolute Accuracy	Absolute Eng.Factor	Absolute Display	Relative Unit	Relative Accuracy	Relative Eng.Factor	Relative Display	
	Impedance	Ω	8	4	123.5 Ω					
	Inverselmoedance	8	8	4	123.5 v					
	ImpedancePercent	%	8	4	123.5 %	-				
	Inductance	Н	8	4	123.5 H					
	Capacitance	F	8	4	123.5 F					
	Voltage	V	8	4	123.5 V	Vn	3	0	123.457 Vn	
	Current	A	8	4		In	3	0	123.457 In	
	Current Differential	In	3	0						
	Current Overcurrent	Iref	3	0	123.457 Iref					
	Current Prefault Overcurrent	IFault	2	0	123.46 IFault					
	Current Prefault IBias	IBias	2	0	123.46 IBias					
	Anale	•	2	0	123.46 °					
	Percent Dev	%	2	0						
_	Percent IHarmonic	%	2	0	123.46 %	_				
	Percent ForComtradeSionalScale	%	8	4	123.5 %					
	Time	5	8	4	123.457 cv	cv	3	0	123.457 cv	
	TimeInput	S	3	4	123.457 cv	cv	3	0	123.457 cv	
	Time Percent	%	2	0	123.46 %					
	Negative Time	1/s	8	4		1/cv	3	0	123.457 1/cv	
	Minute	min	4	0						
	Frequency	Hz	4	4	120.0112	fn	3	0		
_	Power S	VA	8	4	100010.000	Sn	3	0	123.457 Sn	
	Power P	W	8	4	12010 11	Pn	3	0	123.457 Pn	
	Power Q	Var	8	4		Qn	3	0	123.457 Qn	
	EneravPQ	VAh	8	4						
	EneravP	Wh	8	4						
_	EnerovO.	VARh	8	4	123.5 VARh					

If an error occurs during the test, in the "Hardware" menu click on "Clear Error" to remove it and run the test again.

File View Test Parameters	Hardware Window Help	
Image: Constraint of the second se	Clear Error F8 Reset Hardware	ALL
Table View ×	Configuration Ctrl+H Calibration	?

Use "Reset Hardware" to reset the device's hardware automatically. Select "Configuration" to open the "Hardware Configuration" page. In this page output voltage and current, input and output binaries setting and extra setting is set.

•••	nput Binary Output Extra Setting				
itage Output		Voltage 0	utput Signal —		
50V, 60VA @ 400mArms	A I 2 3 N B I N		Output Target	Output Label	Show Actual Value
50V, 120VA @ 800mAms 00V, 120VA @ 400mAms	် စုံစုံစုံစုံ	X1	V L1-E	V L1-E	False
50V, 200VA @ 400mAms		X2	V L2-E	V L2-E	False
Used		X3	V L3-E	V L3-E	False
	X2 Y1	Y1	Not Used	Not Used	False
rnet Output		r Current C	Output Signal —		
2A, 100VA @ 32A, 3Vms, 5A, 12Vms	A 1 2 3 N	Current C	Dutput Signal — Output Target	Output Label	Show Actual Value
2A, 100VA @ 32A, 3Vms, 5A, 12Vms IA, 200VA @ 64A, 3Vms, 10A, 12Vms		Current C		Output Label	Show Actual Value
2A, 100VA @ 32A, 3Vms, 5A, 12Vms IA, 200VA @ 64A, 3Vms, 10A, 12Vms IA, 200VA @ 32A, 6Vms, 5A, 24Vms	φοφφ		Output Target		
2A, 100VA @ 32A, 3Vms, 5A, 12Vms A, 200VA @ 64A, 3Vms, 10A, 12Vms A, 200VA @ 32A, 6Vms, 5A, 24Vms A, 400VA @ 32A, 12Vms, 5A, 48Vms 8A, 400VA @ 128A, 3Vms, 30A, 12Vms	φοφφ	X1	Output Target IL1 IL2 IL3	1L1 1L2 1L3	False False False
2A, 100VA @ 32A, 3Vms, 5A, 12Vms A, 200VA @ 64A, 3Vms, 10A, 12Vms A, 200VA @ 32A, 6Vms, 5A, 24Vms A, 400VA @ 32A, 12Vms, 5A, 48Vms 8A, 400VA @ 128A, 3Vms, 30A, 12Vms	φοφφ	X1 X2 X3 Y1	Output Target IL1 IL2 IL3 Not Used	IL1 IL2 IL3 Not Used	False False False False
2A, 100VA @ 32A, 3Vms, 5A, 12Vms AA, 200VA @ 64A, 3Vms, 10A, 12Vms ZA, 200VA @ 32A, 6Vms, 5A, 24Vms 2A, 400VA @ 32A, 12Vms, 5A, 48Vms 8A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1 Y2	Output Target IL1 IL2 IL3 Not Used Not Used	IL1 IL2 IL3 Not Used Not Used	False False False False False
2A, 100VA @ 32A, 3Vms, 5A, 12Vms A, 200VA @ 64A, 3Vms, 10A, 12Vms A, 200VA @ 32A, 6Vms, 5A, 24Vms A, 400VA @ 32A, 12Vms, 5A, 48Vms 8A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1	Output Target IL1 IL2 IL3 Not Used	IL1 IL2 IL3 Not Used	False False False False
	φοφφ	X1 X2 X3 Y1 Y2	Output Target IL1 IL2 IL3 Not Used Not Used	IL1 IL2 IL3 Not Used Not Used	False False False False False
2A, 100VA @ 32A, 3Vms, 5A, 12Vms AA, 200VA @ 64A, 3Vms, 10A, 12Vms ZA, 200VA @ 32A, 6Vms, 5A, 24Vms 2A, 400VA @ 32A, 12Vms, 5A, 48Vms 8A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1 Y2	Output Target IL1 IL2 IL3 Not Used Not Used	IL1 IL2 IL3 Not Used Not Used	False False False False False
2A, 100VA @ 32A, 3Vms, 5A, 12Vms A, 200VA @ 64A, 3Vms, 10A, 12Vms A, 200VA @ 32A, 6Vms, 5A, 24Vms A, 400VA @ 32A, 12Vms, 5A, 48Vms 8A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1 Y2	Output Target IL1 IL2 IL3 Not Used Not Used	IL1 IL2 IL3 Not Used Not Used	False False False False False

Click on "Calibration" to open the calibration page. Vebko's experts use this page for device calibration.

tion		3								Name	Value ^		Name	Valu
log	Output					- Volta	ge Current —			 NVA1	0mA	•	NVA1	0mA
-										NVA2	0mA	<u> </u>	NVA2	0mA
	Signal	DC: -8	DC: 8	AC: 9	Time		Signal	x	Y	NVA3	0mA		NVA3	0mA
5	VL1-E	-55600 mV	55600 mV	50000 mV	5.000		VL1-E (+)	1750	100850 uA	NVB1	0mA		NVB1	0mA
-		-55600 mV	55600 mV	50000 mV		- ·		-1750		NVB2	0mA	-	NVB2	0mA
	VL2-E						VL1-E (-)		-100850 uA	NVB3	0mA		NVB3	0mA
	VL3-E	-55600 mV	55600 mV	50000 mV			VL2-E (+)	1750	100850 uA	NIA1	-3mA		NIA1	-1m4
	VL1-E(2)	-54700 mV	54700 mV	50000 mV			VL2-E (-)	-1750	-100850 uA	NIA2	3mA		NIA2	4mA
	VL2-E(2)	-55600 mV	55600 mV	50000 mV			VL3-E (+)	1750	100850 uA	NIA3	3mA		NIA3	2mA
	VL3-E(2)	-55600 mV	55600 mV	50000 mV			VL3-E (-)	-1750	-100850 uA	NIB1	0mA		NIB1	0mA
	L1	-42000 dmA	42000 dmA		2.200		VL1-E(1) (+)	1750	100850 uA	NIB2	2mA		NIB2	0mA
	L2	-42000 dmA	42000 dmA		2.200		VL1-E(1) (-)	-1750	-100850 uA	NIB3	0mA		NIB3	-1m4
	IL3	-42000 dmA	42000 dmA	50000 dmA	2.200		VL2-E(1) (+)	1750	100850 uA	PVA1	0mA		PVA1	0mA
	L1(2)	-42000 dmA	42000 dmA	50000 dmA	2.200		VL2-E(1) (-)	-1750	-100850 uA	PVA2	0mA		PVA2	0mA
	L2(2)	-42000 dmA	42000 dmA	50000 dmA	2.200		VL3-E(1) (+)	1750	100850 uA	PVA3	0mA		PVA3	0mA
	IL3(2)	-42000 dmA	42000 dmA	50000 dmA	2.200		VL3-E(1) (-)	-1750	-100850 uA	PVB1	1m		PVB1	1mA
					10,000,000,000					m (DO	0-0		0.000	0

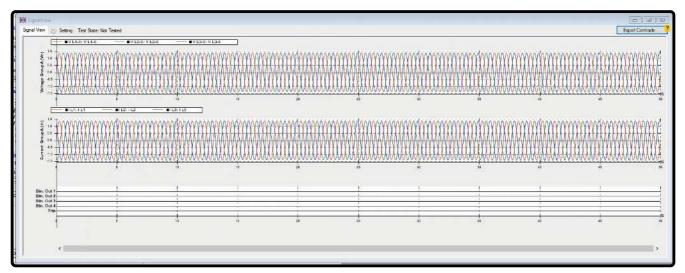
In the "Window" menu you can adjust the layouts. The "System Default Layout" option displays a default arrangement of windows for the software. Also the "Custom Default Layout" option displays the windows as "Default Layout" saved by the user.

File View	Test Parameters Hardwar	e Win	dow Help	
	abs 🛄)(🗋 - 💽 -	6	Cascade	
K < 1/		F 🖪	Crystom Default Layout	s
			System Default Layout	
Table View			Default Undock Layout	e
()))	S1 0	ien 📳	Default Layout For Transient	,
Name V L1-E: V L1-E	State 1 1.000 Vn 0.00 °		Default Layout For Quick	ł
V L2-E: V L2-E	1.000 Vn -120.00 *	FI	Manage Layouts	
V L3-E: V L3-E I L1: I L1	1.000 Vn 120.00 ° 1.000 ln 0.00 °	TH	Current Style as Default	ţ
1L2:1L2 1L3:1L3	1.000 ln -120.00 ° 1.000 ln 120.00 °	_		
Bin. Out	B1. J - B2. J - B3. J -		Schema: VS2015 Dark	-
Trigger	0 4 -0-		Schema: VS2013 Light	E.
Туре	Normal		Schema: VS2012 Light	it
Comment			Schema: VS2005	1
Trigger	C1 O	-	Schema: VS2003	Į
	Trip		VL3-E:	
			1 L1: 1 L 1 L2: 1 L	
Bin. Input			113:11	
			F Binary C	Dutpu
			B1. 🤳 🗕	B2

The "Default Undock" option displays the windows as "Undock" and the location of each window can be adjusted.

Image: Construction of the second	File View	Test Parameters	Hardware	Win	dow He	elp		
Table View System Default Layout State Default Undock Layout Default Layout For Transient Default Layout For Transient Name State 1 V L1-E: VL1-E V L2-E: VL3-E: V L3-E: VL3-E: IL1: 1.000 kn 1L2: 1.000 kn VL3-E: VL3-E: Schema: VS2015 Dark Bin. Out Bin. Input Trigger C1 O Trigger C1 O Trip Condition Bin. Input		abs 🛄)([) • 🔂 • 🗁	•	Cascade			C
Table View X Default Undock Layout Si Gen Default Layout For Transient Name State 1 Default Layout For Quick V L1-E: V L1-E 1.000 Vn 0.00* V L2-E: V L3-E 1.000 Vn -120.00* I L1: 1.100 Nn 0.00* Current Style as Default I L2: I L2 1.000 Nn -120.00* I L3: I L3 1.000 In -120.00* Bin. Out B1. - B2. - B3. - Trigger C Comment Schema: VS2013 Light Schema: VS2013 Light Dirigger C1 O Trip Schema: VS2005 Schema: VS2003 VL3-E: VI Bin. Input C1 O Trip Schema: VS2003 Schema: VS2003	K 🛛 1/1	► H C	191917	B	Custom	Default La	ayout	s
S1 Gen Default Layout For Transient Name State 1 Default Layout For Quick V L1-E: V L1-E 1.000 Vn 0.00° V L2-E: V L2-E 1.000 Vn -120.00° I L1: I L1 1.000 ln 0.00° I L2: I L2 1.000 ln -120.00° I L3: I L3 1.000 ln -120.00° Bin. Out B1 B2 B3 Trigger Schema: VS2013 Light Comment Schema: VS2012 Light Schema: VS2005 Schema: VS2005 Bin. Input C1 O Trigger C1 O Trigger C1 O Trigger C1 O Bin. Input Bin. Input				F	System	Default La	yout	- 1
Name State 1 Default Layout For Transient V L1-E: V L1-E 1.000 Vn 0.00° Manage Layouts V L2-E: V L1-E 1.000 Vn 120.00° Manage Layouts V L3-E: V L1-E 1.000 Vn 120.00° Manage Layouts I L1: I L1 1.000 In 0.00° Current Style as Default I L2: I L2 1.000 In 120.00° Schema: VS2015 Dark Bin. Out B1 B2 B3 Y Schema: VS2015 Dark Schema: VS2013 Light Schema: VS2012 Light Trigger C Comment Schema: VS2005 Trigger C1 O Trip Trigger V L3-E: VI Bin. Input Ein. Input Binary Out Binary Out	Table View	×		F	Default	Undock La	ayout	e
VL1-E: VL1-E 1.000 Vn 0.00° Manage Layout For Quick VL2-E: VL2-E 1.000 Vn -120.00° Manage Layouts VL3-E: VL3-E 1.000 Vn 120.00° Current Style as Default IL1: IL2 1.000 ln -0.00° Current Style as Default IL3: IL3 1.000 ln 120.00° Schema: VS2015 Dark Bin. Out B1 B2 B3 I Schema: VS2013 Light Trigger	Ś	🗆 S1	Gene					,
V L1-E: V L1-E 1.000 Vn 0.00° V L2-E: V L2-E 1.000 Vn -120.00° V L3-E: V L3-E 1.000 Vn 120.00° I L1: I L1 1.000 In 0.00° I L2: I L2 1.000 In -20.00° I L3: I L3 1.000 In 120.00° Bin. Out B1 B2 B3 Y Schema: VS2013 Light Schema: VS2013 Light Schema: VS2012 Light Comment Schema: VS2005 Trigger C1 O Trigger C1 O Trigger C1 O Bin. Input Trig	Name	State 1			Default	Lavout Fo	r Quick	ł
V L3-E: V L3-E 1.000 Vn 120.00° Image Layous I L1: I L1 1.000 ln 0.00° Image Layous I L2: I L2 1.000 ln -0.00° Image Layous I L3: I L3 1.000 ln -120.00° Schema: VS2015 Dark Bin. Out B1. J = B2. J = B3. J = I Schema: VS2013 Light Trigger Image Layous Schema: VS2013 Light Type Nomal Schema: VS2012 Light Comment Image L3 Schema: VS2005 Trigger C1 O Trip Bin. Input Image L3 Image L3 Bin. Input Image L3 Image L3	VL1-E: VL1-E	1.000 Vn	0.00 *		Derdunt	Layout ro	Quick	
V L3-E: V L3-E 1.000 Vn 120.00 * I L1: I L1 1.000 ln 0.00 * I L2: I L2 1.000 ln -120.00 * Bin. Out B1 B2 B3 Schema: VS2015 Dark Schema: VS2013 Light Schema: VS2013 Light Trigger Schema: VS2013 Light Trigger Trigger Trigger Trigger Trigger Trigger Trigger C1 O Trip Bin. Input Bin. Input				TH	Manage	Lavouts		
I L2: I L2 1.000 ln -120.00 ° I L3: I L3 1.000 ln 120.00 ° Bin. Out B1 B2 B3 Y Schema: VS2015 Dark Trigger Comment Schema: VS2013 Light Comment Schema: VS2015 Dark Trigger C1 O Trigger C1 O Trigger C1 O Bin. Input Finary Out	and the second se				1			
I L3: I L3 1.000 ln 120.00° Bin. Out B1 B2 B3 S Schema: VS2015 Dark Trigger Schema: VS2013 Light Schema: VS2013 Light Type Nomal Schema: VS2012 Light Schema: VS2005 Comment C1 O Schema: VS2003 V L3-E: VI Bin. Input C1 O Trip V L3-E: VI Bin. Input Bin. Input Bin. Input Binary Out					Current	Style as D	efault	d
Bin. Out B1 B2 B3 Schema: V52013 Light Trigger Characteristic Schema: V52012 Light Comment Schema: V52005 Trigger C1 O Trig Schema: V52003 Bin. Input Finary Out					-	0215107253	1999	-
Trigger Schema: VS2013 Light Type Nomal Schema: VS2012 Light Comment Schema: VS2005 Trigger C1 O Trigger C1 O Trig Trip Bin. Input Image: Signal Schema: VS2003	and the second se				Schema	: VS2015 I	Dark	
Trigger Commal Schema: VS2012 Light Comment Schema: VS2005 Trigger C1 O Trip Trip Bin. Input C1 O Trip Trip				~	Schema	V\$20131	ight	t
Comment Schema: VS2005 Trigger Condition Trip VL3-E: VI Bin. Input Bin. Input Bin. Input	Trigger	0 1 -0	>		Jenema		light	F
Trigger Condition C1 O Trip Schema: VS2003 Bin. Input Image: C1 O Trip Image: C1 O Trip	Туре	Normal			Schema	: VS2012 I	light	u
Lingger C1 O Condition Trip VL3-E: VI Bin. Input VL3-E: VI IL1: IL1 Bin. Input Binary Out	Comment				Schema	: VS2005		
Bin. Input					Schema	: VS2003	-	ŀ
Bin. Input	Condition	Trip					and the second s	
Bin. Input								
	Bin. Input						handle and a second statement of the	
							F Binary Ou	Itput
B1/_							B1/_	B2.

With the "Cascade" option, the windows are in a row and behind each other. Note that these options are used when the room layout is in "Default Undock Layout".



The "Default Layout for Transient" option is for the test mode and the "Default Layout for Quick" option is used for the "Quick" mode.

File View Te	st Paramete	ers Hardwa	re Win	dow	Help	
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K 🚽 1/1		0 2 2	r 🖪	Cust	tom Default Layout	St
				Syst	tem Default Layout	1
Detail View:	(S1: State 1)	×		Def	ault Undock Layout	
-	ut Binary Ou	t Trigger S	Seri:	Def	ault Layout For Transient	+
State Type		State Name:	B	Def	a 🖞 Layout For Quick	F
Normal	~	State 1		Mar	nage Layouts	F
- Set Mode and Fa	ultType			Curr	rent Style as Default	
Set Mode :				Sch	ema: VS2015 Dark	sp
General: Direct	~		~	Sch	ema: VS2013 Light	t
Analog Output C	hannels —			Sch	ema: VS2012 Light	-
Signal	Amplitude	Phase	Fre	Sch	ema: VS2005	
VL1-E: VL1-E V12-E: V12-E	1.000 Vn 1.000 Vn	0.00 °		Sch	ema: VS2003	

"Manage Layout..." is used to store the desired layouts, and even several "Layout" can be stored in it. To use a stored "Layout" click on its name, then select "Apply Layout" to open the "Layout".

Layout list:	
N	Rename
13	Remove
	Import
	Export .
	Apply Layout
	Close

By choosing the "Current Style as Default" option, the page layout that is being used is determined a "Custom Default Layout"

File View Te	st Paramete	ers Hardwa	14	indow	Uala	
	st Paramete		bire W		Help cade	Ē
K 🚽 1/1		0 9 9		Cus	tom Default Layout	s
Detail)(and	C1 (1-1-1)			Syst	tem Default Layout	
Detail View: (×		Def	ault Undock Layout	
	ut Binary Ou	t Trigger	Seri:	Def	ault Layout For Transient	-
State Type		State Name:		Def	ault Layout For Quick	F
Normal	~	State 1		Mar	nage Layouts	F
Set Mode and Fa	ultType		_ []	Cur	r{\}t Style as Default	
Set Mode :				Sch	ema: VS2015 Dark	s
General: Direct	~		~	Sch	ema: VS2013 Light	
Analog Output C	hannels			Sch	ema: VS2012 Light	F
Signal	Amplitude	Phase	Fre	Sch	ema: VS2005	
VL1-E: VL1-E	1.000 Vn	0.00 *		Sch	ema: VS2003	
VL2-E: VL2-E	1.000 Vn	-120.00 *	100		11	_

The "Schema" option shows different states and colors for the toolbar and the background of the test page which can be selected as desired. In the "Help" menu, the "Help topics" option opens the tips of the software and the tester.

AMT Sequencer - AM	/IT Sequencer			
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Detail View: (S1:	State 1) 🛛 🗙			
Analog Out	Binary Out	Trigger	Serial Report	Setting

lpPlayer	- 0
	پیشگفتار
A	۱) پیشگفتار
	۳ اسل اول: تاریخچه (2-1 تاریخچه شرکت ویکی و نستگاه تستر AMT105
17	(۲۹ ماریخچه سر کت ویکو و کنستان استر ۵۵۵ ۸۸۸۱
	(۳-۱) کانال ک دستگان
17	۲) فعل سود: مجنوبات دستگاه و مسائل ایمنی
17	(4-1 محتوبات دستگاه تستر رله AMT
	۲-۴) ایسنی ۱۴
١٣	۲-۲-۱) قوانين لازم الاجرا براي كاربر
	۲-۲-۴) دستورالعمل های ایمنی
10	۳-۲-۳) اتصال ایمن کابل ها
10	۲-۲-۴) تىويض فيوز قدرت
18	۵) فعل چهارد: سخت الزار
19	۵-۱) مشخصات فنی دستگاه
	(1-1-5 اطلاعات فنی برای تنظیم تستر AMT105
19	(5-1-2 خروجیهای ولتاز
١٧	۵-۱-۳) جریانهای خروجی AMIT105
14	۵-۱-۴D(۱+۱۹ های پنل جلوی دستگاه
۱۸	۵-۲) قــمـتحای مختلف دستگاه در نمای سه بعدی
19	۵-۲-۱) پنل جلوی دستگاه
19	(S-2-2 ماژول A/D
	۵-۲-۳) برد اصلی متبع تغذیه
<u><u>zz</u></u>	۵-۲-۵) چيه
۹	۲-۲-۵) برد اصلی متبع تغذیه

The "Shortcut keys" option shows all the shortcut keys in the software. The "About" option also gives the user information about the company.



About Vebko AMPro Test		×
~	AMPro Test	?
	Version 99.03.15.01-Test	
AMI	Copyright © 2009 - 2020	
	VEBKO is a company serving the electrical power industry with innovative testing and diagnostic solutions. The application of VEBKO products allows users to	^
	assess the condition of the primary and secondary equipment on their systems with complete confidence. Services offered in the area of consulting,commissioning, testing, diagnosis and training make the product range complete.	
	Contact Us	~

17 : TOOLBAR AND STATUS BAR, PART 2

There are icons for faster and easier access in the toolbar at the top of the screen. The first six icons are, in fact, the same as the "View" menu and the "Unit" field which are available at this page too.

AN	IT Sequenc	er - AN	/IT Sequencer			
File	View	Test	Parameters	Hardware	Window	Help
	∆ rel	abs	H 🛄 🗋	• 🔂 • 📂	· 🖰 🕼	🎧 🗘 👯 🕗 + 🛃 🐝 📴 🔚 🚍 🜌 🕸 🕸 I ► + 8℃ 📾 🗶 Connected 💿
Manda	1/	3	► N [o	100	○ - ⊡ €	E ALL State Current State

The "Time in Second" and "Time in Cycle", "Relative Values" and "Absolute Values", and "Primary Values" and "Secondary Values" icons are used to select the time in seconds or cycles, to specify the values in relative or absolute values and to specify whether the values entered are primary or secondary, respectively.

AM	T Sequenc	er - AN	/IT Sequ
File	View	Test	Parar
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K	/ا	3	► H

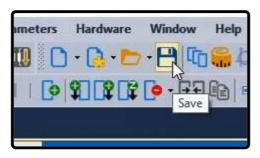
By clicking on the "New Room" icon, a new window opens on the test page. If you hold this icon down by the "Control" key and then click on one of the rooms, a separate room opens without closing the current room.

Noti	current Error Percent		0.0	0%
] Sy Sav	e all changes??	ion has change	d	
	Yes	No	Cancel	

By clicking on the "Open" icon, a saved test file opens. If the user wishes to search for a file with a specific extension, they can click on this icon and then select the desired room. After that, they can search among the saved files in the selected room.

cer			
ters	Hardware	Window	He
[[0			
		Normal	

Also, the "Save" icon, saves the test file. These icons show the different windows on the "Sequencer" page.



In this section, you can see the "Report View", "Test Object" and "Hardware Configuration" icons. By clicking on any of these icons, the user is referred to the respective page.



By using the "Number of Decimal Places Setting" icon, it is possible to specify the number of integers and decimal digits displayed by the software as well as the quantity of that unit.

Parameter Name	Absolute Unit	Absolute Accuracy	Absolute Eng.Factor	Absolute Display	Relative Unit	Relative Accuracy	Relative Eng.Factor	Relative Display	
Impedance	Ω	8	4	123.5 Ω					
InverseImpedance	ប	8	4	123.5 u					
ImpedancePercent	%	8	4	123.5 %					
Inductance	Н	8	4	123.5 H					6
Capacitance	F	8	4	123.5 F					2
Voltage	v	8	4	123.5 V	Vn	3	0	123.457 Vn	
Current	A	8	4	123.5 A	In	3	0	123.457 In	
Current Differential	In	3	0	123.457 In					
Current Overcurrent	Iref	3	0	123.457 Iref					
Current Prefault Overcurrent	IFault	2	0	123.46 IFault					1
Current Prefault IBias	IBias	2	0	123.46 IBias					
Anale	•	2	0	123.46 °					6
Percent Dev	%	2	0	123.46 %					
Percent IHarmonic	%	2	0	123.46 %				1	
Percent ForComtradeSionalScale	%	8	4	123.5 %					1
Time	5	8	4	123.5 s	cv	3		123.5 s	
TimeInout	S	3	4	123.5 s	CV	3	0	123.5 s	1
Time Percent	%	2	0						

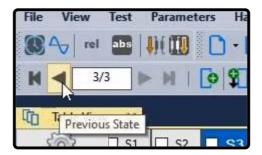
By using the "Static Output" icon, it is possible to specify that the device will only inject the values of a "State" (a selected "State"). The icons in this section are used to "Stop", "Start", and "Clear Test", respectively.

	- R Connected 🕥 FullPermission
te	Static Output

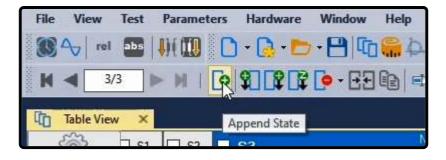
The phrase "Ready to Connect" means that the software is ready to connect to the device. The "Refresh" icon disconnects and connects the connection one more time to fix any existing problem with the test.



This row of the toolbar is only for the "Sequencer" room. If there are several "State"s, it is possible to select the desired "State" by using these icons and even jump to the first or last "State". By using these icons, it is possible to select the first, previous, next and last "State", in the mentioned order.



The "New State", "Delete State", "Copy Before", "Copy After" icons are used to create a new "State", delete an existing "State", create a "State" similar to the previous "State", and create a "State" similar to the next "State", respectively.



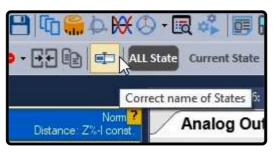
The "Insert Z shot" icon creates three "State"s as an impedance test. The "Select File to Merge" icon inserts the "State"s of other saved files in this room and adds them to the "State"s existing in the file. By using the "Copy & Paste State" icon, it is possible to copy a "State" and "Paste" it somewhere else.

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]	► M [0		: • • • • • • • • • • • • • • • • • • •		ALL State
×			Insert Z Sho	t	× 🗖
51	S2	S3		Nor General: Dir	m <mark>?</mark>

By clicking on the "Copy & Paste State", a new page opens with the same name. Then, the desired "State" is selected from the list and in the "Options for Paste" section, the location for pasting and its number are specified and, finally, "Ok" is clicked.

States list for Conu					
States list for Copy S1: State 1 S2: State 2 S3: State 3 S4: Prefault S5: L1-L2-L3,100% S6: Postfault					
Options for Paste – Before v 1	State: S1: State	1 ~	Repetition:		1
	1	1		-	
		1	OK	Can	cel

The "Correct Name of State" icon restores the default name of "State"s in case they have been changed. By clicking on the "All State" icon, the waveform of all the "State"s is displayed in "Signal View".



If the user only wants the current "State" to be displayed, they should click on the "Current State" icon. Of course, the "Current State" has other uses too, especially in transient state testing which will be explained in the future video tutorials.



The next icon shows the status of receiving the binary signals from the inputs of the device in case they are enabled. The icons in the status bar show the status of the voltage and current ports. If there is something wrong during the test with any of the ports, the corresponding icon in this section turns red.

Level Assessme

The phrase "St. Cond. "Immed" indicates the start time of the test, run by the user, which can be displayed instantaneously after clicking on "Start", in accordance with receiving signals from the binaries or the "GPS" clock time.

St. Start Condition: Immediat	ely line Running Room : No	ne 🗸 🖓 🍋 33 ° 🕐 AMT +

The phrase "CT: Dir. Line" indicates the location of the "CT" on the line which can be on the "Line" side or on the "Bus bar" side. This is important in tests such as "Distance" when injecting current.

St. Cond.: Immed.	CT: Dir.	line Run	ning Room : None	34 ^e	CAMT +
Ser Coller - Linnen -	Carl Maria	and and a	any noom induce		Salvit &

The phrase "Running Room: Noun" indicates which room of the software is running the test. Also, this figure shows the connection status of the device.

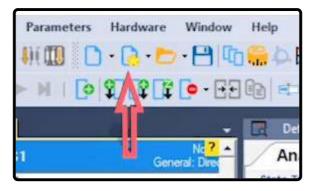
St. Cond + Immed	CT: Dir. Line Running Room	: None
Str Conver Limbeur	Cri bir inte Indining room	

In the case of connecting to several devices at the same time, from this section, it is possible to specify that to which "AMT" device should this room be connected for performing the test.



18 : "NEW BASED ON CUSTOM TEMPLATE" OPTION

In addition to "New" option, this option is designed to ease the test and save time. It is possible for you to create a default "Template" in accordance with your needs and when necessary, by loading this "Template" apply the saved changes.



First Mode: "Custom Template"

In "Custom Template" you can create a "Template" by using "Device Template", "Report Template", or "Decimal Places Template" modes. This can be explained by creating a "Template". To do so, in "Preferences" in "Room" section, you can create a "Template" from "Device Template" and "Template Report Package" or "Decimal Places Template".

Report Refresh Interva	l:	2.000 s
Template Report Pack	age :	Settings
Extra Tools		
Report Genrator	Remove Signature	
Templates		
Device		Decimal Places
		63

For example, after entering "Preferences" window, in "Decimal Places Template" section for "Sequencer" room, select and apply "Volt" as the unit for voltage in "Template". Enter "Vebko" in "Name" and "Manufacturer" fields in "Device" section, and then by applying the settings, save these changes as a "Template". Now, to use these "Templates" in the rooms, you need to select the saved "Templates". If you open "Decimal Places" in "Sequencer" room, you can see that the changes made in "Preferences" is not applied to this section. Now to apply the "Template", by clicking on "New Based On Template" in "New" window, you can see "Custom Template" and "Saved Template" radio buttons. By selecting "Custom Template" radio button, you can specify which of the three mentioned sections is to be applied to the new file. Then, by confirming the settings by selecting "Ok" you can view the applied changes.

Custom Template Devices Decivital Places Report Settings Saved Template	💀 New	-18	
	 Devices Decimal Places 		-
	O Saved Template		1
			>

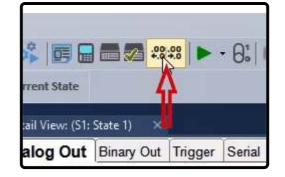
Second Mode: "Saved Template"

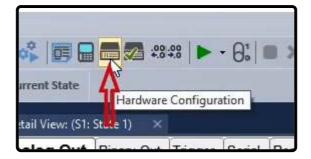
In "Saved Template", you can specify the default necessary windows, arrangements and the number of fields. To better understand this, select "State Type Continuous", open "Vector View" window and specify the desired size. Then, select "Save as Template" from 'File" menu and select a title for it. If you wish to apply your specified "Template" in a new room, you need to click on "New Based On Template" and select "Save Template" radio button. In the end, select the desired "Template" and apply it.

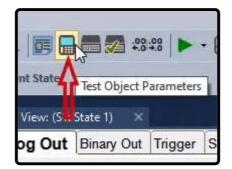
	\rightarrow		×
			?
ſ	ОК	Cano	cel
		OK	

19 : DETERMINING DECIMAL NUMBERS, PART 1

After explaining the toolbar, it is necessary to give an introductory about the basic concepts in the system. Each room includes four main parts: 1- "Number of Decimal Places Setting" Display settings for numbers and quantity units in the test rooms. 2- "Hardware configuration" For the Device hardware settings. 3- "Test Object Parameters" To access the relay settings. 4- "Report View" To access the output and the test reports. Given these four components and the nature of each window and its functions in every room, you can run a test.

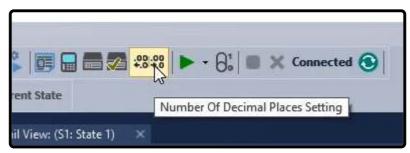






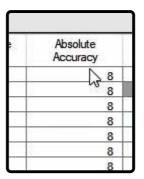


Click on the "Number of Decimal Places Setting" to open its page. In this page you will find the names of the quantities in the "Parameters Name". You will find the units of every quantity written in the "Absolute Unit" block and they can be changed. The "Absolute Eng. Factor" shows a Number of meaningful figures, for example, if you enter the number 545569 in the "Sample Value" and enter the number 3 in the "Absolute Eng. Factor" block, the program shows 546K Ω which is also displayed in the "Absolute Display" block. If you enter the number 2 in this block, the number displayed in the "Absolute Display" block is 550.00K Ω .



	ber of Decimal Places Settings									_
mb	er of Decimal Places ———			_						_
	Velue George	1								
npie	Value: 123.4567]								
		Absolute	Absolute	Absolute	Absolute	Relative	Relative	Relative	Relative	
	Parameter Name	Unit	Accuracy	Eng.Factor	Display	Unit	Accuracy	Eng.Factor	Display	
•	Impedance	Ω	8	4	123.5 Ω					
	Inverselmpedance	U	8	4	123.5 v					
	ImpedancePercent	%	8	4	123.5 %					
	Inductance	Н	8	4	123.5 H					
		-	8		123.5 F					
	Capacitance	F	ŏ	.4.3	120.01					

"Absolute Accuracy" block shows the number of decimal fractions rounded up. For example, if you enter the number 5.235 and enter the number 2 in the "Absolute Accuracy" block, the final number is 5.2.



	er of Decimal Places]			
	Parameter Name	Absolute Unit	Absolute Accuracy	Absolute Eng.Factor	Absolu Displa
	Impedance	Ω	2	2	520
•	Inverselmoedance	ប	8	4	5.632
	ImpedancePercent	%	8	4	5.235 %
	Inductance	Н	8	4	5.235 H

Now, in this case, if you enter the number 5 in "Absolute Eng. Factor", the number 5.2400 is displayed in the "Absolute Display" which shows 5 meaningful figures that the last two digits are rounded up corresponding to the "Absolute Accuracy" block.

Absolute Eng.Factor	Absolute Display
5	5.2400 Ω
4	5.240
4	5.235 %
4	5.235 H
4	5.235 F

The blocks "Relative Accuracy", "Relative Unit", "Relative Eng. Factor" and "Relative Display" also have the same functions but only for relative values. For example, if the voltage unit in "Absolute Unit" is VATR and in the "Relative Unit" is HYU, clicking on "OK" shows that the voltage unit is changed and changing the mode from "Absolute" to "Relative" has also changed its unit.

	Parameter Name	Absolute Unit	Absolute Accuracy	Absolute Eng.Factor	Absolute Display	Relative Unit	Relative Accuracy	Relative Eng.Factor	Relative Display
	Impedance	Ω	2	5	5.2400 Ω	10			
	InverseImpedance	U	8	4	5.235 v	8			1
	ImpedancePercent	%	8	4	5.235 %				
	Inductance	н	8	4	5.235 H				
	Capacitance	F	8	4	5.235 F				
•	Voltage	VATR	8	4	5.235 VATR	HYU	3	0	5.235 Vn
	Current	A	8	4	5.235 A	In	3	0	5.235 In
	Current Differential	in	3	0	5.235 In				
	Current Overcurrent	Iref	3	0	5.235 Iref			-	
	Current Prefault Overcurrent	IFault	2	0	5.24 IFault	8			1
		1001			E OLI INC				

Table View	×				Detail Vi
ţ.	🗆 S1		Normal General: Direct	?	Analog
Name	State 1				State Type
VL1-E: VL1-E	63.51 VATR	0.00 °	50.00 Hz		State Type:
VL2-E: VL2-E	63.51 VATR	-120.00 °	50.00 Hz		
VL3-E: VL3-E	63.51 V/VR	120.00 *	50.00 Hz		Normal
I L1: I L1	1.000 Min:	-76.21 VATR,	Max: 76.21 VA1	TR	-
112:112	1.000 Show	vn Value: 63.51	I VATR, Main\	/alue: 63.50852961	08588 VATR e ar
I L3: I L3	1.000 A	120.00	50.00 Hz		Set Mode :
Bin. Out	B1. 🥒 – B2	J- B3. J.	- B4		General: Direc
Trigger	0 -	-©	1.000 s		General: Direc
Туре	Normal		~		Analog Out
Comment					Signal

20 : DETERMINING DECIMAL NUMBERS PART 2

After setting the "Number of Decimal Places Setting", it is necessary to get familiar with a number of concepts as well as the method for initializing the software. Generally, there are three methods for entering the information. 1-The information that is entered in the tables. 2-The information that is entered in a separate cell where only entering numbers is possible. 3-The information that is entered in a separate cell where only entering text is possible. The point is that it is not possible to enter any information in those cells which are "Read only" in conditions such as "Line-Line" mode.

	S1	Gene	Normal ral: Line-Line
	State 1		
	63.51 V	0.00 *	50.00 Hz
L2-E	\$.51 V	-120.00 *	50.00 Hz
L3-E		120.00 *	50.00 Hz
	1.000 A	0.00 *	50.00 Hz
	1.000 A	-120.00 °	50.00 Hz
	1.000 A	120.00 *	50.00 Hz
	B1 B2.	✓- B3. ✓-	B4. ⊿-
		-0-	1.000 s
	Normal		~
	C1 O		
n	Trip		

If you double-click on a cell, the content inside the cell becomes highlighted and while entering the information, its unit of quantity remains stable. In these cells, there is a space between the entered number and its unit which makes a better view for the user. By holding the mouse on each cell and clicking on it, the minimum and maximum numbers which can be entered in the intended cell are displayed. Close the "Measurement View" and "Detail View" windows and open the "Vector View" window. Then, right-click on this window and select "Show" in the opened list and check the "Line-Line" option so that the linear values are displayed on this window.

ŝ	🗆 S1	Ge	Normal meral: Direct	?	Analog Ou	It Binary O	ut Trigger S
Name	State 1				State Type		
VL1-E: VL1-E	T 63.51 V	0.00 *	50.00 Hz		State Type:		State Name:
VL2-E: VL2-E	63.51 V	-120.00 °	50.00 Hz		Normal	~	State 1
V L3-E: V L3-E	63.51 V	120.00 *	50.00 Hz		Normal	Ť	Judie
I L1: I L1	1.000 A	0.00 °	50.00 Hz			1010	
112:112	1.000 A	-120.00 °	50.00 Hz		Set Mode and Fa	ultType	
1 L3: 1 L3	1.000 A	120.00 °	50.00 Hz		Set Mode :		
Bin. Out	B1. J- B2	/- B3. /-	B4				
Trigger	0 4 -	©-	1.000 s		General: Direct	~	
Туре	Normal		~		Analog Output C	hannels —	
Comment					Signal	Amplitude	Phase
					VL1-E: VL1-E	63.51 V	0.00 °
	C1 ()				VL2-E: VL2-E	63.51 V	-120.00 °
- Condition	Trip				VL3-E: VL3-E	63.51 V	120.00 °
					1L1:1L1	1.000 A	0.00 °
					112:112	1.000 A	-120.00 °
Bin. Input					113:113	1.000 A	120.00 °
					Binary Outputs	Trigger Condi	

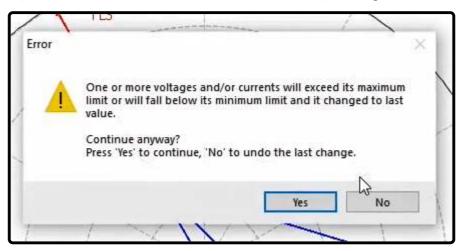
Now in the "Table View", enter "23.00" for the second phase voltage with zero phase. You can see that the value of "VL1-L2" in the "Vector View" window is zero. Now, enter "23.0001" for the first phase in the "Table View". Then, you can see that in the "VL1-L2" linear voltage field, the number "100µV" is displayed while in the "Table View", both first phases show the same value of (23.00). The number "23.0001" is in the memory of the software but since it is specified in the "Number of Decimal Places Setting" that only four meaningful numbers should be displayed, the number "23.00" is being shown while the original number is "23.0001" which is stored in the memory of the software. If you double-click on the first phase, and after it gets highlighted, press "enter" on your keyboard, this time the number "23.00" gets recorded in the software and, also, the linear voltage amount changes to zero.

63	S1	G	Nomal ieneral: Direct
Name	State 1		
V L1-E: V L1-E	23.0001V	0.00 *	50.00 Hz
VL2-E: VL2-E	23.00 V	0.00 *	50.00 Hz
VL3-E: VL3-E	63.51 V	120.00 °	50.00 Hz
I L1: I L1	1.000 A	0.00 °	50.00 Hz
112:112	1.000 A	-120.00 *	50.00 Hz
I L3: I L3	1.000 A	120.00 *	50.00 Hz
Bin. Out	B1. 🥒 – B2. 🚽	′- B3. √-	B4. 🤳 🗕
Trigger	0 4 -	0-	1.000 s
Туре	Normal		~
Comment			
Condition	C1 O Trip		

If you enter "23.2568" in the first phase, the "VL1-L2" linear voltage field will display the number "256.6mV" while in the "Table View" the number "23.26" will be displayed which means that, not only according to the "Number of Decimal Places Setting", only four meaningful digits of this number are being displayed, but also, this number has been rounded. It is also possible to use measurement units while initializing. For example, you can enter "10m" instead of the number "0.01". In this case, there is a space between "m" and "V" after pressing the "enter" button, the "m" acronym sticks to the quantity unit and the "Space" gets removed in order to make a better view for the user. In some cells, after entering the intended value, a message is displayed saying that the entered value is above the allowed limit. In this case, there are two possibilities:

Table View	×		
(i)	🗖 S1	Norma General: Direct	
Name	State 1		٦
VL1-E: VL1-E	10m V	0.00 ° 50.00 Hz	z
VL2-E: VL2-E	23.00 V	0.00 * 50.00 Hz	z
VL3-E: VL3-E	63.51 V	120.00 ° 50.00 Hz	z
1 L1: I L1	1.000 A	0.00 ° 50.00 Hz	z
112:112	1.000 A	-120.00 ° 50.00 Hz	z
1L3:1L3	1.000 A	120.00 ° 50.00 Hz	z
Bin. Out	B1 B2.	J - B3. J - B4. J -	
Trigger	G 8	-©- 1.000 s	5
Туре	Normal	· · · · · · · · · · · · · · · · · · ·	1
Comment			
Condition	C1 O Trip		
Bin. Input			

1-In some cells, after clicking on the "OK" option, there is another message displayed saying that if you select the "No" option, the entered number will not be recorded in the cell and the previous number will replace the new one but if you select the "Yes" option, the new number will be recorded and the cell turns red, indicating an error in the recorded number.



2-In some other cells, if the entered number is above the allowed limit, if you click on the "OK" option in the displayed message, the software will not allow this number to get recorded in the cell and uses the previous number instead.

Error	×
Value is gre	eater than Max (Max=4.000 ks[4000]).
A	

In addition to directly entering a number, it is possible to use mathematical expressions and operations to enter a number in the software. For example, if you "1/256", which the software will automatically calculate and put the result in the cell. Or you can enter a mathematical operation in the cell, like "sin(45)*sqrt(25)" which is the amount of "sin" in radians. The point to note is that it is not possible to enter mathematical operations as something like "11m*1" and no measurement units are to be used in mathematical operations.

Table View	X	
i i	S1 Nomal General: Direct	
Name	State 1	
VL1-E: VL1-E	1/256 V 0.00 * 50.00 Hz	
V L2-E: V L2-E	23.00 V 0.00 * 50.00 Hz	
V L3-E: V L3-E	Min: -76.21 V, Max: 76.21 V	1
I L1: I L1	Shown Value: 23.00 V, MainValue: 23 V	
112:112	1.000 A -120.00 50.00 Hz	•
1L3:1L3	1.000 A 120.00 * 50.00 Hz	
Bin. Out	B1. J - B2. J - B3. J - B4. J -	
Trigger	- C 1.000 s	
Туре	Normal ~	
Comment		
☐ Trigger Condition	C1 O Trip	
Bin. Input		

21 : ANALOG OUTPUT SETTING

By clicking on "Hardware Configuration", a new page with the same name opens where the settings for voltage and current outputs, binary inputs, and outputs of the device as well as some other settings in "Extra Setting" are set. In the "Analog Output" tab, the settings for voltage and current outputs, activeness or inactiveness of outputs, labeling them and displaying the actual values for the output signals of the device are adjusted.

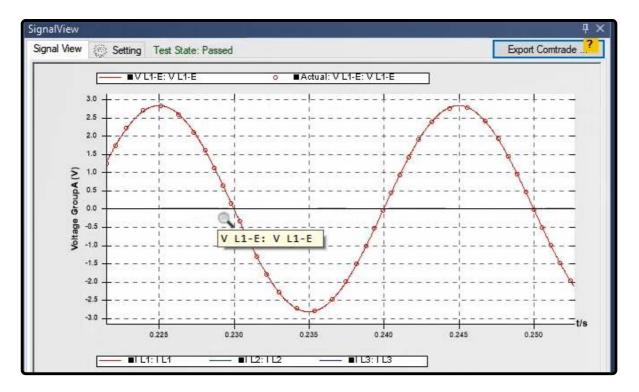
oltage Output		Voltage O	utput Signal —		
0150V, 60VA @ 4000 Ams 1150V, 120VA @ 8000 Ams 300V, 120VA @ 4000 Ams 4450V, 200VA @ 400m Ams ot Used	X1 X2 X1 X1 X1 X1 X1 X1	X1 X2 X3 Y1	Output Target V L1-E V L2-E V L3-E V L1(1)-E	Output Label V L1-E V L2-E V L3-E V L3-E V L1(1)-E	☐ Show Actual Value False False False False False
urrnet Output 32A. 100VA @ 32A. 3Vms, 5A. 12Vms 63A. 200VA @ 64A. 3Vms, 10A. 12Vms 32A. 200VA @ 32A. 6Vms, 5A. 24Vms 32A, 40VA @ 32A. 12Vms, 5A. 48Vms 12A, 400VA @ 128A. 3Vms, 30A, 12Vms ot Used		Current C X1 X2 X3 Y1 Y2 Y3	Output Signal - Output Target 1L1 1L2 1L3 Not Used Not Used Not Used	Output Label IL1 IL2 IL3 Not Used Not Used Not Used	Show Actual Value False False False False False False False

In "Voltage and Current Output" sections, the maximum receivable voltage and current from the outputs of the device are specified according to their wiring, which the users can use depending on their needs. By selecting any of the options, a figure of the wiring for receiving the required voltage and current is displayed in a box in the middle of the page. For example, by selecting single-phase 300 V, to receive up to 300 V with a 400 mA current, the user needs to do the wiring according to this figure. In the "Current Output" section, there is some information about wiring. For example, in the first wiring, there are 6 32 amp current Outputs. In this case, a maximum of 32 amp with 3 V is fed by every phase and up to 5 amp with 12 V is receivable from the current outputs.

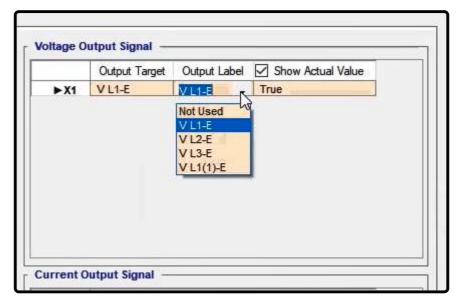
Voltage Output	Show Actual Value Ise
1x150V, 120VA @ 800mArms Tx450V, 120VA @ 400mArms Tx450V, 200La @ 400mArms Not Used	of the set of the set of the set of
1x400v, 120vA@ 400mArms Not Used	lse
Not Used XN X1	
XN X1	
X1	
Current Output	
x 32A, 100VA @ 32A, 3Vms, 5A, 12Vms A 1 2 3 N Output Target Output Label 3	Show Actual Value
3x64A, 200VA @ 64A, 3Vms, 10A, 12Vms	
2 SZA, ZUUVA @ SZA, DVIIIIS, SA, Z4VIIIIS	
Vot Used V126A, SWITTIS, SURA, 12VITTIS V1120A, 400VA (@ 126A, SWITTIS, SURA, 12VITTIS V120A, 400VA (@ 126A, SWITTIS, SWITTI	
1128A, 400VA @ 128A, 3Vms, 30A, 12Vms kot Used XN Y1 Not Used Not Used Fak Y2 Not Used Not Used Fak Y3 Not Used Not Used Fak Y3 Not Used Not Used Fak	
Y1 Y3 Not Used Not Used Fall	
Ý2 Y3 NOUSEU NOUSEU NOUSEU NOUSEU	30
Y3	
B 1 2 3 N	
B 1 2 3 N	

In the "Show Actual Value" column in "Voltage Output Signal" and "Current Output Signal" sections, it is possible to activate displaying the "Actual" value of output signal in the "Signal View" window. To do this, you need to change the value of the cell of your intended signal in the "Show Actual Value" from "False" to "True". For example, if the "Show Actual Value" of "VL1-E" signal is changed to "True", by running the test, it is observed that there are circles on the waveform of its signal.

►X1 VL1-E VL1-E False + False	ow Actual Value	Output Label	Output Target	
			-	►X1

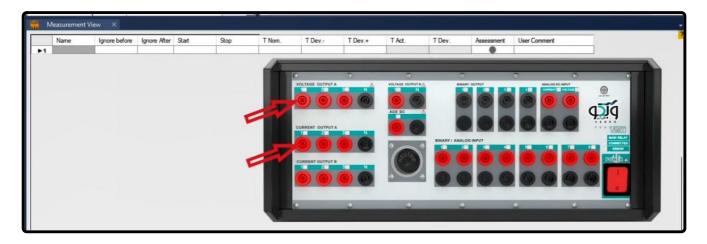


In the "Output Label" column, it is possible to specify a "Label" for each of the outputs. In addition to the labels in the drop-down field, it is possible to add new label by typing it.



In the "Output Target" column for each of the outputs a target will be specified. In selecting an "Output Target", it is important to note that each of these "Output Target" has a meaning. For example, if "VL1-E" is selected for the first output of the "voltage output A" and "IL1" for the first output of the "current output A", by selecting "Set Mode: Z-I const", the software divides the 2 volts of "VL1-E" into 1 amp of "IL1", which are the first output of the "voltage output A" and the first output of the "current output A", respectively, to simulate phase to ground fault with a 2 ohm fault impedance. Now, if, in the "Hardware Configuration" page, "VL1-E" is selected for the second output of "voltage output A", in simulating the fault impedance of the previous example, the software, again, divides the 2 volts voltage of "VL1-E" into 1 amp current of "IL1", except that this time the voltage of "VL1-E" and "IL1" is injected from the second output of the "voltage output A" and the first output of the "current output A", respectively. Also, it should be noted that if "VL3-E" is selected for the third output of the "voltage output A", and the same "Output Target" is selected for the single-phase output of the "voltage output A", the third output of the "voltage output A". This means that each of the available "Output Target" can only be selected for a single output.

	Output Target	Output Label	Show Actual Value	
X1	IL1 LIL1	IL1	False	
X2	112	112	False	
Х3	IL3	IL3	False	
Y1	1L1(1)	IL1(1)	False	
Y2	1L2(1)	1L2(1)	False	
Y3	1L3(1)	1L3(1)	False	



	Output Target	Output Label	Show Actual Value	
X1	IL1 LIL1	IL1	False	
X2	1L2 13	IL2	False	
X3	IL3	IL3	False	
Y1	1L1(1)	IL1(1)	False	
Y2	1L2(1)	1L2(1)	False	
Y3	IL3(1)	1L3(1)	False	

M M	easurement View	×							+
	Name Igno	e before Ignore Afte	r Start	Stop					
F1									
Time Ass 1: Not Te	essment sted	Level Assessment 1: Not Tested		Ramp Assessment 1: Not Tested	Value Assessment 1: Not Tested	Calculated Assess 1: Not Tested	ment	Transient Assessment 1: Not Tested	

As another example, in the "AMT Distance" Room, the software uses "voltage output A" and "current output A" to simulate fault impedance. If the user wants to use the "current output B" instead of the "current output A" for current injection, they should select "IL1", "IL2" and "IL3" as the "Output Target" for the three outputs of the "current output B" in the "Hardware Configuration" page.

Volta	age Output Sign	al	
A 1 2 3 N B T N	Output Ta	arget Output Label	Show Actual Value
0000	X1 VL1-E	V L1-E	False
	X2 V L2-E	V L2-E	False
	X3 V L3-E	V L3-E	False
	Y1 Not Used	Not Used	False
Curr	ent Output Sign	al	
·	ent Output Sign Output Ti		Show Actual Value
A 1 2 3 N	Output Ta	arget Output Label	
·	Output Ta X1 Not Used	arget Output Label Not Used	False
	Output Ta	arget Output Label	
	Output Ta X1 Not Used X2 Not Used	arget Output Label Not Used Not Used	False False
	Output Ta X1 Not Used X2 Not Used X3 Not Used Y1 IL1 Y2 IL2	arget Output Label Not Used Not Used Not Used IL1 IL2	False False False False False
	Output Ta X1 Not Used X2 Not Used X3 Not Used Y1 IL1	Arget Output Label Not Used Not Used Not Used IL1	False False False False
	Output Ta X1 Not Used X2 Not Used X3 Not Used Y1 IL1 Y2 IL2	arget Output Label Not Used Not Used Not Used IL1 IL2	False False False False False
	Output Ta X1 Not Used X2 Not Used X3 Not Used Y1 IL1 Y2 IL2	arget Output Label Not Used Not Used Not Used IL1 IL2	False False False False False
	Output Ta X1 Not Used X2 Not Used X3 Not Used Y1 IL1 Y2 IL2	arget Output Label Not Used Not Used Not Used IL1 IL2	False False False False False
	Output Ta X1 Not Used X2 Not Used X3 Not Used Y1 IL1 Y2 IL2	arget Output Label Not Used Not Used Not Used IL1 IL2	False False False False False
×	A L Z Z N B L N	A 1 2 3 B 1 M Output Ta A I Z I VI-1-E X1 VI-1-E YN Y1 Y1 VI-2-E X3 VI-2-E X3 VI-2-E Y1 Y1 Not Used	A 2 8 0 0 0 0 0 0 0 0 0 0 0 1 <th1< th=""> <th1< th=""> <th1< th=""> <th1< th=""></th1<></th1<></th1<></th1<>

22 : BINARY INPUT SETTING, PART1

Under the "Binary Input" tab in "Hardware Configuration" window, the settings of the 10 binary inputs of the device are set. Binaries 1 to 8 are located at the bottom of the device from left to right. Binaries 9 and 10 are located in the upper right row of the device. Binaries 1 to 8 are of the voltage type. The binaries 9 and 10 are used for measuring AC and DC currents (with 50micro precision) up to 500mA and 240mv respectively.

	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
►C1	Trip 🗾	Trip	Drv		False	None	True		(Short)=>(input=1)
C2	Not Used	Not Used	Drv		False	None	True	6 7	
C3	Not Used	Not Used	Drv		False	None	True		
C4	Not Used	Not Used	Drv		False	None	True		
C5	Not Used	Not Used	Drv		False	None	True	J.	
C6	Not Used	Not Used	Drv		False	None	True		
C7	Not Used	Not Used	Drv		False	None	True	1	
C8	Not Used	Not Used	Drv	í.	False	None	True		
9	Not Used	Not Used	Shunt 1 Ohm			None			
2 ¹⁰	Not Used	Not Used		-		None			
~0				-	_		_	-	-

Activating and deactivating a "Binary Input": Activation or deactivation of binaries is determined in the "Binary Input Target" column. For example, you can activate binary number 3 by clicking on its relevant field. In this case, a list of different targets is displayed and you can select one depending on your test's needs. Note that the binary inputs of the device may be sensitive to your selected target. While testing the equipment and changing the hardware configuration of the device, you should note that the label of binary inputs must be selected in accordance with the information in the test configuration. By clicking on this field and selecting "Not Used", it is possible to deactivate the corresponding "Binary Input". It is also possible to use the "N" shortcut to deactivate a "Binary Input". You can activate or deactivate the binaries 1 to 8 at the same time by using the square above the binaries' numbers column.

Analo	g Outpy Binar	y / Analog Inp	ι
	Binary-Input Target	Binary-Input Label	Ī
C1	Trip	Trip	T
C2	Not Used	Not Used	
►C3	Not Used -	Not Used	
C4	Not Used	Not Used	
C5	Trip	Not Used	
C6	Trip L1	Not Used	
C7	Trip L2	Not Used	
C8	Trip Lat	Not Used	
9	Trip L1 only	Not Used	
10	Trip L2 only	Not Used	
	Trip L3 only		
	Trip 1 phase		
	Trip 3 phase		
<	Trip Idiff>		
	Trip Idiff>>		
	Trip A		
	Trip B		
	Trip C		
	Trip D Trip E		
	Trip F		
	Start		
	Start 1		

aral	Analo	g Output Binar	y / Analog Inp
log	R	Binary-Input Target	Binary-Input Label
iog	C1	Trio	Trip
nal	C2	Trip L1	Trip L1
-E	►C3	Trip L2	Trip L2
	C4	Trio L3	Trip L3
	C5	Trip L1 only	Trip L1 only
ry	C6	Trip L2 only	Trip L2 only
/	C7	Not Used	Not Used
	C8	Not Used	Not Used
ry	9	Not Used	Not Used
Shc	10	Not Used	Not Used

Selecting a "Label" for a "Binary Input": You can select a "Label" for your desired "Binary Input" in the "Binary Input Label" column. By default, the "Label" selected in the "Binary Input Target" is listed in this part but the user can, also, select a different "Label" from the drop-down list or enter a new "Label" in Persian or English. It should be noted that in "Report" and binary signal display in "Signal Label", the "View" specified in this section is displayed as the label for the signal. This also applies to "Analog Output" and "Binary Output" and in the "Report" the "Label" is displayed for the desired parameter.

ary-Input Target	Binary-Input Label	Binary
	vebkol N -	Drv
L1	Not Used	Drv
L2	Trip	Drv
L3	Trip L1	Drv
L1 only	Trip L2	Drv
L2 only	Trip L3	Drv
L3 only	Trip L1 only	Drv
1 ohase	Trip L2 only	Drv
Used	Trip L3 only	Shunt
	Tale d alarse	

Specifying Binary-Input Type: In the "Binary Input Type" column, the type of binary inputs number 1 to 8 is selected from two generic modes of "Dry" and "Wet", which is by default set as "Dry". In this case, there is a 2V DC on the two ends of "Binary Inputs" (Zero Mode) and by short-circuiting the output contacts of the relay, the voltage decreases to zero and the digital signal 1 is detected by the binary.

alog Inp	ut Binary Output	Extra S
-Input Label	Binary-Input Type	Threshold
	Drv N+	
0	Dry	-
	Wet Max 188 (V)	
only	Wet Max 30 (V) Wet Max 4.5 (V)	
only	Drv	
only	Drv	
ohase	Drv	

In the "Wet" mode, the binaries number 1 to 8 are set to measuring mode. There are three levels for this mode. In the "Wet Max 4.5(V)" level, the "Binary Input" measures up to 4.5V (with 1mV precision), up to 30V (with 3mV precision) in the "Wet Max 30(V)" and up to 188V (with 10mV precision) in the "Wet Max 188(V)" level. When the "Wet" mode is selected for "Binary Input", the "Threshold" column is activated. In this column, a threshold is specified for "Binary Input" status. For example in the "Wet Max 188(V)" level, if the threshold is set to "50", if the maximum input voltage is less than 50V, digital signal 0 is detected while with a maximum input voltage more than 50V, digital signal 1 is detected.

Inp	ut	Binary Out	out	Extra Sett	ing		
abel	Binary-Input Type			Threshold Reverse		Show Actual Value	S
	Wet Max 30 (V)			,10.00 V	False	None	T
	Drv			Vin: na V, Max: 30.00 V			
	Dr	v		Shown Value: 10.00 V, MainValue: 10			Tr Tr
	Dr	v		-	False	None	Tr
	Dr	v	1		False	None	Tr
	Dn	v			False	None	Tr
	-		1.0				100-0

If the "Binary Input" is used for measuring the voltage, it is important to select the maximum level of "Wet" measurement. For example, to measure a 23V voltage, the binary level "Wet Max 30(V)" must be selected. If "Wet Max 4.5(V)" is selected, when the voltage exceeds 4.5V, the software gives an "Over Voltage Binary" error message and if the "Over Voltage" error has not been enabled, by exceeding the specified voltage, the binary input operates in a dual-purpose mode which means that it records the logical signal (pick up or trip) and, also, measures the voltage and by injecting AC voltage, the binary turns into repetitive zeros and ones. In this case, the memory of the software gets full and a "Result is Full" error is displayed. Also, if the "Wet Max 188(V)" is selected, the measurement precision is decreased.

e	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show R True	
	Wet Max 4.5 (V) 💌	. 1.00 V	False	None		
	Drv	Min: na	V, Max: 4.50) V	True	
	Drv	Shown Va	alue: 1.00 V,	MainValue: 1 V	True	
2	Drv		False	None	True	
-	Drv		False	None	True	
	-	15			-	

: . -	6:	Connected 🛞 Clear E	rror ResultisFull	~	
rigger	Serial	Report Setting			
ite Name:		Comment			

t Label	Binary-Input Type	Threshold	Reverse	Sh
	Wet Max 188 (V) 💌	1.00 V	False	No
	Drv	72	False	No
	Drv		False	No
	Drv		False	No

23 : BINARY INPUT SETTING, PART2

"Reverse" column: In "False" mode in the "Reverse" column, the logic of binary's becoming 0 and 1 is the same as described earlier. If the "True" mode is selected, the detection logic of the binary's becoming 1 is reversed. For example, in the "Wet Max 188(V)" level with a 50V threshold, if the binary voltage goes below 50V, its status is detected as 1, otherwise, it equals 0. In the "Dry", the "Binary Input" status is 1 only when it's "Open Circuit" and it's 0 in the short circuit state.

Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value
vebko	Wet Max 188 (V)	1.00 V	False -	None
Trip L1	Drv		Faise	None
Trio L2	Drv		True	None
Trip L3	Drv		raise	None
Trip L1 only	Drv		False	None
			-	

Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
Trip	vebko	Wet Max 188 (V)	50.00 K	True 💌	None	True	0.000 V	(Vin < 50)=>(input=1)
Trin 1.4	Trin 1.4	Der	2	Ealaa	Naza	True		(Chard) + Count 4)

The "Show Actual Value" column: In the "Show Actual Value" column, the mode of displaying the actual voltage value of the input binary is selected from "AC" and "DC". The "DC" mode is used for situations where the input voltage of the "Binary Input" is "DC". The "AC" mode, on the other hand, is for situations where the incoming voltage to the "Binary Input" is "AC". In this case, this is done for a better display and precision of the phase calibration and frequency. "None" mode is used for not displaying the actual value of the binaries. To view the actual value in the "Vector View", it is possible to view the measured value by the binary after opening this window.

og Outpu	It Binary Input Bina	ary Output Extra Sett	ing						
	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
▶1	Trip	vebko	Wet Max 188 (V)	188.00 V	True	AC 🔹	True	0.000 V	(Vin < 188)=>(input=1
2	Trip L1	Trip L1	Drv		False	None	True		(Short)=>(input=1)
3	Trio L2	Trip L2	Drv		False	None	True		(Short)=>(input=1)
4	Trip L3	Trip L3	Drv		False	Not	True		(Short)=>(input=1)

Type: Normal Signal	Magnitude	00 s Refere	Phase	al: None Real	Imaginany	Show Arrow	Color
-	-		204220000000		Imaginary		COIOF
VL1-E: VL1-E	10.00 V	10.00 V	0.00 °	10.00 V	0.000 V	True	
Bin1: vebko	92.56 V	na	-97.40°	-11.9	-91.79 V	True	

"Show Result" column: In the "Show Result" column, it is specified that whether the changes of the 1 and 0 logical signals

of the "Binary Input" should be recorded by the software or not. "True" means that the logical signal should be recorded and "False" means the opposite. For example with 50 voltage threshold and "False" for "Show Result" and "Reverse" the trip signal is sent by the relay to the device. As signal of binary input 1 excess the threshold the binary changes are not recorded by "signal view" becquese the signals are not being recorded

og Outpu	t Binary Input Bina	ry Output Extra Sett	ing						
	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
▶1	Trip	vebko	Wet Max 188 (V)	50.00 V	False	AC	False +	0.000 V	(Vin > 50)=>(input=1)
2	Trip L1	Trip L1	Drv		False	None	False		(Short)=>(input=1)
3	Trip L2	Trip L2	Drv		False	None	True		(Short)=>(input=1)
4	Trip L3	Trip L3	Drv		False	None	nue		(Short)=>(input=1)
-			-				-		

Type: Normal	~ 0.00)0 s Sh	ow VLL fr	om zero			
Signal	Magnitude	Harmonic 1	Phase	Real	Imaginary	Show Arrow	Color
VL1-E: VL1-E	10.00 V	0.000 V	0.00 °	10.00 V	0.000 V	True	
Bin1: vebko	0.000 V	0.000 V	0.00°	0.000 V	0.000 V	True	

DC Voltage Injection: In the "Apply VDC" column, it is possible to inject a DC voltage into the binary input. For example, in the "Wet Max 188(V)" with a 50V threshold, the number 100V is entered and subsequently the wiring to inject the DC voltage into the binary input is displayed. According to this wiring, the output relay contact is switched to "Wet". In this case, if the input voltage of the binary exceeds 50V, the "Binary Input" equals 1. It should be noted that it is possible to inject DC voltage only into one "Binary Input" and not into multiple Binary Inputs simultaneously. If for any reason, the output relay contact is corrupted, it may not get stimulated by the 2V on the "Binary Input" of the device; so a, for example, 100V DC is injected into it. In this case, a mild current passes through the relay contact and its short-circuiting is detected.

vebko Trio L1 Trio L2 Trio L3 Trio L1 onlv	Wet Max 188 (V) Drv Drv Drv	50.00 V	False False False	AC None None	False True True	100.(3∨	(Vin (Sho
Trip L2 Trip L3 Trip L1 only	Drv Drv		False			w	
Trip L3 Trip L1 only	Drv			None	True	1	
Trip L1 only			12233423282			0	(Sho
and the second se			False	None	True		(Sho
	Drv		False	None	True		(Sho
Trip L2 only	Drv		False	None	True		(Sho
Trip L3 only	Drv		False	None	True		(Sho
Trip 1 phase	Drv		False	None	True		(Sho
Not Used	Shunt 1 Ohm			None			
Not Used				None			
	BINARY				0 0 0	•	

The "Description" column: In this column, there is some information about the condition where the binary input of the device equals 1. For example, in the "Wet Max 188(V)" with a 50V threshold, when the input voltage exceeds 50V, the binary status equals 1.

Binary Input Bina	ry Output Extra Sett	ing						
Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
Trip 🔹	vebko	Wet Max 188 (V)	50.00 V	False	AC	False	100.00 V	(Vin > 50) (Vin > 50)=>(input=
Trip L1	Trip L1	Drv		False	None	True		(Short)=(nput=1)
Trip L2	Trip L2	Drv		False	None	True		(Short)=>(input=1)
Trip L3	Trip L3	Drv		False	None	True		(Short)=>(input=1)

Configuration of the Binary Input 9 and 10: As mentioned before, "Input "9 is used for measuring currents up to 500mA and "Input "10 is used for measuring Voltages up to 240mV. The columns "Show Result", "Reverse", "Threshold", Apply VDC" and "Description" are disabled for these two binaries. In the "Binary Input Type" column, the precision of "Input" 9 is set. On the back of this binary, there are four 10hm, 200hm, 1000hm and 1megaohm resistors which are used to measure the current in different ranges. By selecting any of these resistors in the "Binary Input Type" column, the 500mV voltage is divided into the resistor and the measurable current is calculated by the binary. It is, also, possible to display the actual measured current and voltage value in "DC" or "AC" in the "Show Actual Value" column.

8	Trip 1 phase	Trip 1 phase	Drv	
▶9	Meas. mA	Meas. mA	Shunt 1 Ohm -	
10	Meas. mV	Meas. mV	Shunt 100 Ohm Shunt 20 Ohm Shunt 1 Ohm Shunt 1M Qhm	
			2 and a second s	

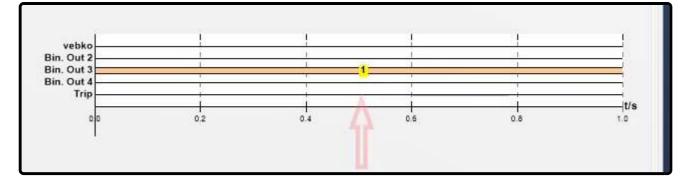


24 : BINARY OUTPUT'S SETTING

Under the "Binary Output" tab in the "Hardware Configuration" window, the settings related to Binary Outputs of the device are set. "AMT 105" has four Binary Outputs and on the back of each of them, there is a 10amp/240V relay. Activation or deactivation of "Binary Output" is determined in the "Binary Output Target" column. For example, to activate "Binary Output 1", by clicking on the related field, it is possible to select a target according to your need from the drop-down list. For example, for Open / Close command of power keys, you can select "CB52a" and "CB52b". To deactivate this output, select "Not Used" in the same drop down list. By checking the square option above the device's "Binary Output" numbers, it is possible to activate or deactivate all 4 binaries at the same time. In the "Binary Output Label" column (just like "Binary Input" section), a "Label" is selected for the activated Binary Outputs.

			Timeout		1.000 s		
Hardware	Configuration						
Analo	g Output Binary / /		Binany Outr	Extra Satting	 		
Analog	goulput Dinary//	shalog inpy	Binary Out				
\square	Binary-Output Target	Binary-Output	Label				
▶1	Bin Out 1 +	Bin. Out 1					
4	Not Used	Bin. Out 2					
3	Bin. Out 1	Bin. Out 3 Bin. Out 4					
	Bin. Out 2	Din. Out 4					
	Bin. Out 3 Bin. Out 4						
	Bin. Out 4						
	CB aux.						
	CB aux. L1						
	CB aux. L2						
	CB aux. L3 CB aux. Par.						
	CB aux. Ser.						
	CB 52a						
	CB 52b						
	Ext. Zone Active						
					10	-	04
					Import	Export	OK Cancel

After setting the related settings, it is necessary to become familiar with the application of binary outputs. In the older versions of the software, the "Binary Output" was opened and closed only once in each "State" but in new versions of the software, there is a feature added that allows you to change the status of Binary Outputs up to 4 times in a state. The initial status of a "Binary Output" can be changed in several ways. 1- In the "Bin. Out" section in the "Table View" window, it is possible to change the status of a binary to close or open by clicking on while any changes are, also, displayed in the "Signal View" at the same time.



2- Similarly, it is possible to change the status of binaries in the following address: Detail View>Analog Out>Analog Output Channels>Binary Outputs. The changes are, also, applied in the "Table View" at the same time. In fact, these two sections are linked and every change is applied in both sections at the same time.

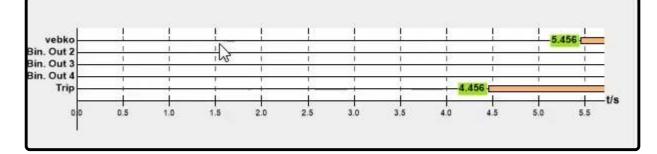
	State Name:		-1
-	State Name:		
14			
*	State 1		
ItType ———			
~			
2000/10/10/10			
annels			
	Phase	Frequency	
	Phase 0.00 *		-
Amplitude	0.00 *	50.00 H	z
Amplitude 63.51 V	0.00 *	50.00 H 50.00 H	z
Amplitude 63.51 V 63.51 V	0.00 * -120.00 * 120.00 *	50.00 H 50.00 H 50.00 H	z z z
Amplitude 63.51 V 63.51 V 63.51 V	0.00 ° -120.00 ° 120.00 ° 0.00 °	50.00 H 50.00 H 50.00 H 50.00 H	z z z
	ItType	ItType	ItType

3- It is, also, possible to change the status of a "Binary Output" from "Binary Output" tab in "Detail View" section. To determine additional start/stop and other options in a state, "Detail View" section should be used. In this section, for every "State", you can change the status of Binary Outputs up to 4 times. By entering your desired time in "1st Ch.", "2nd Ch.", "3rd Ch." and "4th Ch." you can specify the time for changing the Binary Output status. For example, in a normal situation, "Bin. Out1" is open. If number "1" is entered in "1st Ch." column, it means that after performing the test, "Bin. Out" is open for 1 second and then it closes. If "2" is entered in "2nd Ch." column, it means that 2 seconds after closing, the "Binary Output" must open. As All these changes are simultaneously displayed in "Signal View" as well. You can, similarly, determine the change time for the 3rd and 4th states of the "Binary Output" for "3rd Ch." and "4th Ch." columns.

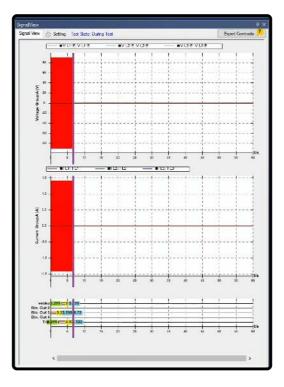
An	alog Ov Bin	ary Out	Trigger	Serial	Report S	Setting		
Out	Display Name	First State	1st ch.	2nd ch.	3rd ch.	4th ch.	Trigger	Toggle
1	vebko	7-13	0.000 s	0.000 s	0.000 s	0.000 s	+	-
2	Bin. Out 2	<i></i>	0.000 s	0.000 s	0.000 s	0.000 s	•	
3	Bin. Out 3	1-	0.000 s	0.000 s	0.000 s	0.000 s	•	-
4	Bin. Out 4	1-	0.000 s	0.000 s	0.000 s	0.000 s	-	

In the Trigger column, it is possible to set a condition for executing the changes for "Binary Output" and no changes are made to the "Binary Output" until the "Trigger" condition is met and the binary remains the same. After the "Trigger" condition is met, the "Binary Output", immediately, starts changing its status according to the specified time. By clicking on

the "Toggle" column, a list of other Binary Outputs is opened and by selecting any of them, the status of the "Binary Output" will be the opposite of the intended binary. This means that whenever "Binary Out 1" is closed, "Binary Out 3" must be open and vice versa. These changes are, also, displayed in "Signal View".



Out	Display Name	First State	1st ch.	2nd ch.	3rd ch.	4th ch.	Trigger	-	Toggle
1	vebko	1_	1.000 s	2.000 s	0.000 s	0.000 s	C1: Trip	•	-
2	Bin. Out 2	7-	0.000 s	0.000 s	0.000 s	0.000 s		. ★.)	
3	Bin. Out 3		0.000 s	0.000 s	0.000 s	0.000 s			B2: Bin Out
1	Bin. Out 4	<i>_</i>	0.000 s	0.000 s	0.000 s	0.000 s			B3: Bin. Dut
									B4: Bin. Out



25 : EXTRA SETTING

Under the "Extra Setting" tab in the "Hardware Configuration" page, the settings for the serial port of the device as well as some other operation enhancer settings are set. In tests where the test run time is longer than 100 seconds, a lot of memory is required to display the "Actual Value" in "Signal View" throughout the test. This amount of information slows down the software. By checking "Save last actual data" in "Extra Setting" during the test run, the "Actual Value" is displayed in "Signal View", for example in the last 10 seconds of the test, according to the amount of data. In fact, this option plays the role of a short memory oscilloscope. By clicking on "Maximum fan during test" during the test run, the fan of the device starts working in "Maximum fan" mode and after the test ends, it returns to normal mode. In "Binary Link Serial" field, it is

possible to enter a number between 0 and 255 so that before the test begins, the device sends a command to the equipment test board through "Binary Output" number four and this board adjusts the appropriate connections for any of the equipment tests in accordance with the received command.

Analog Output	Binary / Analog Input	Binary Output	Extra Setting
Extra Setting		1	
Save last actual of Maximum fan duri			
Binary Linke Serial			

In this section, there is a part named "Serial Setting". By adjusting the settings in this section, it is possible to send a serial "Packet" in each "State" via the "AMT105" device. In the "Baud Rate" field, the transmitting and receiving speed (the speeds must be the same) are adjusted for making the connection. In "Data" field, the bit number of each data that is sent is specified. In this section, to identify the end of the original data, one or two bits, which are called "Stop bit", are sent. The "Parity" field is used to indicate whether the number of 1 bits is odd or even and is also used to identify the error code. In the "Initial Serial Command" section, you can write a message to identify the data exchange. After setting under the "Serial" tab in "Detail View", the sent command is written in the "Serial Command" field. For each "State" of the device, the "AMT105" can send a command for the intended equipment. In fact, this section can be used in equipment test because there is an interface board between the "AMT105" and the equipment being tested. By doing this while performing the test, the device sends a "Serial Command" to the board and this board adjusts the settings according to the "Serial Command". For example, send "abc" to "State1" and "cvf" to "State2".

Data	8	
	•	~
Stop	1	~
Parity	None	Ý

	5 S	2				EQ Decan view.	Joci state 21	<u>^ </u>		
in the second se	G	Normal eneral: Direct	S2	G	Norm <mark>?</mark> eneral: Direct	Analog Out	Binary Out	Trigge	Serial	Report Setting
ame			State 2			Serial Command	abc I			
L1-E: V L1-E	*	50.00 Hz	63.51 V	0.00 *	50.00 Hz					
L2-E: V L2-E	0	50.00 Hz	63.51 V	-120.00 °	50.00 Hz					
L3-E: V L3-E	٠	50.00 Hz	63.51 V	120.00 °	50.00 Hz					
L1: L1	۰.	50.00 Hz	1.000 A	0.00 *	50.00 Hz					
L2: 1 L2	٥	50.00 Hz	1.000 A	-120.00 °	50.00 Hz					
L3: 1 L3	•	50.00 Hz	1.000 A	120.00 °	50.00 Hz					
in. Out	1-	B4. J-	B1. J- B2.	J- B3. J-	B4. J-					

ŝ	Normal General: Direct	🗆 S2	G	Norm <mark>?</mark> ieneral: Direct	Analog Out	Binary Out	Trigger	Serial	Report Setting
Name		State 2			Serial Command	abc			
/ L1-E: V L1-E	50.00 Hz	63.51 V	0.00 *	50.00 Hz		1			
/ L2-E: V L2-E	50.00 Hz	63.51 V	-120.00 °	50.00 Hz					
/ L3-E: V L3-E	50.00 Hz	63.51 V	120.00 °	50.00 Hz					
L1: L1	50.00 Hz	1.000 A	0.00 *	50.00 Hz					
L2:1L2 *	50.00 Hz	1.000 A	-120.00 °	50.00 Hz					
L3: 1 L3	50.00 Hz	1.000 A	120.00 °	50.00 Hz					

26 : RELAY SPECIFICATION IN TEST OBJECT

By clicking on "Test Object", you can open the "General Test Object" page. On this page, the settings related to "Object" or relay are adjusted. To enter the information of the relay on this page there are several ways. In the first case, the user reads all the information of the relay and enters manually. For example, to enter the nominal Specifications of the relay,

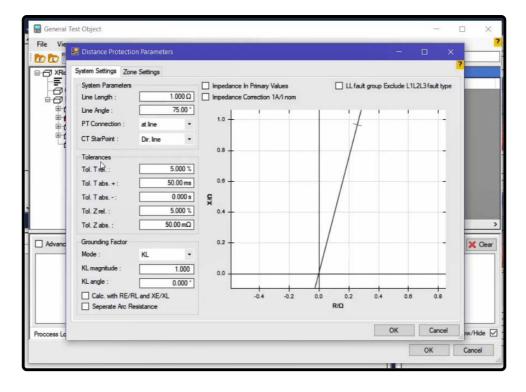
you can double-click on "Device" in the "Service Setting" page in the "Nominal Values" section and enter frequency and nominal voltage of the PTs as well as the nominal current of the CTs.

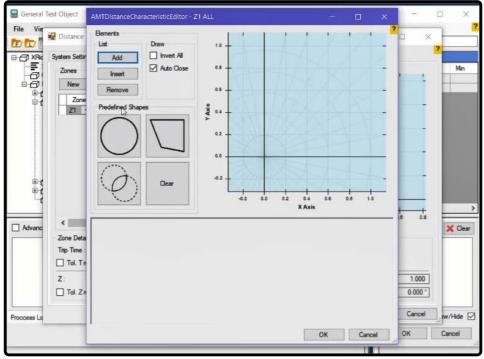
File View	🛃 Device Settings				– 🗉 🗙	
🖸 🔂 🔭 Resize Co	Device Settings				?	ee :
Script Function	Device			Nominal Values		Max Formula
Custom	Name/Description :			f nom :	50.00 Hz	Max Pormuta
RIO BO	Manufacturer :			V nom(secondary) : [110.0 V(L-L)	
🗈 🗂 Distance	Device Type :				63.51 V(L-N)	
Differential Overcurrent	Device Address :			V primary : 🍃	230.0 kV(L-L)	
CBConfigur	Senal/Model Number :	[1	45	132.8 kV(L-N)	
				I nom(secondary) :	1.000 A	
	Additional Information 1 :	E		I primary :	1.000 kA	
	Additional Information2 :			Residual Voltage/Currer	nt Factors	
	Substation			VLN/VN :	1.730	
	Name :	-		IN/I nom	1.000	
	Address :		1	Limits		
Advanced	Bay			V max :	132.0 V	💥 Clea
	Name :			I max :	64.00 A	
	Address :			Debounce/Deglitch Fite		
		12 C		Debounce Time :	3.000 ms	
				Degitch Time :	400.0 µs	
occess Log Error / Wat	Save to Template	Load Template	Export	Import OF	(Cancel	Show/Hide

Also, it is possible to enter information such as device name, serial number etc. in the "Device" section. After that, to save the information, it is necessary to click on "OK". It should be noted that whatever is in the "Device" block on the "Device Setting" page also exists in the "Device" block Tree diagram and the values can be entered here too. For example, there is a series of information about nominal values of the device, "Substation", "Bay", "Nominal Values", etc. You can also find this information in the branches of "Device" Tree diagram. This means that in the "Name plate" section, you can also find information about device's ID or in the "Nominal Values" section, you can find information about the nominal values of the relay. If "Vebko" is entered in the "Value" field, in the "Device Name" row in the "Name Plate" section, by opening the "Device" page, this word is also recorded in the intended section.

File View							
🔁 🛅 Resize Columns : Auto 🔹	- 🖧 🚰 Recalcu	late Disabled F	ormula(s) 🗲 Qui 🖞	/alue :	Tre	e:	
	Name Plate - Dev		1.				
Script Functions	State		ID	Description	Value	Туре	Min
Custom	0	Device name	DEVICE_MODEL	Device model/name		String	
	0	Manufacturer	MANUFACTURER	Manufacturer		String	
Device Mame Plate	0	Device type	DEVICE_TYPE	Device type		String	
	0	Serial Number	SERIALNR	Serial/model number		String	
Nominal Values	0	Add, info 2	ADDITIONAL INFO2	Additional information 2		String	

In fact, these two sections are linked and enter changes simultaneously. After entering the nominal values of the relays manually, it is, also, necessary to manually enter the specifications of the protective function. For example, to enter the specifications of the "Distance" protective function, you can enter the related information such as tolerances, length and angle of the line by clicking on "Distance" block in the "Distance Protective Parameters" page. You can also draw the relay zones according to the catalog under the "Zone Setting" on this page. To do this, click on "New" to open a new row and then click on "Edit" and in the opened page enter the zone information according to the relay catalog and then click on "OK". After that you can see that the zone is drawn.

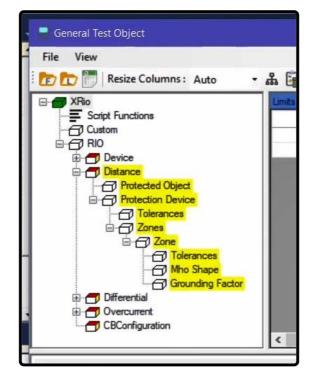




By opening the "Distance" block, the entered information can be seen in the form of a tree diagram. For example, the information related to "Zone" is displayed in this section too. You should note that these sections are linked. To enter information of functions such as "Differential" and "Over Current" you can click on the related block and enter the information. After entering the relay information manually, by clicking on "OK", you can import the settings to the software and continue the test. You can enter a value in the upper right corner of the "Value" feed and the software displays the parameters that have this value.

General Test Object					-	×
File View	Recalculate D	Disabled Formula(s)	4 Qui Value	Tree		2
XPie Script Functions Custom Custom Device Distance Differential Differential CBConfiguration CBConfiguration C	State Nan	ert function block ne ID	Description	Value	Type	Mn
Advanced Proccess Log Error / Warning Formula References Relay	y Cantig Log			ОК		W/Hide Zancel

You can also search for your intended word, by entering it in the "Tree" section. For example, by entering "360" degrees in "Value", the parameters that have this value are displayed and if the word "Distance" is entered, this block and its subcategories are displayed in a highlighted mode. There are two options of "OK" and "Cancel" on the bottom of the page. "OK" is used to enter the information and "Cancel" is used to cancel entering the information. If you check "Show/Hide" option on the bottom, you can change the status of the lower window to hidden or visible which will be fully explained in future videos. The important point is that some of the relays provide the user with the settings as a "Rio" file. By directly loading, all the settings of the relay are entered to the software automatically and there is no need for manual insertion of the information.

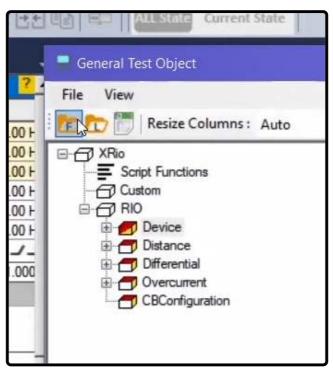


27 : INTRODUCING THE "RIO"

By opening a "Rio" file in notepad, you see that the specifications of the relay are <mentioned> in this file. For example, between "BEGIN DEVICE" and "END DEVICE" section, information and nominal specifications of the relay are mentioned. Or, in the "BEGIN DEVICE" section to the "END DISTANCE", the information regarding the distance function and in the "BEGIN ZONE" section, the information regarding the relay zones are. Similarly, all the relay information is mentioned in this file.

GIN TESTOBJECT BEGIN DEVICE NAME "" MANUFACTURER " SERIALNO " DEVICE-TYPE "" DEVICE-ADDRESS " SUBSTATION-ADDRESS BAY " SUBSTATION-ADDRESS BAY "BAY-ADDRESS "" BAY-ADDRESS "" PROTECTED-OBJECT-NAME ADDITIONAL INFO2 PHASES 3 VMRM 110 VMRM 110 VMRM-LL 23000 INOM 1 IMAX 64 IPKIM 1000 FNOM 50 END 50 ENDETIME 8.000 DEGLITCHTIME DEBOUNCETIME ININOM 1 VUNVN 1.732 0.000 END DEVICE BEGIN DISTANCE ACTIVE YES LINEANGLE 75 PICONN LINE CISTARPOINT LINE IMPCORR NO IMPORTM NO ARCRES NO TTOLPEUS 0.05 TTOLREL 5 ZTOLREL 5 ZTOLABS 0.05 KL 1, 0 KM 0, 0 LINELENGTH 1 BEGIN ZONE TYPE TRIPPIN

By having a "Rio" file, you can "Load" this file in "Test Object" through "File" option. After loading, all of the information existing in the Rio file is displayed. So, the second method for entering information of relays whose software gives a "Rio" output file, is loading "Rio" file in "Test Object". This is how the relay information is loaded in the software.



The point is that the information in a "Rio" file is fixed, meaning that it is not possible to add or delete a new block or

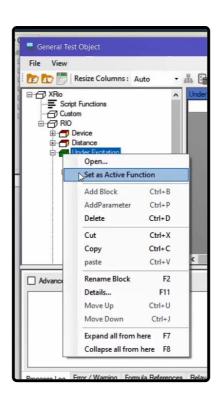
parameter in the "Device" block. In fact, "Rio" is a fixed file and much of the "Test Object" design is related to the "Rio" file design. The purpose of "Rio" file is that, for example, each "Distance" relay be end to "Device" and "Distance" blocks and contain a series of nominal specifications, zones and a series of times. However, it is possible that the "Distance" relay itself contains thousands of parameters and not all of these parameters exist in the "Rio" file but ultimately the "Rio" output file of the "Distance" relay contains information mentioned in "Device" and "Distance" blocks. This is, also, true for "Differential" and "Overcurrent" relays. So, the "Rio" file is a fixed part of the relay settings and includes information related to "Device" block and protective functions. Also, the "CB Configuration" block is added to "Rio" files for simulation of power key operation. It is possible to add other blocks to "Rio" file. For example, by opening "AMT Distance" room from "Test Object" window it is possible to add another block, if necessary, by right-clicking on "Rio" and selecting the "Add Block" option.

File Vi			
	Resize Columns	: Auto	•
	o Script Functions		
	Custom		
ė- P	RIO		_
	Open Set as Active Fun	at an	
_			
	Add Block	Ctrl+B	
	AddParameter	Ctrl+P	
	Delete	Ctrl+D	
	Cut	Ctrl+X	
	Сору	Ctrl+C	
	paste	Ctrl+V	
	Rename Block	F2	
	Details	F11	ļ
Adv	Move Up	Ctrl+U	İ
	Move Down	Ctrl+J	-
	Expand all from h	ere F7	
	Collapse all from	here F8	

After making a new block, it is possible to rename it by right-clicking on the block. Assume that a relay has two functions of "Distance" and "Under Excitation". These functions are tested by the impedance method. So it is necessary that there are two "Distance" blocks in this section. After adding a new block, by right-clicking on it and selecting "Rename Block", its name is changed to "Under Excitation". By double-clicking on "Under Excitation" block and selecting "Zone Setting" tab on this page, a "Quad" zone is defined for this block according to the described settings. After that, click on "OK".

	est Object	
File View		
00	Resize Columns :	Auto •
	Set as Active Fun	ction
	Add Block	Ctrl+B
	AddParameter	Ctrl+P
	Delete	Ctrl+D
	Cut	Ctrl+X
	Сору	Ctrl+C
	paste	Ctrl+V
Advar	Rename Block	F2
	Details	F11
	Move Up	Ctrl+U
	Move Down	Ctrl+J
	Expand all from H	here F7
	Collapse all from	here F8

Now that there are two "Distance" blocks, one of them should be active. If the cube next to the block is colored, it means that it is active; if it white, it means that it is not active. Now, if you click on "OK", the information of the active distance block is displayed. Here, the "Mho" characteristic is active. Now, for activating the second distance block it is necessary to right-click on the intended block in the "Test Object" window and select "Set as Active Function". By doing this, the intended block is activated and the previous block is deactivated and by clicking on "OK" the characteristics of "Distance" and "Under Excitation" blocks that are from the "Quad" type are displayed in the "Impedance View". Also, in the advanced mode, it is possible to mix these two blocks. By right-clicking on each block of "Rio" file, it is possible to delete it.



Column Description: Each of these parameters has some information in their row. In the "State" column, by double-clicking

on each cell, "Rio Parameter Viewer" page is opened. In the "Enabled" section, you can activate or deactivate this parameter. By deactivating a parameter, the status of its "state" changes. In the "Name" column, the name of the intended parameter is provided. In the "ID" column, there is a unique name selected for each parameter. In the "Description" column, there is an additional description provided for the intended parameter.

🔚 General Test Object			- [) X
File View	Rio Parameter Viewer 🗙 🗙			?
🗄 🛅 🛅 🛛 Resize Columns :	k 7		e:	
8-67 XRio	General Settings			
Script Functions	ID : DEVICE_MODEL Name : Device name	alue	Туре	Min
Custom	Description : Device model/name		String	1
Device	Foreign ID :		String	
Mame Plate	Comment :	-	String	
Cocation			String String	
- 1 Nominal Values		1	oung	
- Misc				
Distance	Enabled			
OBConfiguration	Enable O Disable			
Coconiguration				
	O Formula			
	Result : True			
	Value Properties			>
Advanced	Value : Refrence value :			💢 Clear
				👗 Clear
	Data Type : String v Define Values			
	Min Value : Max Value :			
	Display Properties			
	Multiplier Unit: Digits after decimal:			
	Multiplier Onic . Digits alter decimal.			
Proccess Log Error / Warning F			Sh	now/Hide 🗹
			ж	Count
	< > OK Cancel			Cancel

In the "Value" column, the user can select a value for the intended parameter. In the "Type" column, the type of the inserted data for the parameter is specified. In the "Min" and "Max" columns, the minimum and maximum allowed value for the parameter are specified. The "Formula" column is an indicator of that whether this parameter is derived from a formula or is dependent on another parameter. More will be said about this column in the "XRio" section.

🔚 General T	est Object								-	• ×
File View										?
🖿 💼 🛅	Resize Column	s: Auto 🔹 á	ሔ 🚰 R	ecalcu	late Disabled F	ormula(s) 🛉 Qui	Value :	Tree	H:	
	nana ma		Name Plat	e - Dev	rice Data					
					Name	ID	Description	Value	Туре	Min
			F	8	Device name	DEVICE_MODEL	Device model/name	13	String	
Image: Solution of the state of the sta										
				0	Device type	DEVICE_TYPE	Device type		String	
				0	Serial Number	SERIALNR	Serial/model number		String	
		es		0	Add. info 2	ADDITIONAL_INF02	Additional information 2		String	
	Cocomgaration		<							>
Advanced	ľ									🗙 Clear
Proccess Log	Error / Warning	Formula References	Relay Con	ifig Log	I				S	how/Hide 🗹
								OF	(Cancel
										4

How to make a Rio file by Excel: The point is that there is a series of relays that do not provide a "Rio" file as an output. To

get a "Rio" file from this type of relays, click on the "Excel to Rio Files" icon on the "Rio Converter Excel" page. Then, select your intended relay from the list. In this list, you can find the name of relays whose "Excel" file exists in the created software. After selecting the relay, its related "Excel" file opens. On this page, you can enter information about the relay and after entering the information, by clicking on the "Save Rio File" option, a "Rio" file is created from the intended relay. This "Rio" file can be imported by using the "Import from File" icon and after that you can save the relay information. By selecting "Advanced" from the "View" menu, a new row is added to this toolbar page so you can add or delete new blocks or parameters manually if you decide to do that.

escription Value Type Min Max Formula vvice mode/name String Autor anufacturer String Autor vvice type String Autor rial/model number String Autor	Resize Columns : Auto	ት 🖬 Rec	alculate Disat	bled Formula(s)	ui Value :			Tree :	
vice model/name String Anufacturer String St	CEN'S.					(P) (P)			
anufacturer String	Script Functions	þ		Description	Value	Туре	Min	Max	Formula
vice type String difference of the string diff		VICE	_MODEL	Device model/name		String			
ria/model number String diditional information 2 String	Name Plate Description Value Type Mn Ma Custom Custom Description Value Type Mn Ma Device Outron Plate Device model/name String Image: String Ima								
dditional information 2 String		Name Plate - Device Data Description Value Type Min Max VICE_MODEL Device mode/name String Min Max VICE_MODEL Device mode/name String Min Max VICE_MODEL Device mode/name String Min Max VICE_FORE Device type String Min Max VICE_FYRE Device type String Min Min Max RIALNR Serial/model number String String Min Min VDITIONAL_INFO2 Additional information 2 String Min Min Min							
		RIAL	.NR	Serial/model number		String			
		DITI	ONAL_INFO2	Additional information 2		String			
		4				Value Type Min Max Formula String			
	CBConfiguration	٤							Max Formula
	CBConfiguration	٢	Description Value Type Min Max Formula ICE_MODEL Device model/name String Image: Comparison of the string Image: Compar						
	CBConfiguration	٤							X Ce
	CBConfiguration	٢							X Ce
	CBConfiguration	٤							X Ci
S		<.							

ALSTOM LFZR to RIO Converter	Rio Converter Excel	×
General Substation Substation Feeder Feeder Seral No. 123456 VT Primary 132 kV CT Primary 800 A	Distance Options Section Quadriateral enabled Custom options disabled Angle setting 80.000 ° Residual comp 0.800 Ω 77.75	50 °
Distance Settings Zone 1 Zone 1X Zone 2 Zone 3 Zon Operation Phase + ground ▼ Phase Reach 5.000 Ω 80.000 Ground Reach 5.000 Ω 80.000	ne 4 Residual Reach 4.000 Ω 79.000 ° Quad res. 10.000 Ω	0
Save RIO File	ave Settings Exit	
For use with OMICRON Test Universe softwa (c) Alectrix (Pty)Ltd 2003; For questions cor		3.00

28 : INTRODUCING "XRIO"

The first matter that should be discussed in the "XRIO" part of the instruction is the reason for turning to these files. The first reason was that "RIO" files did not have a specific set of standards for coding. For example, if from the list of "RIO" files of the relays on the "Load XRio and Rio File From list" page which is provided in the software, the () and () files are opened in the notepad, you can see that these two files have different coding and there is no specific standard to them.

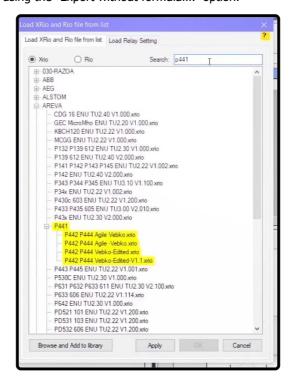
The second reason was that when an "RIO" file was loaded, only "RIO" information was available. "RIO" information is that into which all relay settings can be compiled. For example, when "Distance" characteristic of the "Micom" relay is translated and the characteristic curve is formed, there is some information that is not inserted into the software. For example, it is possible that it exists in the relay of "power swing blocking" function but its information is not inserted into the "RIO" because, basically, it is not possible to do so. The third reason was that specification changes of the relay were not the same in relay and the software. It means that, if the user made a change to the translated "RIO" which was a known format, it is not clear that which settings needed to change in the relay so that it could follow the curve of specified characteristics. The fourth reason was that if a parameter was changed from the setting of the relay, it was necessary to get those settings, again, from the "RIO" relay and this file had to be loaded and translated in the software so that the relay and software settings were exactly the same.

The second important matter which is related to "XRio" is that the user needs to know the components of an "XRio" file and what happens when it is loaded in the Vebko software. To explain this a little further, a "XRio" file is loaded from the "Micom p441" relay. You can see that the first thing that happens is that a "SCRIPT FUNCTION" and a tree diagram of the settings are formed in this section of the software. In the end, the "RIO" which is a translated version of the relay characteristics is completed. We will discuss more the concept of "XRIO" and its components in future videos.

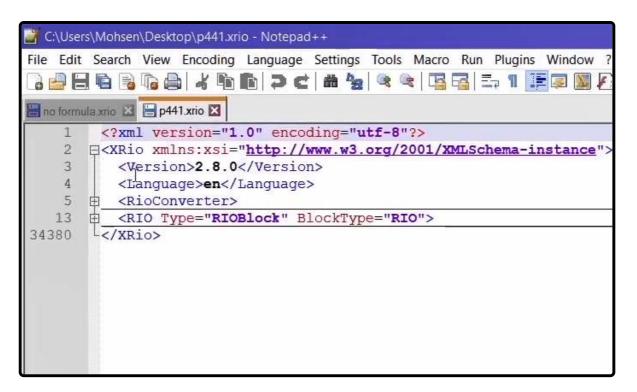
gs	File View	
Ine	XRio Script Functions MICOM P441 P442 P444 RIQ Device Distance Overcurrent Forward Direction Line-Ne Overcurrent Reverse Direction Line-Lir Overcurrent Reverse Direction Line-Lin Overcurrent Reverse Direction Line-Lin CBConfiguration	1 2 3 4 5 6 7 8 9 10 11 12 13 14 14 15 16⊡ f
	< >>	
	Type Tag Target Name	Descriptio

29 : XRIO CONVERTER FILE

To further study the "XRio Converter" file, by clicking on "Import from list" icon on the "Load XRio Converter and Rio file from list" page, an "XRio Converter" file related to the "AREVA MiCOM P441" is loaded. After the "XRio Converter" file is loaded, it is possible to export this file from the software separately. To do this, by clicking on "File" menu, you can export the "XRio Converter" file in forms of with or without formula. In this part, for a better understanding, first, export the "XRio Converter" file without formula by using the "Export without formula...." option.



Then, the same "XRio Converter" file is loaded in the software without formula. By opening the "XRio Converter" file in notepad++, you can see that this file is written in "xml" format. In the subset of "XRio", the version and language of the file are defined. It is then observed that the "XRio Converter" file without formula consists of two main parts of "Rio Converter" and "Rio Type".

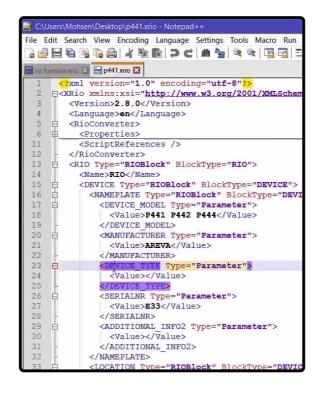


By opening the "Rio Converter" section, you can see that this section consists of another section named "Properties" where information about date and time are mentioned. In fact, the style of this type of coding is "xml" where each section opens and closes with a tag. For example, "XRio" tag is opened here and again closed in the end and the "</" sign indicates its closure. also, it is possible to open or close the "Rio Converter" tag by clicking on the square next to it. The "ScriptReference" tag is opened and closed in the same line because there is a "/>" sign in the end. The second part which is the "Rio Type" tag, contains fixed information of the relay and is the same "Rio" file as described before.

C:\Users\	\Mohsen\Desktop\p441.xrio - Notepad++
File Edit	Search View Encoding Language Settings Tools Macro Rur
	🖻 🗟 🕼 🎝 🏠 🏠 💼 ⊃ C 📾 🖢 🍳 👒 🖼 🖼
no formula	a.xrio 🔀 🔚 p441.xrio 🔀
1	<pre><?xml version="1.0" encoding="utf-8"?></pre>
	<pre>XRio xmlns:xsi="http://www.w3.org/2001/XMLSc</pre>
3	<version>2.8.0</version>
4	<language>en</language>
5 8	<rioconverter></rioconverter>
6 8	<properties></properties>
7	<revision>0</revision>
8	<changedate>2019-11-03</changedate>
9	<author></author>
10	<pre>- </pre>
11	<scriptreferences></scriptreferences>
12	-
13 8	<pre><rio blocktype="RIO" type="RIOBlock"></rio></pre>
34380	

By opening this tab, it is observed that the "Rio" tag consists of "DEVICE", "DISTANCE", "OVERCURRENT", "CBCONFIGURATION" blocks which are originated from the relay specifications. These blocks are the "xml" model of the "Rio" file which is included in the "XRio Converter" file. As it is written, the "Rio" tag is of the "Block" kind. By opening this block it is observed that the "Rio" block consists of other blocks. By opening this block it is observed that inside this block there is a "DEVICEMODEL" which is of the "Parameter" kind. This means that this block has a "value" of "P441 P442 P444". Likewise, there are other parameters including "MANUFACTURER", "DEVICETYPE", etc. in the "NAMEPLATE" block.

Ja xrio 🔀 🔚 p441.xrio 🔀
<pre><?xml version="1.0" encoding="utf-8"?></pre>
<pre>F<xrio xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"></xrio></pre>
<version>2.8.0</version>
<language>en</language>
RioConverter>
<properties></properties>
<pre><scriptreferences></scriptreferences></pre>
-
<pre></pre>
<name>RIO</name>
<pre>device Type="RIOBlock" BlockType="DEVICE"></pre>
<pre>def <distance blocktype="DISTANCE" id="DISTANCE1" type="RIOBlock"></distance></pre>
<pre>OVERCURRENT Id="OVERCURRENTFD" Type="RIOBlock" BlockType="OVERCURRENT"></pre>
<pre></pre>
<pre>OVERCURRENT Id="OVERCURRENTFD1" Type="RIOBlock" BlockType="OVERCURRENT"></pre>
<pre>OVERCURRENT Id="OVERCURRENTFD3" Type="RIOBlock" BlockType="OVERCURRENT"></pre>
CBCONFIGURATION Id="CBCONFIGURATION1" Type="RIOBlock" BlockType="CBCONFIGURATION">
-
L



This information can be observed in the "Vebko AMPro Test" software after entering the "XRio Converter" file. The information related to "XRio Converter" file is available in the "Test Object" window. In the tree diagram of this section is the "XRio Converter" block and its subsets -similar to the "Rio" Block-. Likewise, the "Device" block and its subsets are -similar to the "Name Plate" block. In the "Name Plate" block the parameters mentioned in "XRio" are entered in the table. For example, the "DEVICE MODEL" parameter which has the value of "P441 P442 P444", is displayed in the "Value" column of this table. As another example, in the "Rio" block in the "XRio Converter" file and in the path of "DISTANCE" and "PROTECTEDOBJECT" blocks, it is observed that the value of "LINE" is entered for "PT connection" with "ID": "PTCONN".

📲 🚍 Test Object -p441.xrio					-		× •
File View							?
📄 📅 🛅 Resize Columns : Auto 🔹 🔹 🔓	Recalcu	late Disabled F	ormula(s) 🛛 🗲 Qui 🛽	Value :	Tree :		
	Plate - Dev	vice Data					
Script Functions	State	Name	ID	Description	Value	Туре	Min
Custom		Device name	DEVICE MODEL	Device model/name	P441 P442 P444		
E-T Device	0		MANUFACTURER	Manufacturer	AREJA	String	-
Name Plate		Device type Serial Number	DEVICE TYPE	Device type Serial/model number	E33	Strina Strina	
(1) Location		Add. info 2		Additional information 2	200	String	
		Aug. 1110 2	ADDITIONAL INFO2			ound	
Residual Factors							
- D Limits							
Overcurrent Forward Direction Line							
Overcurrent Forward Direction Line							
Overcurrent Reverse Direction Lin							
Overcurrent Reverse Direction Lin							ľ
CBConfiguration Y							
< > <							>
Advanced						X	Clear
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Proccess Log Error / Warning Formula References Relay	Config Log					Show/Hid	ie 🗹 -
					OK	Cance	4
	_						4
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If you follow the same path in the "Test Object" window in the "Vebko AMPro Test" software, namely the "Distance" directory in the "Rio" block, you can see in the "Protected Object" table that for a parameter with "ID" :"PTCONN" in the "Value" column, "at line" is entered while in the "XRio Converter" file, "Line" was entered as the value. The reason for the difference in values of the "Vebko AMPro Test" software and the "XRio Converter" file is that the codes written in the "Rio" section, receive the values from "XRio" and then enter the corresponding values for different parameters in accordance with design of the codes, which is here "Line" for a parameter with "ID":"PTCONN" in the "XRio" corresponds to "at line" in "Rio".

B-C XRio	100				ince :		
		ID	Description	Value	Туре	Min	Max ^
		PTCONN	Potential transformer connection side	at line 🔻	Enumeration		
		CTSTARPOINT	Used to invert the sign of the currents				
Custom Rio Device PTCONN Potential transformer connection size Stime Funderation CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line ande LINELRIGH Line impedance Tvoe of arounding factor KL Anole Overcurent Forward Direction Line-Ve Overcurent Reverse Direction Line-Ve CZI Anole CCBConfiguration VE Advanced PTCONN Potential transformer connection size Stime Funderation CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line ande UNEALE Line CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line ande UNEALE Line CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line ande UNEALE Line CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line ande UNEALE Line CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE Line CTSTARPOINT Used to invert the sion of the currents Dir. Ine Enumeration UNEALE CTSTARPOINT Used Transformer CTSTARPOIN	36						
Distance		Recalculate Disabled Formula(s) Qui Value Tree: Tree: Tree: Protected Object - Protected object properties D D D Description Value Type Min Max Max PTCONN Potential transformer connection size at line Enumeration CTSTARPONT Used to invert the sign of the currents Dr. line Enumeration UNEANOLE Line ande UNELENGTH Line invedance Vit Vit Real Complex arounding factor KL Angle Grounding factor KL Angle Grounding factor Real ZO21 MAG Grounding factor mode ZD(21 0.000 Real 360 ZO21 ANGLE Angle Grounding factor MM KM ANGLE Angle Grounding factor MO ZO21 ANGLE Angle Grounding factor MM Complex arounding factor Nu ZO21 MAG Grounding factor mode ZD(21 0.000 Real 360 SO ZN K MAG Angle Grounding factor MO Vitale Complex arounding factor Nu Complex arounding factor Nu ZO21 ANGLE Grounding factor mode ZD(21 0.000 Real 360 SO Se ZN X Grounding factor mode ZD(21 0.000 Real 360 SO Se ZN X Grounding factor Mo Nu KM ANGLE Angle fortubal coupling factor 0.000 Real 360 SO Se ZN X Complex Angle Angle fortubal coupling factor 0.000 Real 360 Se ZN X Complex Se X X Se Se X Se X Se Se X X Se Se X Se X Se X Se X Se X Se X Se Se X Se Se X Se Se X Se Se					
Protected Object			Disabled Formula(s) Qui Velue: Tree: Tree: Description Description				
Protection Device			Construction Yelve: Tree: Constructed object properties D Description Value Type Min Max D Description Value Type Min Max Max TCONN Potential transformer connection size at line Enumeration Instructure TCONN Potential transformer connection size at line Enumeration Instructure TCONN Potential transformer connection size at line Enumeration Instructure TCONN Potential transformer connection size at line Enumeration Instructure NEANCE Line anole Min 360.00 * p0 361 NELENGTH Line impedance Attractor 0.000 * Max 360.00 361 N MAG Groundino factor mode ZE/ZL 1.00 Real na na N MAG Groundino factor mode ZO/Z1 4.00 Real 0.00 361 C1 MGLE Fore of mutual coupling factor 0.000 Real 0.00 361 C21 ANGLE Groundino factor mode ZO/Z1 0.000 Real<				
Overcurrent Forward Direction Line-Ne	Columns: Auto Image: Recalculate Disabled Formula(s) Qui Value: Tree: T						
				Value Type Min Max te at line • Ebumeration ts Dir. line • Enumeration Min Max • ts Dir. line • Enumeration Min Max • Min Max • ts Dir. line • Min Max • Max • • 1.00 Real -360.00 0.000 Real -360.00			
		ZN X			Real		
			Grounding factor mode Z0/Z1	4.00	Real	0.00	2 Max ∧ 000 360 000 360 0.00 36
		Recalculate Disabled Formula(s)					
Coconiguration			Type of mutual coupling factor	KM ·	Enumeration		
		KM MAG	Magnitude of mutual coupling factor	0.000	Real	0.00	
		KM ANGLE	Angle of mutual coupling factor	0.000 *	Real	-360.00	361
		ZM R	R of mutual coupling factor	0.000	Real	na	
		74 V	V of mutual coupling faster	0.000	Deal		~
	<						>
Advanced						3	Clear

In "Vebko AMPro Test" software, there are columns like "Name", "Description", etc. for each parameter which provides the user with information about the intended parameter and there may be no code for these sections in the "XRio Converter" file. Initialization of these columns in the "Rio" is in the way that according to the code written by the programer, wherever in the "ID" column the phrase "PTCONN" is written, its name is "PT Connection" and "Potential transformer connection side" is entered as described in the "Description" column for it. Also, the programer coded other columns like "Type" has mentioned it in the code to be displayed in the "Rio" section. For the mentioned parameter it is "Enumeration" which means that it is selective and the user can select a value from the drop-down field in the "Value" column.

Test Object -p441.xrio	- 111 -				×
File View					?
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			/		
⊟-⊕ XRio Protec Protec		- Protected object properties			Value 🛆
	State	Name	ID	Description	VOIDC
		PT connection	PTCONN	Potential transformer connection side	at line
Device		CT star point	CTSTARPOINT	Used to invert the sign of the currents	Dir. line
		Line anole	LINEANGLE	Line andle	70
Protected Object	0	Line length	LINELENGTH	Line impedance	12.1
Protection Device	0	Grounding factor mode kL mag.	GRF MODE	Type of arounding factor	KL
Overcurrent Forward Direction Line-Ne	Ö	kL mao. kL angle	KL MAG	Magnitude of complex grounding factor	0.0
Overcurrent Forward Direction Line-Ive	Ő	KL andle RE/RL	KL ANGLE ZN R	Angle of complex grounding factor Grounding factor mode ZE/ZL	0.0
		XE/XL	ZN X	Grounding factor mode ZE/ZL Grounding factor mode ZE/ZL	
Overcurrent Reverse Direction Line-N		Z0/Z1	Z0Z1 MAG	Grounding factor mode 20/21	
Overcurrent Reverse Direction Line-Li	ŏ	Z0/Z1 Angle	Z0Z1 ANGLE	Grounding factor mode 20/21	0.0
CBConfiguration	ŏ	Mutual coupling factor mode	MCF MODE	Type of mutual coupling factor	KM
		kM mag.	KM MAG	Magnitude of mutual coupling factor	0.
		kM angle	KM ANGLE	Angle of mutual coupling factor	0.0
	ŏ	RE/RL	ZM R	R of mutual coupling factor	0.
		VENI	711 V	V of mutual coupling factor	0. V
					>
Advanced					🗙 Clear
		₽			
	.				
Proccess Log Error / Warning Formula References Relay	Contig Log			Sho	w/Hide 🗹
				ОК	Cancel

It should be noted that for every piece of information in the "Custom" part which is not fixed, its code must be written in "XRio". This will be more explained in future videos. Another point is that the "User Interface" mode is included in "Rio" section. This means that by double-clicking on any block of the subsets of "Rio", for example, "Device" block, the "Device Setting" page opens where all parameters of the subset of this block can be observed and changed. These changes are, simultaneously, recorded in parameters table as well. But, if you double-click on any block other than "Rio", a series of information about "ID" of the block as well as its name are displayed.

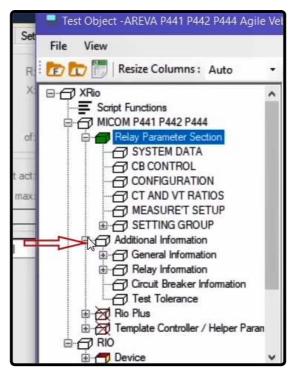
30 : XRIO CONVERTER, PART2

After identifying the problems with "RIO" files, "OMICRON" company decided to implement a new idea. According to this idea, a file format named "XRIO" was created in which a section named "Relay parameter section" was designed for every relay and all relay menus were arranged and addressed exactly the same way as in the relay software.

	Test Object - AREVA P441 P442 P444 Agile Vel
earch Test Set	File View
R. X:	Contractions Contractions Contractions Contractions MICOM P441 P442 P444
t act t max:	Relay Parameter Section Additional Information Additinformation Additional Informatio
ent Z	Distance Distance Overcurrent Forward Direction Line-Ne Overcurrent Forward Direction Line-Lir Overcurrent Reverse Direction Line-Ni Overcurrent Reverse Direction Line-Lir CBConfiguration
	< >

Another section of this file is "Additional information" which includes that necessary information which is not available in the relay software and should be read from its catalogue. For example, if you click on "General information" tree diagram on

"General" block, you can see that "AREVA" is recorded as the "Manufacturer" which is not available in the relay menu but is necessary to complete the device information.



General - Gene	ral Information							
State	Name	ID	Foreign ID	Description	Value	Туре	Min	P
	Manufacturer	MANUFACTURER		Manufacturer	AREVA	String		
	Device Model	DEVICE_MODEL		Device Model	P441 P442 P444	String		
	Serial Number	SERIAL_NUMBER		Serial Number	E33	String		
	Device Address	DEVICE_ADDRESS		Device Address	1	String		
						Land La		

The important point in getting familiar with "XRio" is that you should know how "XRio" blocks are defined. For example, in "Relay Parameter Section" tree diagram and in the "SYSTEM DATA" block, the "Language" parameter is of "Enumeration" type and its value is defined as "English". Now, if the "XRio" file of this relay is opened in "Notepad++", after opening the

"Custom" tag, you can see the "Setting" block, "ID_00" block and parameter with "id=ID_0001". The "Name", "ForeignId"

and "DataType" of this parameter are "Language", "0001" and "Enumeration" respectively. In the "EnumList" tag, you can see that, four languages including English, French, German and Spanish are available as "Value" for this section and in this case "English" has been selected.

le View							Value :			Tree :	
🔂 🛅 Resize Columns : Auto 🔹 👪	🔒 Recalcu	ulate Disabled For	mula(s)	🗲 Quick Acc	ess Ok Can	cel					
	STEM DATA		. E								
Script Functions	State	Name	ID	Foreign ID	Description	Value	Туре	Min	Max	Formula	
MICOM P441 P442 P444	0	Language	ID_0001	0001	Language	English	Enumeration				
Relay Parameter Section		Description	ID_0004	0004	Description	MICON	English				
	0	Plant Reference	ID_0005	0005	Plant Reference	AREVA	String				
CONFIGURATION	0	Frequency	ID_0009	0009	Frequency	50 Hz	 Enumeration 				



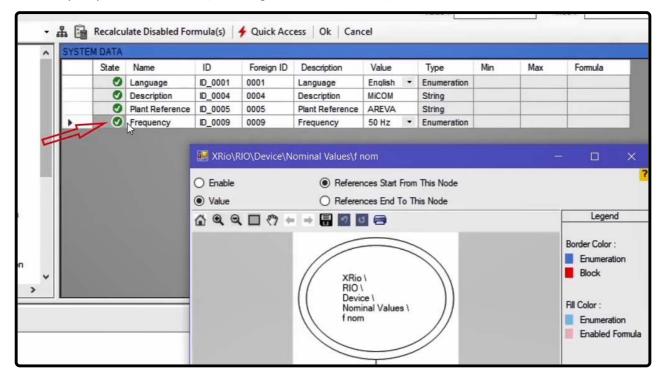
Now, if you return to the "Vebko AMPro Test" software, you can see the exact same information in the "Test Object" section. This means that by double-clicking on "Relay Parameter Section" in the tree diagram you can see that its "ID" is defined as "SETTINGS"; then by double-clicking on the "System Data" block you can see that its "ForeginID" is defined as "ID_00". In its parameters table, you can see that "Enumeration" is defined as "Type" for the parameters named "Language" and "ForeignID:0001". Also, in the "Value" field there are four languages of English, French, German and Spanish available where "English" is selected by default in accordance with the displayed codes.

State	Name	ID	Foreign ID	Description	Value		Туре		Min	Max	Fomula
0	Language	ID_0001	0001	Language	English	-	Enumerati	ion			
O	Description	ID_0004	0004	Description	English	inglish					
0	Plant Reference	ID_0005	0005	Plant Reference	Francais						
0	Frequency	ID_0009	0009	Frequency	Deutsc S Espanol		1	on			

After an "XRio" file is loaded, the necessary settings and information of the "Rio" section are completed accordingly and the cells whose information is dependent on a formula or parameter from the "XRio" file, are turned purple. For example, the value of nominal frequency in the "Nominal Values" block is defined according to a formula from the "Formula" column and if this value is modified manually, the color of the cell changes to pink which means that there is no more a connection between the value of this cell and the formula defined for it. To make the value of this cell again dependent on the formula, right-click on it and select "Recalculate formula".

ile View							Value :			Tree :	
🗗 🛅 🛛 Resize Columns : Auto 🔹	ቆ 🔒	Recalcu	late Disable	d Formula(s	s) 🛉 Quick Access Ok 0	Cancel					
@ XRio ^	Nomin	al Values -	Nominal Valu	Jes							
Script Functions		State	Name	ID	Description	Value	Туре	Min	Max	Formula	
MICOM P441 P442 P444 MICOM P441 P442 P444			Phases	PHASES	Number of phases	3	Integer	2	3		
Additional Information	•		fnom	FNOM	Nominal frequency	60.00 Hz	Real	0.00	na	NOMVAL	
Rio Plus			V nom	VNOM	Nominal secondary L-L voltage	110.00 V(L-L)	Real	0.00	na	VLLNOM	
Template Controller / Helper Paran			V prim L-L	VPRIM_LL	Nominal primary voltage L-L	110.00 V(L-L)	Real	0.00	na	VLLNOM	
		0		INOM	Nominal current	1.00 A	Real	0.00		INOM	
🖨 🗂 Device		0	1 prim	IPRIM	Nominal primary current	1.00 A	Real	0.00	na	INOM	
Nominal Values											
- G Limits											
Misc											
🕀 🗂 Distance											
Overcurrent Forward Direction Line											
⊕ ⊕ Overcurrent Forward Direction Line											
🗄 🕣 Overcurrent Reverse Direction Lin 🗸											

To find out about that how the nominal frequency (with purple color) is defined, first, you should select it and then click on the "Reference Map" icon to view a map of the parameters to which the frequency is dependent. By clicking on any of the boxes in this section, the parameter that affects the final value of the frequency is displayed which, in here, the frequency is taken from "Fnom". The value of "Fnom" parameter is, itself, based on a formula and is dependent on another parameter which by clicking on the "Map" box, you can see that a parameter named "Frequency" is used. This means that, since "50" is set as the value for "Nominal Values", the value for "Fnom" is, according to its formula, "50" too and finally the amount of nominal frequency in "Nominal Values", according to the defined relation, is "50" Hz.



Now, if you open the "XRio" file in "Notepad++", you can view the path that was used to find the affective parameters in the software in the codes of this file. Follow the path "Rio->Device->Nominal Value" in the codes of this file until you find "Fnom". You can see that this parameter has a value of "50" but has a "ValueRefList" whose affective parameters are in the mentioned "Reference". To find this parameter, you need to follow the mentioned path which is "CUSTOM.RIOPLUS.POWERSYSTEMPARAMETERS.FNOM". You can see that type, value, unit and formula of this parameter are mentioned in this path. It is mentioned in the formula of this section that if "ID_0009=FIFTY", the value for this parameter is 50, otherwise it equals 60. It is also necessary to define the two phrases "ID_0009" and "FIFTY". To view the definition of these two phrases, you need to open the "ValueRefList" tag. You can see that there is a "Value reference list" mentioned for each of these phrases. For "ID_0009" you should follow the path "CUSTOM.SETTINGS.ID_00" and find the value of "ID_0009". In this case, you can see that this parameter is named "Frequency" and its "ForeginID:0009" and is of the "Enumeration" type. Also, in the "EnumList" tag, "50" Hz is defined for "FIFTY" while "60" Hz is defined for "SIXTY".

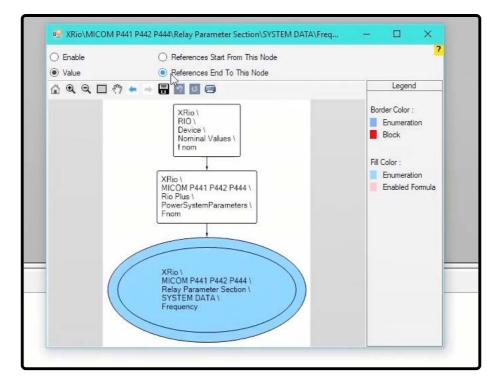
4	· 中·	Antio
3		<version>2.8.0</version>
4		<language>en</language>
5	由	<rioconverter></rioconverter>
997	申	<custom></custom>
5681	ф_	<rio blocktype="RIO" type="RIOBlock"></rio>
682		<name>RIO</name>
5683	白	<pre><device blocktype="DEVICE" type="RIOBlock"></device></pre>
5684		<nameplate blocktype="DEVICE NAMEPLATE" type="RIOBlock"></nameplate>
5713	申_	<location blocktype="DEVICE LOCATION" type="RIOBlock"></location>
5753	白	<nominalvalues blocktype="DEVICE_NOMINALVALUES" type="RIOBlock"></nominalvalues>
5754	由	<phases type="Parameter"></phases>
5757		<pre><fnom type="Parameter"></fnom></pre>
5758		<value>50</value>
5759		<valuerormula>NOMVAL</valuerormula>
5760	白	<valuereflist></valuereflist>
5761		<refparam refid="NOMVAL">CUSTOM.RIOPLUS.POWERSYSTEMPARAMETERS</refparam>
5762	-	

The explained case is a very simple example of defining parameters values of a relay for test. An another example, it is possible to select and open the "ZONE P GROUND" block from the tree diagram of the distance block and then click on "M3" to view its parameters in the table. If the "Reference Map" of the "Angle" parameter is opened, you can see that this parameter is dependent on many other parameters. By clicking on any of the available boxes in this "Reference Map", the given parameter for address is displayed.

31 : COMPLEMENTARY EXPLANATION ABOUT "XRIO CONVERTER"

In previous sections, some explanations about "XRio converter" and ways of addressing parameters were provided. According to what have been said, "XRio" has a series of "Xml" codes as well as various parts such as "Script", "Custom" and "Rio". In "Custom", all the information that is included in a tree diagram of the software is defined in "XRio Converter". "Script" includes intermediate functions by using which it is easier to create or define blocks and parameters of "Custom". "Rio" block, mostly, contains specific fixed parts some of which such as "Name" and "Description" do not exist in the codes of "XRio Converter" and are added to the "Vebko AmPro Test" software separately.

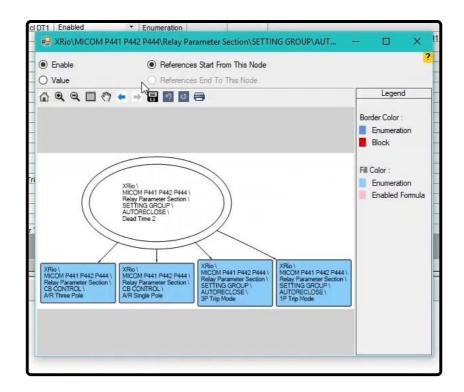
As has already been said, if the cell color of any parameter is purple, it means that the value of this parameter is obtained by using <<from>> a formula and is related to some other parameters. To investigate the relationship between parameters and the influence of each parameter on other parameters, open its "Reference map". For a more thorough examination of "Reference map", if you select "Frequency" parameter from "System Data" block and then open its "Reference map", by selecting "Reference End To this Node" radio button, you can see that this parameter affects two other parameters. You can see those parameters by clicking on any of the boxes (in which your intended parameter's address is mentioned).



As another example, if you click on "DISTANCE ELEMENT" from "SETTING GROUP" tree diagram and open "Reference map" after selecting "Zp" parameter, you can see that this parameter has influence on so many other parameters in the settings of this relay and by changing this parameter, the related ones change too. On this page, in addition to observing the relationship between parameters based on value, it is possible to specify that based on what parameter is each block or parameter active or inactive. For example, by selecting "AUTORECLOSE" block and opening its "Reference map", you can see that this block's activeness is related to "Internal A/R" parameter but because "Disabled" mode is selected in the "Value" column, this block is inactive as well.



As another example, if you select "Dead time2" parameter from "AUTORECLOSE" and select "Enable" radio button from "Reference map", you can see that this parameter's activeness is related to the four other parameters displayed on the map of this page ("Reference map").



32 : XRIO AND XRIO CONVERTER

After getting familiar with "XRio Converter", it is necessary to, also, get familiar with the concept of "Name", "ID", "Foregin ID" and "Description". "ID" Definition: The relay producer companies define a unique "ID" for every parameter and in all

relays of a brand, this 'ID" is used for a specific parameter; for example, in the "7UT613" Siemens relay, "ID=21015" is related to the "PROT.OBJECT" parameter. This "ID" is used in other relays produced by this company for the same parameter. Also, in connecting to the relay via Modbus protocol, if this "ID" is sent to the relay as a "Packet", the relay will return the parameter value related to the sent "ID".

Test Object -Siemens 7UT613 7UT633 V4.	5 ENU TU	2.22 V1.300.	xrio			
File View						
😥 🛅 🔚 Resize Columns : 🛛 Auto	- #	Recalcu	late Disabled Form	ula(s) 🕴 🗲 C	Juick Access	Ok Car
- C XRio	^ Der	/ice Configura	tion - Device Configu	ration		
Script Functions		State	Name	ID	Foreign ID	Description
0-70T613/7UT633 - Converter		0	Grp Chge OPTION	PID_16611	0103	Setting Grou
Relay Parameter Section		0	OSC. FAULT REC.	PID_16621	0104	Oscillograpi
Device Configuration		0	PROT. OBJECT	PID_21015	0105	Protection C
⊕-⊖ P.System Data 1 ⊕-⊖ Setting Group A		0	87	PID_32153	PID_21015	87 Different
Additional Information		0	87G	PID_21018	0113	87G Restric
Rio Plus		0	87G#2	PID_21548	0114	87G#2 Rest
TemplateController		0	Coldload Pickup	PID_20035	0117	Cold Load P
RIO		0	50/51	PID_20296	0120	50/51
🗄 🗂 Device		0	50/51#2	PID_21549	0130	50/51#2
🗄 🗂 Distance		0	50/51#3	PID_21550	0132	50/51#3
🖅 🗂 Differential		0	50N/51N	PID_21020	0122	50N/51N
🔄 🗂 Overcurrent Primary		Ø	50N/51N#2	PID_21551	0134	50N/51N#2
Overcurrent Secondary		Θ	50N/51N#3	PID_21552	0136	50N/51N#3
Overcurrent Tertiary		0	50G/51G	PID_20297	0124	50G/51G
Thermal Overload primary		O	50G/51G#2	PID_21553	0138	50G/51G#2
🗈 🔂 Thermal Overload Warn. primary	~	0	50 1Ph	PID 21023	0127	50 1Ph

"Foreign ID": Unlike "ID" which is used as a standard for identification of the same parameters in relays produced by a company, "Foreign ID" is used as a means of differentiation between parameters of different relays which allows them to be used in other software's. As an example, in "7UT613" relay of Siemens, there is a parameter named "PROT.OBJECT" defined with "ID=21015" and "Foreign ID=0105". If the user intends to enter and analyze some models of relays produced by different companies in a software like "Digsilent".

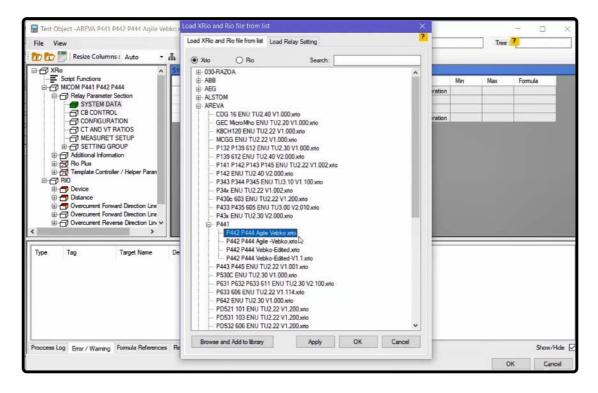
Test Object -Siemens 7UT613 7UT633	V4.6 ENU TU	2.22 V1.300	xrio			
File View				-		-
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⊡-⊖ XRio	∧ Dev	vice Configura	tion - Device Configu	ration		
Script Functions		State	Name	ID	Foreign ID	C
□ 7UT613/7UT633 - Converter		0	Grp Chge OPTION	PID_16611	0103	S
Relay Parameter Section		0	OSC. FAULT REC.	PID_16621	0104	0
Device Configuration		0	PROT. OBJECT	PID_21015	0105	PI
⊕		0	87	PID_32153	0105	8
Additional Information		0	87G	PID_21018	0113	8
B A Bio Plus		3	87G#2	PID_21548	0114	8
TemplateController		0	Coldload Pickup	PID_20035	0117	C
E-FI RIO		0	50/51	PID_20296	0120	5
B. C. Device		B	50/51#2	PID 21549	0130	5

The interesting point is that in some relays such as Siemens, the "ID" and "Foreign ID" are different while in some other relays such as "P441", after loading its file in the "Load XRio and Rio file from list" page, it can be seen that the "ID" and "Foreign ID" are the same. Also, in "Name" and "Description" sections there is information, provided by the producer company, about name of the parameter as well as some description about that parameter.

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File View								V	alue :		Tree	?	
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⊡-⊖ XRio	SYSTE	M DATA											
Script Functions Gript MICOM P441 P442 P444		State	Mame	ID	Foreign ID	Description	Value		Туре	Min	Max	Formula	
E C Relay Parameter Section		0	Language	ID_0001	0001	Language	English	٠	Enumeration				
SYSTEM DATA			Description	ID_0004	0004	Description	MICOM		String				
- CB CONTROL			Plant Reference	ID_0005	0005	Plant Reference	AREVA		String	U	1		9
- CONFIGURATION		0	Frequency	ID_0009	0009	Frequency	50 Hz	٠	Enumeration				
Borner Template Controller / Helper Paran PRI PRI Device D Device D Detance Overcurrent Forward Direction Line D Overcurrent Forward Direction Line D Overcurrent Reverse Direction Line D Overcurrent Reverse Direction Line D Overcurrent Reverse Direction Line													
Type Tag Target Name	Descrip	tion	Target Locatio	n									

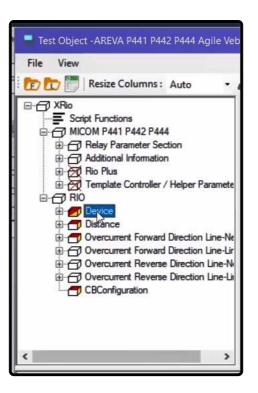
An introduction to "XRio" and its difference with "XRio Converter": By clicking on the "Import from list" icon on the "Load XRio and Rio file from list" page, "XRio Converter" of a relay is selected where the information regarding the relay is complete in the "Custom" and "Rio" sections. It should be noted that it is not possible to extract the "XRio Converter" file from a relay because producer companies do not put the file in their relays. In fact, the relay producer companies never limit their relays to a single tester device such as "Omicron".

File View							Va	alue :
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	SYSTEM DATA							
Import from list	State	Name	ID	Foreign ID	Description	Value		Туре
MICOM P441 P442 P444	0	Language	ID_0001	0001	Language	English	٠	Enumerati
Relay Parameter Section	0	Description	ID_0004	0004	Description	MiCOM		String
CB CONTROL	0	Plant Reference	ID_0005	0005	Plant Reference	AREVA		String
CONFIGURATION	0	Frequency	ID_0009	0009	Frequency	50 Hz	•	Enumerati
CT AND VT RATIOS MEASURET SETUP Additional Information Additional Information Additional Information Rio Plus Properties Rio Device Distance Overcurrent Forward Direction Line Overcurrent Forward Direction Line								

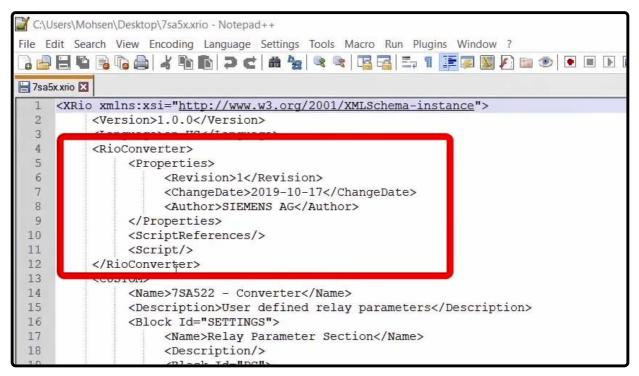


Therefore, instead of the "XRio Converter" file, the relay producer companies provide a file with ".CSV" or ".text" format in which information of the "Custom" section along with the values set to the relay can be found. Upon extensive use of "XRio" which has been created by "Omicron" company, most relay producers decided to provide their users with "XRio" output files of their relays too. You should consider that this file is not the same as the "XRio Converter" file which is designed and written by producers of the tester device and is available in the tester software.

The "XRio" file of the relay contains "Custom" section as well as "Relay Parameter Section" and "Additional Information" blocks with the information and values set to the relay, but it does not contain "Rio Plus" and "Template Controller" sections. If, in the tester software, the "XRio Converter" file is selected correctly, after loading the "XRio" file of the relay in the "XRio Converter", the settings and necessary information of the relay are completely imported to the "Rio" section.

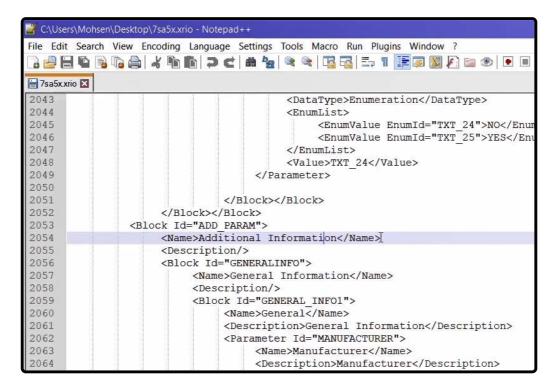


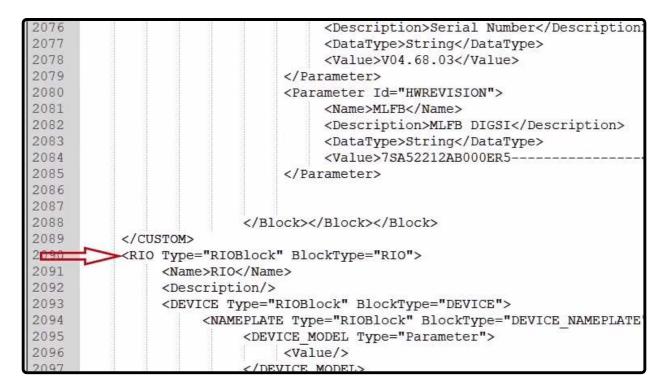
Some more points regarding "XRio" and "XRio Converter" should be mentioned: The first point is that if the "XRio" file of the "7SA522" relay is opened in "notepad++", by opening the "Rio Converter" tag it can be seen that unlike "XRio Converter", there are no "Script References" functions in this section. Einige weitere Punkte zu "XRio" und "XRio Converter" sollen noch erwähnt warden:



The second point is that in the "Custom" tag, only information regarding "Setting" block is available which is the same as "Relay Parameter Section" in the software and in some relays such as "7SA522", the information regarding "Additional Parameter" is also available which is the same as "Additional Information" in the software. Also, the information regarding "Device" block has been made available in the "Rio" section by a producer of the relay.

📑 C:\L	Jsers\Mohsen\Desktop\7sa5x.xrio - Notepad++
File E	dit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
) 🗄 📽 🗟 🕼 🎒 🖌 🏷 🖍 🗶 🗢 🌾 📽 📽 🖾 🔚 📰 🖉 🖾 🔊 💽 💽
📄 7sa	5x.xrio 🔀
1	<xrio xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"></xrio>
2	<version>1.0.0</version>
3	<language>en-US</language>
4	<rioconverter></rioconverter>
5	<properties></properties>
6	<revision>1</revision>
7	<changedate>2019-10-17</changedate>
8	<pre><author>SIEMENS AG</author></pre>
9	
10	<pre><scriptreferences></scriptreferences></pre>
11	<script></script>
12	
13	<custom></custom>
14	<name>7SA522 - Converter</name>
15	<pre><description>User defined relay parameters</description></pre>
16	<pre> <block id="SETTINGS"></block></pre>
17	<name>Relay Parameter Section</name>
18	<description></description>
19	<block id="DC"></block>
20	<pre><name>Device Configuration</name></pre>





The third point is that if the "XRio" file of a relay is selected and loaded by clicking on "Import from file" and without "XRio Converter", it can be seen that the mentioned sections are available in the "XRio" section of the software but because of not using the "XRio Converter", the values of "RIO" section are not linked with the "XRio" information and only the "DEVICE" section has been completed according to the information of the "XRIO" file.

😰 🛅 🕅 Resize Columns : Auto 🔹 🔹	ઢ 📴 Recalcu	late Disabled Formu	ıla(s) 🗲 Quick Access C	0k Cancel					
	Location - Locatio	in data							
Script Functions	State	Name	ID	Description	Value	Туре	Min	Max	Formula
7SA522 - Converter	0	Device address	DEVICE_ADDRESS	Device address		String			
Relay Parameter Section Additional Information	0	Substation name	SUBSTATION	Substation name		String			
	0	Substation address	SUBSTATION_ADDRESS	Substation address		String			
	0	Bay	BAY	Bay		String			
Name Plate	0	Bay address	BAY_ADDRESS	Bay address		String			
	0	Add. info 1	PROTECTED_OBJECT_NAME	Additional information 1		String			
Nominal Values Nominal Values Nominal Values Nominal Values Nominal Values Nominal Values Distance CBConfiguration									

The last point is that if the "XRio" file of a differential relay such as "7UT613" is loaded in a universal room such as the sequencer room, in the "Rio" section, the blocks other than those completed according to the settings of the relay and information of the loaded "XRio" by "XRio Converter", like "Distance" block which are entered to the software by the designer of the tester are empty of information because in the "XRio" file of the relay there is no information about them.

33 : XRIO & RELAY SETTING IN THE SOFTWARE

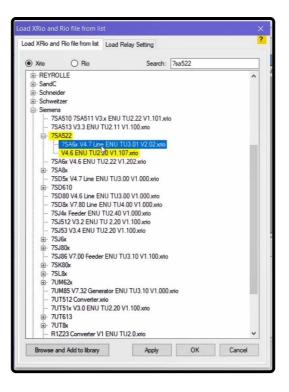
After getting familiar with "XRio" file that is provided by the relay as an output, it is necessary to get familiar with other sections of this file. First, open the "XRio" file of the "7SA522" Siemens relay with "notepad++". In this file, the relay provides the user with the information regarding the "Setting" as well as the values that are "Set" to the relay. As it has been said before, in this file, unlike "XRio Converter", there are no "Script References" functions in "Rio Converter" tag.

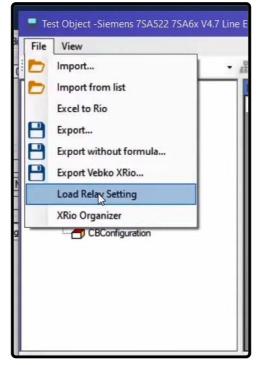
🔄 C:\l	Jsers\Mohsen\Desktop\7sa5x.xrio - Notepad++
File E	idit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
6	
📄 7sa	5x.xrio 🔀
1	<xrio xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"></xrio>
2	<version>1.0.0</version>
3	<language>en-US</language>
4	<rioconverter></rioconverter>
5	<properties></properties>
б	<revision>1</revision> T
7	<changedate>2019-10-17</changedate>
8	<author>SIEMENS AG</author>
9	
10	<scriptreferences></scriptreferences>
11	<script></script>
12	
13	<custom></custom>
14	<name>7SA522 - Converter</name>
15	<pre><description>User defined relay parameters</description></pre>
16	<block id="SETTINGS"></block>
17	<name>Relay Parameter Section</name>
18	<description></description>
19	<block id="DC"></block>
20	<name>Device Configuration</name>
21	<description>Device Configuration</description>
22	<parameter id="PID_16611"></parameter>

The information related to "Relay Parameter Section" block with "ID=Setting" can be found in the "Custom" tag while the relay parameter information is available in its subcategories. For example, you can find "ID=PID_16611", "Description=Setting Group Change Option", "Foreign ID= 0103", "Data Type= Enumeration" and "Enum List" in the parameter with "Name= Grp Chge OPTION". Moreover, the information regarding "Device" block is mentioned in the "Rio" section.

and 200 10	[d="DC">
	ame>Device Configuration
<de< td=""><td>escription>Device Configuration</td></de<>	escription>Device Configuration
<pa< td=""><td>arameter Id="PID 16611"></td></pa<>	arameter Id="PID 16611">
	<name>Grp Chge OPTION</name>
	<pre><description change="" description="" group="" option<="" setting=""></description></pre>
	<foreignid>0103</foreignid>
	<datatype>Enumeration</datatype>
	<enumlist></enumlist>
	<enumvalue enumid="TXT 7">Disabled</enumvalue>
	<enumvalue enumid="TXT 8">Enabled</enumvalue>

Entering relay information in the software: Before loading the "7SA522" relay settings in "Vebko AMvPro Test" software, it is necessary, the "XRio Converter" file related to "7SA522" Siemens relay, which is available in the "Vebko AMPro Test" software, to be loaded. By clicking on "Import from list" icon, the "Load XRio and Rio file from list" page opens. On this page, in "XRio" mode, the model of "7SA522" relay is entered in the "Search" field. Then, its "XRio Converter" should be selected. After this file is loaded, the "XRio" relay output format from "Relay Config Type" field.





In the "Config file path" the path to the "XRio" file is determined and the "XRio" file is selected. In the "Matching Algorithm" section, the user needs to specify the type of information that is to be loaded from the "XRio" file to the "XRio Converter". If "Equal ID" option is checked and the other options are unchecked, then, only those parameters of the relay whose "ID" is the same in the "XRio" and "XRio Converter" files are loaded in the software. By clicking on "OK", a message is displayed. In this message, the phrase "Parameter Values Imported" shows the number of parameters that are loaded in the software and their "ID" is the same as the "XRio Converter".

Relay Config Type :	XRio			~		
Config file path :	C:\Users\	Mohsen\Desk	top\7sa5x.x	rio		
Matching Algorithm :						
Equal Foreign	ID					
XRio Contains	and the second	The Alfred States				
Setting Contair						
Equal Code of	Foreign ID (P	СМ600)				
Equal ID						
XRio Contains	Setting ID					
Setting Contain	ns XRio ID					
				-	ОК	Cancel

Also, the "Different Names" phrase shows the number of loaded parameters that have the same "ID" but whose "Name" is not the same in "XRio" and "XRio Converter" files. The phrase "Corrected Names" shows the number of parameters whose "Name", being different, is corrected by the software in accordance with the "XRio Converter". The phrase "Errors" shows the number of erred parameters. The error can have various reasons; for example, the "Type" of a "Text" parameter can be specified as "String" in the "XRio Converter". The phrase "Corrected Errors" shows the number of parameters whose error is corrected according to the "XRio Converter". The phrase "Duplicate IDs" shows the number of parameters that have the same "ID" or "Foreign ID" in "XRio Converter" or "XRio" file. In such a case, Vebko software does not load the values of these parameters.

Bi	Test Object -Siemens 7SAS22 7SA6x V4.7 Line E File View	ENU TU3.01 V2.02.xrio			1	/alue :	Tree :	- 0 ×
¢	😥 🛅 🦉 Resize Columns : Auto 🔹 🖌	🔓 📔 Recalculate Dis	abled Formula(s)	🗲 Quick Acce	ss Ok Cancel			
	Image: State of the state	Device - Device settings State Name		jæs: 0 ors: 0	×	tin Max	Formula	
	Setting Name Setting Value XRio Name		i Names Have b	<rioconverte Cropertie Chevis Chan; Chatho Chatho Competie Competie Compt/> Chickonvert Chickonvert Chickonvert Chickonvert</rioconverte 	ision> rp a> a>1 peDate>2019-10-17 sSIEMENS AGa> erences/>	<pre>cror</pre>	instance">	Show/Hide
	rioucese cag Enor / warning roimula References	neray Config Log					0	Show/Hide (

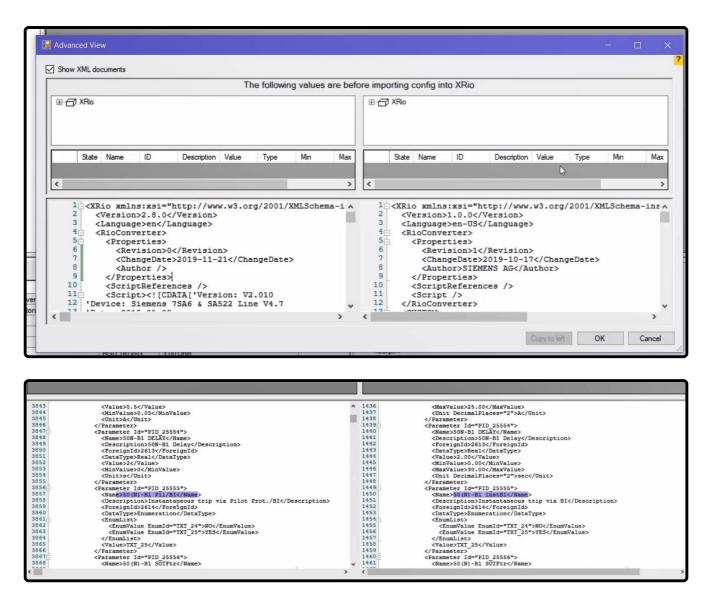
After clicking on "OK", the relay information is loaded in the "XRio Converter". After the relay information is loaded, the parameters entered on the left side are displayed in "Relay Config Log" field at the bottom of "Test Object" page while "xml" format of the "XRio" file is displayed on the right side. For example, the "Grp Chge OPTION" parameter is loaded in the software with no problem or the name of "RG/RL(>Z1)" parameter in "XRio" file is different from its name in "Xrio Converter" file.

<xrio xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"></xrio>	
<version>1.0.0</version>	
<language>en-US</language>	
<rioconverter></rioconverter>	
<properties></properties>	
<revision>1</revision>	
<changedate>2019-10-17</changedate>	
<author>SIEMENS AG</author>	
<scriptreferences></scriptreferences>	
<script></script>	
<custom></custom>	
<name>7SA522 - Converter</name>	
<description>User defined relay parameters</description>	
<block id="SETTINGS"></block>	
<name>Relay Parameter Section</name>	
< <description></description>	
<block id="DC"></block>	
	Show/Hide

Setting Name	Setting Value	XRio Name	XRio Value	Different Name
FItDisp.LED/LCD	Display Targets on every Pickup	FltDisp.LED/LCD	Display Targets on every Pickup	
Format Z0/Z1	Zero seq. comp. factors RG/RL and XG/XL	Format Z0/Z1	Zero seq. comp. factors RG/RL and XG/XL	
RG/RL(Z1)	1.00	RG/RL(Z1)	1.00	
RG/RL(> Z1)	1.00	RG/RL(Z18Z5)	1.00	Different
RG(Z1) Ø-G	2.500 Ohm	RG(Z1) Ø-G	2.50 Ohm	
RG(Z1B) Ø-G	3.000 Ohm	RG(Z1B) Ø-G	3.00 Ohm	Λ
RG(Z2) Ø-G	5.000 Ohm	RG(Z2) Ø-G	5.00 Ohm	
RG(Z3) Ø-G	10.000 Ohm	RG(Z3) Ø-G	10.00 Ohm	
RG(Z4) Ø-G	12.000 Ohm	RG(Z4) Ø-G	12.00 Ohm	
RG(Z5) Ø-G	12.000 Ohm	RG(Z5) Ø-G	12.00 Ohm	
		RG(Z6) Ø-G	15.000 Ohm	-
				>

Load Relay Setting Page: By reopening "Load Relay Setting" window, after determining the format of the relay file and

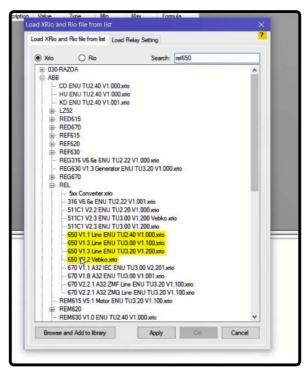
selecting the path of "XRio" file, by clicking on "Advanced View" option, a window with the same name opens. Tree diagrams and the "xml" format of these two files are located at the top and bottom of this page, respectively, in a way that the "XRio" file of the relay can be seen on the right while the "XRio Converter" file can be seen on the left. If "Show XML documents" option is checked, these two files are, also, displayed as "xml". For example, in the "XRio" file of the relay in "CUSTOM" block, the "Grp Chge OPTION" has "ID=PID_16611". This parameter has the same "ID" in "CUSTOM" block in the "Xrio Converter" file of the software. As another example, a parameter in "XRio" file with "Id=PDI_25555" is named "50(N) – B1 instBl" while in "Xrio Converter" file the same "ID" is named "50(N)-B1 Pil/Bl". This is why this parameter is placed in "Different Names" category.



In "Matching Algorithm" part of the "Load Relay Setting" window, if the "Equal Foreign ID" option is checked, the parameters whose "Foreign ID" is the same in both "XRio" and "XRio Converter" files of the relay, are loaded. If the "XRio Contains Setting Foreign ID" and "Setting Contains XRio Foreign ID" options are checked, the parameters whose "Foreign ID" in "XRio" file includes some additional parameters, such as a letter or a half-space, are loaded and vice versa. For example, a parameter's "Foreign ID= 109A" in XRio file while the same parameter's "Foreign ID= 109A-B" in "XRio Converter" file. If the "XRio Contains Setting Foreign ID" option is checked, this parameter is loaded in the software and vice versa.

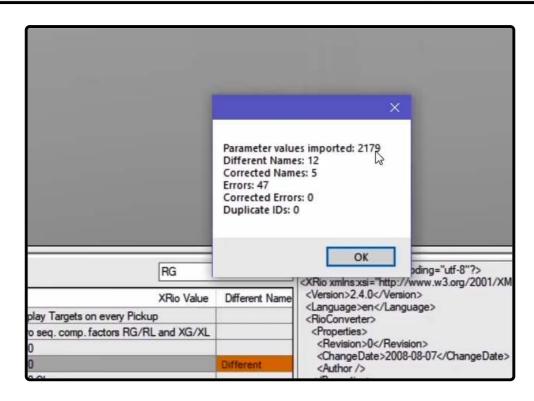
Relay Config Type :	XRio	~		V L.	? g
Config file path :	C:\Users\Mohsen\D	esktop\7sa5x.xrio			
Matching Algorithm :					
Equal Foreign					
	Setting Foreign ID				
	ns XRio Foreign ID Foreign ID (PCM600)				
Equal ID					
✓ XRio Contains ✓ Setting Contains					
					and the second se
Advanced	View		OK	Cancel	ema-insta
Advanced 1		RioConverter	OK	Cancel	ama-insta
	value Different Name	<rioconverter> <properties></properties></rioconverter>	OK		ema-insta

The "Equal Code of Foreign ID (PCM600)" option is for "ABB" relays. There is no connection between the "Foreign ID" of relay's "XRio" and "XRio Converter" file in "XRio" file of these relays but in some conditions, the "Foreign"s in the "XRio" file of the relay and "XRio Converter" file are connected. For example, on the "Test Object" page, by clicking on "Import from file", first, an "XRio Converter" related to the "ABB REL 65f0" is loaded; then, by clicking on "File" menu and selecting "Load Relay Setting" option, the "XRio" file related to this relay is selected. Also, in the "Matching Algorithm" tab, only the "Equal Code of Foreign ID (PCM600)" option is checked. By opening the "Advanced View" page, both files are displayed as "xml".



As an example, a parameter named "BIM_3" with a specific "Foreign ID" is selected in the "XRio Converter" file while this parameter has a different "Foreign ID" in the "XRio" file of the relay. But it is seen that a part of the "Foreign ID" is the same in both files which means that the eight first characters and then the four second, third and fourth characters and the twelve fifth characters should be the same in the "Foreign ID" of both files so that this parameter is loaded in the "XRio Converter". Then, by clicking on "OK", it is seen that "2179" parameters are loaded in the "XRio Converter".

574	<name>Relay Parameter Section</name>	^	25	<name>HW Configuration</name>	^
575	<foreignid>IEDIdentifier REL650 AA1J1Q01A19</foreignid>		26	<description></description>	
576	<block id="IED CONFIG"></block>		27	<foreignid>Fixed</foreignid>	
577	<name>IED Configuration</name>		28	<block id="ID PSM"></block>	
578	<foreignid>Fixed</foreignid>		29	<name>PSM 1</name>	
579	<block id="HW CONFIG"></block>		30	<description></description>	
580	<name>HW Configuration</name>		31	<foreignid>HwModule 5b0b0818-5580-48df-ac0d-e101flef5cd8 2 PSM 1<td>n</td></foreignid>	n
581	<foreignid>Fixed</foreignid>		32		
582	<block id="ID BIM"></block>		33	<block id="ID BIM"></block>	
583	<name>BIM 3</name>		34	<name>BIM 3</name>	
584	<foreignid>HwModule 83385d37-3ffa-42ed-bfed-185dc916a4c6 5 BIM 3-</foreignid>		35	<description></description>	
585	<parameter id="ID APP1 BIM 3 PARAM 0 VALUE PARAMETER "></parameter>		36	<foreignid>HwModule 83385d37-3ffa-42ed-bfed-185dc916a4c6 5 BIM 3<td>n</td></foreignid>	n
586	<name>Operation</name>		37	<parameter id="ID APP1 BIM 3 PARA# 0 VALUE PARAMETER "></parameter>	
587	<description>Operation of/On</description>		38	<name>Operation</name>	
588	<pre><foreignid>Parameter App1.BIM.3.PARAM.0.Value*Parameter** 15045de</foreignid></pre>		39	<description>Operation Off/On</description>	
589	<datatype>Enumeration</datatype>		40	<foreignid>Parameter App1.BIM.p.PARAM.0.Value*Parameter** 15045de8-717d-4</foreignid>	4
590	<enumlist></enumlist>		41	<datatype>Enumeration</datatype>	
591	<enumvalue enumid="ID_ ">Off</enumvalue>	~	42	<enumlist></enumlist>	~
592	ARAUMITATUR REALTABLET IN A A A REALTATION		49	Promitalus Promitality Official Promitalus	



34 : XRIO CONVERTER FORMULA WRITING

To write the "XRio Converter" file, it is necessary to get familiar with some concepts. To begin, load "XRio Converter" of "7SJ62" relay in "Test Object" window. By clicking on "50" block in the path of "50/51 Overcur", "Setting Group A" and "Relay Parameter Section" on tree diagram of the "XRio Converter" file, parameters of the "50" block are displayed.

File V						Val		Tree : ?	
D D	Resize Columns : Auto		Recalculate Disabled For		and the state	ess Ok Cancel			
	Group A Group A Group A Group A	^ 50/51	Overcur - 50/51 Phase/Gro State Name	ID	Foreign ID	Description	Value	Туре	Mn
	□ ← 50/51 Overcur.				and the second second second second		True RMS *	1.000	iviti
11	General		 50-3 measurem. 50-3 active 	PID 17032 PID 17022	1219A 1216A	50-3 measurement of 50-3 active	Always *	Enumeration Enumeration	
	- 🔊 50		S0-3 PICKUP	PID 17022 PID 17023		50-3 Pickup	10.00 A		1.00
	- 51		50-3 DELAY	PID 17023		50-3 Time Delay	na	Real	0.00
	🐵 🥁 51 User Pickup		50-2 measurem,	PID 17033		50-2 measurement of	Fundamental component	Enumeration	4.94
101	🛞 🥁 51 User Reset		S0-2 active	PID 20078		50-2 active	Alwavs *	Enumeration	
101			50-2 PICKUP	PID 20066		50-2 Pickup	na	Real	0.10
	- 2 51N		50-2 DELAY	PID 20067		50-2 Time Delav	0.000 s	Real	0.00
TI E	E 60 51N User Def.PU	100	S0-1 measurem.	PID 17034		50-1 measurement of	Fundamental component *	Enumeration	
11	⊕ 😿 51N User Reset		50-1 PICKUP	PID 20068		50-1 Pickup	3.00 A		0.10
		50-1 DELAY	PID 20069	1205	50-1 Time Delav	0.30 s	Real	0.00	
	 ⊕ ⊕ 67 Direct. O/C ⊕ ∰ 50 1Ph ⊕ ∰ ColdLoadPickup ⊕ ∰ 27/59 O/U Volt. 	v c							
pe		v c Descrip	ption Target Locatio	n					
	 ● 67 Direct. 0/C ● 전 ColdLoad Rickup ● 전 27/59 0/U Volt. ● 전 27/59 0/U Volt. ● 전 81 0/U Freq. ● 전 81 0/U Freq. 	Descrip		n					Show/Hide

Description of a block's specifications: By double-clicking on "50" block, the "Rio Parameter Viewer" window opens; you can find "ID", "Name" and "Description" of a block in "General Settings" section. Also, it is possible to specify a "Comment" and "Foreign ID" in every block. In the "Enabled" section you can see whether a block is enabled and if it's dependent on a formula. By clicking on "..." option, "XRio Formula Editor" window opens.

g Group A .System Data 2	Rio Parameter V				× ?	
0/51 Overcur.	General Setting			[-
7 General	ID :	SP1	Name :	50		
50 10 51 10 51 User Pick <u>up</u>	Description :	50	-			10.00
1 51 User Pickup	Foreign ID : Comment :]			I component
7 50N	Comment.					
of 51N of 51N User Def.PU						0.000
51N User Def.PU						I component
51N User Reset						3.00
Marin Inrush Restraint 6 Negative Seq		1				0.50
7 Direct. O/C	Enabled					
0 1Ph	O Enable	O Disable				
oldLoadPickup	Formula	not DMT_IDMT_PI	HASE = DISABLED] []	10.00
7/59 O/U Volt. 8/66 Motorprot	Result :	True			d Reconcilead	
1 O/U Freq.	Theorem .	1100				
9 Th Overload						
Target Name	< >			ОК Са	ancel	1

On the right of this window, a formula is written for this block. "References" section includes "Ref. Enums" and "Ref. Params" sections and whether the "50" block is enabled depends on parameters and the "Enumerations" added in this section. To add a parameter, click on "+" option and select a parameter from the "XRio" tree diagram on the "Add Ref. Param" window; its details are displayed in the "Details" section. Details include "Name", "ID", "Description", "Value", "Data Type", RefParam Name" and "RefEnum Name". "Ref Enums" of this parameter are displayed in the form of a tree diagram at the bottom of the page.

References Ref. Params		+ - * / ^ Sin Cos Tan Asin Acos At Abs Floor Ceiling IEEERemainder Exp Log Log
ID DMT_IDMT	Value TXT_12715	not DMT_IDMT_PHASE = DISABLED

tor		🖁 Add Ref. Pai	ram				□ ×	
Value TXT_12715		⊨ ∂ 75 ⊨ ∂	Relay Parameter Section Device Configuration P.System Data 1 P.System System Configuration Configuratio Configuration Configuration Configuration Configura				Add RefEnum	-
			CT PRIMARY			~		
		Details Name :	CT SECONDARY	D:	PID_20001			
		Name : Description :	CT Rated Secondary Current		PID_20001			
Name	Path	Value :	TXT_12921	Data type :	Enumeration			
Disabled	CUS	RefParam Name :	PID_20001	RefEnum Name :	TXT_12921			
		_						
			0001 (T_12921 (1A) (T_12922 (5A)					-
not DMT Boolean	_IDM							
			leferences Relay Config Log					

By clicking on "Add RefParam" and "Add RefEnum" options respectively, the selected parameter and its "RefEnum" are added to the "References" section. After adding the parameters to the "References" section, the formula should be entered on the right side by using the "ID" of the added parameters. Also, you can use the toolbar available on this page to write the formula. In the "Result" section, the final formula along with the type of acceptable data and the result of this formula are displayed. After writing the formula, you should click on "Test" option. If the formula is written correctly, a notification "Test was successful" is displayed.

Ref. Params 🔓		-		cript Functions	
ID DMT_IDMT	Value TXT_127	15		SJ&x V4.8 Relay Parameter Section Device Configuration P.System Data 1 P.System Data 1 Power System CT's CT SECONDAS	٩Y
<			Details		
Ref. Enums			Name : Description :	CT SECONDARY CT Rated Secondary Curr	ID :
ID DISABLED	Name Disabled	Patr CWS	Value : RefParam Name :	TXT_12921 PID_20001	Data type RefEnum Name :

🚽 XRio Formula Ec	litor																						100	I		×
References Ref. Params			+	+ Abr				Sin Co IEEERem																		
ір 🌍 омт_іомт	Value TXT_1271	15	•					= DISABL		cxp	Log		Ividx	Min	Pow	Jigh	squ	IIIII	cate			.)		ser Der	ined	
<		>																								
Ref. Enums												×														
	Name Disabled	Path CUST(Те	st was	succes	sful.														
< Result		>																								
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Description of a parameter's specifications: If you double-click on one of the parameters from the "State" column, for example, "50-3 PICKUP" parameter, the "Rio Parameter Viewer" window opens. In the "General Setting" section, just like the "Block" section's description, the same info, such as "Foreign ID" and "ID" are displayed but this time for a parameter. The difference is that this time there are "Value Properties" and "Display Properties" sections as well. In the "Value Properties" section, the value of a parameter, as well as its type and maximum / minimum allowed values are mentioned. Also, it is possible to depend on the value of a parameter on another parameter by using the formula.

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ia 50/51 Overcur.	0	50-3 measurem.	PID 17032	1219A	50-3 measurement of	True RMS *	Enumeration		
- General	0	50-3 active	PID 17022	1216A	50-3 active	Alwavs ·	Enumeration		
		50-3 PICKUP	PID 17023	1217	50-3 Pickup	10.00 A	Real	1.00	
	10	50-3 DELAY	PID 17024	1218	50-3 Time Delav	na	Real	0.00	
🕀 🥁 51 User Pickup	0	50-2 measurem.	PID 17033	1220A	50-2 measurement of	Fundamental component	Enumeration		
i⊞- 😿 51 User Reset	0	50-2 active	PID 20078	1214A	50-2 active	Alwavs 👻	Enumeration		
	Ø	50-2 PICKUP	PID 20066	1202	50-2 Pickup	na	Real	0.10	
	0	50-2 DELAY	PID 20067	1203	50-2 Time Delav	0.000 s	Real	0.00	
⊞-🔂 51N User Def.PU	0	50-1 measurem.	PID 17034	1221A	50-1 measurement of	Fundamental component ·	Enumeration		
⊕-😿 51N User Reset	0	50-1 PICKUP	PID 20068	1204	50-1 Pickup	3.00 A	Real	0.10	
InrushRestraint	0	50-1 DELAY	PID 20069	1205	50-1 Time Delav	0.30 s	Real	0.00	
						111			

In this case, its formula is displayed in the "Formula" field which is exactly similar to the "Block" section. If the value of a parameter depends on another parameter, its cell is purple. In "Display Properties" section, the settings related to how the value of a parameter is displayed are set. In the "Unit" field, the unit of the parameter and in the "Digits after decimal" field, the number of decimals displayed the "Value" field is specified. In the "Multiplier" field, it is possible to specify a coefficient for unit of the parameters. For example, if unit A is specified, by selecting coefficient K, this parameter is displayed in kilo amperes.

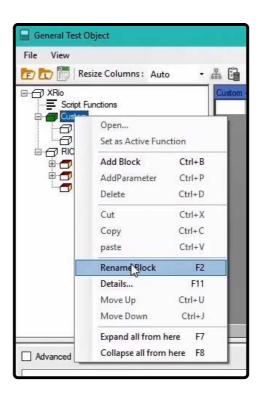
General Setting	75		
ID :	PID_17023	Name :	50-3 PICKUP
Description :	50-3 Pickup		(V)
Foreign ID :	1217		
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35 : WRITING "XRIO CONVERTER" FOR AN OVERCURRENT RELAY

To write an "XRio Converter" file in the "Test Object" page, first, you need to add a block. To begin, right-click on "Custom" block and select "Add Block". Also, you can use "Ctrl+B" Combined key to add a block. Likewise, another block is added to the subset of "Custom" block.

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Open Set as Active Fun	oction	State	Name	ID	Foreign ID	Description	Value	Туре	Min	Max
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Collapse all from	here F8									💢 Clear
	Set as Active Fun Ard Block AddParameter Delete Cut Copy paste Rename Block Details Move Up Move Down Expand all from I	Set as Active Function Add Parameter Ctrl+ B Add Parameter Ctrl+ D Delete Ctrl+ D Cut Ctrl+ X Copy Ctrl+ C paste Ctrl+ V Rename Block F2 Details F11 Move Up Ctrl+ U Move Down Ctrl+ J	Set as Active Function AddParameter Ctrl+B AddParameter Ctrl+D Cut Ctrl+X Copy Ctrl+V Rename Block F2 Details F11 Move Up Ctrl+J Expand all from here	Set as Active Function AddParameter Ctrl+B AddParameter Ctrl+D Cut Ctrl+X Copy Ctrl+V Rename Block F2 Details F11 Move Up Ctrl+J Expand all from here	Set as Active Function Ard Block Ctrl+B AddParameter Ctrl+P Delete Ctrl+D Cut Ctrl+X Copy Ctrl+C paste Ctrl+V Rename Block F2 Details F11 Move Up Ctrl+U Move Down Ctrl+J Expand all from here F7	Set as Active Function Afg Block Ctrl+ B AddParameter Ctrl+ P Delete Ctrl+ D Cut Ctrl+ X Copy Ctrl+ C paste Ctrl+ V Rename Block F2 Details F11 Move Up Ctrl+ U Move Down Ctrl+ J Expand all from here F7	Set as Active Function AddParameter Ctrl+B AddParameter Ctrl+D Cete Cut Ctrl+X Copy Ctrl+V Rename Block F2 Details F11 Move Up Ctrl+J Expand all from here	Set as Active Function A(*) Block AddParameter Ctrl+B AddParameter Ctrl+D Celete Ctrl+X Copy Ctrl+X Copy Ctrl+V Rename Block F2 Details F11 Move Up Ctrl+J Expand all from here F7	Set as Active Function Aid Block Ctrl+B AddParameter Ctrl+P Delete Ctrl+D Cut Ctrl+X Copy Ctrl+C paste Ctrl+V Rename Block F2 Details F11 Move Up Ctrl+J Expand all from here F7	Set as Active Function Afd Block Ctrl+B AddParameter Ctrl+D Delete Ctrl+X Copy Ctrl+V Rename Block F2 Details F11 Move Up Ctrl+J Expand all from here F7

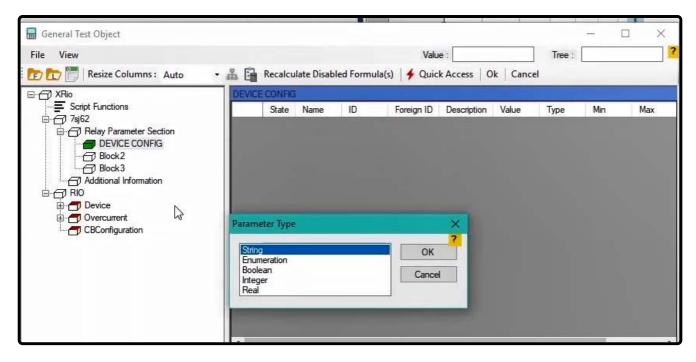
Then, the blocks should be named; to rename the blocks, right-click on "Custom" block and select "Rename Block". "7sj62" is selected as the name for this block which is an example of an Over current relay. It should be noted that you can also use "F2" shortcut key to rename a block. The blocks "Block1" and "Block2" are named "Relay Parameter Section" and "Additional Information" respectively according to the relay menu.



After naming them, you should specify "ID", "Name", etc. for each of the blocks. By double-clicking on "7sj62" block on "Rio Parameter Viewer" page, "ID=CUSTOM" and "Name=7sj62" are specified. You can also specify "Description= Custom defined relay parameters", "Foreign ID" and "Comment" for this block. In "Enabled" section, by selecting "Enable" it is specified that this block is active (enabled). Then, click on "OK" to save the changes. Likewise, double-click on "Relay Parameter Section" and specify "ID=SETTING". Also, for the "Additional Information" block, specify "ID=ADD_PARAM". It should be noted that only capital letters are accepted as "ID" and it is not possible to use characters such as "()", "{}", "/" etc. the only allowed character is "_".

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7 to File Resize Columns : → XRio → Script Functions → 7sj62 → Relay Parameter Se	General Setting ID : Description :	CUSTOM Custom defined relay		7 sj62	? Type	Min	Max
Additional Informatic 	Foreign ID : Comment :		Custom	i defined relay paramet	ers		
CBConfiguration							
	Enabled						
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	O Formula						
	Result :	True					
	< >		[OK Canc	el		

Next, the "Relay Parameter Section" block is selected and three more blocks are added to its subset. The first block is named "Device Config" and by double-clicking on it, "ID=DC" (short for Device Config.) is specified. To add a parameter to this block, right-click on it and select "Add Parameter"; then select the parameter type from the options available in the "Enumeration" on the "Parameter Type" window. Then, the list of "Enumerations" of this parameter is specified on the "Edit Enumeration Items" window and for each "Enumeration", "ID(string)" and "Value(string)" is entered. For example, the first "Enumeration" with "ID=TXT_1_101" and "Value=Disabled", the second "Enumeration" with "ID=TXT_2_101" and "Value=Definite Time" and the third "Enumeration" with "ID=TXT_1_101" and "Value=Definite Time" and the third "Enumeration" with "ID=TXT_1_101" and "Value=Definite Time" and the third "Enumeration" with "ID=TXT_1_101" and "Value=Definite Time" and the third "Enumeration" with "ID=TXT_1_101" and "Value=Definite Time" and the third "Enumeration" with "ID=TXT_1_101" and "Value=Definite Time" and the third "Enumeration" with "ID=TXT_1_101" and "Value=Time Overcurrent" are specified. By clicking on "OK", this parameter is added to the box on the right side and a "Name" and an "ID" should be specified for it. By double-clicking on "State" column, "Rio Parameter Viewer" window opens and "ID=OC_101", "Name=50/51" and "Description=Time Overcurrent" are specified for the parameter.



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	ld (string)	Value (string)	Up 2
	TXT_1_101	Disabled	Down
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Next, rename the second block to "Power System Data" and by double-clicking on it, specify "ID=PS" (short for Power System). Then, add another block named "CT's" with "ID=CT" to the subset of this block. Now, add a "Real" type parameter to this block. "Real" type is used for parameters with numerical value. By double-clicking on "State" column, on this window, specify "ID=CT_PRIMARY", "Name=CT PRIMARY", "Value=300", "Min Value=10", "Max Value=5000" and "Unit=A" for the parameter. This time add an "Enumeration" type parameter and specify two "Enumerations" with "ID=TXT_1_201", "Value=1A", "ID=TXT_2_201" and "Value=5A". Then, by double-clicking on "State" column, specify "ID=CT_SEC" and "Name=CT Secondary".

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Now, to proceed, press "F2" button and rename the third block to "Setting Group" and by double-clicking on it, specify "ID=SG" (short for Setting Group). By using "Ctrl+B" combination key, add another block to the subset of this block and name It "50/51"; then double-click on it and specify "ID=ID_50_51" for this block. Add two more blocks with the names of "50" and "51" to the subset of this block and specify "ID=ID_50" and "ID=ID_51" for them respectively.

General Test Object							-		×
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In the "50" block which includes the function "50", add "Time Delay 50" and "Pickup 50" parameters according to the aforementioned information. As an example, for "Pickup 50" parameter, information such as "ID=PICKUP_50" and "Name=Pickup 50" are specified on "Rio Parameter Viewer" window.

General Test Object							-	
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Likewise, add two parameters to block "51". After adding these two parameters with names of "Pickup 51" and "Time Dial 51", you should add another parameter in which curve function "51" is specified. This parameter is of "Enumeration" type with two "Enumerations" and with "ID=TXT_1_51", "Value=Normal Inverse", "ID=TXT_2_51" and "Value=Very Inverse". Then, double-click on "State" column and specify "ID=CURVE_51" and "Name=IEC_Curve".

PICKUP 51 PICKUP 51 Time Delav 51 Time Delav 51 TIME DELAY 51 PICKUP 51 PICKUP 51 TIME DELAY 51 PICKUP 51
Id (string) Value (string) Up TXT_1_51 Normal Inverse Down TXT_2_51 Very Diverse
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Id (string) Value (string) Up TXT_1_51 Normal Inverse Down TXT_2_51 Very fiverse
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OK Cancel

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Additional Informatic Additional Informatic P RIO P Device P Overcurrent CBConfiguration	Enabled Formula Result: True		
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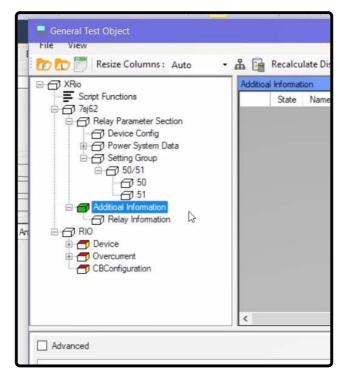
Add a block named "Relay Information" with "ID=RI" (short for Relay Information) to the subset of "Additional Parameter" block. In this new block, information such as time and current tolerances are entered which are specified according to the manual of the relay. To do this, press "Ctrl+P", select a "Real" type parameter and specify "ID=I_TOL_ABS1" and "Name=I Tolerance abs" for this parameter and then according to the manual of the relay, specify "10mA" as its "Value". Add more parameters to this block with names of "Operate Time", "t-Tolerance rel", t-Tolerance abs", "I-Tolerance abs5" and "I-Tolerance rel5". The information related to these parameters is mentioned on each line. So far, the information about "Relay Parameter Section" and "Additional Information" for the overcurrent function is provided simply and briefly. Also, the structure of "XRio Converter" is completely covered. Now, whether these blocks are enabled should be determined.

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36 : WRITING FORMULA FOR THE "XRIO CONVERTER" 3

So far, "Relay Parameter Section" and "Additional Information" for an Overcurrent function have been explained simply and briefly; also we have completely covered the structure of "XRio Converter" menu. Now we should talk about determining whether these blocks and parameters are enabled.



Enabling and disabling blocks: "50/51" block is located under the subcategory of "Setting Group". To associate the enabling of "50/51" block to the parameter measure of "50/51" in the "Device Config" block, double-click on "50/51" block and select "Formula" in "Enabled" section. Then, click on "..." icon to open "XRio Formula Editor" window. The parameter with which the enabling of "50/51" block is associated should be entered in "References" section.

General Settin	gs			
ID :	ID_50_51	Name :	50/51	
Description :				
Foreign ID :				
Comment :				_
Enabled Enable Formula	O Disable			
Result :	True			45
2 2			OK C	ancel

To enter the intended parameter, click on "+" to open "Add Ref.Param" window. From the box at the top of the page, select "50/51" parameter from the tree diagram of "XRio Converter" file in the "Device Config" block. After selecting this parameter, by clicking on "Add RefParam", "50/51" parameter is added to the "References" in the "Ref.Params" section. "Enumerations" of this parameter are listed at the bottom of the page in the form of a tree diagram. Select your intended "Enumeration" and click on "Add RefEnum" to add the enumeration to "Ref. Enums" section. "Enumeration=Disabled" with "ID=TXT_1_101" is selected here. After closing this window, you can view the path to each parameter in the "Path" column. Paths are displayed by using the "ID" of each block. For example, "50/51" parameter with "ID=OC_101" is located along the path of "CUSTOM", "SETTING" and "ID" blocks. Also, for writing the formula, "ID" of these parameters is used.

	ript Functions 162 9 Relay Parameter Section 1 Device Config 1 Device			Close Add RefParam
	0			
Details Name :	50/51	D ID:	OC_101	
Description :	Overcurrent			
Value :	TXT_3_101	Data type :	Enumeration	
RefParam Name :	OC_101	RefEnum Name :	TXT_1_101	
	(T_1_101 (Disabled)			
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	🛃 Add Ref. Param			vaue :		Tre
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1D 1015-101	Value TXT_3_101	Path CUSTOM.SET	TING.DC.0	C_101		

In the right box, it is specified that if there is a parameter with "ID=OC_101" and "Enumeration=Disabled", "50/51" block should be enabled. This formula is written as "NOT OC_101=TXT_1_101". After clicking on "Test", if a message saying "Test was successful" is displayed, the formula is correct and there is no problem. If a tiny change is made to the formula, for example the "ID" is changed, by clicking on "Test" a message saying that there is no parameter with "ID=TXT_2_101" will be displayed. Then, by clicking on "OK" two more messages will be displayed saying that the displayed formula is not correct and the last message says "Test was not successful". By correcting the formula and closing the "XRio Formula Editor" window, you can see that the status of the block is "False" and this block, displayed with an "X" sign, is disabled. If the measure of "50/51" parameter is changed in the "Device Config" block, (Value=Definite Time), the "50/51" block is enabled and the "X" mark is removed.

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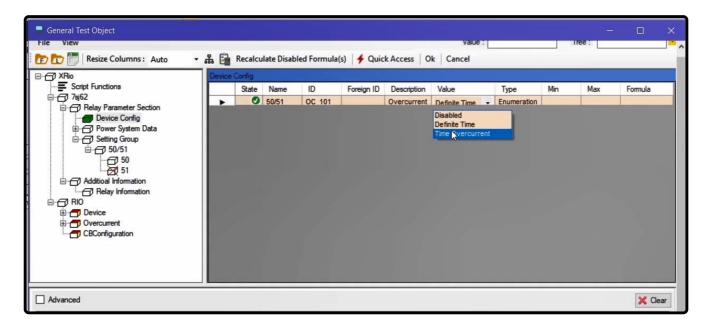
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Advanced		OK Cancel	🔀 Clear

Likewise, it is possible to associate enabling or disabling of other blocks with one or several parameters. Like the previous situation, a formula should be written for "50" block. By repeating the previous stages and selecting "50/51" parameter and "Enumeration=Disabled" with "ID=TXT_1_101", a formula should be written for the activeness of this parameter on the "XRio Formula Editor". This formula is written as "NOT OC_101=TXT_1_101". So, whenever "50/51" block is enable, this block should be enable as well. Click on "Test" to validate the written formula and in the end click on "OK".

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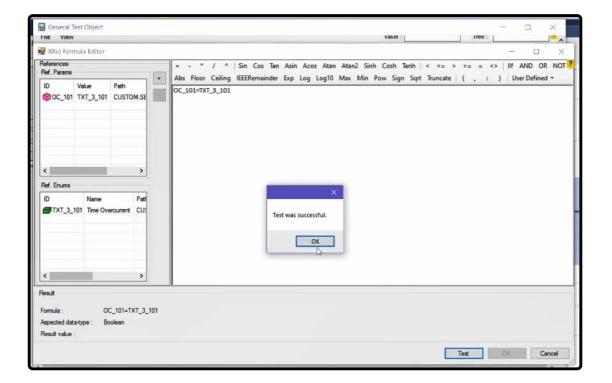
For enabling of "51" block, double-click on it and select "Formula". After opening the "Add Ref.Param" window, select "50/51 parameter and "Enumerations" of "Disabled" and "Definite Time". In fact, "51" block is enabled when enumerations of "Disabled" and "Definite Time" are not selected. Then, the formula is written as "NOT OC_101=TXT_1_101_ AND NOT OC_101=TXT_2_101". Click on "Test" to validate the formula and finally click on "OK". If "Definite Time" is selected as the value of "50/51" parameter in the "Device Config" block, "50/51" and "50" blocks are enabled while "51" block is disabled. If "Time Overcurrent" is selected as the value of "50/51" parameter, all three blocks are enabled.

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Enabling and disabling parameters: In each block, it is possible to associate Enabling of parameters with another parameter. For example, in "51" block, "IEC Curve" parameter is enable when "Time Overcurrent" is selected as the value of "50/51" parameter. To do this, double-click on "State" column and select "Formula" from the "Enabled" section. By clicking on "..."icon in the "XRio Formula Editor" window like the previous example, in the "Add Ref.Param" window "50/51" parameter and "Enumeration=Time Overcurrent" with "ID=TXT_3_101" are selected and added to the "References" section. The formula is written as "OC_101=TXT_3_101" at the right side and by clicking on "Test" the validity of the formula is examined and the "OK" is selected. If in "Device Config" block, "Time Overcurrent" is selected as the value of "50/51" parameter, "IEC Curve" parameter is enabled while if "Definite Time" is selected, "IEC Curve" parameter is disabled.

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37 : WRITING FORMULA FOR "XRIO CONVERTER"4

After completing the information regarding "Relay Parameter Section" and "Additional Information" sections, it is necessary to-you should- complete information of the "Rio" section as well. In "Rio" section, by double-clicking on any block, a window, which includes information about parameters of that block, opens; this information is also available in the tree diagram of that block. For example, parameters like "Device Name", "Manufacturer", etc. are located in "Name Plate" block. It is possible to assign a value to these parameters directly or associate them with parameters from "Custom" section by using formulas. In this video, necessary parameters for an overcurrent function are linked to values from the "Custom" section. Note that in writing a formula, the "ID" of each parameter is used.

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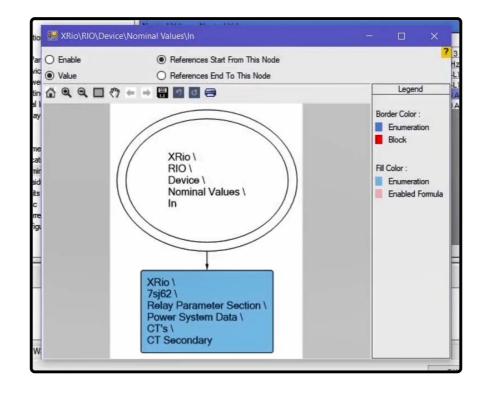
Linking parameters of "Rio" section: In this video –the target- our goal is to complete the information regarding the "51" function. "In", "I prim", etc. parameters are located at the "Nominal Values" section. To link values of the "In" parameter with the values of "XRio", it is necessary to define a formula for this parameter. To do so, after double-clicking on "State" column, in "Rio Parameter Viewer" window from "Value Properties" section, click on "..." icon in the "Formula" field to open "XRio Formula Editor" window. On this window, first the intended parameter (CT Secondary) should be entered. To do this, click on "+" and in "Add Ref.Param" window, select "CT Secondary" parameter from the "XRio" tree diagram. Then, select "Enumeration=1A" and "ID=TXT_1_201" from the box at the bottom of the page to add them to the "References" section. - For The "In" parameter when the "CT Secondary" parameter's "Enumeration=1A", the value of the parameter "In=1A"; otherwise, it should be "5A". To write this formula, the "If" command is used in a way that the final formula is "IIf(CT_SEC=TXT_1_201,1,5)". Then, click on "Test" to validate the formula. In the "Result" section, "Result Value=1A". Finally, click on "OK" to save the settings.

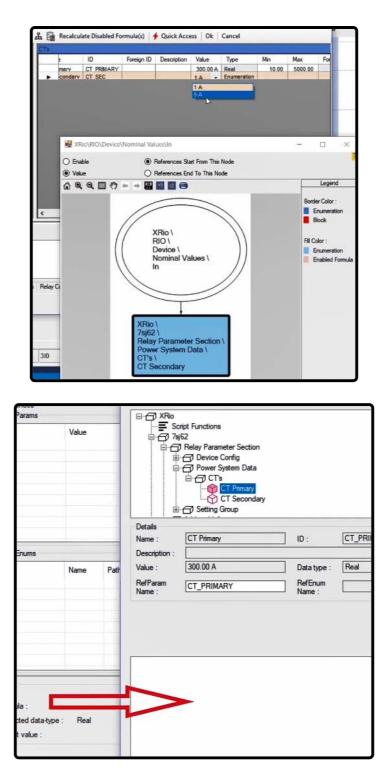
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юм	Image: Script Functions Image: Script Functions Image: Script Functions Image: Script Functions
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Ref. Enums ID N Path ID TXT_1_201 1 A CUSTOM.SETTIR	Test was successful.
Result Formula : Iff(CT_SEC=TXT_1_ Aspected data-type : Real Result value :	01.1.5)
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You can see that the color of "Value" cell of "In" parameter is turned into purple which means that its value is associated with another parameter based on the formula in the "Formula" column. Also, by clicking on "Reference map", you can see that the value of this parameter is linked to another parameter. By double-clicking on the box of the parameter, the given address for this parameter (CT Secondary) is displayed. If the value of this parameter is changed to "5A", the value of "In" parameter changes accordingly. The value of "I prim" parameter is linked to the value of "CT Primary" parameter in the same way. By following the mentioned steps, "CT Primary" parameter is added to the "References" section. Because this parameter is of the "Real" type and lacks "Enumeration", to write the formula, only the phrase "CT_PRIMARY" is entered. The written formula means that the "I prim" parameter will have the same value as the "CT Primary" parameter.

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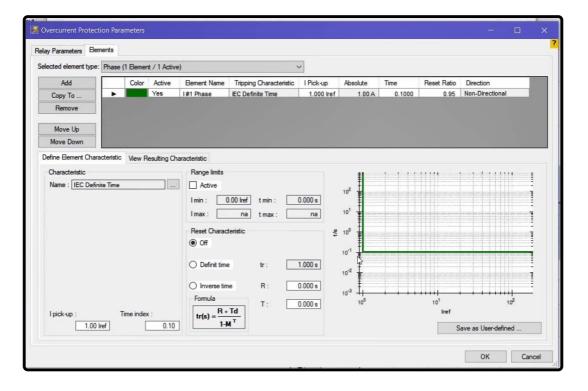




"Overcurrent" block: After completing "Device" block, information of the "Overcurrent" block should be completed. By

double-clicking on this block, you can see that there is a series of parameters in "Relay Parameters" and "Elements" tabs which are also available from the "Overcurrent" tree diagram separately. Also, in the "General" block, parameters such as "Time Tolerance Relative", "Time Tolerance Absolute", Current Tolerance Relative" and "Current Tolerance Minimum" are available. The information regarding these parameters is available from "Relay Information" block in "Custom" section. These parameters should be used in the "Rio" section as well. It should be noted that the value of "Reference Current" parameter is, by default, linked to the value of "INOM" parameter in the "Nominal Values" block. Double-click on the "State" column in "Time Tolerance Relative" parameter and on "Rio Parameter Viewer" window, click on "..." option. On the "XRio Formula Editor" window in the "References" section, after clicking on "+", "t-Tolerance rel" parameter is added to the "References" section from the "XRio" tree diagram. Then, the formula is written in form of "TTOLREL". Next, click on "TEST" and after "Test was successful" message is displayed, click on "OK". A "5%" value is displayed in the "Result Value" section. Likewise, the value of "Time Tolerance Absolute" and "Current Tolerance Relative" parameters are linked to and associated with the values of "t-Tolerance abs" and "I-Tolerance rel" parameters. In the manual of the relay, "Current Tolerance Minimum" parameter is stated as that there is at least "10mA" and "50mA" current error in "1A" and "5A" nominal currents respectively. To state this parameter in the software, the formula should be written as "0.01*Inom". First, it should be determined whether the nominal current is "1A" or "5A". Because the "Current Tolerance Minimum" parameter is stated in accordance with "IREF", to write the formula, "CT Secondary" and "Reference Current" parameters and "Enumeration=1A" with "ID=TXT_1_201" are should be selected and added to "References" section. Finally, the formula is written as " $0.01*if(CT_SEC=TXT_1_201,1,5)/IREF$ ".

Relay Parameters Elements		
Relay behavior		
Directional behavior:	VT connection:	CT starpoint connection:
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O Directional	Not at protected object	From protected object
Tolerances		
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Absolute : 50.00	50.00 mA Absolute : 40	.00 ms Angle Tot



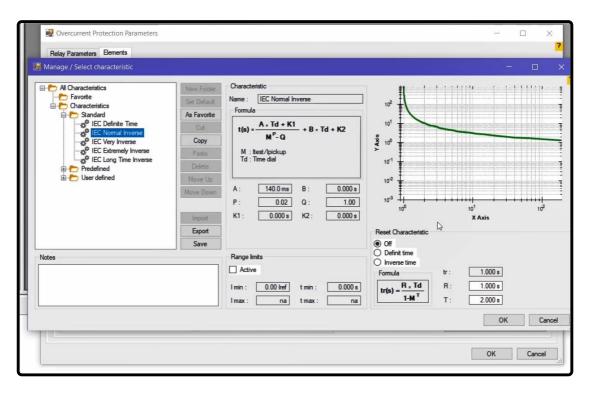
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R	0	Current Tolerance Relative	CURRENTTOLREL	Current tolerance as percentage of test current	2.00 %	Real
13	0	Time Tolerance Absolute	TIMETOLABS	Absolute time tolerance	0.03 s	Real
	0	Time Tolerance Relative	TIMETOLREL	Relative time tolerance	5.00 %	Real
	0	Reference Current	IREF	Reference current(refer e.o.to Inom or a CT Isec)	1.00 A	Real
	Ø	Compatibility	COMPATIBILITY	Can be used to emulate Overcurrent 2.30 behaviour(i.e. do not combine elements)	TU 2.40 Elements *	Enur
	Ø	Angle Tolerance	TOLANGLE	Angle tolerance	5.00 °	Real

Note that in the "CT" block, the values of "IPrim" and "ISec" parameters are, by default, linked to the values of "IPRIM" and "INOM" parameters in "Nominal Values" section. Moreover, the parameters of "VT", "Neutral CT" and "Residual VT" blocks are, by default, linked to the values of "XRio Converter". The "Timed Overcurrent Element" subcategory in the "Overcurrent Elements" block gives us information about "50/51" function like "Pickup" current and operation time. As mentioned before, in this video, our goal is to complete the information of "51" function. To activate "51" block, double-click on "OverCurrent" block. Then, in the "Element" tab double click on "Tripping Characteristic" column and select "IEC Normal Inverse" curve from the "Manage / Select characteristic" window and then click on "OK". Then, in the "Operating Curves" block, you can see that the "51" curve is defined as an "IEC Normal Inverse" and the information about this curve is displayed as well.

O IPrim IPRIM Primary rated CT current 300.00 A Real 0.00 na IPRIM ✓ ISec ISEC Secondary rated CT current 1.00 A Real 0.00 na INOM ✓ CT Groundino CTGROUNDING CT oroundino orientation To protected object ▼ Enumeration Final				Description	Value	Туре	Min	Max	Formula
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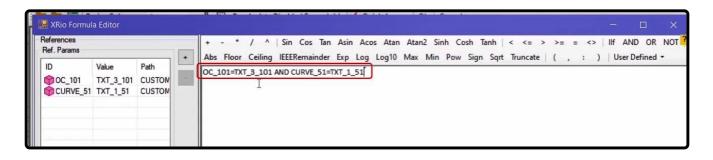
38 : WRITING FORMULA FOR "XRIO CONVERTER"5

In the previous video, the information regarding "Device" block and some parts of "Overcurrent" block such as "General", "CT" and "VT" were completely covered. As mentioned before, under the "Elements" tab by double-clicking on "Overcurrent" block, "Normal Inverse" curve is selected for "51" function; the information related to this curve is located in "Overcurrent Elements" block. Now we are going to complete the "Overcurrent Elements" block information.

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Enabling a characteristic curve: As you can see, activeness or inactiveness of the characteristic curves is determined in "Active" column. To link the value of this parameter which is located in the "Timed Overcurrent Element" block, by following the mentioned steps in previous videos, in "Add Ref.Param" window in "Device Config" block, "50/51" parameter with "Enumeration=Time Overcurrent IEC" and "ID=TXT_3_101" is selected and in "51" block, "IEC Curve" parameter with "Enumeration=Normal Inverse" with "ID=TXT_1_51" is selected and added to "References" section. Then, the formula is written as "OC_101=TXT_3_101 AND CURVE_51=TXT_1_51". To validate the written formula, click on "Test" and finally click on "OK".

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Determining the value of lpickuup.nom: The parameters related to "Ipickup" current and its tolerances are located in "Pick up Current" block. To link the current value of "Ipickup" whose value is a coefficient of "IREF", double click on "State" column and by clicking on icon "..." in "Value Properties" section, click on "+" on "XRio Formula Editor" window and select parameter "Pickup 51" from "51" block and "Reference Current" parameter from "General" block on the "XRio" tree diagram to add them to "References" section. Then, using the "ID" of added parameters, the formula is written in the box at the right side as "PICKUP_51/IREF". The formula is validated by clicking on "Test". The value of "Ipickup.nom" parameter is calculated in accordance with that the value of "Pickup 51=1A" in "51" block and the value of "CT Secondary=1A" in "CT'S" block.

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			0	Tolerance Absolute Positive	TOLABSPOS	Positive absolute tolerance	0.00 lref	Real	na	na	
	Misc		0	Tolerance Absolute Negative	TOLABSNEG	Negative absolute tolerance	0.00 lref	Real	na	па	
	🖶 🕣 Overcurrent		0	Tolerance Relative Positive	TOLRELPOS	Relative positive tolerance	0.00 %	Real	na	na	
			0	Tolerance Relative Neoative	TOLRELNEG	Relative neoative tolerance	0.00 %	Real	na	na	
-	- CT CT		0	Tolerance Actual Positive	TOLACTPOS	Resulting actual positive tolerance	0.00 lref	Real	na	na	
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	- 🔂 Neutral CT		0	Test Positive	TESTVALPOS	Positive tolerance for test	0.00 Iref	Real	na	na	
100			0	Test Neoative	TESTVALNEG	Neoative tolerance for test	0.00 Iref	Real	na	na	
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A	Timed Overcurrent Bemer Pickup Current Pickup Current Pickup Current Max Operate Time Max Operate Time Max Operate Current Reset Delay Time X	۲								l	>

Determining the current tolerances: To link the value of "Tolerance Absolute Positive" parameter with "Current Tolerance Minimum" parameter, by following the mentioned steps from the "XRio" tree diagram, in the "General" and "Overcurrent" blocks from the "Rio" section, the "Current Tolerance Minimum" parameter is added to "References" section and the formula is written as "CURRENTTOLABS" in the box at the right side and then the formula is validated.

e View					Value :			Tree :		
🔭 🛅 Resize Columns : Auto 🔹	# 📴	Recalcu	late Disabled Formula(s)	Quick Acces	s Ok Cancel					
🗗 General 🔨 🔨	Pick-up	Current -	Pick-up current							
-OCT		State	Name	ID	Description	Value	Туре	Min	Max	For
			lpickup.nom	NOMVAL	Nominal pick-up current	1.00 lref	Real	0.00	na	PICI
	•	0	Tolerance Absolute Positive	TOLABSPOS	Positive absolute tolerance	0.05 Iref	Real	na	na	CUF
- Besidual VT		0	Tolerance Absolute Negative	TOLABSNEG	Negative absolute tolerance	0.00 lref	Real	na	na	
Overcurrent Bements		0	Tolerance Relative Positive	TOLRELPOS	Relative positive tolerance	0.00 %		na	na	-
Timed Overcurrent Elemen			Tolerance Relative Neoative	TOLRELNEG	Relative neoative tolerance	0.00 %		na	na	
Pick-up Current		0	Tolerance Actual Positive	TOLACTPOS	Resulting actual positive tolerance	0.00 lref		na	na	-
		0	Tolerance Actual Neoative	TOLACTNEG	Resulting actual negative tolerance	0.00 lref		na	na	-
Min Operate Time			Test Positive	TESTVALPOS	Positive tolerance for test	0.00 lref		па	na	-
- 🗇 Max Operate Time			Test Negative	TESTVALNEG	Negative tolerance for test	0.00 lref		na	na	-
	_	0	Test Tolerance	TESTTOL	Additional tolerance for test equipment	0.00 %	Real	na	na	-
Max Operate Current Reset Delay Time Harmonic Restraint Be Time Multipler/Trip Tir Reset Curves Operating Curves Directional Bements CBConfiguration V					Þ.					

Likewise, the values of "Tolerance Absolute Negative", "Tolerance Relative Positive" and "Tolerance Relative Negative" parameters are linked with parameters with "ID=CURRENTTOLABS", "ID=CURRENTTOLREL" and "ID=CURRENTTOLREL" respectively. The "Tolerance Actual Positive" parameter selects the highest amount of positive tolerance from "Tolerance Absolute Positive" and "Tolerance Relative Positive" and based on a percentage of "IREF" puts it in its "Value" field. So, by "Ref.Params", adding the formula is written following the previous steps and as "Max(TOLABSPOS,TOLRELPOS*NOMVAL/100)" and validated.

	State	Name	ID	Description	Value	Туре	Min	Max	Formula	
	0	loickup.nom	NOMVAL	Nominal pick-up current	1.00 Iref	Real	0.00	па	PICKUP 51/IREF	
	0	Tolerance Absolute Positive	TOLABSPOS	Positive absolute tolerance	0.05 Iref	Real	na	na	CURRENTTOLABS	
	Ø	Tolerance Absolute Negative	TOLABSNEG	Negative absolute tolerance	0.05 Iref	Real	na	na	CURRENTTOLABS	
		Tolerance Relative Positive	TOLRELPOS	Relative positive tolerance	5.00 %	Real	na	па	CURRENTTOLREL	-
4	0	Tolerance Relative Negative	TOLRELNEG	Relative neoative tolerance	5.00 %	Real	na	na	CURRENTTOLREL	
	Ø	Tolerance Actual Positive	TOLACTPOS	Resulting actual positive tolerance	0.00 Iref	Real	na	na		
	0	Tolerance Actual Neoative	TOLACTNEG	Resulting actual negative tolerance	0.00 lref	Real	na	na		
	0	Test Positive	TESTVALPOS	Positive tolerance for test	0.00 Iref	Real	na	na		
	0	Test Negative	TESTVALNEG	Neoative tolerance for test	0.00 lref	Real	na	na		
	0	Test Tolerance	TESTTOL	Additional tolerance for test equipment	0.00 %	Real	na	na		

🔛 XRio Formula	Editor			-	
References Ref. Params			+	+ - * / ^ Sin Cos Tan Asin Acos Atan Atan2 Sinh Cosh Tanh < <= > >= = <> Ilf Abs Floor Ceiling IEEERemainder Exp Log Log10 Max Min Pow Sign Sqrt Truncate (, :) U	
TOLABSPOS	5.00 %	Path RIO.OVER/ RIO.OVER/ RIO.OVER/	•	Max(TOLABSPOS,TOLRELPOS*NOMVAL/100)	ser Denned *
<		>		×	
	Name	Path		Test was successful. ΟΚΓ	
Result Formula : Aspected data-type Result value :		2000-000-000-00-00-00-00	.TOLRE	ELPOS'NOMVAL/100)	Cancel

"Tolerance Actual Negative" parameter is almost the same as the previous parameter. The only difference is that it calculates the highest amount of negative tolerance and its formula is written as "Max(TOLABSNEG,TOLRELNEG*NOMVAL/100)". Also, for "Test Positive" parameter, the formula is written as "NOMVAL+TOLACTPOS+NOMVAL*TESTTOL/100". This parameter shows the maximum total error of the test which may occur because of measurement error of current transformers, test device, noise, etc. in "Test Negative" parameter, the formula is written as "NOMVAL - TOLACTNEG -NOMVAL * TESTTOL / 100" which shows the minimum total error of the test.

State	Name	ID	Description	Value	Туре	Min	Max	Formula
0	lpickup.nom	NOMVAL	Nominal pick-up current	1.00 Iref	Real	0.00	na	PICKUP 51/IREF
0	Tolerance Absolute Positive	TOLABSPOS	Positive absolute tolerance	0.05 Iref	Real	na	na	CURRENTTOLABS
0	Tolerance Absolute Negative	TOLABSNEG	Negative absolute tolerance	0.05 Iref	Real	na	na	CURRENTTOLABS
0	Tolerance Relative Positive	TOLRELPOS	Relative positive tolerance	5.00 %	Real	na	па	CURRENTTOLREL
0	Tolerance Relative Neoative	TOLRELNEG	Relative neoative tolerance	5.00 %	Real	па	na	CURRENTTOLREL
0	Tolerance Actual Positive	TOLACTPOS	Resulting actual positive tolerance	0.05 lref	Real	na	na	Max(TOLABSPOS.TOLRELPOS*NOMVAL/100)
0	Tolerance Actual Neoative	TOLACTNEG	Resulting actual negative tolerance	0.00 lref	Real	na	na	Max(TOLABSNEG.TOLRELNEG*NOMVAL/100)
0	Test Positive	TESTVALPOS	Positive tolerance for test	1.05 Iref	Real	na	na	NOMYAL ATOL ACTROSANOMYAL TESTTOL (100
0	Test Negative	TESTVALNEG	Negative tolerance for test	1.00 lref	Real	na	na	N&MVAL+TOLACTPOS+NOMVAL*TESTTOL/10
0	Test Tolerance	TESTTOL	Additional tolerance for test equipment	0.00 %	Real	na	na	

Determining trip time and the range of relay performance:

After determining current tolerances, the information related to "Time Multiplier/Trip Time" block should be completed. In this block, by following the mentioned steps, the value of "Nom.Time Multiplier" parameter should be linked with "Time Dial 51" parameter which is located in "51" block.

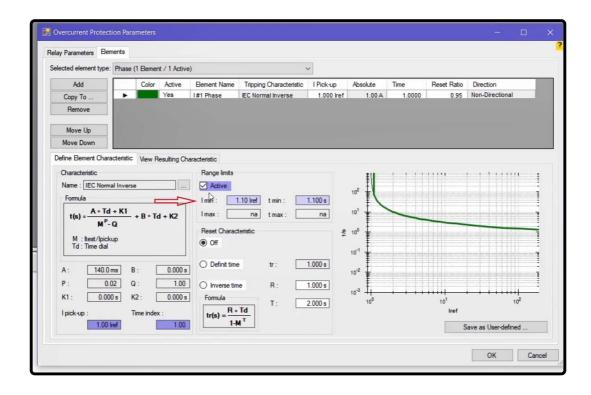
ime M	luitiplier/T	rip Time - Time multiplier (secon	ds for DT elemen	ts)					
	State	Name	ID	Description	Value	Туре	Min	Max	Formula
		Nom. Time Multiplier	NOMVAL	Nominal time multiplier (inverse elements) / trip time in sec. (DT elements)	0.10	Real	0.00	na	
	0	Towrance Absolute Positive	TOLABSPOS	Positive absolute tolerance	0.00	Real	na	na	
	Ø	Tolerance Absolute Negative	TOLABSNEG	Neoative absolute tolerance	0.00	Real	na	na	
	0	Tolerance Relative Positive	TOLRELPOS	Relative positive tolerance	0.00 %	Real	na	na	
	0	Tolerance Relative Negative	TOLRELNEG	Relative neoative tolerance	0.00	Real	na	na	
	Ø	Tolerance Actual Positive	TOLACTPOS	Resulting actual positive tolerance	0.00	Real	na	na	
	0	Tolerance Actual Neoative	TOLACTNEG	Resulting actual negative tolerance	0.00	Real	na	na	
	0	Test Positive	TESTVALPOS	Positive tolerance for test	0.00	Real	na	na	
	0	Test Negative	TESTVALNEG	Neoative tolerance for test	0.00	Real	na	na	
	0	Test Tolerance	TESTTOL	Additional tolerance for test equipment	0.00 %	Real	na	na	

According to "IEC" standard, the "Ipickup" current value of relays can range from "1.1" times to "1.3" times of the nominal current. Based on the manual of this relay, "1.1" is selected for this relay which means that the relay must not "Pickup" less than the determined current. This parameter is located in "Min Operate Current" block with the name of "Nom.Min.Op.Curr" and its value should be linked with "1.1" times of the nominal current. So, the formula is written as "1.1*NOMVAL". According to "IEC" standard, if the injected current is bigger than "20" times of the nominal current, the relay should give a

trip at a "Definite" time. This parameter is located in "Max Operate Current" block with the name of "Nom.Max.Op.Curr" but in this video, we skipped entering the information of this parameter. It should be noted that the activeness of "Range Limits" value should be linked with another parameter in "Device Config" block. This parameter is located in "Timed Overcurrent Element" block with the name of "Use Range Limits". By repeating the mentioned steps for linking and selecting the "50/51" parameter and "Enumeration=Time Overcurrent IEC" with "ID=TXT_3_101", the formula is written as "OC_101=TXT_3_101" and after testing, the "OK" option is selected. You can find this parameter in "Elements" tab of "Overcurrent" block. If this option is enabled, the relay must not "Pickup" in current values less than "Imin".

Min O	perate Cun	rent - Minimum operate current fo	or selected chara	cteristic					
	State	Name	ID	Description	Value	Туре	Min	Max	Formula
•		Nom. Min. Op. Curr.	NOMVAL	Nominal minimum operate current	1.10 lref	Real	na	na	1.1*NOMVAL
	0	Tolerance Ausolute Positive	TOLABSPOS	Positive absolute tolerance	0.00 lref	Real	na	na	
	Ø	Tolerance Absolute Neoative	TOLABSNEG	Negative absolute tolerance	0.00 lref	Real	na	na	
	0	Tolerance Relative Positive	TOLRELPOS	Relative positive tolerance	0.00 %	Real	na	na	
	0	Tolerance Relative Neoative	TOLRELNEG	Relative neoative tolerance	0.00 %	Real	na	na	
	0	Tolerance Actual Positive	TOLACTPOS	Resulting actual positive tolerance	0.00 Iref	Real	па	na	
	0	Tolerance Actual Neoative	TOLACTNEG	Resulting actual negative tolerance	0.00 lref	Real	na	па	Í
	0	Test Positive	TESTVALPOS	Positive tolerance for test	0.00 lref	Real	na	na	
	0	Test Negative	TESTVALNEG	Negative tolerance for test	0.00 lref	Real	na	na	
	0	Test Tolerance	TESTTOL	Additional tolerance for test equipment	0.00 %	Real	na	na	

ned C	vercurre	nt Bement - Timed overcurre	nt element (stage)							
	State	Name	ID	Description	Value		Туре	Min	Max	Formula
	0	Name	NAME	Name of the element (stage)	1#1 Phase		String			
	0	Active	ACTIVE	Characteristic is operational	Yes		Boolean			OC 101=TXT 3 101 AND CURVE 51=TXT 1 51
	0	Use Range Limits	USERANGELIMITS	Range limits limit //t characteristic	Yes		Boolean			OC 101=TXT 3 101
	0	Use Reset Characteristic	USERESETCHARACTERISTIC	Reset characteristic is operational	No		Boolean			
	0	Reset Characteristic Type	RESETCHARACTERISTICTYPE	Type of the reset characteristic	None	٠	Enumeration			
	0	Use Blinder	USEBLINDER	Blinder limits directional characteristic	No	-	Boolean			
	0	Supervised Current	SUPERVISEDCURRENT	Supervised Current	Phase	•	Enumeration			
	0	Directional Mode	DIRECTIONALMODE	Directional mode of the element	Non-Directional	-	Enumeration			



Final review:

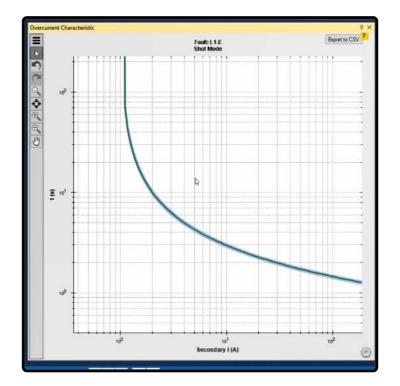
The information regarding the curve is mentioned in the tree diagram of "Operating Curves" and "Standard Curve" blocks.

	 Stand 	ard Curve -	Standard o	curve (characteristic)							
- D Location		State	Name	ID	Description	Value	1	Туре	Min	Max	Formula
Nominal Values		0	Active	ACTIVE	Characteristic is operational	Yes	*	Boolean			
		0	Name	NAME	Characteristic Name	IEC Normal Inverse		Strina			
		0	Type	STANDARDCURVETYPE	Characteristic Type	IEC Normal Inverse	-	Enumeration			
Misc											
Overcurrent											
- General											
- नि पा											
- D Neutral CT											
Overcurrent Bements											
	en										
Pick-up Current											
Pick-up Current											
Pick-up Current	•										
Pick-up Current Drop-off/Pick-up rat Min Operate Time	0										
Pick-up Current Drop-off/Pick-up rat Min Operate Time Max Operate Time											
Pick-up Current Pick-up Current Pick-up Current Min Operate Time Min Operate Current Min Operate Current											
Pick-up Current Drop-off/Pick-up rat Min Operate Time Max Operate Time											
Pick-up Current Drop-off/Pick-up rat Min Operate Time Min Operate Time Min Operate Current Max Operate Current Max Operate Current											
Pick-up Current Drop-off/Pick-up rat Min Operate Time Min Operate Current Min Operate Current Min Ax Operate Current Min Querate Min Querate Current Min Querate Min Querate Current Min Querate Min Querate											
Pick-up Current Drop-off/Pick-up rat Min Operate Time Min Operate Time Max Operate Curren Reset Delay Time Hamonic Restariat	Be										
Pick-up Current Drop-off/Pick-up rat Mn Operate Time Max Operate Current	Be										

You can view the changes made by double-clicking on "Overcurrent" block. Under the "Relay Parameters" tab, the tolerance values are derived from the determined formula and its cell color is turned purple. Also, under the "Elements" tab, the parameters for which a formula is determined are turned purple. Then, click on "Ok" so save the settings. You can see that the "Normal Inverse" curve is displayed on "Overcurrent Characteristic" window.

Relay Parameters Element	8			
Relay behavior				
Directional behavior:		VT con	nection:	CT starpoint connection:
Non-directional	B) At	protected object	To protected object
O Directional		O No	t at protected object	From protected object
Tolerances				
	00 % 0.00 10).00 mA	and the second	Angle Angle Tol. : 5.0

lected element type: Phase (1 Elen	nent / 1 Activ	e)	,	~					
Add Cold	or Active	Element Name	Tripping Characteristic	l Pick-up	Absolute	Time	Reset Ratio	Direction	
Copy To	Yes	1#1 Phase	IEC Normal Inverse	1.000 lref	1.00 A	1.0000	0.95	Non-Directional	
Remove									
Move Up									
Move Down									
efine Element Characteristic View	Resulting Ch	aracteristic							
Characteristic	6	Range limits			*18				
Name : IEC Normal Inverse		Active			Į.				-
Formula			.10 Iref t min :	1.100 s	102				1
t(s) = + B *	T 1 1/2	I max :	na t max :	na	101				÷
$f(s) = \frac{M^{P}-Q}{M^{P}-Q}$	1d + K2				ŧ				1
M : Itest/Ipickup		Reset Charac	teristic	t/s	100				1
Td : Time dial		Off			10-1				1
		O Definit time	tr:	1.000 s	ŧ				1
A: 140.0 ms B:	0.000 s				10-2				1
P: 0.02 Q:	1.00	Inverse tim	e R:	1.000 s	10-3				
K1: 0.000 s K2:	0.000 s	-	T:	2.000 s	10 100		101	10 ²	
I pick-up : Time in	dex :	$tr(s) = \frac{R \star}{1 - k}$	Td				Iref		
1.00 Iref	1.00	1-1	AT					ave as User-defined	



To further examine the validity of written "XRio" file, some cases are tested as a sample. To do this, "Disabled" is selected in "Device Config" block and then by double-clicking on "Overcurrent" block, you can see that the curve has been disabled. Also, by clicking on "Ok", no curve is displayed on "Overcurrent Characteristic" window.

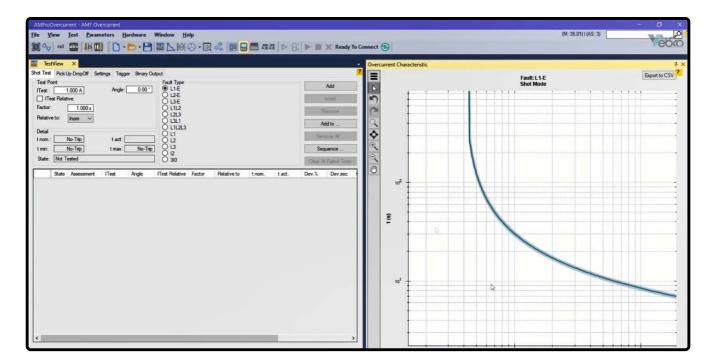
Device	Config						
	State	Name	ID	Foreign ID	Description	Value	Т
•	0	50/51	OC 101		Overcurrent	Time Overcurrent	Er
						Disable	
						Definite Yime Time Overcurrent	

Overcurrent Pr	otect	ion Para	ameters		
Relay Parameters	Elen	nents			
Selected element	type:	Phase	(1 Eleme	nt / 0 Activ	(e)
Add			Color	Active	E
Copy To		•		No	1
Demouro					w

As another example, the value of "Time Overcurrent IEC" is selected in "Device Config" block and in "51" block, "Pickup 51=4A" is determined as the current value while "Time Dial 51=0.5" is determined as time. In the "Overcurrent" block it is observed that the same changes are made. For example, the minimum current value is "Ipickup=4.4A". After clicking on "OK", the changes are made to "Overcurrent Characteristic" window.

File View												
🔁 🛅 🕅 Resize Columns : 🛛 Auto		£ 🔒	Recalcu	late Disabled	Formula(s)	Quick Acc	ess Ok C	Cancel				
- CI XRio	^	51										
Script Functions			State	Name	ID	Foreign ID	Description	Value	Туре	Min	Max	Formula
□ [] 7sj62			0	Pickup 51	PICKUP 51			4.00 A	Real	0.00	20.00	
Relay Parameter Section					TIME DIAL 51			0.50 s	Real	0.00	na	
			0	IEC Curve	CURVE 51			Normal Inverse *	Enumeration			
Power System Data			110			<u>8</u>						

ay Parameters Elements								
lected element type: Phase (1 Element / 1 Activ	e)	,	~					
Add Color Active	Element Name	Tripping Characteristic	I Pick-up	Absolute	Time	Reset Ratio	Direction	
Copy To Yes	I#1 Phase	IEC Normal Inverse	4.000 Iref	4.00 A	4.0000	0.95	Non-Directional	
Remove								
Move Up								
Move Down								
Define Element Characteristic View Resulting Ch	naracteristic							
Characteristic	Range limits			≢n∎ i				
Name : IEC Normal Inverse	Active			102				1
Formula	1 min : 4	1.40 lref t min :	4.400 s	10"	-			1
$t(s) = \frac{A * Td + K1}{M^{P} - Q} + B * Td + K2$	I max :	na tmax:	na	101				-
	Reset Charac	teristic		100				-
M : Itest/Ipickup Td : Time dial	Off		-	ŧ				1
				10*1				1
A: 140.0 ms B: 0.000 s	O Definit time	e tr:	1.000 s	10-2				-
P: 0.02 Q: 1.00	 O Inverse tim	ne R:	1.000 s	I				1
K1: 0.000 s K2: 0.000 s				10-3	101	+ +	10 ²	-
I pick-up : Time index :	tr(s) = R *	Td	2.000 s		10	Iref	10-	
4.00 Iref 4.00	tr(s) =	M T				S	ave as User-defined	
							6	



39 : COMPLEMENTARY EXPLANATIONS OF "DEVICE" SECTION

Before talking about the "AMT-Sequencer" room and its features, because there are items that are related to the "Device Setting" information, it is necessary to provide some additional information about this section. At the left of this page, the general information about the relay is entered. This information includes name of the manufacturer, type of the relay, serial number, installation location etc. As the type of information in this section indicates, this information is used merely as report and does not affect the test or its results. But the information at the right which is partly derived from the relay settings can be used as a reference for determining the voltage and current output of the device.

File View	🔡 Device Settings				- 🗆 🗙	-	
😰 沈 🛅 🛛 Resize Co	Device Settings				?		
C XRio	Device	6		Nominal Values		Мах	Formula
- Custom	Name/Description :			f nom :	50.00 Hz	Pias	FUnitura
E P Device	Manufacturer :			V nom(secondary) :	110.0 V(L-L)		
🕀 🗂 Distance	Device Type :				63.51 V(L-N)		
 Differential Overcurrent 	Device Address :			V primary :	230.0 kV(L-L)		
- CBConfigur	Serial/Model Number :				132.8 kV(L-N)		
				I nom(secondary) :	1.000 A		
	Additional Information1		1	I primary :	1.000 kA		
	Additional Information2			Residual Voltage/Cum	ent Factors		
	Substation			VLN/VN :	1.730		
	Name :	[IN/I nom	1.000		
	Address :			Limits			
				Umits V max :	132.0 V		
	Bay Name :			I max :	64.00 A		1
Advanced	Name : Address :	[24 01
_ Advanced	Address .	I		Debounce/Deglitch Fil Debounce Time :			💢 Clear
					3.000 ms		
				Deglitch Time :	400.0 µs		
roccess Log Error / Wat	Save to Template	Load Template	Export	Import C	OK Cancel		Show/Hide 🗹

In "Nominal Values" section the information related to nominal frequency and turn ratio of PT and CT are entered. From the information of this section, the PT secondary voltage is known as nominal voltage while the CT secondary voltage is known as nominal current. Note that in "Vprimary" and "Vsecondary" section, it is possible to enter the ratio of transformation in line to line or phase. In "Residual Voltage/Current Factor" section, the coefficients of residual voltage and current for relays where the residual voltage and current are separated from the input voltage and current are mentioned. These coefficients are used to calculate VE and IE. In "Limits" section, the range of maximum output voltage and current of the device are specified and the user can, according to the type of wiring specified in "Hardware Configuration" section, determine the maximum output voltage and current of the device.

🔚 General Test Object			- 🗆 X
File View	📲 Device Settings	- 🗆 X	?
💼 💼 🛅 Resize Co	Device Settings	?	
XRio XRio Script Functions Custom RIO Differential Overcurrent CBConfigur	Device Name/Description : Manufacturer : Device Type : Device Address : Serial/Model Number : Additional Information 1 :	Nominal Values f nom : 50.00 Hz V nom(secondary) : 110.0 V(L-L) 63.51 V(L-N) 63.51 V(L-N) V primary : 230.0 kV(L-L) 132.8 kV(L-N) 132.8 kV(L-N) I nom(secondary) : 1.000 A I primary : 1.000 kA	Max Formula
	Additional Information2 : Substation Name : Address : Bay Name :	Residual Voltage/Current Factors VLN/VN : 1.730 IN/1 nom 1.000 Limits V max : V max : 132.0 V I max : 64.00 A	
Advanced	Address :	Debounce/Degitch Filters Debounce Time : 3.000 ms Degitch Time : 400.0 µs	X Clear
Proccess Log Error / Wa	Save to Template Load Template Export	Import OK Cancel	Show/Hide 🗹 OK Cancel
		1.	,ii

In the "Debounce Time" field In "Debounce/Deglitch Filter" section, it is specified that every 3 milliseconds, the device examines the signal transmission from the relay. In "Deglitch Time" section, it is specified that the transferred signal from the relay should be retained for 400 microseconds until the reception of signal is detected. Note that both of these values can range from 200 to 1.5 microseconds.

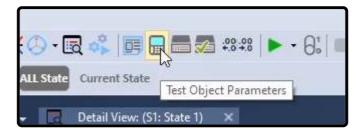
evice Settings		
Device	Nominal Values	
Name/Description :	f nom :	50.00 Hz
Manufacturer :	V nom(secondary) :	110.0 V(L-L)
Device Type :		63.51 V(L-N)
Device Address :	V primary :	230.0 kV(L-L)
Serial/Model Number :		132.8 kV(L-N)
	I nom(secondary) :	1.000 A
Additional Information 1 :	I primary :	1.000 kA
Additional Information2 :	Residual Voltage/Cum	ent Factors
Substation	VLN/VN :	1.730
Name :	IN/I nom	1.000
Address :	Limits	
Bay	V max : 🕞	132.0 V
Name :	I max :	64.00 A
Address :	Debounce/Deglitch Fi	iters
	Debounce Time :	3.000 ms
	Deglitch Time :	<u>400.0 µs</u>
	L	

By using "Save to template" option, the information entered in this section is saved in the software as a template and it is possible to load this template by using the "Load Template" option. The "Import" option is used when the user wishes to use the settings of this section on another computer or to be able to recover the settings after cleaning the cache of the software.

ce Settings		
evice	Nominal Values	
me/Description :	f nom :	50.00 Hz
nufacturer :	V nom(secondary)	: 110.0 V(L-L)
vice Type :		63.51 V(L-N)
vice Address :	V primary :	230.0 kV(L-L)
rial/Model Number :		132.8 kV(L-N)
	I nom(secondary)	: 1.000 A
ditional Information1 :	I primary :	1.000 kA
ditional Information2 :	Residual Voltage/	Current Factors
bstation	VLN/VN :	1.730
me :	IN/I nom	1.000
dress :	Limits	
v	V max :	132.0 V
me :	I max :	64.00 A
dress :	Debounce/Deglito	ch Filters
	Debounce Time :	3.000 ms
	Deglitch Time :	400.0 μs
Save to Template Load Temp	Export Import	OK Cancel

40 : AN INTRODUCTION TO THE SEQUENCER ROOM

After getting familiar with "Hardware Configuration" and "Test Object" pages which are used for configuring the device and entering the relay characteristics, now it is time to get familiar with the "AMT-Sequencer" room. As mentioned in previous videos, "AMT-Seque ncer", is the main room of the software and it is possible to design, run and evaluate all tests of the relays and equipment from this room. To design any test, first, it is necessary to become familiar with the pages as well as features of this room. This room includes all windows, diagrams and options that a user needs for doing a test.



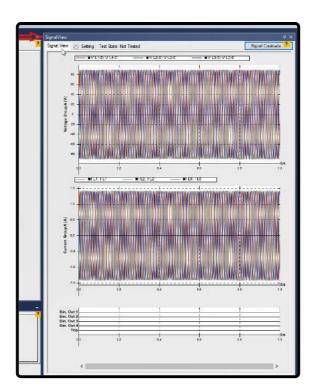
"Table View" window: different states of injected signal, analog and digital inputs and outputs of the device for performing a test are created in this window as tables named "state".

Table View	×			
i i	S 1	Ge	Normal neral: Direct	?
Name	State 1			
VL1-E: VL1-E	63.51 V	0.00 *	50.00 Hz	
V L2-E: V L2-E	63.51 V	-120.00 °	50.00 Hz	
VL3-E: VL3-E	63.51 V	120.00 °	50.00 Hz	
1 L1: I L1	1.000 A	0.00 °	50.00 Hz	
112:112	1.000 A	-120.00 °	50.00 Hz	
1 L3: 1 L3	1.000 A	120.00 °	50.00 Hz	
Bin. Out	B1. ⊿ − B2.	J- B3. J-	B4. 🥒 🗕	
Trigger	C 4	-©-	1.000 s	
Туре	Normal		~	
Comment		N		
Condition	C1 O Trip	6		
Bin. Input				
				21

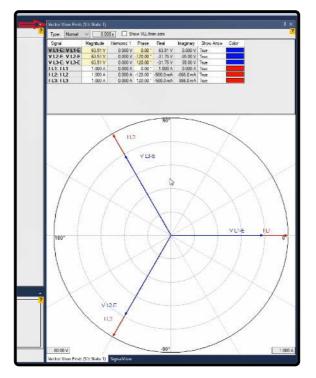
"Detail View" window: details related to each "State", including the type of "State", status of "Binary Outputs", status of all "States" etc. are located in this window.

🔐 🕁 🕅 🕗 - 💽 🧩 📴		00.00 +0 +0 +0 +	6°¦ ■ ×	Connected 😒	
State Type	It Binary Ou		Serial Repo	rt Setting Trigger Setting Comment State termination Timeout: Space Key Press Use binary trigger condition as specified below Binary trigger condition Trigger Logic: AND OR	Disable Relay 2 UA1 UA2 VA3 IA1 IA2 IA3
Analog Output C	and the second second			C1:Trip : X ~	
Signal	Amplitude	Phase	Freque		
VL1-E: VL1-E	63.51 V	0.00 °	50.00 Hz	Trigger Logic Minimum Time : 0.000 s	
V L2-E: V L2-E V L3-E: V L3-E	63.51 V 63.51 V	-120.00 °	50.00 Hz 50.00 Hz		
111:111	63.51 V 1.000 A	120.00 ° 0.00 °	50.00 Hz		
112:112	1.000 A	-120.00 °	50.00 Hz	Error/Trigger Overcurrent	
113:113	1.000 A	120.00 *	50.00 Hz	Overcurrent Trigger Overcurrent Error Percent 0.00 %	
Binary Outputs B1 B2	/B3/_	B4. 🧾		Threshold 0.000 A	

"Signal View" window: the overall waveform of the output signal of the device and "Binaries/Analog"s of inputs and outputs of the device during a test are displayed in diagrams of this window in accordance with the settings of every "State".



"Vector View" window: injected signals of the device in form of vectors, differentiating between imaginary and real values, main harmonic etc. are displayed on this window. This window and "Signal View" window are used to analyze the performance of the relay as well as resolving issues.



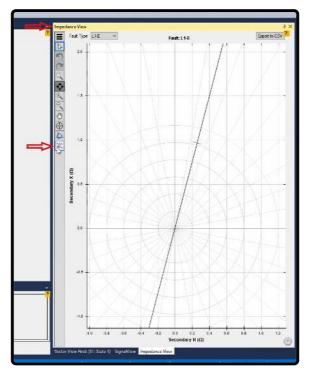
"Measurement View" window: this window is used for time and value assessment of the results of the performed tests. It is possible to set the settings of this page before or after performing the test and evaluate the performance of the relay and the tested equipment.

Nam	me	Ignore before	Ignore After	Start	Stop	T Nom.	T Dev	T Dev.+	T Act.	T Dev.	Assessment	User Comment	
▶1											•	3	
ime Assessm	ment		ssessment		Ramp Assessme		Value Assessme		Calculated As		1	Assessment	

"Star-condition Repetition" window: this window has three main tabs where it is possible to specify the conditions to start the test, repetition time of every test and settings related to the test counter.

Start Condition Repetition Start Test Condition -	meen
 Immediately On Binary Input 	C1: Trip 🗸
O On GPS	
Next Full	00:00:00

"Harmonic Restraint View" and "Impedance View" windows: these two windows are used to view the impedance, differential trajectory and "Power Swing" test.



41 : "TABLE VIEW" WINDOW

The first step in designing a test is to make different states of the test in "Table View" window. This means that to simulate fault state, it is necessary to inject signal several stage and receive feedback. Every stage of the test is showed on this window in form of a table named "state" and each "state" is made of several components.

Name State 1 V L1-E: V L1-E 63.51 V 0.00 ° 50.00 Hz V L2-E: V L2-E 63.51 V -120.00 ° 50.00 Hz V L3-E: V L3-E 63.51 V 120.00 ° 50.00 Hz V L3-E: V L3-E 63.51 V 120.00 ° 50.00 Hz I L1: I L1 1.000 A -0.00 ° 50.00 Hz I L2: I L2 1.000 A -120.00 ° 50.00 Hz I L3: I L3 1.000 A 120.00 ° 50.00 Hz Bin. Out B1. B2. B3. B4. - Trigger Comment - 1.000 s 1.000 s Dirigger C1 O Trip Trip Bin. Input -	(i)	🗖 S1				Normal ierieral: Direct	
V L2-E: V L2-E 63.51 V -120.00° 50.00 Hz V L3-E: V L3-E 63.51 V 120.00° 50.00 Hz I L1: I L1 1.000 A 0.00° 50.00 Hz I L2: I L2 1.000 A -120.00° 50.00 Hz I L3: I L3 1.000 A 120.00° 50.00 Hz Bin. Out B1. - B2. - B3. - B4. - Trigger Ommal Comment Comment Condition C1 O Trip C1 O	Name	State 1					
V L2-E: V L2-E 63.51 V -120.00* 50.00 Hz V L3-E: V L3-E 63.51 V 120.00* 50.00 Hz I L1: I L1 1.000 A 0.00* 50.00 Hz I L2: I L2 1.000 A -120.00* 50.00 Hz I L3: I L3 1.000 A -120.00* 50.00 Hz Bin. Out B1. - B2. - B3. - B4. - Trigger Ommal Out Trigger 1.000 s I.000 s	VL1-E: VL1-E	63	51 V		0.00 *	50.00 Hz	<
I L1: I L1 1.000 A 0.00 ° 50.00 Hz I L2: I L2 1.000 A -120.00 ° 50.00 Hz I L3: I L3 1.000 A 120.00 ° 50.00 Hz Bin. Out B1. J - B2. J - B3. J - B4. J - 1.000 s Trigger I L00 - 1.000 s 1.000 s Type Normal ✓ Comment C1 O Trip	V L2-E: V L2-E	63	51 V	2		50.00 Hz	
I L2: I L2 1.000 A -120.00 ° 50.00 Hz I L3: I L3 1.000 A 120.00 ° 50.00 Hz Bin. Out B1. J = B2. J = B3. J = B4. J = 1.000 s Trigger 1.000 s 1.000 s Type Normal ✓ Omment Condition C1 O Trip	V L3-E: V L3-E	63	51 V	1	20.00 *	50.00 Hz	
I L3: I L3 1.000 A 120.00* 50.00 Hz Bin. Out B1. J - B2. J - B3. J - B4. J - Trigger 1.000 s 1.000 s 1.000 s Type Normal V V V Comment C1 O Trip Trip V	I L1: I L1	1.0	A 00		0.00 °	50.00 Hz	
Bin. Out B1. J = B2. J = B3. J = B4. J = Trigger I.000 s I.000 s I.000 s Type Normal V V I.000 s I.000 s Comment C1 O Trip I.000 s I.000 s	112:112	1.0	A 00	-	20.00 *	50.00 Hz	
Trigger I.000 s Type Normal Comment Image: Condition Trigger C1 O Trip	1 L3: 1 L3	1.0	A 00		20.00 *	50.00 Hz	
Type Normal ~	Bin. Out	B1	B2.		B3	B4. 🖌 🗕	
Comment	Trigger	3	-6	@		1.000 s	
Trigger C1 O Condition Trip	Туре	Normal	_			~	
	Comment						
Bin. Input							
	Bin. Input						

To open the "Table View" window, it is possible to use "View" menu or the toolbar at the top of the page. In the first part of every "state", RMS value, phase and frequency of the outputs of the device, which are selected in "Hardware Configuration" part, are specified. In the first column of this part, the RMS value of the outputs of the device is specified. The maximum allowed value is determined in "Limits" section in "Test Object" page. In the second column, the phase of the output signals of the device is specified which can be between 0 to 360 degrees. Also, in the third column the frequency of the output signals of the device are specified which can be between 0 to 1.5 kHz. If DC signal is needed, the frequency should be specified as 0.

File View	Test Parameters Hardware	Window
384	Toolbars •	80
M	Status Bar	• - 🖽
lio 1	Urits	
Name	Table View Ctrl+Alt+T	Normal L Direct
V L1-	Measurment View Ctrl+Alt+M	0.00 Hz
V L3- 4	Characteristic View Ctrl+Alt+I	0.00 Hz
	Vector View	0.00 Hz 0.00 Hz
Bin. C	Signal View Ctrl+Alt+S	1.000 s
Trigge Type	Report View Ctrl+Alt+R	1.000's
Comm 🗟	Detail View Ctrl+Alt+D	
	Start-Condition & Repetition	
	Script View	
Bin. li 💮	Revision History Ctrl+Alt+H	
		-

In LA CO	555 Di 000	0.0.1	
	_		
			🛱 🕒 - 🗗
Table View	×		
6	S1.	، <mark>ال</mark>	eneral Diect
Vame	State 1	V	V
/ L1-E: V L1-E	63.51 V	0,00	50.00 Hz
12-E: V12-E	63.51 V	-120:00*	50.00 Hz
13-E: V L3-E	63.51 V	120.00 °	50.00 Hz
L1: L1	1.000 A	0.00 *	50.00 Hz
12:112	1.000 A	-120.00 °	50.00 Hz
L3: 1 L3	1.000 A	120.00 °	50.00 Hz
Sin. Out	B1 B2	J- B3. J-	B4
Frigger	0 4	- <u>©</u> -	1.000 s
Гуре	Normal		~
Comment			
Trigger Condition	C1 O Trip		
šin. Input			

and the second second		T State type	
Device Settings			- 0
evice Settings			
Device		Nominal Values	·
Name/Description :		f nom :	50.00 Hz
Manufacturer :		V nom(secondary)	: 110.0 V(L-L)
Device Type :			63.51 V(L-N)
Device Address :		V primary :	230.0 kV(L-L)
Serial/Model Number :			132.8 kV(L-N)
		I nom(secondary) :	1.000 A
Additional Information1:		I primary :	1.000 kA
Additional Information2 :		Residual Voltage	e/Current Factors —
Substation		VLN/VN :	1.730
Name :		IN/I nom	1.000
Address :		Limits	
Bay		V max :	132.0 V
Name :		I max :	64.00 A
Address :		Debounce/Degli	tch Filters
		Debounce Time :	3.000 ms
		Degitch Time :	400.0 µs
Save to Template	Load Template	Export Import	OK Cancel

Table View	×	
(i)	🗖 S1	Normal General: Direct
Name	State 1	
VL1-E: VL1-E	63.51 V 0.000 1/s	0 900 Hz
VL2-E: VL2-E	63.51 V 0.000 1/s	0.000 Hz
VL3-E: VL3-E	63.51 V 0.000 1/s	0.000 Hz
1L1:1L1	1.000 A 0.000 1/s	the second se
112:112	1.000 A 0.000 1/s	
1 L3: 1 L3	1.000 A 0.000 1/s	0.000 Hz
Bin. Out	B1. J- B2. J- B3	/- B4/-
Trigger	-C-	1.000 s
Туре	Normal	~
Comment		
Condition	C1 O Trip	
Bin. <mark>In</mark> put		

In the "Bin. Out" section, the open/close state of "Binary Outputs" of the device is determined in accordance with the user's wish. In the "Trigger" section, the conditions of "state" completion are determined which can be based on time, by pressing "space" button by the user and, also, based on receiving a specified signal from the relay or a combination of all three of these conditions. It is necessary to consider these two points:

The first point is that in this section, it is possible to activate the related condition by double-clicking on any of the icons. To adjust the settings related to the "Inputs" you can do so from "Detail View" window or simply by checking "Trigger Condition" option.

S	😬 👯 🛄 🗧 🛃 🗖 🖓	0 🛲 🖓 版 🔗 • 國 🖮 🔤 🖮 🚍 🥨 • 🗛 🔝 • 🕹 🔤 🗶 Connected 🕑
M 🔺 🔤	¹ ► M ○ \$ \$ \$ • • •	E ALL State Current State
Table View		👱 📴 Detail View: (S1: State 1) 🗙 👘
ê	S1 Normal General: Direct	Analog Out Binary Oyr Trigger Serial Report Setting
Name	State 1	Comment
VL1-E: VL1-E		r State termination
V L2-E: V L2-E		☑ Timeout : 1.000 s
V L3-E: V L3-E		Space Key Press
L1: L1 L2: L2	1.000 A 0.000 1/s 0.000 Hz 1.000 A 0.000 1/s 0.000 Hz	Use binary trigger condition as specified below
1 L3: 1 L3	1.000 A 0.000 1/s 0.000 Hz	Binary trigger condition
Bin. Out	B1. J- B2. J- B3. J- B4. J-	Trigger Logic : O AND O OR
Trigger	-C- 1.000 s	
Туре	Normal	C1:Trip : X 🗸
Comment	€3	Trigger Logic Minimum Time : 0.000 s
Trigger	C1 O	
Condition	Trip	Delay after Binary Trigger : 0.000 s
A		Error/Trigger Overcurrent
Δ		Overcurrent Trigger
Bin input		Overcament Broom 0.00 %
U		Threshold 0.000 A

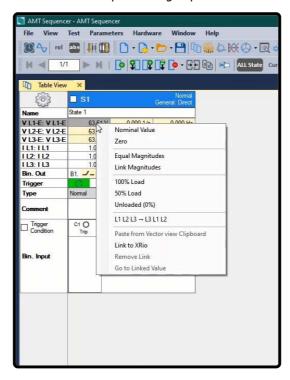
The second point: these conditions have "OR" logic with each other. This means that if several conditions are met, if one of them is true, the current "state" ends. In the next section the type of "state" is determined which can be selected from the available drop-down list. Note that each of these types is described in "Detail View" section. In "Bin. Input" section, the momentarily receival state of signal on every activated binary inputs is specified. In the "Comment" section, any important note about each "state" is recorded by the user. Note that entering information in this section is only possible in "Detail View" page.

	er - AMT Sequence Test Paramete		e Window
S A rel	abs ([[]	D • D • I	
Table View	×		
ê	🗌 S1	G	Normal ieneral Direct
Name	State 1		
V L1-E: V L1-E	63.51 V	0.000 1/s	0.000 Hz
VL2-E: VL2-E		0.000 1/s	0.000 Hz
VL3-E: VL3-E	63.51 V	0.000 1/s	0.000 Hz
1 L1: I L1		0.000 1/s	0.000 Hz
112:112		0.000 1/s	0.000 Hz
1 L3: 1 L3	1.000 A	0.000 1/s	0.000 Hz
Bin. Out	B1 B2	/- B3. /-	B4. 🖌 🗕
Trigger		-0-	1.000 s
Туре	Normal		Ý
Comment	Normal Quick Step Ramp		
	Continuous Ramp		
Condition	Hamonic Transient	5	
	Tracking	2	
P 1 1	Trip		
Bin. Input			

Right-click on "Table View" window

RMS value column

By right-clicking on any column of the "Table View" window, a list containing several options opens. Each of these options is designed for a specific purpose. After right-clicking on the column related to "RMS" value, by selecting "Nominal Value", the amount of current and voltage in each cell is changed to specified nominal values in "Device" block in "Test Object" page. By selecting "Zero" it is possible to set the cell value to zero. If the user wishes the voltage or current in all three phases to be equal to the selected cell value, they can select the "Equal Magnitudes" option. Also by checking "Link Magnitude" option, the values of all three phases will be linked together. It should be noted that if two groups of voltage or current are activated from "Hardware Configuration", you can see that the three phases of group A are linked together while the three phases of group B are linked together. To better understand this, enter 2amps as the current for one of the phases of group B.



Device	Nominal Values	
Name/Description :	f nom :	50.00 Hz
Manufacturer :	V nom(secondary) :	110.0 V(L-L)
Device Type :		63.51 V(L-N)
Device Address :	V primary :	230.0 kV(L-L)
Serial/Model Number :		132.8 kV(L-N)
	I nom(secondary) :	1.000 A
Additional Information 1 :	I primary :	1.000 kA
Additional Information2 :	Residual Voltage/Cu	Irrent Factors —
Substation	VLN/VN :	1.730
Name :	IN/I nom	1.000
Address :	Limits	
Bay	V max :	132.0 V
Name :	I max :	64.00 A
Address :	Debounce/Deglitch	Filters
	Debounce Time :	3.000 ms
	Deglitch Time :	400.0 µs

The "100% Load" option is used for changing the current to nominal value. The "50% Load" option is used for changing the current to half of the nominal value and the "Unloaded" option is used for changing the current to zero. Note that by selecting any of these options, the voltage is changed to the nominal value.

If the user copies the values of voltage and current by right-clicking in "Vector View" window and selecting "Copy to Clipboard", by selecting "Paste From Vector View Clipboard" in "Table View" window they can paste these values in their intended "state". Also, by clicking on "L1L2L3->L3L1L2" option, the rotation of the phases as well as their values will change.

AMT Sequence	r - AMT Sequencer			
File View 1	Test Parameters Hardwa	re Windo	w Help	
88 ↔ rel	■ (11) <mark> </mark>			
Table View	Vector View First: (S1	State ×		
Signal	Magnitude Harmonic 1 Phas		Imaginary	Show Arrow
VL1-E:VL1-E VL2-E:VL2-E VL3-E:VL3-E IL1:IL1 IL2:IL2 IL3:IL3 IL1(1):IL1(1) IL2(1):IL2(1) IL2(1):IL2(1)	S2 51 V 0.000 V 0.000 Nominal Value Zero Equal Magnitudes 100% Load 50% Load Unloaded (0%) L1 L2 L3		0.000 V 0.000 V 0.000 V 0.000 A 0.000 A 0.000 A 0.000 A 0.000 A	True True True True True True True True
	Copyto Clipboard Show/Hide Link to XRio Remove Link		90	

	er - AMT Sequence Test Paramete	
		D • 🕞 • 🗁 • 💾 🐚 🎧 🕹 🛞 • 🗟 🐝
1/1	▶ ₩	💁 💱 💱 📭 - 🕂 🖭 📾 🖬 All State Curren
Table View	× 🕐 Vector	View First: (S1: State
() ()	🗆 S1	Normal General: Direct
Name	State 1	
VL1-E: VL1-E	63.51	Nominal Value
VL2-E: VL2-E	63.51	Zero
VL3-E: VL3-E	63.51	Zero
1L1:1L1 1L2:1L2	0.000	Equal Magnitudes
112:112	0.000	Link Magnitudes
I L1(1): I L1(1)	0.000	
I L2(1): I L2(1)	0.000	100% Load
I L3(1): I L3(1)	0.000	50% Load
Bin. Out	B1 E	
Trigger		Unloaded (0%)
Туре	Normal	L1 L2 L3 - L3 L1 L2
Comment		Paste from Vector view Clipboard
		Link to XRio
Trigger	C1 O	Remove Link
	Trip	
		Go to Linked Value
Bin. Input		
on, apor		

"Link to XRio" option enables the user to relate the value of voltage, current, phase or frequency to any desired parameter in "XRio". By selecting this option, "Link to XRio" window opens where the desired parameter can be selected. For example, in the "XRio" tree diagram in "Rio" section, in "Nominal Value" branch in "Device" block, the "In" parameter is selected. Also, it is possible to multiply the selected parameter by a specific value or add it to a specific value which is, finally, displayed in the box at the bottom. On the top right of this window it is possible to search a parameter. By checking "Filter by Sender Unit" on the left, all "XRio" parameters which have the same "unit" with the selected parameter in "Sequencer" are marked.

Filter by sender unit Search: Script Functions Custom RIO Device Name Plate Location Nominal Values Phases f nom 	Filter by sender unit Script Functions Custom Custom RIO Device Name Plate Location Dominal Values Phases F nom V nom V prim L-L Iprim	Filter by sender unit Search: Script Functions Custom RIO Device Name Plate Location Nominal Values Phases fnom V nom V prim LL I prim 	Link to XRio —		×
Filter by sender unit Search: Script Functions Custom RIO Device Name Plate Location Nominal Values Phases f nom 	Filter by sender unit Script Functions Custom Custom Device Name Plate Location Nominal Values Phases Fnom V nom V prim L-L Iprim V	Filter by sender unit Script Functions Custom Custom BIO Device Name Plate Docation Noninal Values Phases Y nom Y prim LL Iprim V	Link to XRio —		
Custom	Custom Cu	Custom RIO Device Name Plate Location Nominal Values Phases f nom V rom V rom V prim L-L In	Filter by sender unit Search:		
	Alias name : In	1.0000 × 1.0000)	Custom RIO Device Name Plate Location Nominal Values Phases f nom V nom V nom V nom		
	= 1.0000 V		ОК	Cance	el

After linking the intended voltage, you can see that the selected cell is turned purple which indicates that this cell is linked with a value from the "XRio". By selecting "Go to Linked Value", it is possible to view that the selected parameter in "Sequencer" is linked with which parameter in "XRio". If the user does not wish the parameter to be linked with "XRio", it is possible to remove the link by selecting "Remove Link" option.

Table View	🗙 🕕 Vector Vi	ew First: (S1: S	tate				
Ś	□ S1	General, Direct					
Name	State 1						
VL1-E: VL1-E	3.000 V	0.00 *	50.00 Hz				
V L2-E: V L2-E	63.5 V	0.00 *	50.00 Hz				
VL3-E: VL3-E	63.51 V	0.00 *	50.00 Hz				
I L1: I L1	0.000 A	0.00 *	50.00 Hz				
112:112	0.000 A	0.00 °	50.00 Hz				
1 L3: I L3	0.000 A	0.00 °	50.00 Hz				
I L1(1): I L1(1)	0.000 A	0.00 *	50.00 Hz				
I L2(1): I L2(1)	0.000 A	0.00 *	50.00 Hz				
I L3(1): I L3(1)	0.000 A	0.00 *	50.00 Hz				
Bin. Out	B1. J- B2. J.	- B3. J-	B4				
Trigger	C	\succ	1.000 s				
Туре	Normal		~				
Comment							
☐ Trigger Condition	C1 O Trip						
Bin. Input							

Phase column

	Test Parameter		ware Window Help
rel 🕄		U • 🔒	• 🗁 • 💾 🛅 🧁 🕀 🚫 • 🗟 🧩
K < 1/1		91	🛱 📑 💽 🔁 📴 🔤 🗛 All State Current
Table View	× 🕐 Vector V	/iew First: ((S1: State
ŝ	🗆 S1		Normal General: Direct
Name	State 1		
VL1-E: VL1-E	3.000 V	0.00	
VL2-E: VL2-E	3.000 V	5	Line Angle
VL3-E: VL3-E	3.000 V		Zero
1 L1: I L1	0.000 A	_	90°
112:112	0.000 A	_	90
1 L3: 1 L3	0.000 A	_	Balance Angle
I L1(1): I L1(1)	0.000 A	_	
I L2(1): I L2(1)	0.000 A	_	Reverse Rotation
I L3(1): I L3(1)	0.000 A		Link Angles (Equal)
Bin. Out	B1 B2	-	
Trigger		9-1	Link Angles (Balance)
Туре	Normal		L1 L2 L3 → L3 L1 L2
Comment			Paste from Vector view Clipboard
Trigger	C1 O		Link to XRio
Condition	Trip		Remove Link
			Go to Linked Value
			GO LO LINKED VAIUE
Bin. Input			

By right-clicking on this column and selecting "Line Angle", the angles of the selected voltage or current will equal with angle value of transmission line. It is possible to view and adjust this value in "Distance" block in "Test Object" page. By selecting "Zero", it is possible to set the selected voltage or current to zero. If the user wishes to have the minimum amount of received current in the beginning of voltage injection, by selecting "90°" option, the phase of the injected voltage is set to 90 degrees. Balance Angle" option is selected for each cell, the related signal is selected as the reference signal and other phases are set at a degree with a 120 degrees, degree of difference with the reference signal.

The "Reverse Rotation" option does the same in counterclockwise. This means that if this option is selected for a cell, regardless of its phase value, -120 degrees is Added to the next phase, respectively. By clicking on "Link angles (Equals)", the angles of all three phases are equated and if one of them is changed, the others change accordingly. Also, the "Link angles (Balance)" option causes that if one of the phases is changed, the others change with a 120 degree difference.

"Frequency" Column

By selecting the "Nominal Value" from the options available for this column, the frequency value in each cell is changed to its nominal value in the "Device" block in the "Test Object" page. By selecting "DC", the frequency is changed to zero and it

is possible to produce "DC" signal.

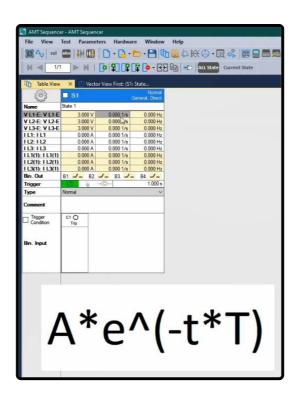
88 4√ rel	► H [Help
Table View	× Vector State 1	View First: (S1:	State Normal Seneral: Direct	
VL1-E: VL1-E VL2-E: VL2-E VL3-E: VL3-E IL1: 1L1 IL2: 1L2 IL3: 1L3 IL1(1): 1L1(1) IL2(1): 1L2(1) IL3(1): 1L3(1) Bin. Out Trigger Type	3.000 V 3.000 V 3.000 V 0.000 A 0.000 A 0.0	0.00 ° -120.00 ° 120.00 ° -75.00 ° -75.00 ° 0.00 ° 0.00 ° 0.00 ° -83	50.00 H2 50.00	Nominal Value DC Equal Frequency Link Frequency Paste from Vector view Clipboard Link to XRio Remove Link Go to Linked Value
Comment Trigger Condition Bin. Input	C1 O Trip			

If the user wishes all the frequency values to be equal, the "Equal Frequency" option can be used. By selecting this option for any cell, the frequency of other signals is set equal to the selected cell."Link Frequency" links all values of the frequencies with each other. This means that if one of the frequencies is changed, the other frequencies change the same amount as well and all the signals will always have the same frequency. If you need signals with different frequencies, you should uncheck this option.

Decaying signal

If you wish to create "DC" decaying signal, after setting the frequency to zero, it is possible to enter the time constant in the phase column. As you know, the relation of a decaying signal is written as " $A^*e^{-(-t^*T)}$ ". In this relation "A" is amplitude while "T" is the opposite of time constant. This means that the number you enter is the "T".

1/1				🗅 👬 🕁 👯 🕗 • 🗟 🐝 🗐
Table View		or View First: (S1:		
ê	🗆 S1	(Normal ieneral. Direct	
Name	State 1			
VL1-E: VL1-E	3.000 V	3.000 1/s	0.000 Hz	
VL2-E: VL2-E	3.000 V	0.000 1/s	0.000 Hz	
VL3-E: VL3-E	3.000 V	0.000 1/s	0.000 Hz	
1L1:1L1	0.000 A	0.000 1/s	0.000 Hz	N
112:112	A 000.0	0.000 1/s	0.000 Hz	G.
113:113	0.000 A	0.000 1/s	0.000 Hz	
I L1(1): I L1(1)	A 000.0	0.000 1/s	0.000 Hz	
I L2(1): I L2(1)	0.000 A	0.000 1/s	0.000 Hz	
I L3(1): I L3(1)	A 000.0	0.000 1/s	0.000 Hz	
Bin. Out	B1 B2.	J- B3. J-	B4. J-	
Trigger	(Q)	-©-	1.000 s	
Туре	Normal		~	
Comment				
Condition	C1 O Trip			
Bin. Input				



42 : THE SEPARATE TOOLBAR OF "TABLE VIEW" WINDOW

By double-clicking on any window in the software it is possible to maximize it and by repeating the double-click it is possible to restore the previous state. The separate toolbar of the "Table View" window is located in the second row at the top of the "Vebko AMPro" software in the "Sequencer" room. By using the "New State" option, it is possible to create a new "State". This "State" will be placed after the last created "State". This is equal to the "Append" option available by right-clicking anywhere at the top of any "State". When there are multiple "States", it is possible to make the intended "State" smaller by double-clicking on it or clicking on the cog icon and selecting "Small Mode".

203	□ S1	Ge	Normal eneral: Direct
Vame	State 1		
/ L1-E: V L1-E	63.51 V	0.00 *	50.00 Hz
/ L2-E: V L2-E	63.51 V	-120.00 *	50.00 Hz
/ L3-E: V L3-E		120.00 *	50.00 Hz
L1: L1	1.000 A	0.00 *	50.00 Hz
L2:1L2	1.000 A		50.00 Hz
L3: L3	-	120.00 *	
Bin. Out	B1 B2.	J - B3. J -	
l'rigger 💦	0	-0-	1.000 s
Гуре	Normal		~
Comment			
Trigger Condition	C1 O Trip		
Bin. Input			

	Test Param		e Window
rel 🕄	abs 🕴 🛄) D • Q • I	🗁 - 💾 🛙
M - 1/1	▶ M		P
Table View	×		
503	S 1		Normal General: Direct
Name	State 1		
VL1-E: VL1-E	63.51 V	0.00 *	50.00 Hz
V L2-E: V L2-E	63.51 V	-120.00 °	50.00 Hz
VL3-E: VL3-E	63.51 V	120.00 °	50.00 Hz
I L1: I L1	1.000 A	0.00 °	50.00 Hz
112:112	1.000 A	-120.00 °	50.00 Hz
I L3: I L3	1.000 A	120.00 °	50.00 Hz
Bin. Out	B1 B2	2. J- B3. J-	B4
Tri: 3ger	C I	-C-	1.000 s
Type	Normal		~
Countment			
Trigger	C1 O		
Condition	Trip		
Bin I. Input			

File View					
S A rei	abs (0	- 💽 - (-
H a 1/1		4 I	0		🛱 🧔 - 🖸
Table View	×	k	4		
ê	🗖 S1		U	G	Normal ieneral: Direct
Name	State 1		_		
V L1-E: V L1-E	63.5	il V		0.00 *	50.00 Hz
V L2-E: V L2-E		1 V		120.00 °	50.00 Hz
V L3-E: V L3-E	63.5	51 V		120.00 *	50.00 Hz
I L1: I L1		A 0		0.00 °	50.00 Hz
112:112	-	A 0		120.00 °	50.00 Hz
1 L3: 1 L3	and the second sec	A 0	3.5.5.1	120.00 *	50.00 Hz
Bin. Out	B1/-		710000	B3. 🤳 🗕	B4. ┛-
Trigger		6 .	-©		1.000 s
Туре	Normal				~
Comment					
Condition	C1 O Trip				
Bin. Input					

File View	icer - AMT Sequen Test Parame	ters Hardwar						
	/3 ► N							×.8
503	□ S1	0	Normal	□ S2			Normal General: Direct	□ S3
Name	Show Trigger Con			State 2		, ,	Jeneral, Direct	State 3
VL1-E:	Small Mode		3	63.5	11	0.00 *	50.00 Hz	63
VL2-E:	Enable Middle Cli	ck to Show Detai	View	63.5	Contraction -	-120.00 °	50.00 Hz	63
VL3-E: VL3		120.00	JU.UU FIZ			120.00 °	50.00 Hz	63
1 L1: I L1	1.000 A	0.00 *	50.00 Hz	1.00	A OI	0.00 °	50.00 Hz	1.
112:112	1.000 A	-120.00 °	50.00 Hz	1.00	A O	-120.00 °	50.00 Hz	1.
1 L3: I L3	1.000 A	120.00 °	50.00 Hz	1.00	A OI	120.00 °	50.00 Hz	1.
Bin. Out	B1 B2.	J - B3. J -	B4. 🖌 🗕	B1. 🤳 🗕	B2. 🤳 -	- B3. 🤳 -	- B4/-	B1. 🚽 –
Trigger		-©	1.000 s	CA I	-C)—	1.000 s	Q.
Туре	Normal		~	Normal			~	Normal
Comment								
Trigger Condition	C1 ()			C1 ()				C1 ()
- Condition	Trip			Trip	-			Trip
Bin. Input								

By using the "Delete State" option, it is possible to delete a "State". This option contains "Selected State" and "Unselected State". As you can see, there is a small square at the top of every "State". By checking this square, you can select this "State". If when deleting a "State", "Selected State" option is selected, all of the states whose "Square" has been checked will be deleted. If "Unselected State" is selected, all "States" whose square has not been checked will be deleted. You can view this option by right-clicking on the ribbon at the top of any "State" and selecting the "Delete" option. Moreover, by selecting a "State" and right-clicking on it and then selecting "Delete" or "Delete State" option from the toolbar, it is possible to delete that "State".

📑 AMT Sequence	er - AMT S	Sequencer				
File View	Test P	arameter	s Hard	lware	Window	He
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H 🚽 3/3	►	MI	• \$		• • • • •	
Table View	×				A	
503	🗌 S1	□ S2	S 3	67	U	
Name	State 1	State 2	State 3	-0		
VL1-E: VL1-E	63.51 V	63.51 V	63.51 V			
VL2-E: VL2-E	63.51 V	63.51 V	63.51 V			
V L3-E: V L3-E	63.51 V	63.51 V	63.51 V			
111:111	1.000 A		1.000 A			
112:112	1.000 A		1.000 A			
1 L3: 1 L3	1.000 A	1.000 A	1.000 A			
Bin. Out		105	(199)			
Trigger	1.000 s	1.000 s	1.000 s			
Туре	Normal	Normal	Normal			
Comment						
- Trigger	C1 O	C1 O	C1 O			
Condition						
Bin. Input						
			<u>.</u>			

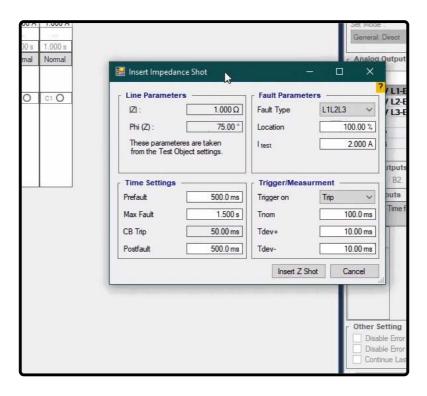
📘 AMT Sequence	er - AMT S	equencer				
File View	Test P	arameters	Hardware	Window	Help	
rel 🖉	abs Џ	(🎟 🛛 🖸) • 🔂 • 🗁	- 🕒 🔟	₩ ₽₩?	- 🖪 🐝 📑
K < 2/2		M O	\$1 C\$ C\$	[• - ⊡ €		State Current Sta
Table View	×			Selec	ted State	
	🗆 S1	S2		UnSe	lected State	
Name	State 1	State 2				
VL1-E: VL1-E	63.51 V	63.51 V				
VL2-E: VL2-E	63.51 V	63.51 V				
VL3-E: VL3-E	63.51 V	63.51 V				
1 L1: I L1	1.000 A	1.000 A				
112:112	1.000 A	1.000 A				
1 L3: 1 L3	1.000 A	1.000 A				
Bin. Out						
Trigger	1.000 s	1.000 s				
Туре	Normal	Normal				

	Test Par	rameters Hardware Wi	indow Help → III 🔐 🗭 💥 ⊘ - III 🐗 - III III III III III III III III III I
Table View	×		*
Name VL1-E: VL1-E VL2-E: VL2-E VL3-E: VL3-E IL1: IL1 IL2: IL2	63.51	Copy State Paste State Insert Copy After Insert Copy Before	
IL3: IL3 Bin. Out	1.000 /	Append Dele	Selected State UnSelected State
Trigger Type Comment	1.000 s Normal	Insert After Insert Z Shot	
Condition	c1 O	Default State	
Bin. Input			

If the user wishes to add a "State" and place this new "State" in a specific order, they can use "Insert Before" and "Insert After" options. In this case, the user clicks on a "State" and then selects "Insert Before" to add a new "State" with similar information before the current "State". By clicking on a "State" for the second time, the user can place the new "State" after the current "State" by selecting "Insert After". It is, also, possible to view these options by right-clicking on any "State".

To create an impedance shot in the "Sequencer" room, "Insert Z Shot" option can be used. By selecting this option, a window named "Insert Impedance Shot" opens where you can adjust the value of the parameters. In "Line Parameters" section, impedance of the line as well as its angle can be specified. To change these values, you should go to the "TestObject" page in the "Distance" block. In "Fault Parameters", the error information is specified. The type of the error, the location of the error in form of a relation of length of the line and the error current are specified in "Fault Type" section, "Location" and "Itest" section respectively.

📘 AMT Sequence	er - AMT S	equencer	<u>a</u>	
File View	Test P	arameter	s Hard	lware Window Help
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K 🚽 2/3		MI	• \$][
Table View	×			Insert Z Shot
ê	🗌 S1	S2	🗌 S3	
Name	State 1	State 2	State 3	
VL1-E: VL1-E	63.51 V	63.51 V	63.51 V	
VL2-E: VL2-E	63.51 V	63.51 V	63.51 V	
VL3-E: VL3-E	63.51 V	63.51 V	63.51 V	
1 L1: I L1	1.000 A	1.000 A	1.000 A	
112:112	1.000 A	1.000 A	1.000 A	
1 L3: 1 L3	1.000 A	1.000 A	1.000 A	
Bin. Out				
Trigger	1.000 s	1.000 s	1.000 s	
Туре	Normal	Normal	Normal	
Comment				
Trigger Condition	C1 O	C1 ()	C1 O	



In "Time Setting" section, the time related to "Prefault", "Maxfault" and "Postfault" "States" and also the delay time of the circuit breaker operation is specified. This value should be adjusted from the "CBConfiguration" block in "TestOject" page. In "Trigger/Measurement" section, the reception contact of "Trip" signal is specified and in the slide bar of that section, the active binaries of the device are displayed. You can see that only the binary number one is active here. Also, in "Tnom", "Tdev+" and "Tdev-"section, it is possible to adjust the nominal time for reception of "Trip" with the values of positive and negative tolerance for evaluation of the test in the "Measurement View" window. By selecting the "Insert Z Shot" option, three "States" are created consecutively after the current "State" with the names of "Prefault", "Maxfault" or "L1L2L3, 100%" and "Postfault". This can be done, also, by right-clicking on any of the "States" and selecting "Insert Z Shot".

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File View				~		-	Tree :		_
😰 🛅 Resize Columns : Auto 🔹 a	🖁 🔒 Recalco	ulate Disabled F	ormula(s)	4 Quick Acces	ss Ok	Cancel			
E-C7 XRio	CEConfiguration	- Crout breaker	configuration b	slack					
Script Functions		Name	1D	Description	Value	Type	Min	Max	Form
- G Custom		CB trip time	TRIPTIME	CB trip time	0.05 s		0.02	0.50	
E RIO	0	CB close time			0.10 s		0.02	0.50	
Device Distance	0	52a/b %	P52AB	52a/b %	20.00 %		0.00	45.00	
Auto Scroll	<							×	> Dear
		g						X C	Clear
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		g	•			1.	OK T	Show/Hid	Jear Jear

The "Default State" option in the right-click menu of "States" returns all values of "States" to the default settings in the "Device" block in "TestObject" page. "Select File to Merge" option is used when the user wishes to import the information of several "States" to his page from a saves test file. By selecting this option, the corresponding window opens and in "Select File" section, by selecting "Browse", you can select your intended file. By doing so, the "States" existent in the intended file are displayed. By checking any of these "States", you can select that "State" to import its information to the current page. Then, in the section related to "Insert Information", the intended location for importing the "State" and in "Current State" section, it is specified that the "State" should be added before or after the current "State" and in "Current State" section, it is possible to determine the current "State". Finally, by selecting "Add" you can import the information.

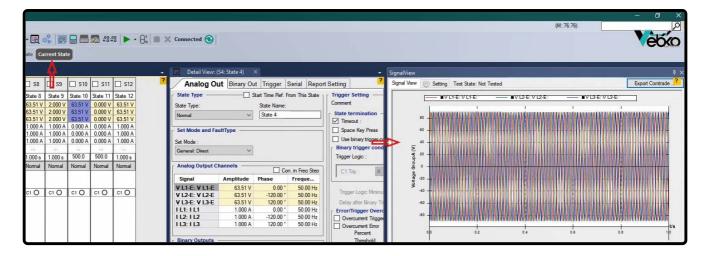
and the second s							₩Ø
4/6		NI	e ST		9 - Lit		ALL S
Table View	×				4		
503	🗌 S1	🗌 S2	🗌 S3	S4	🗆 S5	🗌 S6	
	State 1	State 2	Prefault	State 4	Postfault	State 6	
E: VL1-E	63.51 V	63.51 V	63.51 V	63.51 V	0 300 V	63.51 V	
E: VL2-E		63.51 V	63.51 V	63.51 V	0.000 V	63.51 V	
E: VL3-E	63.51 V	63.51 V	63.51 V	63.51 V	0.000 V	63.51 V	
L1	1.000 A	1.000 A	0.000 A	1.000 A	0.000 A	1.000 A	
L2	1.000 A	1.000 A	0.000 A	1.000 A	0.000 A	1.000 A	
113	1.000 A	1.000 A	0.000 A	1.000 A	0.000 A	1.000 A	
)ut	(***)	3.00					
भ	1.000 s	1.000 s	500.0	1.000 s	500.0	1.000 s	
	Normal	Normal	Normal	Normal	Normal	Normal	
ent							
ger ndition	C1 O	C1 O	C1 O	C1 ()	C1 O	C1 O	
nput							

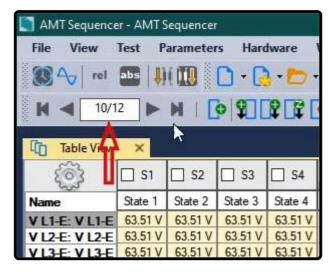
Hardware Window Help							
C		PG	180	₩ C	- 🗟 🖧		
53	S4	🗌 S5	⊑S6	S7	S8		
ault	State 4	State 5	Prefault	Postfault	State 8		
itv	63.51 V	2.000 V	63.51 V	0.000 V	63.51 V		
i V	63.51 V	2.000 V	63.51 V	0.000 V	63.51 V		
VI	63.51 V	2.000 V	63.51 V	0.000 V	63.51 V		
A 0	1.000 A	1.000 A	0.000 A	0.000 A	1.000 A		
A 0	1.000 A	1.000 A	0.000 A	0.000 A	1.000 A		
	1 000 A	1 000 A	0 000 A	0 000 A	1 000 A		

The next option is "Copy & Paste of State" and by selecting it, the corresponding window opens. In "States List For Copy" section of this window, the list of currently available "States" opens and by checking any of them, it is possible to select the information of that "State" for copying and in the "Options For Paste" section, just like the previous part, the location for pasting the "State" is specified. Also, in "Repetition" section, you can specify how many times this copying procedure is to be repeated. You can do this by using the options available in the right-click menu or any "State". By clicking on "Paste State", you can paste the copied "State" information to the current "State". If the user has changed the name of "States" and wishes to restore the default name of the "States", the "Correct Names of States" option can be used.

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s Hard	rs Hardware Window Help							
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Image: State Image: State Image: State Current State								
				Correct	name of 1	States		
🗌 S3	S4	🗌 S5	🗌 S6	S 7	🗌 S8	🗌 S9	S10	
State 3	State 4	State 5	State 6	Prefault	State 8	State 9	Prefault	
63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	2.000 V	63.51 V	
63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	2.000 V	63.51 V	
63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	2.000 V	63.51 V	
1.000 A	1.000 A	1.000 A	1.000 A	0.000 A	1.000 A	1.000 A	0.000 A	
1.000 A	1.000 A	1.000 A	1.000 A	0.000 A	1.000 A	1.000 A	0.000 A	
1.000 A	1.000 A	1.000 A	1.000 A	0.000 A	1.000 A	1.000 A	0.000 A	
	39 9		211		(2 4)			
1.000 s	1.000 s	1.000 s	1.000 s	500.0	1.000 s	1.000 s	500.0	
Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	

The last part has two options which are related to displaying the signal of "States" in the "Signal View" window. By selecting "All States", it is possible to view the voltage and current signals of all "States" in "Signal View" but if "Current State" is selected, it is only possible to view the signals of the current "State" in the "Signal View". At the left of the toolbar, the number of "States" and "State" numbers are displayed. In this section, it is possible to move to after and before the current "State" as well as the last and first "State" by using "Next State", "Previous State", "Last State" and "First State" respectively.





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\$][<mark>●</mark> - 🗄			State Cu	rrent Stat	e	
S3	S4	🗆 S5	🗌 S6	🗌 S7	🗆 S8	🗌 S9	🗌 S10	🗌 S1
ate 3	State 4	State 5	State 6	State 7	State 8	State 9	State 10	State 1
3.51 V	63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	2.000 V	63.51 V	0.000
3.51 V	63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	2.000 V	63.51 V	0.000
3.51 V	63.51 V	63.51 V	63.51 V	63.51 V	63.51 V	2.000 V	63.51 V	0.000
A 000	1.000 A	1.000 A	1.000 A	0.000 A	1.000 A	1.000 A	0.000 A	0.000
A 000	1.000 A	1.000 A	1.000 A	0.000 A	1.000 A	1.000 A	0.000 A	0.000
A 000	1.000 A	1.000 A	1.000 A	0.000 A	1.000 A	1.000 A	0.000 A	0.000

43 : "DETAIL VIEW" TAB

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				_
2	Detail View: (S Analog Out	-	-	Serial Report
	State Type	. Dinary Out	inggei	oenai report
	State Type:		State Name	
	Normal	~	State 1	
	- Set Mode and Faul	tТуре ———		
	Set Mode : General: Direct	~		
	Analog Output Cha	annels ——		
	Signal	Amplitude	Phase	Freque
	VL1-E: VL1-E	63.51 V	0.00 *	50.00 Hz
	V L2-E: V L2-E	63.51 V	-120.00 *	50.00 Hz
	VI2E-VI2E	C2 51 V	120.00 *	50 00 H-

After creating different "States" for the test in "Table View" window, it is necessary to specify the details of each "State" separately in "Detail View" window. To open this window, click on "Detail View" from the "View" menu or click on "Detail View" icon from the toolbar at the top of the page. you can Also keep "Alt" key and press left click or press mouse scroller to open "Detail View" as "Pop up" Style.

File Vie	w Test Parameters Hardwa	re Win
8	Toolbars	• E
M ~	Status Bar	•
0	Units	+
Name	Table View Ctrl+Alt+T	
V L1-	Measurment View Ctrl+Alt+M	
	Characteristic View Ctrl+Alt+	E I
	Vector View	•
Bin. C 🔆	Signal View Ctrl+Alt+S	
Trigge Type	Report View Ctrl+Alt+R	
Comm 🗔	Detail View Ctrl+Alt+D	4
Tric 🕉	Start-Condition & Repetition	
	Script View	
Bin. li	Revision History Ctrl+Alt+H	l.

a star	ALL State Cetail Views (S1:	/iew te		••••	- 6:
?	Analog Out		Trigger	Serial	Repo
	State Type		State Name		
	Normal	~	State 1	_	
	Set Mode and FaultT Set Mode : General: Direct	уре			
	Analog Output Chan)haaa	From	

"Analog Out" tab: Generally, in the "Analog Out" tab, the details related to each "State" including output voltage and currents of the device, the type of "State", the state of input and output binaries of the device, the ending conditions of each "State" and some other settings are mentioned.

ELE BO	ALL State Cu				- 6,
ED	ALL State CL	irrent state			
	Detail View: (S1: State 1) 🔷			
2	Analog Ou	It Binary Ou	t Trigger	Serial	Repor
	State Type				
	Sta Type:		State Name		
	Normal		State 1		
	1 m				100
	Set Mode : General: Direct	~			
		→ hannels —			
	General: Direct	hannels	Phase	Frequ	ie
	General: Direct		Phase 0.00 *		ie DO Hz
_	General: Direct Analog Output C	Amplitude	14-10023-0-14-	50.0	223.6
	General: Direct Analog Output C Signal V L1-E: V L1-E	Amplitude 63.51 V	0.00 *	50.0 50.0	00 Hz
	General: Direct Analog Output Cl Signal V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E I L1: I L1	Amplitude 63.51 V 63.51 V	0.00 ° -120.00 °	50.0 50.0 50.0	00 Hz 00 Hz
	General: Direct Analog Output Cl Signal VL1-E: VL1-E VL2-E: VL2-E VL3-E: VL3-E IL1: IL1 IL2: IL2	Amplitude 63.51 V 63.51 V 63.51 V 1.000 A 1.000 A	0.00 ° -120.00 ° 120.00 °	50.0 50.0 50.0 50.0 50.0	00 Hz 00 Hz 00 Hz 00 Hz 00 Hz 00 Hz
	General: Direct Analog Output Cl Signal V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E I L1: I L1	Amplitude 63.51 V 63.51 V 63.51 V 1.000 A	0.00 ° -120.00 ° 120.00 ° 0.00 °	50.0 50.0 50.0 50.0 50.0	00 Hz 00 Hz 00 Hz 00 Hz 00 Hz

"Binary Out" tab: In this tab, the settings related to opening and closing the active output binaries of the device and their connection with each other are adjusted.

- 🖓		(A) - 🗔 🖧		.00.00
•		ALL State Rurre	nt State	
	Detail View: (S1: State 🍿 🚿		
?	Analog Ou	It Binary Out	Trigger	Serial Repor
	State Type			
	State Type:		State Name:	
	production of the second secon			
	Normal Set Mode and Fa	ultType	State 1	
			State 1	
	Set Mode and Fa	ultType	State 1	
	- Set Mode and Fa Set Mode : General: Direct	ultType	State 1	Freque
	Set Mode and Fa Set Mode : General: Direct Analog Output C	ultType		Freque 50.00 Hz
	Set Mode and Fa Set Mode : General: Direct Analog Output C Signal	ultType	Phase	
	Set Mode and Fa Set Mode : General: Direct Analog Output C Signal V L1-E: V L1-E	hannels Amplitude 63.51 V	Phase 0.00 °	50.00 Hz
	Set Mode and Fa Set Mode : General: Direct Analog Output C Signal V L1-E: V L1-E V L2-E: V L2-E	hannels Amplitude 63.51 V 63.51 V	Phase 0.00 ° -120.00 °	50.00 Hz 50.00 Hz
	Set Mode and Fa Set Mode : General: Direct Analog Output C Signal V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E	Amplitude 63.51 V 63.51 V 63.51 V	Phase 0.00 ° -120.00 ° 120.00 °	50.00 Hz 50.00 Hz 50.00 Hz

"Trigger" tab: In "Trigger" tab, the ending conditions of each "State" and some settings related to the "Overcurrent" errors of the device are adjusted. Moreover, the comments of the testing person are recorded in the comment box of this section.

Window <u>H</u> elp	
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• • • • • • • • • • ALL State Current Stat	1.
👻 🙀 Detail View: (S1: State 1) 🛛 🗙	
Analog Out Binary Out Trigg	t Setting
Comment	
F State termination	
✓ Timeout : 1.000 s	
Space Key Press	
Use binary trigger condition as specified below	
Trigger Logic : O AND O OR	
C1:Trip : X	
Trigger Logic Minimum Time : 0.000 s	
Delay after Binary Trigger : 0.000 s	
r Error/Trigger Overcurrent	
Overcurrent Trigger	
Overcurrent Error Percent 0.00 %	
Threshold 0.000 A	

"Serial" tab: This tab is used to send a series of hardware codes in form of a "Packet" from the "AMT105" to an external instrument.

/ind	low Help
-	🕼 🤮 Þ 🕅 🖉 📲 🛃 🗱 🕨 - 83
	E E All State Current State
	Detail View: (S1: State 1) ×
?	Analog Out Binary Out Trigger Serial Report Setting
	Comment
	State termination
	✓ Timeout : 1.000 s
	Space Key Press
	Use binary trigger condition as specified below
	Binary trigger condition
	Trigger Logic : O AND O OR
I	C1:Trip: 1
I	Trigger Logic Minimum Time : 0.000 s
	Delay after Binary Trigger : 0.000 s
	Error/Trigger Overcurrent
	Overcurrent Trigger
	Overcurrent Error
	Threshold 0.000 A

"Report Setting" tab: This tab is used for the report settings of every "State". It is possible to add or remove the characteristics of the selected "State" to or from the report. In future videos, every introduced section along with its details will be explained separately.

ndow <u>H</u> elp
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ALL State Current State
Detail View: (S1: State 1) ×
Analog Out Binary Out Trigge Serial Report Setting
Serial Command

44 : ANALOG OUT TAB

In the beginning of this video, we close the "Measurement View" window and change the size of other windows. In "State Type" section, the type of "State" is selected from the "State Type" dropdown field and in the "State Name" field a name (Vebko) is selected for the "State".

AMT Sequence	r - AMTS	equencer				
<u>File View</u>	Test Pa	arameters <u>H</u> ardw	are Window <u>H</u>	lelp		
😻 🔶 rei	abs Џ	(🔟 🚺 · 💽 ·	- 🕒 🔁		- 🗟 🐝	
₩ ◀ 1/1	►	M [0 \$] [\$	🛱 🌔 - 🖅 🕅	ALL S	tate Currer	it State
Table View	×	+	Detail View: (S1: State 1) 🛛 🗙		
ŝ	<mark> S1</mark>	?	The second s	It Binary Out	Trigger	Serial Re
Name	State 1		State Type			
VL1-E: VL1-E	63.51 V		State Type:		State Name:	
V L2-E: V L2-E	63.51 V		Normal		State 1	
V L3-E: V L3-E	63.51 V		Normal	-		
I L1: I L1	1.000 A		- Quick			
1L2:1L2	1.000 A		Step Ramp			
1 L3: 1 L3	1.000 A		Continuous Ramp			
Bin. Out			Harmonic			
Trigger	1.000 s		Tracking			
Туре	Normal		Analog Output CI	nannels —		
Comment			Signal	Amplitude	Phase	Freque
	~		V L1-E: V L1-E	63.51 V	0.00 *	50.00 H
	C1 ()		V L2-E: V L2-E	63.51 V	-120.00 *	50.00 H
Condition			VL3-E: VL3-E	63.51 V	120.00*	50.00 H
			1 L1: I L1	1.000 A	0.00 *	50.00 H
Bin, Input			1L2:1L2	1.000 A	-120.00 *	
oin. input			1 L3: 1 L3	1.000 A	120.00 °	50.00 H
			Binary Outputs			_

In "Set Mode and Fault Type" section, the outputs of the device are specified according to parameters and types of faults. For example, in "Direct" mode, the output voltage and current of the device are determined directly but in "Line-Line" mode, the user specifies values of the line voltage and the zero sequence voltage, and the device produces the output voltage and current values in accordance with those other values. It should be noted that in this video, the instruction is done in "Direct" mode and descriptions about different "Set Modes" will be provided in future videos.

AMT Sequence <u>F</u> ile <u>V</u> iew	22.2		lwar	e Window <u>H</u> elj	,			
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₩ ◄ 1/1		1 0 9		F 🕒 - 🗗 🕼	E ALL S	tate Curren	t State	
Table View	×	÷		Detail View: (S1: N	ormal) ×			
203	S1	2		Analog Out	Binary Out	Trigger	Serial	Rep
Name	NORMA		F	State Type				
VL1-E: VL1-E	63.51 V			State Type:		State Name:		
VL2-E: VL2-E				Normal	~	NORMAL		
V L3-E: V L3-E				Nomia		Internet		
I L1: I L1	1.000 A			Set Mode and FaultT	vne -			
112:112	1.000 A			Set mode and rauti	ype			
1 L3: 1 L3	1.000 A			Set Mode :				
Bin. Out				General: Direct	NY			
Trigger	1.000 s			General: Direct	2			
Туре	Normal			General: Line-Line	-			
				General: Symmetrical Co General: Powers		2.7	1.1.1.1	
Comment				General: Foult Values		Phase	Frequ	ie
				Distance: Z-I const.		0.00 *	50.0	DO Hz
	C1 O			Distance: Z-V const.		-120.00 *	50.0	DO Hz
- Conaition				Distance: Z-Zs const. Distance: Z%-I const.		120.00 *	50.0	DO Hz
				Distance: Z%-I const. Distance: Z%-V const.		0.00 *	50.0	DO Hz
-				Distance: Z%-Zs const.		-120.00 °	50.0	00 Hz
Bin. Input				Overcurrent: ITest		120.00 *	50.0	00 Hz
				Differential: IBias, Idiff				
				VI Starting: Current, Vol Transducer	tage			
				Meter		B4		

In "Binary Outputs" box, the state of binary Outputs of the device are specified where the user can enable or disable any binary according to the condition of the test. Moreover, from the "Binary Out" tab the user can adjust the settings related to binary Outputs in more details.

1	Analog Out	Binary Out	Trigger	Serial	Rep
	- State Type	11.			
	State Type:		State Name:		
	Normal	~	NORMAL		
	Set Mode and Fault	Туре ——	_		
	Set Mode				
	Set Mode :	~			
	Set Mode : General: Direct	~			
		v			
	General: Direct Analog Output Cha	h			
	General: Direct Analog Output Cha	h	Phase	Frequ	ie
	General: Direct Analog Output Cha	h	Theorem A. C.	10.000 C	ıe 00 Hz
	General: Direct Analog Output Cha Signal	Amplitude	TUGUNS VINIT	50.	
	General: Direct Analog Output Cha Signal V L1-E: V L1-E	Amplitude 47.74 V	0.00 ° -127.86 °	50. 50.	00 Hz
	General: Direct Analog Output Cha Signal V L1-E: V L1-E V L2-E: V L2-E	Amplitude 47.74 V 63.33 V	0.00 ° -127.86 ° 127.86 °	50. 50. 50.	00 Hz 00 Hz
	General: Direct Analog Output Cha Signal V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E	Amplitude 47.74 V 63.33 V 63.33 V	0.00 ° -127.86 ° 127.86 °	50. 50. 50. 50.	00 Hz 00 Hz 00 Hz

In "Binary Inputs" section, the state of active binaries of the device and the reception time of contact is specified. "Trigger setting" section: In "Comment" field, the user can add a note about the current "State". This note is, also, viewable from the "Table View" window, "Comment" field. In "State Termination" section, the user determines the conditions for termination of the current "State" and initiation of the next "State". In "Timeout" field, the signal injection time is determined by the user and after that the test ends or goes to the next "State".

Binary Outputs	k :		
B1/_ B2.	B3	B4. 🤳	
Binary Inputs	Trigger Conditio	on —	_
Show Time f	om this State	Show Only Last Ch	ange
C1 O			
Trip			

	Comment State termination Timeout : Space Key Press
	Use binary trigger condition as specified below Binary trigger condition Trigger Logic : O AND O OR
reque	C1:Trip : 1
50.00 Hz 50.00 Hz 50.00 Hz	Trigger Logic Minimum Time : 0 Delay after Binary Trigger : 0
50.00 Hz 50.00 Hz 50.00 Hz	Error/Trigger Overcurrent Overcurrent Trigger Overcurrent Error Percent

me:		Comment	COMMENT	
AL		State termination -	ß	1.000 s
		Use binary trigger c		ed below
		Binary trigger cond		
		Trigger Logic :	🔿 AND 🔘	OR
		C1:Trip : 1	~	
	Freque			
00 °	50.00 Hz	Translavia Maine		0.000 s
36 °	50.00 Hz	Trigger Logic Minim	im time .	
86 °	50.00 Hz	Delay after Binary Tr	igger :	0.000 s
° 00	50.00 Hz	F Error/Trigger Over	current	
00 °	50.00 Hz	Overcurrent Trigge	r	
00 °	50.00 Hz	Overcurrent Error Percent		0.00 %
www.		Threshold		0.000 A
1_		Synchronizer Mode		

If the user wishes to specify conditions to terminate the current "State" according to reception of "Pickup" and "Trip" signals from the relay, they need to use the "Use binary trigger condition as specified below" option. To do this, first, the needed binaries should be enabled from the "Hardware Configuration" page. Then, in "Binary Trigger Condition" section, the condition of each binary for terminating the current "State" is specified. The conditions that the user can use are mentioned in the slide bar in front of each contact.

Condition "0", no contact has been received by the binary. Condition "1", the binary, has received "Pick Up" or "Trip" contact. Condition "0 -> 1", the binary is first in "0" condition (no contact received) and then "Pick up" or "Trip" contact is received. In this condition, it is necessary for the binary to detect "0" to "1" signal. Condition "1 -> 0", the binary is, at first, in condition "1" (contact received) and then the contact is removed from the binary. In this condition, it is necessary for the binary to detect "1" to "0" signal. Condition "1 -> 0". "0 -> 1", if the binary detects any of the conditions "0 -> 1" or "1 -> 0", the termination command of "State" is made. Condition "X" means there is no condition determined for "State" termination of this binary. It should be noted that if more than one condition is determined for "State" termination, the user needs to choose one logic from "AND" and "OR" logics from the "Trigger Logic" section to apply to the determined conditions. By using the "AND" logic, to terminate the "State" all conditions should be met while by using "OR" logic, if any of the conditions is met, the "State" is terminated.

It should be noted that all this setting can be adjusted in "Binary Inputs" box by checking "Trigger Condition". In this section in "Detail View" window, by checking "Show Time from this State" option, the contact reception time origin since the current "State" started is specified. Also, if you wish only for the last binaries state change to be displayed, check

"Show only last change" and select one from among "1", "0" and "0&1" radio-buttons in accordance with your needs. "0&1" option displays the last state of zero and one. It should be reminded that in the default mode of the software, if the binary is open circuited, it means that no contact is received and when the two ends of the binary are short circuited it means that contact has been received. This setting can be adjusted by changing the value of each binary from "True" to "False" in "Reverse" column of the "Hardware Configuration" page.

Signal		Amplitude	Phase	Freque
V L1-E: V	/ L1-E	47.74 V	0.00 *	50.00 Hz
VL2-E: V	112-E	63.33 V	-127.86 *	50.00 Hz
VL3-E: N	L3-E	63.33 V	127.86 °	50.00 Hz
IL1: IL1		1.000 A	° 00.0	50.00 Hz
112:112	!	1.000 A	-120.00 *	50.00 Hz
113:113		1.000 A	120.00 °	50.00 Hz
and the second	1010200002	B3/_ Trigger Condi	2020 2020 2020 2020	3
Binary In	puts -[Service States and	tion 🗲	st Change

		y / Analog Inp							1775
	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
►C1	Trip	Trip	Dry	1.00 V	False -	None	True		(Short*)=>(input=1)
C2	Start	Start	Dry	1.00 V	Fals	None	True		(Short*)=>(input=1)
C3	Not Used	Not Used	Dry		Irue	None	True		
C4	Not Used	Not Used	Dry		False	None	True		
C5	Not Used	Not Used	Dry		False	None	True		
C6	Not Used	Not Used	Dry		False	None	True		
C7	Not Used	Not Used	Dry		False	None	True		
C8	Not Used	Not Used	Dry		False	None	True		
9 10	Not Used Not Used	Not Used Not Used	Shunt 1 Ohm			None None			

For example, from the "Hardware Configuration" window and "Binary / Analog Input", 6 binaries are selected with specific active "Targets". Then, in "Trigger" section, the conditions of the binary are set at "0" ."1"."1 > .0" .0 > .1 .0 > .1 .1 > .0 and X and "OR" is selected as the logic between them. In this case, by fulfilling any of condition, the current state is terminated but if "AND" logic is selected, all conditions must be fulfilled for the "State" to be terminated.

Note that in "State Termination" section, between "Time Out", "Space Key Press" and "Use Binary trigger condition as specified below" there is an "OR" logic and if they are selected simultaneously, if any of the conditions is fulfilled, the current "State" is terminated. By using "Trigger Logic Minimum Time", the user specifies that how long the determined condition should last for the "State" to be terminated. It should be noted that this feature only works on conditions "1" and "0".

In the field related to "Delay after Binary Trigger", the user makes a delay time between when the condition is fulfilled and when the "State" is terminated. For example, to simulate key performance delay, if 50 milliseconds is entered in this field,

the current "State" is terminated after a 50 milliseconds delay and the key cutoff time is simulated. View videos of "Synchronizer Room" to see how "Synchronizer Mode" works.

In "Other Setting" section, by checking "Disable Error Other", errors of "Other" type are disabled in the current "State". Also, by checking "Disable Error Overvoltage of Binary", the "Overvoltage" errors of the analog binary inputs of the device are disabled in the current "State".

State Type: State Name:											
Normal	~	NORMAL		٦							
Set Mode and F	aultType ——			-							
Set Mode :											
General: Direct	~										
Analog Output Channels											
Signal	Amplitude	Phase	Freque	1							
VLI-E: VLI-E	47.74 V	0.00 *	50.00 H	z							
VL2-E: VL2-E		-127.86 °	50.00 H	z							
VL3-E: VL3-E	63.33 V	127.86 *	50.00 H	z							
1 L1: I L1	1.000 A		50.00 H	z							
112:112	1.000 A	-120.00 °	50.00 Hz 50.00 Hz								
1 L3: I L3	1.000 A	120.00 °									
	Binary Inputs - Trigger Condition Show Time from this State Show Only Last Change Any 1 0 0 0 0 8 1										
Show Time fr	(Anv () 1 (And								
	() Any () 1 (~							
		○ Any ○ 1 (~ 0->1,1-> ~	0->1 ~	×							
And	∨ 1 O ⊂3 O			~							
And 0 ~ 1->0 C1 O C2 0	∨ 1 O ⊂3 O	 0->1,1-> C4 O 	0->1 ~ c5 O	×							
And 0 ~ 1->0 c1 O c2 0	∨ 1 O ⊂3 O	 0->1,1-> C4 O 	0->1 ~ c5 O	×							
And 0 ~ 1->0 C1 O C2 (Trip Sta <	∨ 1 O ⊂3 O	 0->1,1-> C4 O 	0->1 ~ c5 O	× T							
And 0 ~ 1->0 C1 O C2 (Trip Sta	V 1 O C3 O Trip L1	 Q>1,1-> C4 O Trip L2 	0->1 ~ c5 O	× T							

In the "Error/Trigger Overcurrent" box a condition for the software overcurrent error or the termination of the state in case high current extraction is specified. By selecting "Overcurrent trigger" if the current extracted is more than 2A from the device, current state terminate. Therefore the software applies the next "state" and if it's the last "state" the test ends without giving any error message.

-11	Trigger Setting	Disable Relay
	Comment COMMENT State termination	□ VA1 □ VA2 □ VA3 □ IA1 □ IA2 □ IA3
• Hz Hz	C1:Trip : 0 C2:Start : 1>0 C2:Start : 0>1,1 C2:Start : 0 C2:Start : 0>1,1 C2:Start : C2:Start : C2:Start :	
Hz Hz Hz Hz	Trigger Logic Minimum Time : 200.0 m Delay after Binary Trigger : 50.00 m Error/Trigger Overcurrent Overcurrent Trigger Overcurrent Finor	<u> </u>
0&1	Percent 0.00 Threshold 0.000 Synchronizer Mode	

In "Overcurrent" section, the user adjusts the settings related to "Overcurrent" error of the outputs of the voltage outputs. Note that the maximum current of each output is 400 milliamps and 2amps in transient state. In the field related to "Percent Error Overcurrent", the maximum voltage output current is specified in percent and in the field related to "Threshold Error Overcurrent", the maximum output current is specified as a number for the "Overcurrent" error. For example, if in the "Percent Error Overcurrent" field 90 percent is entered, if the output current of the device reaches to 90 percent of the voltage output current, which is 1.8 amps, the device errors. Also, if in the "Threshold Error Overcurrent"

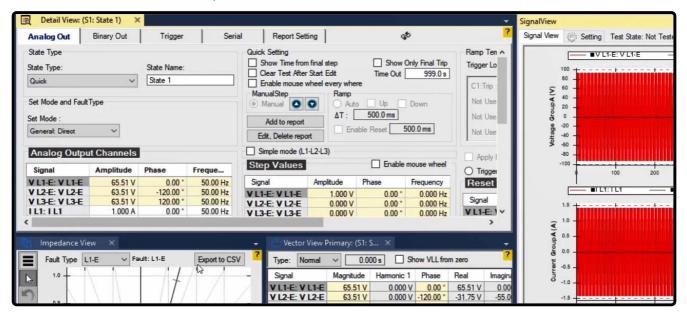
field, 1 amps is entered, as soon as the current drawn from the voltage outputs exceeds 1 amps, the "Overcurrent" error is displayed and the test stops.

"Disable Relay" section: Generally, the device works in a way that there are relays embedded behind all current and voltage outputs of the device. Before the test, all amplifiers of the device are off and all relays are open. By "Running" the test, the amplifiers turn on in 20 milliseconds, then, for 20 milliseconds the device produces a 60 volts voltage and 5 amps current and then examines that there is no "Self-calibration" error. After that, for 20 milliseconds, zero current and voltage are produced behind the current and voltage outputs. After these steps, the relays close. Now, after 100 milliseconds, the voltage and current of the test are created. By doing this before the test, the device is isolated from any outside voltage. Also, the amplifiers are off and the device is silent.

By checking the box next to the title of every output in each "State", the related relay opens and no more voltage or current is sent to the outputs. For example, to test "Magnetic Balance" of the transformer, it is necessary to open circuit some wiring in some state which it is done by disabling the relay of the related phase in the device.

45 : QUICK TYPE

because "State Type: Quick" is very useful, for this "State Type", there is a "Layout" named "Default Layout for Quick" designed for this "State Type" in "Window" menu. In this "Layout", "Detail View", "Signal View", "Impedance View" and "Vector View" windows are located by default.



To describe this "State Type" and to view the outputs, it is better to maximize only "Detail View" and "Signal View" windows. In this "State Type" it is possible to, either manually or automatically, adjust the voltage and current signal output of the device in form of an increasing or decreasing ramp. In this "State Type" the user can create an increasing or decreasing ramp not only on the amplitude of signals but also on phase and frequency values. In "Analog Out" tab in "State Type" section, "Quick" is selected from the slide bar and in the "State Name" field, a name is selected for the intended "State".

Description about "State Type: Quick" is provided in "General: Direct "mode. In this mode, the voltage and current signals are initialized directly. To create an increasing or decreasing ramp on outputs of the device, information of "Analog Output Channels" and "Step Values" tables should be completed.

"Analog Output Channels" table

In this table the start value of signals is entered which indicates the start point of the ramp. This start value can be entered for all three parameters amplitude, phase and frequency of current or voltage. It should be noted that it is possible to use ramp on both voltage and current signals simultaneously. For example, the start values of voltage signals are "10", "15", and "20" volts and "2", "3" and "4" amps for current signals. Other information related to "Analog Output Channels" has been described before.

"Step Values" table

In this table, the value of "Step" to increase or decrease signals is entered. In this table it is possible to enter the "Step" value for all three parameters amplitude, phase and frequency. This means that it is possible to increase or decrease all these parameters simultaneously with different or the same amplitudes. At the top of this table, by checking "Simple mode (L1-L2-L3)", you will have the same steps for all three voltage or current phases. After checking this option in "Voltage" and "Current" sections, the parameter on which we wish to create a ramp is selected from the slide bar in the "Ramp on" section. Then, the "Step" value is entered in "Step Value" field.

After unchecking "Simple mode(L1-L2-L3)", in "Step Values" table, "1", "2" and "3" volts are entered for voltage signals as

ramp values while for current signals, "0.1", "0.2" and "0.3" amps are entered as ramp values.

By checking "Enable mouse wheel" option, if the cursor is on "Step Values" table, by using the mouse wheel, it is possible to increase or decrease the signal values and the specified steps simultaneously. This can be during or even before running the test. It should be noted that these changes are only possible if the ramp is set on "Manual" mode.

"Quick Setting" section

In this section by checking "Show Time from final step", the time from the final step is displayed. One of the uses for this is in measuring the trip time of the relay. By checking "Clear Test after Start Edit" after running the test, if any changes are made to the test, without using the Clear test option, Information and setting can be altered.

By checking the "Enable mouse wheel everywhere" option and holding the mouse pointer over the "Detail View" window, the values of the signals will increase or decrease with the specified steps if the mouse roller is rotated. If the mouse roller is turned upwards, the ramp will be incremental, and if it is rotated downwards, the ramp will be decreasing. This option is also used when the ramp is changed manually. If you also check the "Enable mouse wheel on step Table" option, the output values will change only by turning the mouse roller if the mouse pointer is on the "Step Values" table.

By checking "Show Only Final Trip" option, the trip time is displayed by binary inputs of the last step. In "Time Out" field, the injection time of "State" is specified which is by default in set on "999" seconds in "Quick" mode. In "Quick" mode, the ramp is created either automatically or manually. After running the test if the "Manual" option is selected, the ramp is

created manually and by clicking on " Λ " and "V" it is possible to create increasing or decreasing ramp.

If during the test "Auto" option is selected, ramp is created automatically. In " Δt " field the time of each step is specified.

By selecting "Up", the ramp increases automatically and by selecting "Down" it decreases automatically. In "Enable Reset" field, it is possible to specify the reset time of signal value in a way that after checking this option during the test, the signal value is "Reset" for the specified period of time which is determined in "Reset" in "Reset Values" table.

In this "State Type" it is possible to add information and results of the test to the output report by clicking on "Add to report" option. After clicking on this option, by opening the "State and Comment of Report" page, the settings related to the output report are adjusted. In the "Title" field, a title is entered for the output report and in "Show in Report" section from the "Quick" tree diagram, it is specified that what information are to be included in the output report. In "Comment" section, it is possible to add an additional comment or explanation for the report. In "Custom Image" section, you can add an image to the report. In this report, it is the user who determines whether the test was successful or not by clicking on "Passed" option for success and "Failed" option for failure of the test. Then, the result is included in the report which can be viewed in the "Report View" window.

By clicking on "Edit.Delete.Report" option, the "Delete from Report" window opens where it is possible to edit or delete the added reports. It is done by selecting the intended report and clicking on "Edit Selected Report" to edit the report and then clicking on "Passed" or "Fail". It is, also, possible to delete a report by clicking on "Delete Selected Report". In the row of every report there are columns like "Trip Time", "Detail View", etc. which are added to the report if "True" is selected as their value but "False" is selected, they are removed from the output report.

By clicking on "Swap" at the top of the page, "Quick Setting" and "Ramp Termination" sections are swapped. This is done, according to the user's need, to show the "Ramp Termination" section. In "Ramp Termination" section, the conditions for terminating the "Ramp" are specified. The difference between this section and "State Termination" is that here the signal injection is continued and only step change of signals is terminated but in "State Termination" after the condition is met, the "State" is terminated. The termination conditions of "Ramp" are just like "Trigger Setting" which has been described in previous videos.

By selecting "Reset Value", it is possible to adjust the "Reset" value for voltage and current signals in "Reset Values" table so if "Apply Reset" is selected during the test, the values of voltage and current signals change to the specified "Reset" values. This feature is useful in tests like "Minimum Voltage to Operate Circuit breaker. By clicking on "Apply Zero", the values of voltage and current signals are changed to zero. By clicking on "Hold Value", the values of voltage and current signals remain as they are and do not change.

The information related to "Trigger Setting" has been described in previous videos. By selecting "Offset Value", it is possible to give an offset to the signal in the "Offset Value" table. For example it is possible to give a value of "DC=10" volts to "VLE-1" signal or even give a value of decaying "DC" to the initial voltage. It is also possible to add a harmonic offset to the initial signal by changing the frequency. After repeating the test, all changes made along with their time are displayed in "Changes" section. "Disable Relay" section has been described in previous videos.

46 : STEP RAMP TYPE

To better explain this "State Type", other than "Detail View" window, "Signal View" window is maximized too so you can view the outputs. In the "Signal View" window, the signal view type is set on "RMS" mode, "Digital" signals are disabled and, to have a better view of the signals, the signals are turned "Bold".



lignalView				
Signal View 💮 Set	ting Test State: No	ot Tested		Export Co
Voltage Group	A 🗹 Current Gro	upA 🗹 Digita	Noltage All 🗌 Current Al	I 🗌 VL1-E 🗌 VL2-E 🗌 VL3-E
<				
General Setting				
Show Table —			T Extra Setting	Show Type
Data table			Snap	O Inst.
Cursor			Live Scroll	RMS
Show All	Cursor [Data Table	Highlight Current State	43
Cursor 1			Show Time On Binary	
Cumor 2			Extra Options	

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	ł	1	
- 18 - S	·		
•	1	1	
	VL1-EI	/ L1-E	
•	V L2-E: V	/ L2-E	1
	V L3-E: V	/ L3-E	
-		1	_
	0.35	0.40	
3: T L3			
1	- ,		
		V L1-E: V V L2-E: V V L3-E: V 0.36	VL1-E: VL1-E VL2-E: VL2-E VL3-E: VL3-E 0.35 0.40

In this "State Type", it is possible to set the voltage and current outputs of the device to increasing or decreasing "Ramp. This "State Type" is used when the user wishes to get a threshold for a parameter. It should be mentioned that it is possible to apply this "Ramp" to amplitude, phase and frequency or a combination of these options for voltage and current signals.

Analog Ou	It Binary Out	Trigger	Serial	Repor
State Type				1
State Type:		State Name:	5	
Step Ramp	~	State 1		
Set Mode :				
General: Direct Start Value	~			
General: Direct	Amplitude	C C	on. in Frea Freque	
General: Direct Start Value			Freque	
General: Direct Start Value Signal	Amplitude	Phase	Freque	e
General: Direct Start Value Signal V L1-E: V L1-E	Amplitude 63.51 V	Phase 0.00 *	Freque 50.0 50.0	e 0 Hz
General: Direct Start Value Signal V L1-E: V L1-E V L2-E: V L2-E	Amplitude 63.51 V 63.51 V	Phase 0.00 ° -120.00 °	Freque 50.0 50.0 50.0	e O Hz O Hz
General: Direct Start Value Signal V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E	Amplitude 63.51 V 63.51 V 63.51 V	Phase 0.00 ° -120.00 ° 120.00 °	Freque 50.0 50.0 50.0 50.0	e O Hz O Hz O Hz

It should be noted that, to better understand the concept of "Step Ramp", only "General: Direct" mode is explained. Creating a "Ramp" output requires three values: start value, step value and final value.

Set Mode :	ultType			Ramp Des Number Of Total Time:	Step Ra 500.0 m	mps:1 s		
General: Direct	×]			No Error In	Step Ra	mp		
Start Value		Cor	n. in Frea Step	Step Value	es —			
Signal	Amplitude	Phase	Freque	Signal	3	Amplitude	Phase	Freque
VL1-E: VL1-E	63.51 V	0.00 *	50.00 Hz	VL1-E: V	L1-E	0.000 V	0.00 *	0.000 Hz
VL2-E: VL2-E	63.51 V	-120.00 *	50.00 Hz	VL2-E: V	L2-E	0.000 V	0.00 *	0.000 Hz
VL3-E: VL3-E	63.51 V	120.00 *	50.00 Hz	VL3-E: V	L3-E	0.000 V	0.00 *	0.000 Hz
1L1:1L1	1.000 A	0.00 *	50.00 Hz	I L1: I L1		0.000 A	0.00 °	0.000 Hz
112:112	1.000 A	-120.00 °	50.00 Hz	112:112		0.000 A	0.00 *	0.000 Hz
1 L3: I L3	1.000 A	120.00 °	50.00 Hz	1L3:1L3		0.000 A	0.00 *	0.000 Hz
NESS ANTIMAL AND AND AND				Final Value	es 🔫			
Binary Outputs								
Binary Outputs B1/ B2	/_ B3/_	B4. 🤳		Signal	_	Amplitude	Phase	Freque
1200	105	S (177429		Signal	L1-E	Amplitude 63.51 V	Phase 0.00 *	Freque 50.00 Hz
B1 B2	Trigger Condit	S (177429	st Change					50.00 Hz
B1 B2 Binary Inputs -[Trigger Condit	tion	st Change	VL1-E: V	L2-E	63.51 V	0.00 *	
B1/_ B2 Binary Inputs -[Show Time from Show Time from	Trigger Condit	tion	st Change	V L1-E: V V L2-E: V	L2-E	63.51 V 63.51 V	0.00 ° -120.00 °	50.00 Hz 50.00 Hz
B1 B2 Binary Inputs -[Trigger Condit	tion	st Change	V L1-E: V V L2-E: V V L3-E: V	L2-E L3-E	63.51 V 63.51 V 63.51 V	0.00 * -120.00 * 120.00 *	50.00 Hz 50.00 Hz 50.00 Hz

"Start Values" table

In this section, the start value of "Ramp" is specified and it indicates that from what point the "Ramp" should start. These values can be specified for the three parameters of amplitude, phase and frequency separately. For example, values of voltage in this section are set at 5, 10 and 15 volts. "Binary Output", "Binary Input" and "Other Setting" sections are explained in previous videos and will not be mentioned here.

General: Direct	~			No Error In Step Ra
Start Value —		Co	n. in Nea Step	Step Values —
Signal	Amplitude	Phase	Freque	Signal
VL1-E: VL1-E	63.51 V	0.00 *	50.00 Hz	VL1-E: VL1-E
V L2-E: V L2-E	69.51 V	-120.00 °	50.00 Hz	VL2-E: VL2-E
VL3-E: VL3-E	Min: -	76.21 V, Max: 7	76.21 V	
L1: L1	• 10.61 million	Value: 63.51 V,		3.5085296108588 V
112:112	1.000 A	-120.00	50.00 Hz	112:112
I L3: I L3	1.000 A	120.00 *	50.00 Hz	113:113
Binary Outputs				Final Values

"Step Values" section

In "Step Values" section, the value for every "Step" is specified. These values can be specified for the three parameters of amplitude, phase and frequency separately. For example, the value of "Step" for voltage is set at 1, 2 and 2 volts.

Signal	Amplitude	Phase	Freque
VL1-E: VL1-E	1.000 V	0.00 *	0.000 Hz
VL2-E: VL2-E	2.000 V	0.00 *	0.000 Hz
VL3-E: VL3-E	3.000 V	0.00 *	0.000 Hz
I L1: I L1	0.000 A	0.00 °	0.000 Hz
112:112	0.000 A	° 00.0	0.000 Hz
113:113	0.000 A	0.00 *	0.000 Hz

"Final Values" section

In this section, the final value of the ramp signal is specified which indicates that at what point should the ramp finish. These values can be specified for the three parameters of amplitude, phase and frequency separately. The final value of voltage in this section is 20, 25 and 30 volts.

Signal	Amplitude	Phase	Freque
VL1-E: VL1-E	20.00 V	0.00 *	50.00 Hz
VL2-E: VL2-E	25.00 V	-120.00 °	50.00 Hz
VL3-E: VL3-E	30.00 V	120.00 °	50.00 Hz
I L1: I L1	1.000 A	0.00 °	50.00 Hz
112:112	1.000 A	-120.00 °	50.00 Hz
1 L3: 1 L3	1.000 A	120.00 °	50.00 Hz

You can see that the signal of all three voltage phases has reached from the start value to the final value, according to the specified steps, in form of a "Ramp". In the "Time Setting" box in "Step Ramp Setting" section, the time of each step is specified. This value is 500 milliseconds by default. By checking the "Enable Reset" option, it is possible to allow the signals to "Reset" after a specific time period. In "Reset Time" section, the time of each "Reset" step is specified which is added to the "State" time. To set the value and its parameter you should go to the bottom of the page in "Reset Values" section. This section and "Disable Relay" section has already been described in previous videos.

 Step Ramp S	etting —	Г Ramp Type —
Step Time	500.0 ms	Step Value
 Enable Res	set	Rate Value per second
- Reset Time	500.0 ms	

There are two options in the "Ramp Type" section where the first option, which is "Step Values", is active by default. By selecting this option, the settings are as described before. As you can see, for example in L1 phase, each "Step" is

increased by 1 volt every 500 milliseconds but by selecting "Rate Value per Second", the number of steps specified in the "Step Values" table is determined as value per second. For example, L1 phase should increase by 1 volt every second. According to the specified "Step Time", every second, there will be two 500millivolts step.

State Type: Step Ramp	~	State Name: State 1		Step Time Generating Section Step Time Reset Time	500.0 ms	Ramp Type – O Step Value Rate Value	
Set Mode and Far Set Mode : General: Direct	ultType			Ramp Descriptio Number Of Step Ra Total Time: 15.50 s No Error In Step Ra	imps: 31		
Start Value		Co	n. in Frea Step	Step Values —			
Signal	Amplitude	Phase	Freque	Signal	Amplitude	Phase	Freque
VL1-E: VL1-E	5.000 V	0.00 °	50.00 Hz	VL1-E: VL1-E	1.000 V/s	0.00 */s	0.000 Hz/s
VL2-E: VL2-E	10.00 V	-120.00 °	50.00 Hz	VL2-E: VL2-E	2.000 V/s	0.00 °/s	0.000 Hz/s
VL3-E: VL3-E	15.00 V	120.00 °	50.00 Hz	VL3-E: VL3-E	3.000 V/s	0.00 °/s	0.000 Hz/s
1 L1: I L1	1.000 A	0.00 °	50.00 Hz	111:111	0.000 A/s	0.00 °/s	0.000 Hz/s
112:112	1.000 A	-120.00 °	50.00 Hz	112:112	0.000 A/s	0.00 °/s	0.000 Hz/s
113:113	1.000 A	120.00 °	50.00 Hz	1L3:1L3	0.000 A/s	0.00 °/s	0.000 Hz/s

In "Ramp Description (Errors)" section, steps of the "Ramp", the total time of the "State" and the errors are described. By using the "Simple Mode" option, it is possible to specify the value of steps of the "Ramp" and the final value of the "Ramp" more easily. By checking the "Simple Mode" option, the settings of "Step Values" and "Final Values" table are disabled and a new section including voltage and current sections are opened.

In these sections, first, the parameter is selected from the slider bar. This slider bar includes amplitude, phase and frequency options. After selecting the parameter, two options are displayed. In the "Step Value" and "Final Value" fields, the step value of the "Ramp" and the final value of the "Ramp" are specified respectively. The difference between this option and the previous state is that in this state all three phases change simultaneously.

Current - Phase
Ramp on: Frequency
in equality

Voltage -				
Ramp on:	Amplitude		~	
Step	value:	1.000 V	Final value:	30.00 V

An important point in "Ramp" on frequency is that there will be signal jump. So, it is possible that while testing the frequency relays, an appropriate response is not received from the relay; while "Ramping" on a frequency, to keep the signal steady, it is necessary to check the "Continuous in Frequency Step". By specifying 2Hz as the start value of frequency and 3Hz as the "Step Ramp" and 50Hz as the final value, there will be a frequency jump in the output signal. To view this frequency jump, first, the output signal must be set on "Inst". As you can see, by checking "Continuous in Frequency Step", this frequency jump disappears.

47 : CONTINUOUS RAMP TYPE

This "State Type" is similar to "Step Ramp". The only difference is that in "Step Ramp" the parameter changes step by step at user-defined time intervals but in "Continuous Ramp", the parameters increase or decrease continuously with 400 microseconds time steps.

	mp Setting	
Total Time	1.000 s	
	1.000 a	

The parameters adjusted for "Continuous Ramp" include start value, final value and total time and the start values are specified in "Start Values" table. Here, the values for voltage signals are 5, 10 and 15 volts. "Binary Output", "Binary Input" and "Other Setting" sections have been described before and we can skip them. In "Final Values" table the final value of the parameters is specified. Here, the values for voltage signals are 20, 25 and 30 volts.

Signal	Amplitude	Phase	Freque
VL1-E: VL1-E	5.000 V	0.00 *	50.00 Hz
VL2-E: VL2-E	10.00 V	-120.00 °	50.00 Hz
VL3-E: VL3-E	15.00 V	120.00 *	50.00 Hz
I L1: I L1	1.000 A	° 00.0	50.00 Hz
112:112	1.000 A	-120.00 °	50.00 Hz
113:113	1.000 A	120.00 °	50.00 Hz

Signal	Amplitude	Phase	Freque	
VL1-E: VL1-E	20.00 V	0.00 *	50.00 Hz	
VL2-E: VL2-E	25.00 V	-120.00 *	50.00 Hz	
VL3-E: VL3-E	30.00 V	120.00 °	50.00 Hz	
111:111	1.000 A	0.00 *	50.00 Hz	
112:112	1.000 A	-120.00 °	50.00 Hz	
113:113	1.000 A	120.00 °	50.00 Hz	

In "Total Time" field in the "Continuous Ramp Setting" section the total time of the "State" is specified which is linked with the "Timeout" time in "State Termination" in "Trigger" setting. "Trigger", "Offset Value", "Error/Trigger Overcurrent" and "Disable Relay" sections have been described in previous videos and more descriptions should not be necessary here.

/ Timeout : Space Key Press		5.000 s
Use binary trigge Binary trigger co	r condition as specified below	
billary trigger co		
Trigger Logic :	O AND O OR	

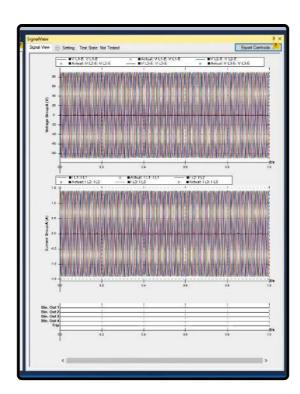
Another important matter about "Ramp" is that, in addition to put ramp on voltage and current, in "Step Ramp" the user can put ramp on impedance by changing the "Set Mode". Since the hardware is only capable of recognizing voltage and current and cannot recognize the impedance parameter, and because there are so many impedance parameters, it is not possible to send these parameters to the hardware in every "Step". So, in "Step Ramp" firstly all values of impedance steps are sent to the software and then measured voltage and current sent to the hardware as an array every time "Step" in "Continuous Ramp" is 400 microseconds, the amount of calculations and arrays is greatly increased and it is not possible for the results of the calculations and created arrays to be sent to the hardware. So, this "State Type" is always carried out in "General: Direct" mode.

Signal	Amplitude	Phase	Freque
VL1-E: VL1-E	2.000 V	0.00 *	50.00 Hz
VL2-E: VL2-E	63.51 V	-120.00 *	50.00 Hz
VL3-E: VL3-E	63.51 V	120.00 °	50.00 Hz
111:111	2.000 A	-80.00 °	50.00 Hz
112:112	0.000 A	0.00 °	50.00 Hz
113:113	0.000 A	0.00 °	50.00 Hz

Analog Ou	It Binary Ou	t Trigger	Serial Repo	rt Setting			
State Type	~			Continuious Ram	np Setting —		
State Type:		State Name:		Total Time	2.000 s		
Continuous Ramp	~	State 1		-			
Set Mode and Fau	итуре ——				N		
Set Mode :					15		
Set Mode : General: Direct	Y				G		
	~			Final Values —	63		
General: Direct	Amplitude	Phase	Freque	Final Values	Amplitude	Phase	Freque
General: Direct Start Value	Amplitude 5.000 V	Phase 0.00 *	Freque			Phase 0.00 *	Freque 50.00 Hz
General: Direct Start Value Signal	a construction of the second			Signal	Amplitude	10000000	
General: Direct Start Value Signal V L1-E: V L1-E	5.000 V	0.00 *	50.00 Hz	Signal V L1-E: V L1-E	Amplitude 20.00 V	0.00 *	50.00 Hz
General: Direct Start Value Signal V L1-E: V L1-E V L2-E: V L2-E	5.000 V 10.00 V	0.00 * -120.00 *	50.00 Hz 50.00 Hz	Signal V L1-E: V L1-E V L2-E: V L2-E	Amplitude 20.00 V 25.00 V	0.00 ° -120.00 °	50.00 Hz 50.00 Hz
General: Direct Start Value Signal V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E	5.000 V 10.00 V 15.00 V	0.00 * -120.00 * 120.00 *	50.00 Hz 50.00 Hz 50.00 Hz	Signal V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E	Amplitude 20.00 V 25.00 V 63.51 V	0.00 ° -120.00 ° 120.00 °	50.00 Hz 50.00 Hz 50.00 Hz

48 : HARMONIC STATE

In order to better explain this "State Type", in addition to magnifying "Detail View" window, the "Signal View" window is also magnified to observe outputs. As you are aware, based on the Fourier series expansion, a periodic signal can be expressed in terms of the sum of several sinusoidal waves with various coefficients and frequencies. In "Harmonic" State Type, the user can inject voltage signals and harmonic current by"AMT105" device. To this purpose, in "Detail View" window, "Analog Out" tab and "State Type" part, the "Harmonic" State Type is selected from dropdown field. As can be observed, in this"State Type", the user can create and inject a signal with two desired harmonics. To this purpose, first the signal data or main harmonic should be entered in "Analog Output Channels" and the other two desired harmonics in "Free-Order Harmonic #2".

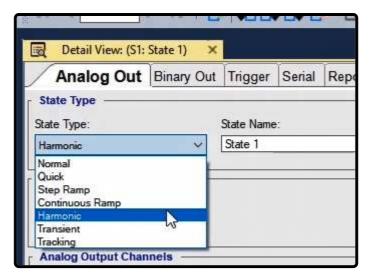


$$f(x) = \frac{1}{2}a_0 + \sum_{n=1}^{\infty} a_n \cos(nx) + \sum_{n=1}^{\infty} b_n \sin(nx),$$

$$a_0 = \frac{1}{T} \int_0^T f(x) dx$$

$$a_n = \frac{2}{T} \int_0^T f(x) Cos(n\omega x) dx, n = 1, 2, \dots$$

$$b_n = \frac{2}{T} \int_0^T f(x) Sin(n\omega x) dx, n = 1, 2, \dots$$



	Free-Order Harm	onic #1			Free-Order Harm	onic #2		
	Tree-order harn	ionic #1			Tree-order harn	AS THE		sī
Freque	Signal	Amplitude	Phase	Freque	Signal	Amplitude	Phase	Frequency
50.00 Hz	V L1-E: V L1-E	0.000 V	0.000 1/s	0.000 Hz	VL1-E: VL1-E	0.000 V	0.000 1/s	0.000 Hz
50.00 Hz	VL2-E: VL2-E	0.000 V	0.000 1/s	0.000 Hz	VL2-E: VL2-E	0.000 V	0.000 1/s	0.000 Hz
50.00 Hz	VL3-E: VL3-E	0.000 V	0.000 1/s	0.000 Hz	VL3-E: VL3-E	0.000 V	0.000 1/s	0.000 Hz
50.00 Hz	1L1:1L1	0.000 A	0.000 1/s	0.000 Hz	1L1:1L1	0.000 A	0.000 1/s	0.000 Hz
50.00 Hz	112:112	0.000 A	0.000 1/s	0.000 Hz	112:112	0.000 A	0.000 1/s	0.000 Hz
50.00 Hz	113:113	0.000 A	0.000 1/s	0.000 Hz	113:113	0.000 A	0.000 1/s	0.000 Hz

"Analog Output Channels" Table

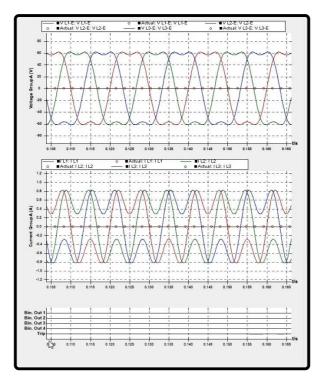
As aforementioned, the main harmonic data are entered in this table. These data include the amplitude, phase, and frequency of each signal. It is noteworthy that the harmonic voltage and current signals can be simultaneously injected by device. For example, the data of three balanced voltage signals with an amplitude of "50" V and a frequency of "50" Hz, and three balanced current signals with an amplitude of "500" milliampere (mA) and a frequency of "50" Hz are entered. Other parts of this section have been explained in previous films.

Signal	Amplitude	Phase	Freque	Sig
VL1-E: VL1-E	50.00 V	0.00 °	50.00 Hz	VL
VL2-E: VL2-E	50.00 V	-120.00 °	50.00 Hz	VL
VL3-E: VL3-E	50.00 V	120.00*	50.00 Hz	VL
111:111	50 QmA	0.00 *	50.00 Hz	LL
112:112		32.00 A, Max:		
113:113	Shown	Value: 1.000 A	, MainValue:	1A L3

Analog Output Channels Table

The data related to the desired "nth" harmonic signal are entered in this table. These data include amplitude, phase, and frequency, which are entered for voltage and current signals. It is noteworthy that the maximum allowed value for frequency is "1500" Hz. For example, the third harmonic data are entered in the table, including three voltage signals with an amplitude of "10" V and a frequency of "150" Hz and three current signals with an amplitude of "300" mA and a frequency of "150" Hz. After data were entered, the waveform corresponding to this signal containing the main and third harmonics is shown in "Signal View" window. During the test, the output waveform and the actual value of harmonic injected by the device can be observed in "Signal View".

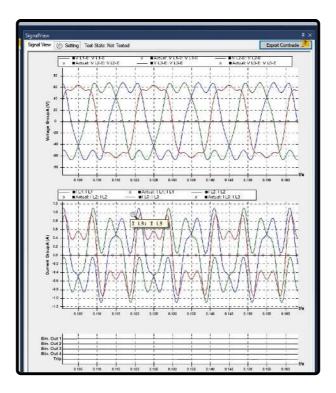
Signal	Amplitude	Phase	Freque	
VL1-E: VL1-E	10.00 V	0.00 *	150.0 Hz	
VL2-E: VL2-E	10.00 V	0.00 °	150.0 Hz	
VL3-E: VL3-E	10.00 V	0.00 *	150.0 Hz	
I L1: I L1	300.0 mA	0.00 °	150.0 Hz	
112:112	300.0 mA	0.00 °	150.0 Hz	
113:113	300.0 mA	0.00 *	150.0 Hz	



Free-Order Harmonic #1 Table

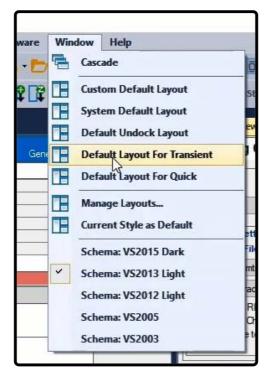
The data related to the desired nth harmonic signal are entered in this table. These data include amplitude, phase, and frequency that are entered for voltage and current signals. It should be noted that the maximum allowed value for frequency is "1500" Hz. For example, the fifth harmonic data are entered into the table, including three voltage signals with an amplitude of "5" V and a frequency of "250" Hz and three current signals with an amplitude of "200" mA and a frequency of "250" Hz. After data was entered, the waveform corresponding to this signal containing the main third and fifth harmonics is shown in "Signal View" window. During the test, the harmonic signal injected by the device can be observed in "Signal View". Please note that a decaying DC offset value can be used in this table instead of harmonic signal.

Signal	Amplitude	Phase	Frequency	
VL1-E: VL1-E	5.000 V	0.00 °	250.0 Hz	
VL2-E: VL2-E	5.000 V	0.00 *	250.0 Hz	
VL3-E: VL3-E	5.000 V	0.00 *	250.0 Hz	
111:111	200.0 mA	0.00 *	250.0 Hz	
112:112	200.0 mA	0.00 *	250.0 Hz	
1L3:1L3	200.0 mA	0.00 °	250.0 Hz	



49 : "TRANSIENT" STATE TYPE:

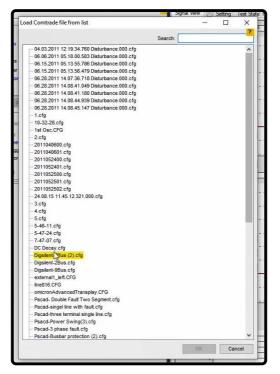
As mentioned before, one of the features of Vebko device and software is relay testing in transient state. To easily access the windows needed for this "State Type", a "Layout" named "Default Layout for Transient" is designed specifically for this state which is located in the "Windows" menu. This layout includes "Detail View", "Signal View", "Measurement View", "Vector View" and "Impedance View" windows. Here, to have a better view of the "Detail View" window, all other windows is closed. When a fault occurs, the relay saves the fault information and moments before the fault as a "Comtrade" file and provides the user with this file. By using this information it is possible to view impedance or differential trajectory or by injecting the same transient signal, simulate the fault moment and test the relay performance again.



Transient Setting —— Comtrade File ———	r Errors
Import Comtrade	No Error
Import Comtrade from list	D D
Calculate RMS Select All Channel Limit value to setting FileName:	

Other than "Comtrade" file with "cfg" extension, there is another file with "dat" extension. These two files have the same name and for the "comtrade" file to be loaded in the software, both files must be together.

In "Transient Setting" section, the settings related to "comtrade" file are adjusted. By selecting "Import Comtrade", the "comtrade" file exported from the relay is imported and loaded. Moreover, a list including several "comtrade" files is located in the software. By selecting "Import Comtrade from List" option this list opens and a file can be selected and loaded. After loading a transient file, the data related to that file is loaded in the table of this section. In "Signal" column, name of the output of the device is specified. To change the outputs of this section, "Analog Out" tab in the "Hardware Configuration" page can be used. In "Channel" column, current or voltage signals allocated to output of the device are displayed. By opening the drop down field, it is possible to change the allocated signal.



	V	_					- <u></u>
Signal	Channel		Scale	Min	Max	Prim. factor	Sec. factor
VL1-E	:Bus1:Phase Voltage A	K	100.0 %	-326.6 kV	326.6 kV	1.000 V	1.000 \
VL2-E	:Bus1:Phase Voltage B	63	100.0 %	-324.8 kV	324.8 kV	1.000 V	1.000 \
VL3-E	:Bus1:Phase Voltage C		100.0 %	-324.8 kV	324.8 kV	1.000 V	1.000 \
IL1	:Line:Phase Current A/Terminal i		100.0 %	-9.698 kA	12.70 kA	1.000 A	1.000 /
112	:Line:Phase Current B/Terminal i		100.0 %	-5.547kA	3.455 kA	1.000 A	1.000 /
113	I ine Phase Current C/Terminal i		100.0 %	.25 24 1-4	157864	1 000 4	1 000 /

In "Scale" column, the user can determine a specific percentage of the Transient signal amplitude for injection. In "Min" and "Max" columns, positive and negative amplitudes of signals of "Comtrade" file are specified. In "Pirm.factor" and "sec.factor" columns, the conversion ratio of "VT"s and "CT"s is specified in relation to the "Comtrade" file and it is possible that values of these coefficients are not the some in some files. In that case, the user needs to edit them. For example,

here "Prim.factor" is set at 1 kilovolt and by right-clicking on this column and selecting "Apply to all Voltage", this value is set for other voltages as well.

Scale	Min	Max	Prim. factor	Sec. factor	PS	^
100.0 %	-326.6 kV	326.6 kV	1.000 V	1.000 V	Primarv	
100.0 %	-324.8 kV	324.8 kV	1.000 V	1.000 V	Primarv	
100.0 %	-324.8 kV	324.8 kV	1.000 V	1.000 V	Primarv	
100.0 %	-9.698 kA	12.70 kA	1.000 A	1.000 A	Primary	
100.0 %	-5.547 kA	3.455 kA	1. 30 A	1.000 A	Primarv	
100.0 %	.25 24 64	1578 LA	1 000 A	1 000 4	Primary	~

In "PS" column, it is specified that the information of "Comtrade" is primary or secondary side. If it is "Primary", in "Min" and "Max" columns the secondary values are placed in "Prim.factor" and "Sec.factor" in accordance with the given conversion ratio. If "Secondary" is selected, in "Min" and "Max" columns, the original values of the file are placed. To calculate the "RMS" value of the signals of "Comtrade" file and displaying it in "Signal View", first, "Calculate RMS, Phase and Other" option should be checked and then in "Setting" tab, in "Show Type" box, the "RMS" radio button is checked. After seeing signal's "RMS" value, "show type" is get back to the instantaneous state.

Transien Comtra	nt Setting ——— de File ————				Original	ling Rate	a
Import	Import Comtrade VA1_Value				Used :	1.000 kHz	4
Import Comtrade from list					Frequency: 50.00 Hz		1
Calculate RMS Calculate RMS		3			Start time: 0.000 s		
nieraditie.	ugaient-zous (z)				End time	e: 9999.0 ms	
Signal	Channel		Scale	Min	Max	Prim. factor	Sec. factor ^
/ L1-E	:Bus1:Phase Volt	age A	100.0 %	-326.6 V	326.6 V	1.000 kV	1.000 \
112-E	:Bus1:Phase Volt	ade B	100.0 %	-324.8 V	324.8 V	1.000 kV	1.000 \
113-E	:Bus1:Phase Volt	ade C	100.0 %	-324.8 V	324.8 V	1.000 kV	1.000 \
L1	:Line:Phase Cum	ent A/Terminal i	100.0 %	-9.698 kA	12.70 kA	1.000 A	1.000 /
12	:Line:Phase Cum	ent B/Terminal i	100.0 %	-5.547 kA	3.455 kA	1.000 A	1.000 /
13	·line Phase Cum	ent C/Terminal i	100.0 %	.25 24 44	1 57864	1 000 4	1 000 1

-		
Signal View 💮 Sett	ting Test State: Passed	
Voltage Group	A 🗹 Current GroupA 🗹 Di	gital 🗌 Voltage All 🗌 Current All 📄 V L1-E 📄 V L2-E 📄 V L3
General Setting		
Show Table		Extra Setting Show Type
Data table		Snap O Inst.
Cursor	\square	🗌 Live Scroll 🛛 📥 💿 RMS
Show All	Cursor Data Table	Highlight Current State
Cursor 1		Show Time On Binary
Comman 2		r Extra Options

By checking "Select All Channel" in "Channel" column, it is possible to select all voltage and current signals existent in the "Comtrade" file for outputs of the device while if this option is unchecked, in the list of every output, it is possible to only select signals from the same type of output. For example, in "VL1-E" output, only voltage signals of the "Comtrade" file are visible. The reason for the existence of this option is that in some transient files, the unit of signals is not given in volt and ampere and the software is not able to differentiate between current and voltage and allocate it to the output of the device. So, it is necessary for the user to manually introduce the voltage and current signals to outputs of the device.

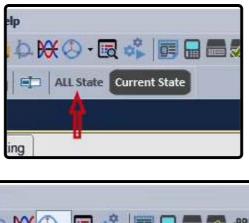
Transient Setting Comtrade File	r Errors
Import Comtrade	VA1_Value
Import Comtrade from list	
Calculate RMS Select All Channel Limit value to setting FileName: digsilent-2bus (2)	

Signal	Channel	Scale	Min	Max	Prim. factor	Sec. factor ^
VL1-E	Bus1 Phase Voltage A	100.0 %	-326.6 V	326.6 V	1.000 kV	1.000 \
VL2-E	0 1 DL 1/ 1/ 10 D	100.0 %	-324.8 V	324.8 V	1.000 kV	1.000 \
VL3-E	Line:Phase Current A/Terminal i	100.0 %	-324.8 V	324.8 V	1.000 kV	1.000 \
IL1	Line: Phase Current B/Terminal i	100.0 %	-9.698 kA	12.70 kA	1.000 A	1.000 /
112	:Line:Phase Current C/Terminal i	100.0 %	-5.547kA	3.455 kA	1.000 A	1.000 /
113	:Bus1:Phase Voltage A	100 0 %	.25 24 - 4	157964	1 000 4	1 000 1

If the user wishes to view the waveform of all voltage, current and digital signals existent in the "Comtrade" file in "Signal View", he should select "Current State" from the toolbar. Then from the "Setting" tab in "Signal View", he should select the signals that he wishes to view. But in "All State" state, it is only possible to view the waveform of the outputs of the device in each "State" and not the waveform of all signals in "Single View". To better analyze the transient signals in "Vector View" window, it is possible to open up to 5 "Vector Views" and, view the vector of different signals in different times. Complementary description about "Vector View" window will be provided in the videos related to this window.

v Help	
to € 4 € 0 • 0	2 🐝 🛅 🖬 🖬 🗖 🗱 🗰 🕨 -
E 👔 💼 ALL State	Current State
	2
rt Setting	Current State
1	Trigger Setting —
	Comment
	State termination

SignalView		
Signal View	🎲 Setting	Test State: Passed
Current Group	oA) 🗌 Group	A Group V I I L1: :Line:Phase Current A/Terminal i(kA) I L2: :Line:Phase Current B/Termin
Genera	Setting	
Show Te	able	Extra Setting Show Type





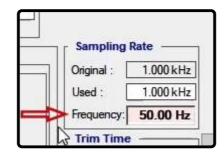
If the current and voltage values allocated to the output of the device which are specified in "Max" and "Min" columns exceed the allowed injection amount of the device, an error message is recorded in the "Errors" section. By selecting the "Limit Voltage and Current of Transient File to Setting", the amplitude of these signals is limited to the injectable amount by the device. The difference between this option and "Scale" is that by selecting this option, a part of the signal amplitude which is exceeding the allowed amount is cut but in "Scale", only a coefficient is multiplied by signal amplitude and no part of the signal is cut. The name of the "Comtrade" file is written in "File Name" section.

Comtrade File	Errors		Orig
Import Comtrade	No Error		Use
Import Comtrade from list			Free
Calculate RMS Select All Channel			Tri
Limit value to setting <		 	Star
FilesName: digsilent-2bus (2)			En

By right-clicking on "Prim. Factor" column or "Sec. Factor" and selecting "Fill Primary Secondary from Device" option, the "Prim. Factor" and "Sec.factor" values are entered in the "Test Object" page from "Device" block and if "Fill Primary Secondary from Comtrade File" is selected, the values of this column are entered from the "Comtrade" file. In "Sampling Rate" section, the information related to sampling frequency of the device and "Comtrade" file is specified. In "Original" field, the original value of the signal sampling frequency, in "Used" field, the value of used sampling frequency to be displayed in "Signal View" window and in "Frequency" section, the test signal frequency is specified.

Prim. f	actor Sec	. factor ^	Delay after Bina	the second
	Applay	to all Voltag	e	er
	FillPrim	ary Seconda	ary From Device	
_	Fill Frim	ary Seconda	ary To Device	
_	Link to 2	XRio		-
_	Remove	Link		
	Go to Li	nked Value		
		1		_

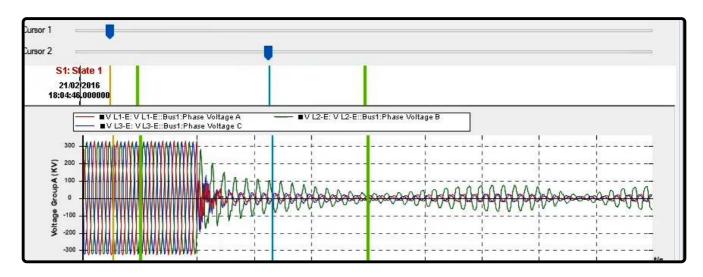
Max	Prim. factor	Sec. factor PS	
56.2 V	230,0141/	110.0 V Primary	
55.3 V	230.	Applay to all Voltage	gge
55.4 V	230.	Fill Primary Secondary From Comtrade File	
2.70 A	1.00	Contraction of the second se	
455 A	1.00	Fill Primary Secondary To Device	
579 Δ	1.00	Link to XRio	F
nge		Remove Link Go to Linked Value	



If the user wishes to apply a part of the transient waveform to the device, he can use the "Trim Time" section where its start time is specified in "Start Time" section and the end time is specified in "End Time" section. In this section, when the "Comtrade" file is loaded, the time value is extracted from the "Comtrade" file. To inject a part of the transient signal by device, first, the "Current State" option should be selected. Then, by activating "Cursor1" and "Cursor2" in "Setting" of the "Signal View" window, the beginning and end of the signal is specified. Finally by clicking on "Apply from trackbars" option, the values of "Cursors" are entered automatically. Also by selecting "Reset Time" option, these times reset.

	Trim Tim	e]
	Start time:	100.0 ms
l	End time:	999.0 ms
lax	Prim. factor	Sec. factor

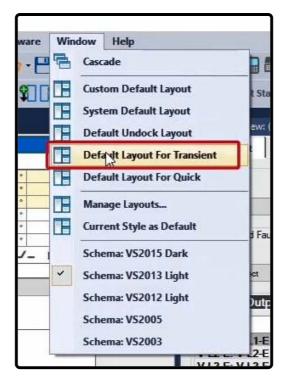
gnalView					
Signal View 🔅 Setting Test State: Passed					
Voltage Group	A 🗌 Magnitude	Harmonic(Voltag			
✓ Data table ✓ Cursor	Turrent	1			
	Cursor	🔳 Data Table			
	Cursor	Data Table			
Cursor Show All	Cursor	Data Table			
Cursor Show All Cursor 1	Cursor	Data Table			
Cursor Show All Cursor 1 Cursor 2	Cursor	Data Table			
Cursor Cursor 1 Cursor 2 Cursor 3		Data Table			

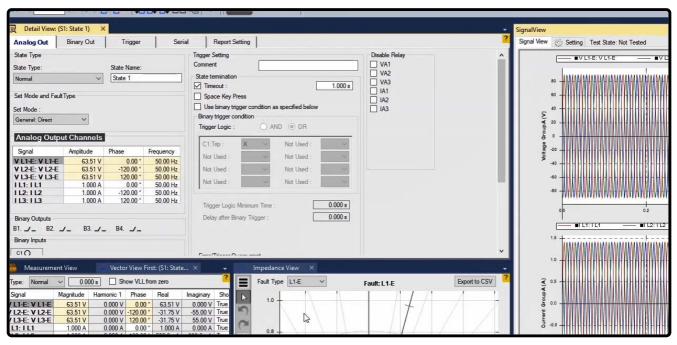


Trim Time	F	Reset Time	C1:T
Start time:	52.95 ms	Apply from	
End time:	331.7 ms	trackbars	Irigge
m. factor	Sec. factor	PS A	Delay

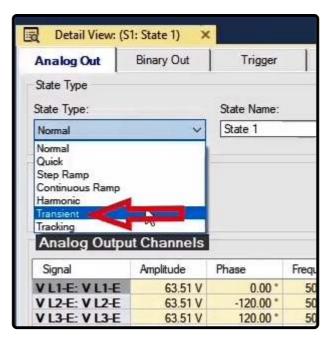
50 : THE "TRANSIENT" STATE (OBSERVING THE IMPEDANCE TRAJECTORY)

One of the applications of "State Type" Transient" is that the impedance and differential trajectories of distance and differential relays could be observed. The meaning of trajectory is the route of the change of differential or impedance characteristic of differential and distance relays in their characteristic curves based on the injected waves to the relay. For this purpose, at first, from the "window" menu, the "Default Layout for Transient" option will be selected so the arrangement of the windows would change. In this arrangement, the "Detail View", "Signal View", "Vector View" and "Impedance View" windows are positioned that is used for observing the trajectory.





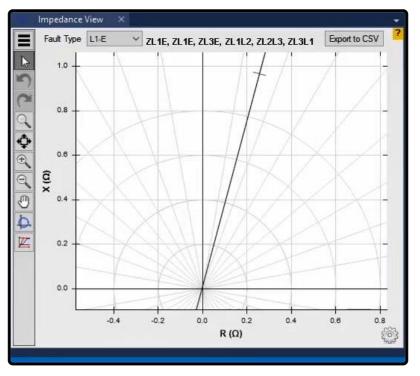
In the following, the "Detail View" window will be selected from the "State Type" drop down field of the "Transient" state. Then, the "current State" option will be selected from the toolbar on the upper part of the page. By doing this, the signals related to "State Type" in the "Signal View" and "Vector View" will be displayed after entering the "Comtrade" file.



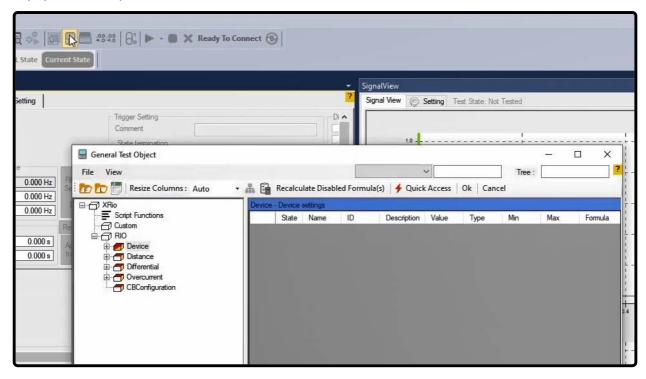


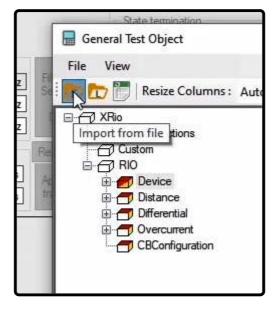
Entering the relay data

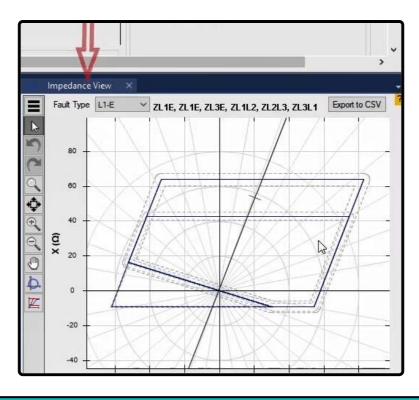
For observing the differential or impedance trajectory, the data related to relay must be loaded in the software so the characteristic curve of the relay would be displayed in the "Impedance View". In this video, the objective is to show the impedance trajectory of a distance relay.



To do so, the "Test Object" icon will be clicked so the "General Test Object" would be opened. On this page, by having "XRio" ad "Rio" files of the relay, the data of the relay would be entered in two ways. In this video, the data are loaded using the "Rio". To do so, we will click on the "Import from File" option, the file of "Rio" of the distance relay will be selected and loaded, and the OK option will be clicked. After loading the relay data, the impedance characteristic relay will be displayed in the "Impedance View".





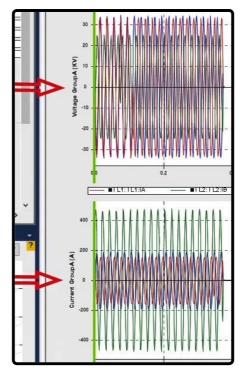


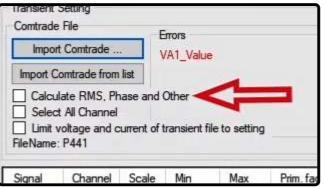
Entering the "Comtrade" file

After entering the relay information, the transient state file that is extracted from the relay should be loaded in the software. As you know, the "Comtrade" output is two files with the format of "CFG" and "DAT". If these two files are not located in a folder, then, this file will not be loaded in the software. To do this, click on the "Import Comtrade" option and then the intended file will be selected and loaded. Note that if the "Rio" has the same name as the "Comtrade" file and is located in a folder, by loading the "Comtrade" file, the data of the "Rio" has the same name as the "Comtrade" file and the "Comtrade" file, the voltage and current signals will be displayed in "Signal View" and the information of voltage and the current signal will be displayed in the "Detail View" window. "Calculate RMS..." should be checked to the software calculates the RMS and phase of the voltage and current signals to trajectory display. After this, in the "Signal View" window, the "Setting" tab, the "cursor" option will be checked. After activating the "Cursor", the impedance trajectory could be observed online in the "Impedance View" by moving the "Cursor 1" in the time axis of "signal View" window. Note that for the differential relays "Comtrade" files, six current phases and for distance relays "Comtrade" files, three current phases and three voltage phases should active. Also, you have to check that the assigned signals to each output to be exactly according to the state that exists in the real state and in case of difference, it should be manually modified.

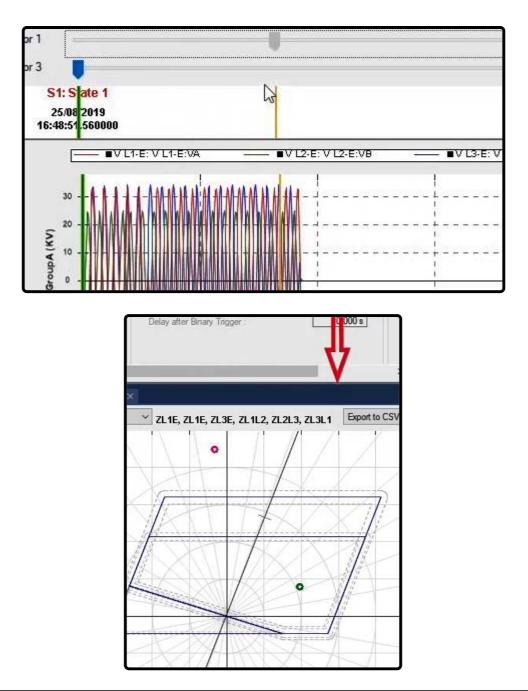
Transient Comtrade		irrors		
	Comtrade from	No Error		
Selec	Ilate RMS, Ph t All Channel voltage and c		nt file to	setting
FileName	•			

^	Name
	🐩 difftracking
	1 P441
	63



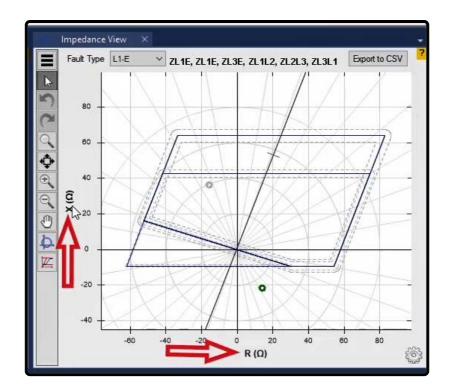


Si	gnal View 🛞 Setti	ng Test State:	Not Tested
_	Voltage GroupA	and a surface second	
<			Thannon liet voice
-	General Setting		
	Show Table		
	Data table		
	Show All	Cursor	Data Table
	-	Cursor	🔳 Data Table
	Show All	Cursor	Data Table
	Show All Cursor 1		Data Table
	Show All Cursor 1 Cursor 2	Cursor	Data Table
	Show All Cursor 1 Cursor 2 Cursor 3	Cursor	Data Table



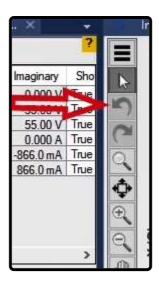
The "Impedance View" window

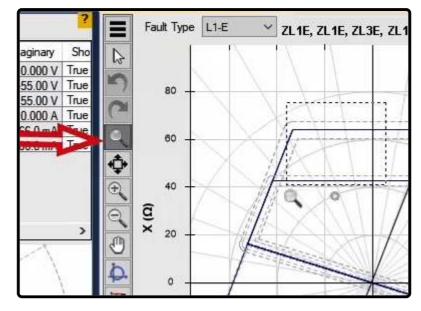
As mentioned in the "Impedance View" window, the impedance or differential characteristic curve of the relays is displayed. By opening this window, the impedance characteristic curve is displayed by default. This curve displays the line impedance in terms of "R" and "X". In the "Impedance View", select the "Differential" icon from the left-side icons for displaying the differential characteristic curve, so the differential characteristic curve of the differential relay would be displayed. This curve will be explained more in the differential trajectory video.

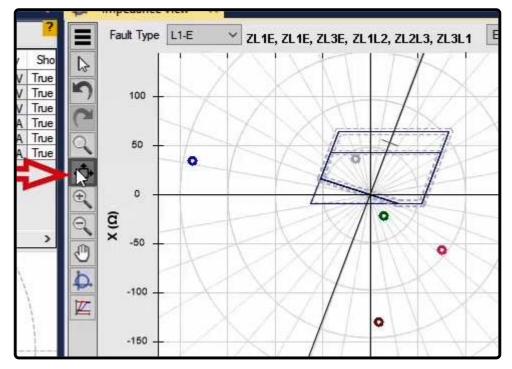


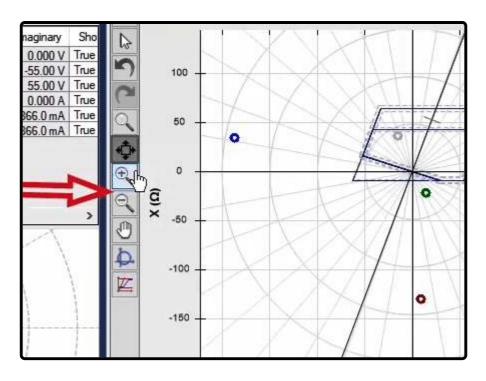


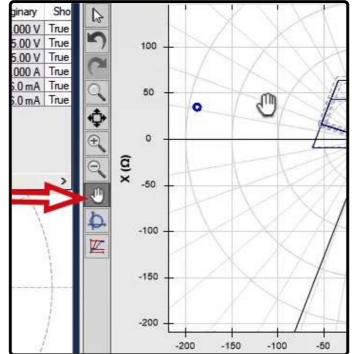
In the "Impedance View" window, by clicking on the "Undo" or "Redo" icons, we can return to the previous or next changes that are done on the characteristic curve. The "Zoom Model" icon places the mouse cursor in the zoomed condition for magnifying a part of the characteristic curve. The "Optimize all" icon will show the characteristic curve shape as a complete curve. The "Zoom In" and "Zoom Out" icons are used for magnifying and zoom out the characteristic curve. Using the "Pan Mode" icon, the characteristic curve could be displaced. By clicking on the "Hide/ Show Toolbox" the existing icons in the "Toolbox" could become hidden and shown again. Using the "Fault Type" icon the fault display can be specified. By clicking on the "Export CSV" from the settings of the relay zones that are checked, a "CSV" format output could be saved. Please pay attention that one CSV file will be given for each zone.

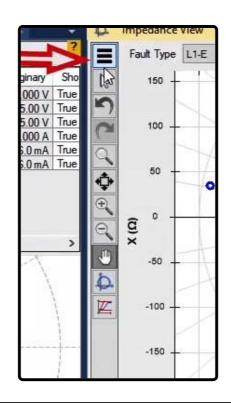


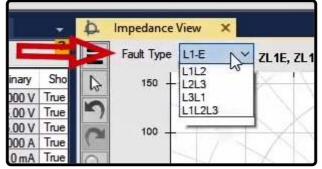






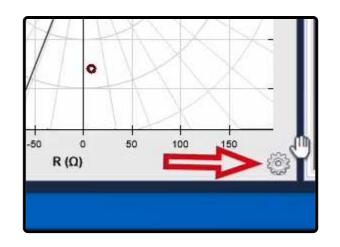


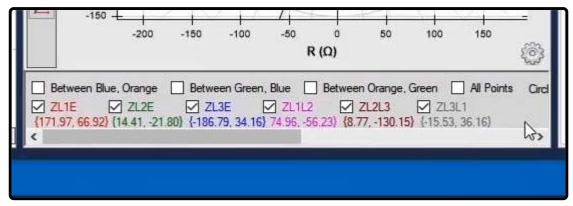




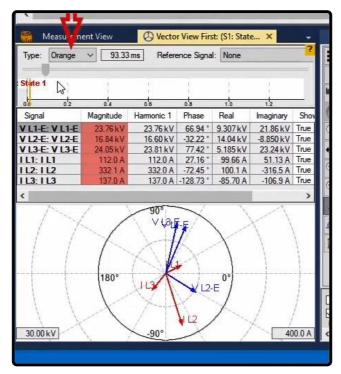


By clicking on the existing gear wheel in the below of this window, some options will be displayed for a better trajectory. By checking the "Between Orange, Green" option, the trajectory will be displayed as a line that its waves are between the orange and green colors in the "signal View". As a result, the trajectory will be displayed between these two "cursors". By checking the "all Points" option, the trajectory will be displayed in all the points and at all the times of the "Comtrade" file. In the "Circle.Ref" field, it will be specified that the trajectory will be simultaneously displayed by displacing which cursor on the "Signal View". Here, by changing the "Cursor" to orange the trajectory changes could be observed. The "ZL1E", "ZL2E", "ZL3E", "ZL1L2", "ZL2L3" and "ZL3L1" options show the impedance trajectory in different faults. The display of the trajectory of that fault can be deleted from the characteristic curve by unchecking each of them. In the below of each of these options, the coordinates of the impedance point is displayed as the "R" and "X" as online by moving the "Cursor 1" in "Signal View".





For observing the amounts of voltage and current at each moment, in the "Vector View" window of the "Type" field, the "Orange" option should be checked that is related to orange-colored "Cursor". Then, the voltage and current values and also the trajectory variations could be observed online by changing this "cursor".

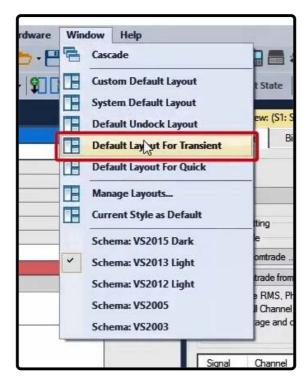


51 : "TRANSIENT" STATE (OBSERVING THE DIFFERENTIAL TRAJECTORY)

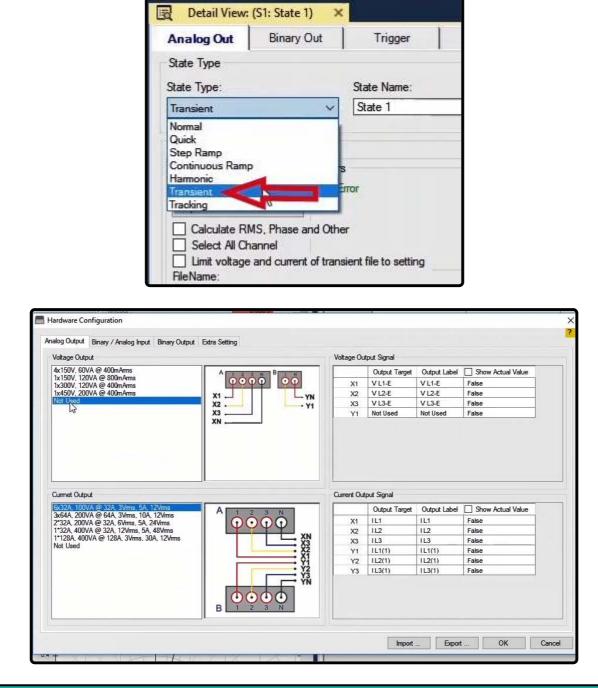
As already said, one of the functions of the "State Type: Transient" is to observe the impedance and differential trajectories of distance and differential relays. The route trajectory signifies the variation of differential or impedance characteristic curve in differential or distance relays based on the injected wave shapes. To this purpose, at first, from the "Default Layout for Transient" option is selected from the "Window" menu, so the arrangement of windows change proportionally to this

test run. In this arrangement, the "Detail View", "Signal View", "Vector View" and "Impedance View" are located in a way to observe the trajectory.

Analog Out	Binary Out	Trigger	Seria	I Report Se	aung			
State Type State Type:		State Name:		Trigger Setting Comment				Disable Relay
Normal Normal Quick Step Ramp Continuous Ramp Harmonic Transient Transient Transig	×	State 1		State termination Timeout : Space Key Pri Use binary trig Binary trigger con Trigger Logic :	iger condition a ndition	as specified below	1.000 s	U VA2 U VA3 I IA1 I IA2 I IA3
Analog Outpu	t Channels			C1:Trip :	x ~	Not Used :	~	
Signal	Amplitude	Phase	Frequency	1		10000000000	100	
VL1-E: VL1-E	63.51 V	0.00 °	50.00 Hz	Not Used :	\sim	Not Used :	~	
VL2-E: VL2-E	63.51 V	-120.00 *	50.00 Hz	Not Used :	\sim	Not Used :	~	
VL3-E: VL3-E	63.51 V	120.00 °	50.00 Hz	Not Used :	~	Not Used :	0	
I L1: I L1	1.000 A	0.00 °	50.00 Hz	I not clack .		Hor Coost 1		
112:112	1.000 A	-120.00 °	50.00 Hz					
I L3: I L3	1.000 A	120.00 *	50.00 Hz	Trigger Logic I	Minimum Time		0.000 s	
Binary Outputs B1/ _ B2	/B3/_	. B4		Delay after Bin	ary Trigger :		0.000 s	



Subsequently, the "Transient" state is selected from the "Detail View" window from the "State Type" slider field. Remember for "Comtrade" files of the differential relay six current phases, three current phases and three voltage phases must be active for "Comtrade" files of distance relay. Also, examine if the assigned signal to each output matches exactly the real condition and in case of any differences you have to correct it manually. At first, six current phases are activated in the "Hardware Configuration" window and the voltage phases are deactivated.



Simultaneous importing of the "Comtrade" file and relay information

In this video, the objective is to import the relay information and "Comtrade" file simultaneously. This case happens when the "Comtrade" and "Rio" files of the relay have an identical name and saved in one folder. Then, click on the "Import Comtrade" option and the "Comtrade" file of the "7ut613" differential relay is selected. After that, the "Open Comtrade File" message is shown. This message signifies that a "Rio" file with the same name as the "Comtrade" file exists. By clicking on "YES", the "Rio" and "Comtrade" files of the relay are loaded simultaneously and in case of selecting "NO", the "Rio" file won't be loaded and the relay information should be loaded separately. In this video, after clicking on the "YES" option, the "Rio" and "Comtrade" files are loaded simultaneously. After loading the "Comtrade" file, the "Detail View" window should be checked to see if the assigned signals to the current outputs accommodate the real condition or not. In this table, the "310" signal is imported instead of the "IL1-M2" signal that is not correct. Therefore, in the "Channel" column, the IL1 (1) slider field is right-clicked and the "IL1-M2" is selected. The "IL2-M2" and "IL3-M2" signals are assigned to fifth and sixth outputs, respectively. Then, from the toolbar on the top of the page, the "Current State" option is selected. By doing this, the signals related to "State Type" is displayed in the "Signal View" and "Vector View" after importing the "Comtrade" file.

Analog Out	Binary Out	Trigg
State Type		
State Type:		State Nam
Transient	~	State 1
Import Comtrad	INO I	Error
Calculate RM	MS, Phase and Oth annel	er sient file to s

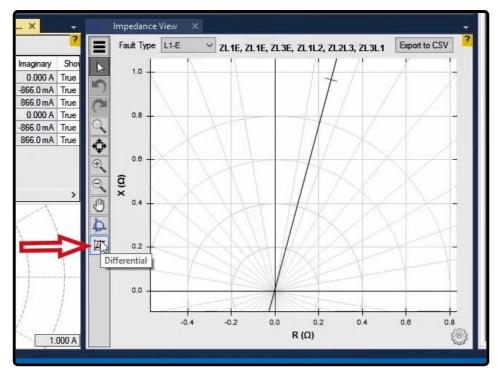
^	Name	Date modified
	🐕 difftracking.CFG	1/5/2020 3:35
	₩ P441.¢3G	8/25/2019 4:4



Signal	Channel	Scale	Min	Max	Prim. factor	Sec. factor	PS
IL1	iL1-M1 -	100.0 %	-20.98 A	20.72 A	500.0 A	1.000 A	Secondary
112	iL2-M1	100.0 %	-20.72 A	20.98 A	500.0 A	1.000 A	Secondary
I L3	iL3-M1	100 0 %	-6.913 mA	6.913 mA	500.0 A	1.000 A	Secondary
I L1(1)			20.5 mA	31.48 mA	500.0 A	1.000 A	Secondary
I L2(1)	iL1 0-M1	100.0 %	-11.75 A	12.01 A	1.200 kA	1.000 A	Secondary
I L3(1)	iL2-M2	100.0 %	-24.03 A	23.49 A	1.200 kA	1.000 A	Secondary

Subsequently, click on the "Differential" icon on the "Impedance View" window, so the characteristic curve of the differential relay is displayed. This curve is based on "I bias" and "I diff" that are bias current and differential current, respectively.

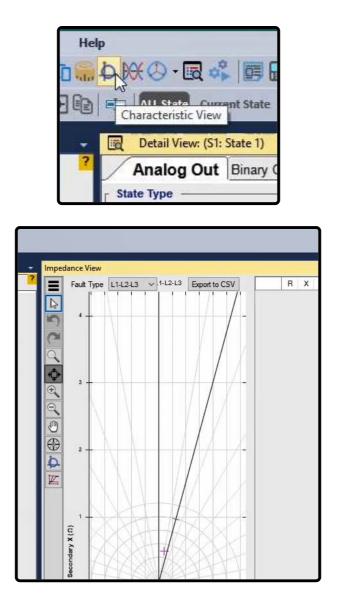
Remember by selecting the "Differential" curve, proportionally, the name of the window is changed to "Differential Characteristic". After this, the "Cursor" option is checked in the "Setting" tab in the "Signal View" window. Do not forget to check "Calculate RMS..." option which displays the differential trajectory. After activating the "Cursor", by moving the "Cursor 1" over the time axis in the "Signal View" window, the differential trajectory could be observed instantly in the "Differential Characteristic" window. By checking the "All Point" option, the differential trajectory is displayed in all the time of the "Comtrade" file. Other options of the "Differential Characteristic" window are similar to the "Impedance View" window that has been explained in previous educational videos.



52 : "TRACKING" STATE

In "State Type: Tracking", power swing test or "power swing blocking" of distance relays is done. Power swing protection or "power swing blocking" is performed at the level of power transmission network. In order to conduct "Power Swing Blocking" test, after selecting "State Type: Tracking", the "Impedance View" window should be opened to display the impedance characteristic of relay, because in vebko software, this test is conducted by impedance characteristic.

1	Analog Ou	ut Binary Ou	It Trigg
	State Type	293) 	
	State Type:		State N
	Normal	~	State
	Vormal Quick Step Ramp Continuous Ramp Harmonic Transient		
	Analog Output C	hannels	
	Signal	Amplitude	Phase
	VL1-E: VL1-E	63.51 V	C



The power swing blocking test is usually conducted in three-phase fault and "Z-I const." mode. That is why in "Fault Type" field, the fault type has been selected to be "L1-L2-L3" by default. In "Z-I const." mode, the test current is constant and different voltages are generated to create fault impedance. "Analog Output Channels" table data have been created based on this "Set mode". The values of voltage and output current from these data are calculated by software and displayed in "Table View" and adjusted by the device. It should be noted that in "State Type: Tracking" state, the "Analog Output Channel" table is "Read Only" and no value can be changed to the table.

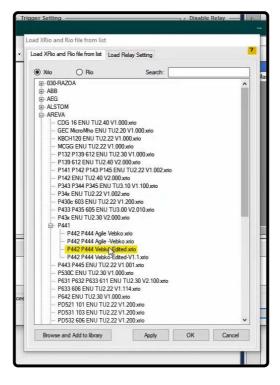
Set Mode :	Fault Type	
Distance: Z-I const.	L1-L2-L3 V	

Entering Relay Data

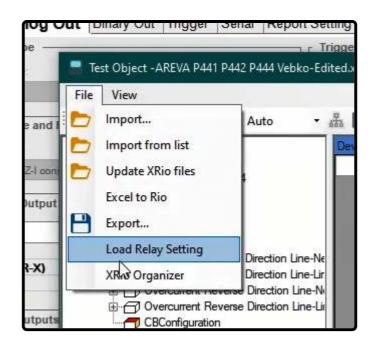
At the beginning of this test, data related to distance relay should be entered into the software so that their impedance characteristic can be displayed in "Impedance View". To this purpose, click on "Test Object"; by selecting "Import from list" icon, "XRio Converter" file for distance relay "P441" is loaded.

		-08.00		Al
Current State		_		001
State 1) 🗙]			
Binary Out	Trigger	Serial	Report	Setti
~	State Name State 1	E.		- Trig Com
			1	





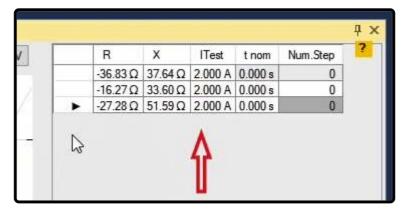
Then in "File" menu, select "Load Relay Setting" option, and in the opened window of "XRio" file, select distance relay "P441". By unchecking the options in "Matching Algorithm" part, which was previously described, "XRio" file is loaded. Upon clicking on the "OK" option, the relay impedance characteristic is displayed in the "Impedance View" window.



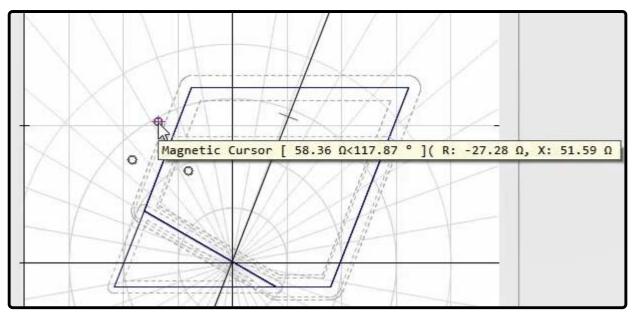
Relay Config Type :	XRio	~	V Log
Config file path :	C:\Users\HP\Deskt	op\P441.xrio	
Matching Algorith	m :		
Equal Foreign	ID		
XRio Contains	Setting Foreign ID		
	ns XRio Foreign ID		
EquilyCode of	Foreign ID (PCM600)		
Equal ID			
XRio Contains	Setting ID		
Setting Contain	ns XRio ID		

Impedance View Window

The power swing blocking test is conducted based on the impedance characteristic. In this test, the impedance observed by the relay enters the tripping zone from a zone out of the characteristic curve (No Tripping Zone) and exits rapidly; in this case, the relay must "block" its trip. There is a table next to the impedance characteristic curve in "Impedance View". This table can be used to enter power swing blocking test data.



In order to conduct this test, one point outside the characteristic curve, one point inside the characteristic curve, and again one point outside the characteristic curve should be added. After the points are added in the characteristic curve, it is observed that a row has been added to the right table per point. In the "Num.Step" column of this table, the number of points are entered between the previous point and the selected point and depicted in the impedance characteristic curve.



	R	х	ITe	est	t nom	Num.Step	?
	-36.83 Ω	37.64 Ω	2.00	A O	0.000 s	0	
	-16.27Ω	33.60 Ω	2.00	A OI	0.000 s	0	
•	-27.28 Ω	51.59 Ω	2.00	Mir	n: 0, Ma	x: 200	5

In "t nom" column, the total time of voltage and current injection corresponding to these are entered. In"I test " column,

the injection current of these points are determined. Considering that the injection is in the form of constant current, the current of all points is constant. The real and imaginary values of the selected point have been entered in "R" and "X" columns, respectively. Once the table data of this test are completed, this test is ready to be executed and upon clicking "Start" option, the test is conducted.

	R	×	ITest	tnom	Num.Step	15
•	-36.83 Ω	37.64 Ω	2.000 A	0.000 s	0	
	-16.27 Ω	33.60 Q	2.000 A	0 90 s	50	
	-27.28 Ω	51.59 0	Min: na	s, Max: r		
			Shown Vi	alue: 0.00	0 s, MainV	alue:

	R	x		ITest	t nom	Num.Step	?
	-36.83 Ω	37.64	Ω	2.000 A	0.000 s	0	1
•	-16.27Ω	33.60	Ω	2.000 A	200.0 ms	50	
	-27.28 Ω	51.59	Ω	2.000 A	600.0 ms	40	
					, Max: na lue: 2,000 /	A, MainVal	ue: 2

+.0.4		o ¹ ₀ ■ X Connecter	1 🕲
	Start	/ Continue Test (F5)	_
liew	🛞 Setting	Test State: Not Tested	Export Comtra

53 : "SET MODE AND FAULT TYPE" : PART 1

Using options in "Set Mode" field in "Set Mode and Fault Type" part, the user can introduce certain parameters to software to test in "Analog Output Channels" table and produce the device voltage and the current corresponding to them. The output values of device can be observed in "Table View" window.

Set Mode and Fault	Туре
Set Mode :	
General: Direct	~

Considering test conditions, the "State Types" of "Continuous Ramp" and "Harmonic" are performed only in "General: Direct" mode. Additionally, considering "Power Swing" test conditions, "State Type :Tracking" is performed in "Distance: Z-I const" mode. Note that since in "Transient Type", the values and type of data are extracted from "Comtrade" file, "Set Mode and Fault Type" part does not exist.

Harmonic	~	Stat
Normal		
Quick		
Step Ramp		
Continuous Ramp		
Harmonic		
Transient		
Tracking	N.	
Analog Outpu	It Channels	
Signal	Amplitude	Phase

Set Mode and Fault Type	Fault Type	
Distance: Z-I const.	L1-L2-L3 ~	

Tracking	~	St
Normal		
Quick		
Step Ramp		
Continuous Ramp		t Typ
Harmonic		2-13
Transient	2	2-63
Tracking	~	
Analog Output	Channels	
Signal		
ZFault	500.0 mΩ	

itate Type: Transient	~	State 1	
Iransient	~	Jalace	
Transient Setting			
Comtrade File			
Import Comtrade	Ело	3	
import comuade	No No	Error	
Import Comtrade fro	om list 5		
Calculate RMS,	Phase and Oth	er	
Select All Chann	el		
Limit voltage and	d current of tran	sient file to	setting
FileName:			

The "Set Mode" filed can be put on different modes in the "State Types" of "Step Ramp", "Quick", and "Normal"; in this film we refer to "General" modes. "Analog Output Channels" table in "General" modes has "Signal", "Amplitude", "Phase", and "Frequency" columns.

Analog Outpu	It Channels	13	
Signal	Amplitude	Phase	Frequency
VL1-E: VL1-E	1.000 V	0.00 *	50.00 Hz
VL2-E: VL2-E	1.000 V	-120.00 °	50.00 Hz
VL3-E: VL3-E	1.000 V	120.00 °	50.00 Hz
I L1: I L1	2.000 A	-80.00 °	50.00 Hz
112:112	2.000 A	160.00 °	50.00 Hz
L3: I L3	2.000 A	40.00 °	50.00 Hz

"General: Direct" Mode:

In this mode, values of voltage signals and the output current of the device are directly determined by adjusting the phase values of voltage signals and the values of current signal lines in "Analog Output Channels" table. In this mode, the

frequency value can be determined in "Analog Output Channels" table, but in other modes, the frequency value is obtained from "Test Object". As it can be observed, values of "Analog Output Channels" table have been directly entered in "Table View" window.

"General: Line-Line" Mode:

In this mode, the output signals values of the device are determined by adjusting the line to line values of voltage and current signals, as well as the value of zero sequence voltage in "Analog Output Channels" table. As it can be observed,

the current values in "Analog Output Channels" table have been directly entered into "Table View" window. By changing the zero sequence voltage to 5V, the voltage value of each phase changes to 6 V in the first phase and 4.583 V in other phases based on the defined relations.

lable view					Detail view:	(SI: State I)		
		S1		?	Analog Out	Binary Out	Trigger	Serial
Name	State 1				Outo Trans	6 S	E. 2000	L:
VL1-E: VL1-E	1.000 V	0.00 °	50.00 Hz		State Type			
V L2-E: V L2-E	1.000 V	-120.00 °	50.00 Hz		State Type:		State Name:	
V L3-E: V L3-E	1.000 V	120.00 °	50.00 Hz		Normal	~	State 1	1
I L1: I L1	2.000 A	-80.00 °	50.00 Hz				Locaro ,	1
112:112	2.000 A	160.00 °	50.00 Hz		Set Mode and Fa	u#Tumo		
I L3: I L3	2.000 A	40.00 °	50.00 Hz		Set Mode and Fa	uiriype		
Bin. Out	B1. J- B2. J	/- B3. J-	B4/-		Set Mode :			
Trigger	()		1.000 s		General: Line-Lin	ie 🗸		
Туре	Normal		~					
Comment					Analog Out	put Channels		
					Signal	Amplitude	Phase	Frequency
	C1O				V 12	1.732 V	30.00 *	50.00 Hz
	Trip				VO	0.000 V	0.00 *	50.00 Hz
					1 L1: I L1	2.000 A	-80.00 °	50.00 Hz
-3943 10.425-439-44					112:112	2.000 A	160.00 °	50.00 Hz
Bin. Input					1 L3: I L3	2.000 A	40.00 °	50.00 Hz

"General: Symmetrical Components" Mode

In this mode, by adjusting the value of voltage and positive, negative, and zero sequence current in "Analog Output

Channels" table, the values of device voltage and current signals corresponding to them are determined. In order to observe these changes, the negative sequence value changes to 5. According to mathematical relations, the value of the first phase and the other two phases was calculated to be 11 V and 4 V, respectively. In addition, by changing the negative sequence current to 2 Amperes, the output values of current changes to 2.391, 3.973, and 1.581 Amperes, respectively.

Signal	Amplitude	Phase	Frequency
V1	1.000 V	° 00.0	50.00 Hz
V2	5.000 V	0.00 °	50.00 Hz
VO	5.000 V	0.00 °	50.00 Hz
11	2.000 A	-80.00 °	50.00 Hz
12	0.000 A	26.57 °	50.00 Hz
12/11	0.0000	106.57°	50.00 Hz
10	0.000 A	-75.96 °	50.00 Hz

	×		
		S1	
	State 1 🔻	V	
E VL1-E	11.00 V	0.00 °	50.00 Hz
E VL2-E	4.000 V	60.00 °	50.00 Hz
E: V L3-E	4.000 V	-60.00 °	50.00 Hz
L1	2.000 A	-80.00 *	50.00 Hz
L2	2.000 A	160.00 °	50.00 Hz
L3	2.000 A	40.00 °	50.00 Hz
lut	B1 B2	/- B3. /-	B4. 🤳 🗕
r	Q.		1.000 s
	Normal		Ý

$$a = e^{j\frac{2\pi}{3}} \rightarrow \begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} V_0 \\ V_0 \\ V_0 \end{bmatrix} + \begin{bmatrix} V_1 \\ a^2 V_1 \\ aV_1 \end{bmatrix} + \begin{bmatrix} V_2 \\ aV_2 \\ a^2 V_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix} = AV_{012}$$
$$\begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix} = A^{-1}V_{abc} \rightarrow A^{-1} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}$$

"General: Powers": Mode

In this mode, the values of device voltage and output current signals are determined by adjusting the phase value of voltage signals, apparent power, active power, and reactive power in "Analog Output Channels" table. The fourth to sixth rows of apparent power are related to each phase and the seventh row is the apparent row of three phases whose magnitude is determined in "Amplitude" column and their angle is determined in "Phase" column. Moreover, the eights to tenth rows are related to the active and reactive power of each phase, and the eleventh row is related to the active and reactive power of each phase, and the eleventh row is related to the active and reactive power value is determined in "Amplitude" column and reactive power value is determined

Table View	N ×			17	Detail View: (S1: State 1) >	<	
		S1		?	Analog Out	Binary Out	Trigger	
Name	State 1				State Type			
VL1-E: VL1-E	E 11.00 V	0.00 *	50.00 Hz		State Type			
V L2-E: V L2-E	4.000 V	60.00 °	50.00 Hz		State Type:		State Name:	
V L3-E: V L3-E	4.000 V	-60.00 *	50.00 Hz		Normal	~	State 1	2.2
L1: L1	2.391 A	-26.72 °	50.00 Hz					5
112:112	3.973 A	153.28 °	50.00 Hz		Set Mode and Fau	tune		
I L3: I L3	1.581 A	-26.72 °	50.00 Hz			1.176		
Bin. Out	B1 B2.	J- B3. J-	- B4/-		Set Mode :			
Trigger	()		1.000 s		General: Powers	~		
Туре	Normal		~					
Comment					Analog Outp	ut Channels		
Commera					Signal	Amplitude	Phase	Frequency
	C1O				VL1-E: VL1-E	11.00 V	0.00 °	50.00 H
	Trip				VL2-E: VL2-E	4.000 V	60.00 °	50.00 H
					VL3-E: VL3-E	4.000 V	-60.00 °	50.00 H
					S1 (IS11. <oh1)< td=""><td>26.31 VA</td><td>26.72 °</td><td>50.00 H</td></oh1)<>	26.31 VA	26.72 °	50.00 H
Bin. Input					S2 (IS2I. <oh2)< td=""><td>15.89 VA</td><td>-93.28 °</td><td>50.00 H</td></oh2)<>	15.89 VA	-93.28 °	50.00 H
					S3 (IS3I. <oh3)< td=""><td>6.324 VA</td><td>-33.28 °</td><td>50.00 H</td></oh3)<>	6.324 VA	-33.28 °	50.00 H
					Sv (ISvI. <ohv)< td=""><td>28.87 VA</td><td>-15.07 *</td><td>50.00 H</td></ohv)<>	28.87 VA	-15.07 *	50.00 H
					P1. Q1	23.50 W	11.83 Var	50.00 H
					P2. Q2	-909.9 mW	-15.86 Var	50.00 H
					P3. Q3	5.287 W	-3.471 Var	50.00 H
					Pv. Qv	27.87 W	-7.508 Var	50.00 H
					Binary Outputs			
					D1 4 D2		D4 4	
					B1/_ B2	J_ 63. J_	_ 04/_	

As it can be observed, the voltage values in "Analog Output Channels" table are directly entered into "Table View" window and by changing the value of apparent power of three phases to 50 volt-ampere (VA) in "Analog Output Channels" table, the current values in the output change to 1.515 A in the first phase and 4.167 A in the other two phases.

"General: Fault Values" Mode:

In this mode, first the fault type is selected from the slider bar of "Fault Type" field, then in "Analog Output Channels" table, the value of fault voltage, fault current, and their angle are entered and the values of device voltage signals and output current corresponding to them can be seen in "Table View" window. As single phase to ground fault is selected here, the values of device voltage and output current in that phase are considered to be equal to the value of fault voltage and current in "Analog Output Channels" table.

Name	State I			State Type					
VL1-E: VL1-E	1.000 V	0.00 *	50.00 Hz	State Type					
V L2-E: V L2-E	63.51 V	-120.00 °	50.00 Hz	State Type:		State Name:			
V L3-E: V L3-E	63.51 V	120.00 *	50.00 Hz	Normal	~	State 1	1		
111:111	2.000 A 🔫	-80000	50.00 Hz	. Transmer	0.535				
112:112	0.000 A	0.00 °	50.00 Hz	Set Mode and FaultType					
1L3:1L3	0.000 A	0.00 *	50.00 Hz	out mode and t dail type					
Bin. Out	B1. J- B2. J.	- B3/-	B4. ┛-	Set Mode :	Set Mode : Fault				
Trigger	Ō.		1.000 s	General: Fault Values	General: Fault Values V L1-E		E Y		
Туре	Normal		~						
Comment				Analog Output Char	190				
				Signal Amplitu	ude	Phase	Frequency		
	C1 O			V Fault 1	V 000.	0.00 °	50.00 Hz		
	Trip			I Fault 2	A 000.	-80.00 °	50.00 Hz		
				Anale(V-I)		° 00.08			
Bin. Input				Binary Outputs					

54 : "SET MODE AND FAULT TYPE": PART 2

As mentioned before, using options in "Set Mode" field in "Set Mode and Fault Type" part, the user can introduce certain parameters into software to test in "Analog Output Channels" table and produce the device voltage and the current corresponding to them.

Set Mode :			
General: Direct	~		
Analog Outpu	ut Channels		
Signal	Amplitude	Phase	Frequency
VL1-E: VL1-E	447.2 mV	0.00 *	50.00 H
VL2-E: VL2-E	63.51 V	-120.00 °	50.00 H
VL3-E: VL3-E	63.51 V	120.00 °	50.00 H
111:111	279.5 mA	-40.00 °	50.00 H
112:112	0.000 A	0.00 *	50.00 H
· · · · · · · · · · · · · · · · · · ·	0.000 A	0.00 °	50.00 H

"Distance: Z-I const" mode

is used for impedance and distance functions, in this mode, the user enters fault impedance and test current, and the device injects the corresponding current and voltages to it. If user determines the fault impedance in terms of magnitude and angle, the software calculates "R" and "X" values and displays them in the second row. For example, the impedance value of 1 ohm (Ω) has been entered with a 45° angle, and the "R" and "X" values are shown in the second row. If the fault impedance is also adjusted in terms of "R" and "X", the software calculates the impedance and angle and shows it in the first row. For example, the value of "R" and "X" has been adjusted to be 100 milliohm ($m\Omega$) and 50 m Ω , respectively, and the values of impedance and fault angle are shown in the first row. In this case, the test current of 2 A is entered for dual phase fault "L1-L2" and the software calculates the voltage and test current values using mathematical relations and shows them in "Table view". In "Distance: Z-V const" mode, by keeping voltage constant and adjusting it by user, and by adjusting the fault impedance value, the test current value is calculated using mathematical relations and displayed in "Table View". Additionally, in"Distance: Z-Zs const" mode, the value of fault impedance and "SIR" parameter value, which is the ratio of source impedance to fault impedance, are adjusted and the values of current and test voltage are calculated using mathematical relations and are displayed in "Table View".

Set Mode :		Fault Ty	pe	
Distance: Z-I co	nst. 🗸	L1-E	~	
Analog Ou	tput Channe	els		
	N	_		
Signal	3			Frequency
Signal ZFault	چا 800.0 r	nΩ	40.00 °	Frequency 50.00 Hz
	800.0 r 612.8 r	A 65 3 1	40.00 ° 514.2 mΩ	

Analog Output	channels		
Signal			Frequency
ZFault	2m 0.008	40.00 °	50.00 Hz
ZFault (R-X)	612.8 mΩ	514.2 mΩ	50.00 Hz
ITest 6	279.5 mA		

Signal			Frequency
ZFault N	1.000 Ω	45.00 °	50.00 Hz
ZFault (R-X)	707.1 mΩ	707.1 mΩ	50.00 Hz
ITest	279.5 mA		

Now if user wants to consider the fault impedance in terms of a percentage of a parameter, he can use three modes: "Distance: Z%-I const" "Distance: Z%-V const", and "Distance: Z%-Zs const." in the "% of" part, it has been determined

that fault impedance should be selected as a percentage of line impedance. In the "Z%" part, it is determined that what percentage of the selected value the fault impedance should be, and in "phiZ" part, the impedance angle is adjusted.

Analog Out	Binary Out	Trigger	Seria	I Report S	Setting	
State Type				Trigger Setting		
State Type:		State Name	đ	Comment		
Normal	~	State 1		State terminatio	n	
				Timeout :		[
Set Mode and FaultType				Space Key I	Press	
Set Mode : Fault Type % of :				Use binary trigger condition as specified below		
Distance: Z%-Zs	const. V L1-L	2 ~	Line length 🗸	Binary trigger o	condition	
Division of the second				Trigger Logic	. O A	ND 🖲 OR
Analog Out	out Channels			C1:Trip :	x	Not Used :
Signal		Phase	Frequency	Constantine of	~	
Z%	11.18 %			Not Used :	~	Not Used :
Phi Z	26.57			Not Used :	~	Not Used :
SIR(ZS/ZL)	2.0000			Not Used :	1000	Not Used :

In "Distance: Z%-I const" mode, the fault current is constant and the software calculates its corresponding voltage and current based on the fault type and impedance. In addition, the value of fault voltage is constant in "Distance: Z%-V const", and when the user adjusts it, the test current values are calculated by software. Additionally, by adjusting "SIR" parameter in "Distance: Z%-V const" mode, the value of current and test voltage is calculated in software. It should be noted that the current and test voltage values are also calculated using the above mentioned formulas with the difference that the impedance value is selected to be a percentage of the line impedance. For example, in "Distance: Z%-Zs const" mode, the impedance test point is selected to be 80% of the line impedance with a 40° angle and "SIR" value is adjusted to be 10. Now the values of voltage and test current are calculated using the above mentioned mathematical relations and displayed in "Table View".

Set Mode :	Faul	Fault Type % of :		
Distance: Z%-Zs co	nst. ~ L1-I	2 ~	Line length 🗸 🗸	
7%	11.18 %			
Phi Z	26.57°			
SIR(ZS/ZL)	2.0000			

If user wants to conduct "OverCurrent" test in this room, he should adjust "Set Mode" on "Overcurrent: ITest" and adjust current, current angle, and voltage for directional functions in "Analog Output Channels" table. In "Table View" page, the values of voltage and test current are calculated based on the selected "Fault Type". For example, for two phase fault "L1-L2", the test current of 1 A with a 40° angle and voltage of 5 V was adjusted and the values of current and test voltage can be observed in "Table View".

Set Mode :	Fault	t Type
Distance: Z%-Zs const. 🗸 🗸	L1-L	2
General: Direct General: Line-Line General: Symmetrical Compon	nels	þ.
General: Powers		Phase
General: Fault Values Distance: Z-I const.	00 %	
Distance: Z-V const.	.00 °	
Distance: Z-Zs const.	000	
Distance: Z%-I const.		
Distance: Z%-V const.		
Distance: Z%-Zs const. Overcurrent: ITest		B4
Differential: IBias, Idiff		. 04
VI Starting: Current, Voltage		
Transducer		
Synchronizer		
Trip		

Signal		Phase	Frequency
Test Overcur	0.000 A		
Anale	35.00 *		
Voltage	0.000 V		

Additionally, in order to test differential relays in this room, the user should open "Hardware Configuration" window and disable the voltage outputs and enable all 6 current phases. Then in "Detail View" window adjust the "Set Mode" on "Differential: IBias, Idiff". By adjusting "IDiff" and "IBias" values to be 0.5 and 7 times of the nominal current in "Analog Output Chnnels" table, the current of different phases is calculated for differential function and displayed in "Table View" window. Pay attention that these values are calculated based on the parameters adjusted in "Differential" block of "Test Object" page, and the user is required to enter the specifications of the protected equipment and tested relay.

salog coupur	Binary / Analog Input	Binary Output Ex	tra Setting				
Voltage Outp	ut			Voltage C	utput Signal		
1x150V, 120 1x300V, 120	/A @ 400mArms WA @ 300mArms WA @ 400mArms WA @ 400mArms				Output Targat	Output Label	Show Actual Value
3x64A, 200V	ut 1A @ 32A, 31mms, 5A, 12 1A @ 64A, 31mms, 10A, 11 1A @ 32A, 61/ms, 5A, 24	2Vims			utput Signal Output Target	IL1	Falso
1*32A, 400V	(A @ 32A, 12Vhms, 5A, 4) NA @ 128A, 3Vhms, 30A,	Wms		XN X3 XN X3 XN X3 X1 Y1 Y2 Y3 Y3 Y3	IL3 Not Used Not Used	1L2 1L3 Not Used Not Used	False False False False False
			B O O O				

-	tion Parameters					- C	1.
Protected Object Prot	tection Device Charac	steristic Definition	Harmonic				
Protected Object		Vector Group	, ,	N	umber of Windings		
Transformer	•	YYO			2 03		
Ro I S	0	nary	Seconda		Tertia		
O Q Nominal Values	For	nary		sry		ny	
Winding/Leg Nam	ne: Primary		Secondary		Tertiary		
Voltage :		115.5 kV		30.00 kV		30.00 kV	
Vinding/Leg Nam Voltage : Cawer : Vector Group :		40.00 MVA	4	0.00 MVA		40.00 MVA	
Vector Group :	Y		Y	-	Y	*	
Connection Numb	per: 0		0		0	-	
Starpoint Groundi	ng: No		No		No	+	
Current:		199.9 A		769.8 A		769.8 A	
Delta-Connected	CT: No	•	No	*			
CT Nominal Values	-		L				
Primary Current :		200.0 A	-	800.0 A		800.0 A	
Secondary Curren	at: [1.000 A	<u> </u>	1.000 A		1.000 A	
Starpoint Groundi	011 (F	and the second	tow. Prot. Obj.		tow. Prot. Obj.	*	
Sor	Use Groun		rement inputs (CT)				
 Ground CT Nominal Primary Current : 	Values	200.0 A		800.0 A	-	800.0 A	
Secondary Current		1.000 A		1.000 A		1.000 A	
No.						1.000 A	
Starpoint Groundin	ng : tow. Prot. Ob	*	tow. Prot. Obj.	*	tow Prot Obj.	1.5	
Los							
					_		
1						ок с	Cancel

55 : ADDITIONAL SETTINGS OF "DETAIL VIEW"

"Continue Last State Amplitude" Option:

This option appears in the "States" after "State Type: Step Ramp" in "Detail View" window. By checking this option, the current or voltage value of the current State is injected from where the previous "State"

is finished. This option is used to measure the relay trip time or "Pickup Drop off" test in relays. For example, in "Pickup Drop off" test an increasing "Step Ramp State" is created where three-phases 2amps to 4amps current increases with 0.2amp steps and "Trigger" condition for reception of "Pickup" signal is specified. Note that "Binary Input 2" is specified for "Pickup" signal reception.

Analog Out	Trigger	Serial	Repor	
State Type				
State Type:		State Name		
Step Ramp	~	State 1		
Set Mode and Fault Typ	be			
General: Direct	~			

Detail View: (S1: State 1)

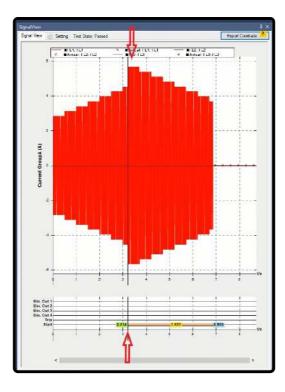
State Type State Type:		State Name:		Step Ramp Sett	500.0 ms	Ramp Type – Step Value		Simple mode
Step Ramp	~	State 1		Reset Time	500.0 ms	Rate Value	per second	
Set Mode and Fa	ultType	_		Ramp Description	on(Errors)			1
Set Mode :				Number Of Step				
General: Direct	~			Total Time: 5.50 No Error In Step				◯ Trigger ◯
Start Value		Co	n. in Frea Step	Step Values -				Offset Value -
Signal	Amplitude	Phase	Freque	Signal	Amplitude	Phase	Freque	Signal
1 L1: 1 L1	2.000 A	0.00 °	50.00 Hz	1 L1: 1	200.0 mA	0.00 *	0.000 Hz	1 L1: 1 L1
112:112	2.000 A	-120.00 °	50.00 Hz	112:112	200.0 mA	0.00 °	0.000 Hz	112:112
1 L3: 1 L3	2.000 A	120.00 °	50.00 Hz	1 L3: 1 L3	200.0 mA	0.00 *	0.000 Hz	1 L3: 1 L3
Binary Outputs -				Final Values –]
B1. 」 B2.	J_ B3. J_	B4. J_		Signal	Amplitude	Phase	Freque	
Binary Inputs				1L1:1L1	4.000 A	0.00 °	50.00 Hz	
C1 O C2 (2			112:112	4.000 A	-120.00 °	50.00 Hz	
Trip Sta				113:113	4.000 A	120.00 °	50.00 Hz	_
								1

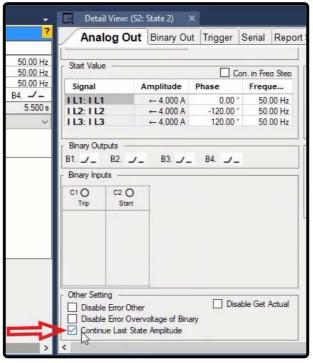
Detail View:	(S1: State 1)	×			
Analog Out	Binary Out	Trigger	Serial	Report Setting	
Comment State termination Timeout : Space Key Pn Use binary trig Binary trigger con Trigger Logic :	ess Iger condition as ndition	specified belo		500 s	
C1:Trip : Trigger Logic N Delay after Bin Error/Trigger Ov Overcurrent T Overcurrent E Percent Thresho	X v Alinimum Time : ary Trigger : ercurrent Frigger Error	C2:Start : [-	i i	

The second "State" is a decreasing "Step Ramp" where three-phases 4amps to 2amps current decreases with 0.2amp steps and "Trigger" condition of "Dropping" the relay (1->0) is specified. After performing the test, you can see that after receiving the "Pickup" contact, the second "State" starts decreasing from 4amps until the relay "Drops". But if you check the "Continue Last State Amplitude" option in "State2" and perform the test, after receiving the "Pickup" signal, the current in the second "State" starts decreasing from where the relay performed the "Pickup" and keeps doing so until the relay performs the "Drop".

Detail View:	(S2: State 2)	×						
Analog O	ut Binary Ou	ut Trigger S	Serial Repo	rt Setting				
State Type	s	Start Time Ref. F State Name: State 2	rom This State	Step Ramp Set Step Time Enable Res Reset Time	500.0 ms	Ramp Type – Step Value Rate Value	per second	Simple mode (L
Set Mode and Fau Set Mode : General: Direct	ultType			Ramp Descripti Number Of Step Total Time: 5.50 No Error In Step	Ramps: 11)0 s			 ◯ Trigger ◯ R∈
Start Value		Co	n. in Frea Step	- Step Values -				Offset Value
Signal	Amplitude	Phase	Freque	Signal	Amplitude	Phase	Freque	Signal
L1: L1	4.000 A	0.00 *	50.00 Hz	1L1:1L1	-200.0 mA	0.00 °	0.000 Hz	1 L1: I L1
112:112	4.000 A	-120.00 °	50.00 Hz	112:112	-200.0 mA	0.00 *	0.000 Hz	112:112
1 L3: I L3	4.000 A	120.00 °	50.00 Hz	1 L3: I L3	-200.0 mA	0.00 °	0.000 Hz	1 L3: 1 L3
Binary Outputs —				Final Values –]
	J_ B3. J_	B4. ∠_		Signal	Amplitude	Phase	Freque	-
Binary Inputs				111:11	2.000 A	0.00 *	50.00 Hz	
C1 O C2 C	2			112:112	2.000 A	-120.00 °	50.00 Hz	
Trip Star				1 L3: 1 L3	2.000 A	120.00 °	50.00 Hz	
۲.								-

🛃 Detail View: (S2: State 2) 🗙		
Analog Out Binary Out Trigger	Serial	Report Setting
Comment Comment		
State termination	5	500 s
Space Key Press		300 5
Use binary trigger condition as specified belo	w	
Binary trigger condition		
Trigger Logic : O AND O OR		
C1:Trip : X V C2:Start :	1->0	×<>>
Trigger Logic Minimum Time :	0.0	00 s
Delay after Binary Trigger :	0.0	00 s
Error/Trigger Overcurrent		
Overcurrent Trigger		
Percent	0	.00 %
Threshold	0.0	000 A





"Disable Get Actual" Option

If you check the "Show Actual Value" option in "Hardware Configuration" window, the "Disable Get Actual" option appears in "Detail View" window. By checking this option, the actual current or voltage value will not be displayed in that "State". If there are two "States" and the injection time in a "State" is too long and you do not want to view the actual value, by checking the "Disable Get Actual" option in "Detail View" window, the actual value will not be displayed in that "State".

Voltage Output	Voltage Ou	tput Signal —		
4x150V, 60VA @ 400mArms 1x150V, 120VA @ 800mArms 1x30V, 120VA @ 400mArms 1x450V, 200VA @ 400mArms Not Used		Output Targe	et Output Labe	I 🗌 Show Actual Value
Curmet Output 5x32A, 100VA @ 32A, 3Vms, 5A, 12Vms 5x64A, 200VA @ 64A, 3Vms, 10A, 12Vms 2*32A, 200VA @ 32A, 6Vms, 5A, 24Vms 1*32A, 400VA @ 128A, 3Vms, 30A, 12Vms	Current Ou X1 X2 X3	and the second second	et Lindoud ab	Show Actual Value
Not Used	Y1 Y2 Y3	Not Used Not Used Not Used	Not Used Not Used Not Used	False False False



"Disable Relay" option

In the back of every voltage or current output of the device there are relays which separate the "Amplifier" section of the inside of the device from the front panel. Before performing the test these relays must be connected and then the voltage or current is injected from the outputs of the device. In "Disable Relay" section in "Detail View" window, by checking any of the options available in the list, it is possible to disable the relay related to that output and then after performing the test you can see that the actual output value of the intended port equals zero. This option is used in tests such as magnetic flux division in transformer because by using this option, it is possible to create different modes of open circuit of coils for the test automatically.

	(S1: State 1)	1000	i de la composición d	
Analog C State Type State Type: Normal Set Mode and Fau Set Mode : General: Direct	Dut Binary Ou	tt Trigger State Name: State 1	Serial Repor	t Setting Trigger Setting Comment State termination Timeout : Space Key Press Use binary trigger condition as specified below Binary trigger condition Trigger Logie : AND OR
Analog Output Ch	annels	Phase	Freque	C1:Trip : X V C2:Start : 1 V
1L1:1L1 1L2:1L2 1L3:1L3	2.000 A 2.000 A 2.000 A	0.00 ° -120.00 ° 120.00 °	50.00 Hz 50.00 Hz 50.00 Hz	Trigger Logic Minimum Time : 0.000 s Delay after Binary Trigger : 0.000 s F Enor/Trigger Overcurrent
Binary Outputs - B1 B2. Binary Inputs - C1 O C2 (Trip Sta	o T	. B4. ノ_		Overcurrent Trigger Overcurrent Error Percent Threshold
(21 L			\$

To perform tests such as transformer wiring resistance test which needs a long time to charge the winding of the transformer, the current starts increasing from zero and during this time, because of the difference between the specified current and the actual current injected by the device, there is error Other. So to make the test practical it is necessary to disable the error "Other" so that the test can continue. Also, in this test, it is possible that huge voltage peaks occur momentarily; therefore to avoid stopping the test, the "Overvoltage" error of the binary needs to be disabled as well.

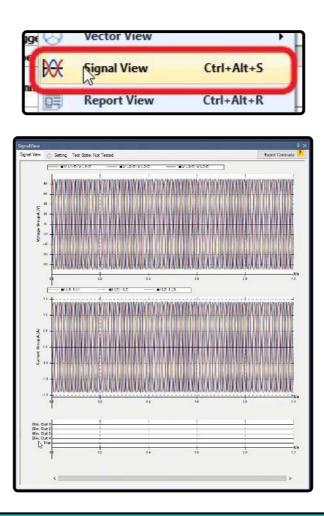
The last option on this page is "Start Time Ref. From This State". To better understand the function of this option, suppose that there are two "States" and the first one is "330" milliseconds while the second is "35" milliseconds. Normally, the first "State" is followed by the second "State" and the signal is continuous. In this example, if you zoom on the border of the two "States" in "Signal View", you can view the continuity of the signal. In this case, the time reference to determine the phase of the signals is the first "State". This is why even though in the second "State" the "II1" current phase is zero, its signal does not begin from zero. Now, by checking "Start Time Ref. From This State" option, you can see that the time reference of the second "State" is changed and considered from the beginning of this "State".

56 : "SIG	NAL VIEW" WI	NDOW PART 1	L
2	Zoom		
	Optimize		
-	View	()	
	Signals	۰.	
	Bold	1	
	Diagram	•	
	Default View		

Signal Pr	operties
Coloctod	signal (Lissaious)

The "signal view" window is used in all test pages, including "AMT Sequencer", "AMT Distance", "AMT Differential", AMT Overcurrent", etc. In order to open this window, one can use the "view" menu, the "signal view" option, or the tool bar, "signal view" icon. The output voltage and current signals as well as the status of the device "binaries" are shown in this window. In "setting" tab, this window setting is performed.

SignalView					ą ×
Signal View 💮 Setti	ng Test State:	Not Tested			Export Comtrade?
1 1 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	5		I 🗌 Voltage All 📃 Current Al	I 🗌 V L 1-E 🗌 V L 2-E 🗌 V	L3-E 🗌 I L1 🗌 I L2 🗌 I L:
<					>
General Setting					
Show Table			Extra Setting	Show Type	-11
Data table			Snap	Inst.	
Cursor			Live Scroll	O RMS	
Show All	Cursor	Data Table	Highlight Current State		
Cursor 1			Show Time On Binary		
Cursor 2			Extra Options		
Cursor 3			Refresh All		
C2-C1			N		
C3-C2			Num. Of Points 100	0	
C1-C3					
Operation Calculated Settings Number of Operation Show Signals	n: 0]	Initiate			



Right clicks of "signal view" window

In order to zoom in or out along horizontal axis, click on "zoom" option and use Zoom In (+) and Zoom Out (-), respectively. Here, "Plus" is used to Zoom In (+). In addition, you can also use the + and - keys on the keyboard or the Scroller.

In order to zoom along vertical axis, hold down Ctrl and roll the mouse wheel. By doing this, you can zoom in on the voltage diagram of group "A" and along "y" axis. This can also be done by holding down the Ctrl key of the keyboard and using the + and - keys.

Using "Optimize" option, the diagram display can be optimized. If the user intends to optimize the curves along horizontal axis, the "Optimize X-Axis" option or the X shortcut key of keyboard can be used. If one intends to optimize the curves along vertical axis, they should use the "Optimize Y-Axis" option, or the shortcut Y on the keyboard. If the "Optimize all" option is selected, the whole curve is displayed within the specified time, and the diagrams are optimized in terms of both "x" and "y" axes.

In the "view" option, you can zoom in on the given diagram along "Y" axis, for example the voltage diagram of "A" group is set on"100". Additionally, some values have been written beside the coefficients of this list that are used to apply changes using the keyboard buttons. Here, for example, it is observed that this diagram is shown along "Y" axis twice magnified using voltage "A" group diagram and by pressing "2" on the keyboard.

In "signals" option, the displayed signals are shown in the corresponding diagram. From this part, the user can hide the signal curve in the selected diagram by unchecking the desired signal. For example here the "V L1-E" signal is hidden in the diagram. Additionally, the user can also hide or show that signal in the diagram by holding down "shift" key on the keyboard by clicking on the desired signal name. For example, by holding down "shift" and clicking on the "VL1-E" signal name, this signal can be added to the diagram.

The "bold" option is used to make the signals displayed on the diagram thicker, for example here by checking "V L2-E", it can be observed that its signal become "bold"; moreover, the line next to the signal name becomes "bold". By holding down "Ctrl" key and clicking on the desired signal name, it can be displayed in "bold" state or the user can leave this state. For example, by holding down the "Ctrl" and clicking on the "VL2-E"signal name, this signal leaves the bold state.

Remember the options "View", "Signals", and "Bold" act differently for each diagram, for example, by right clicking on group "A" voltage diagram and adjusting the "view" on 200%, it is observed that the height of relevant voltage diagram increases by 200%, but the height of the current outputs of group "A" diagram remains unchanged. Additionally, by right clicking on the group "A" voltage diagram and by opening "signal" and "Bold" options, it can be seen that only group "A" voltage signals are shown. So if you want to use the "View", "Signals", and "Bold" capabilities for current outputs of "A" group, you should right click on the current diagram of group "A" and apply the required changes.

In the "diagram" option, the list containing all signals exists and the given signal can be selected to be displayed in "signal view". Please consider that here the signals used in test and enabled from "Hardware Configuration" can be selected. The group "A" voltage outputs, group "A" current outputs, and the device binaries have been selected by default to be displayed in the "signal view". For further explanation, first go to "Hardware Configuration" to enable all voltage and current outputs of the device; now if the "Voltage all" option is selected, all voltage outputs of groups "A" and "B" are shown in a diagram. Moreover, if the "Current all" option is selected, all current outputs of groups "A" and "B" are shown in a diagram. If the user wants to have each of the voltage and current outputs in a separate diagram, that signal should be enabled here by checking it. For example the "IL1" and "IL2" signals are checked. It is observed that each of the "IL1" and "IL2" signals are displayed in separate diagrams. Additionally, if the user needs to display the current outputs of group "B" in a diagram, the "current Group B" should be selected from this part. Each signal can be added to or removed from this window in this way.

If the user has made any changes in the way of displaying signal lines, hiding signal, adding or reducing signal, etc., by clicking on "Default View" option, all settings in this window will be restored to default and the applied changes are removed.

57 : "SIGNAL VIEW" WINDOW, PART 2

The following items "signal view" right clicks menu

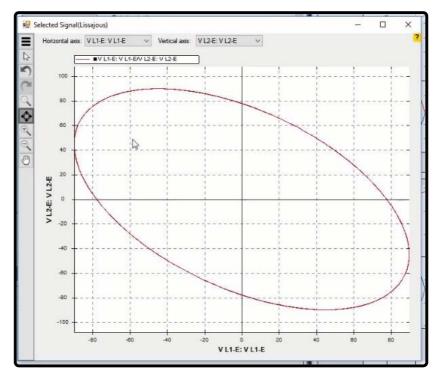
"Signal properties": This item is used for setting the display and color of signals in "signal view". When you click on it, "signal properties" page opens. Also, you can open this window by double clicking "signal view". The display and color of analog signals can be set by "analog signals" tab. You can select the signal from "signal" frame. Here, "V L3-E" is selected as an example. The selected signal can be observed in the field "Name". The selected signal cannot be changed. In "Line style", the user can select a style for signal curve display. Solid is the default style. However, the user can change that in the existing dropdown menu. The line thickness is set by "line width" that has a maximum value of 15 point. By clicking "color", you can select a color for signal line. "Marker type" is used for inserting a special geometric shape along the signal path; the geometric shape can be selected out of the shapes in the list. Here, "square" is selected for "V L3-E". Before leaving this page, any change in the signals can be observed in "preview" field. In the field "space between markers", the space between the selected "markers" on the signal line can be set based on "pixel". For example, "10px" is selected on the space. On "preview" field, you can see some circles created on the signal curve; the space between these circles is "10px".

	Zoom	•	
	Optimize	•	
	View		
	Signals	•	
	Bold	•	
	Diagram		
	Default View		
	Signal Properties		
	63		
	Selected signal (Lissa	jous)	
LILLING -	and the second		
Signal properties			- 0
alog signals Binary Signals	State signals		
	Name:	V L1-E: V L1-E	
ignal: V L1-E. V L1-E		V L1-E: V L1-E Solid	
ignal: V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E	Name:	A CONTRACT OF A	Color
iignal: V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E	Name: Line style: Line width:	Solid	Color
Signal: V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E I L1: I L1 I L2: I L2	Name: Line style:	Solid	Color
Signal: VL1-E: VL1-E VL2-E: VL2-E VL3-E: VL3-E VL1(1)-E: VL1(1)-E IL1: IL1 IL2: IL2 IL3: IL3 IL1(1): IL1(1)	Name: Line style: Line width:	Solid 1 Points <none></none>	Color
Signal: V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E L1: 1 L1 L2: 1 L2 L3: 1 L3 L1(1): 1 L1(1) L2(1): 1 L2(1)	Name: Line style: Line width:	Solid 1 Points <none></none>	Color
Signal: V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E L1: 1 L1 L2: 1 L2 L3: 1 L3 L1(1): 1 L1(1) L2(1): 1 L2(1)	Name: Line style: Line width:	Solid 1 Points <none> Preview</none>	Color
õignal: V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E I L1: I L1 I L2: I L2 I L3: I L3	Name: Line style: Line width: Marker type:	Solid 1 Points <none> Preview</none>	Color
iignal: V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E I L1: I L1 I L2: I L2 I L3: I L3 I L1(1): I L1(1) I L2(1): I L2(1)	Name: Line style: Line width: Marker type:	Solid 1 Points <none> Preview</none>	Color
iignal: V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E I L1: I L1 I L2: I L2 I L3: I L3 I L1(1): I L1(1) I L2(1): I L2(1)	Name: Line style: Line width: Marker type:	Solid 1 Points <none> Preview</none>	Color
ignal: V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E I L1: I L1 I L2: I L2 I L3: I L3 I L1(1): I L1(1) I L2(1): I L2(1)	Name: Line style: Line width: Marker type:	Solid 1 Points <none> Preview</none>	Color
ignal: V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E V L1(1)-E: V L1(1)-E I L1: I L1 I L2: I L2 I L3: I L3 I L1(1): I L1(1) I L2(1): I L2(1)	Name: Line style: Line width: Marker type:	Solid 1 Points <none> Preview 20 px 20 px</none>	Color

The display style and color of binary signals are set in the "binary signals" tab. The signal is selected from the "signal" menu, and the name is observed in the "name" field .Here, "Bin. Out 1" is selected. The signal color is selected from menu "color". Here, orange is selected as the signal color. The changes in the signal can be observed in "preview". By clicking "OK", the settings are applied on the signals. Note that in order to retrieve the default settings of signal display, you can click "reset to default" in "signal properties" window.

naion signal Binary Signals	Nut o change la			
Signal: Signal: Bin. Out 1 Bin. Out 2 Bin. Out 3 Bin. Out 4 Trip	State signals Name:	Bin. Out 1 Color Preview		

You can open "selected signal (lissasous)" by clicking on it. In this window, the user can select two signals from the fields "horizontal axis" and "vertical axis" and display them terms of one another. For example, here the two signals "V L1-E" and "V L2-E" are selected and displayed in terms of one another after clicking "Zoom all". In the left toolbar, there are some tools for making changes in the curve. These tools are respectively used for displaying and hiding the toolbar, selecting the pointer icon, undo and redo, zooming the curve, zoom all, zoom in, zoom out, and selection of pan mode for moving the curve.



Note that the user can press the mouse scroll and move "signal view" curves on the diagram. The window "go to time signal view" can be opened by "Ctrl + G" keys. If the user wants to observe the signal at a specific time, the considered time should be specified in the field "specific time". Also, in order to determine the signal between two points, the user should specify the times in the fields "from" and "to" in "In range" section. For example, 0.5 second is inserted in "from" and 0.8 second is inserted in "to". You will see that the signals of voltage group "A" are displayed in the specified range.

Goto Time				
Specific time	Time	0.000 s		
🔘 In range	From	0.000 s	To	0.000 s

If the user has inserted several curves in "signal view" window, these curves can be observed by using the keys "up" and "down". For instance, some curves are activated and can be seen by using the up and down keys.

58 : "SIGNAL VIEW" SETTING, PART I

At the top bar of this tab, there is a list of enabled signals in the device inputs or outputs being enabled in "Hardware Configuration" window. each of these signals in "Signal View" window, it should be selected in this bar; Note that "Show Actual Value" should be set to see "Binary Input". For example, "voltage group B" is enabled in "Hardware Configuration" window. Then, by enabling "Binary Input" "C3" on "Trip" signal and setting its "Show Actual Value", these signals are added to the list of enabled signals in order to display in "Signal View" settings that the relevant signal can observed by selecting each one.

Signal View 🔯 Setting Test State: Not Tested	Export Comtrade
Voltage GroupA Voltage GroupB Current GroupA Digital Trip Voltage All Current All VL1-E VL2-E VL3-E VL1(1)-E IL1 IL2 IL3	

Since the voltage and current outputs of Group "A" are enabled in "Hardware Configuration" window, all voltage and current signals of Group "A" can be observed by selecting "Voltage GroupA" and "Current GroupA". These options can be displayed in this way if "B" voltage and current groups are enabled; in addition we can also have a specific graph for each phase by selecting each one of the phases.

"Voltage All" and "Current All" options represent the voltage and current output signals of groups "A" and "B" in a graph. "Digital" option represents the status of receiving or not receiving "Binary Input" and "Binary Output" signals in a specific graph. Fot this purpose, set the "State" time to 5 seconds in "Detail View" and "Trigger" is set to 1 "C3" binary. After performing the test, this binary is short circaited and you can see that receiving the signal is shown on "C3" binary in "Digital" graph.

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Ì

In "General Setting", the settings related to the display of signals is performed. In Radio Button, displaying the signal will be effectiove by selecting "RMS" in button radio, and the signal display will be instantaneous by selecting "Inst".

Show Table			Extra Setting	Show Type Inst.			
Cursor		Live Scroll	O RMS Period Time: 20.00 r				
Cursor 1			Show Time On Binary	Num. Of Period	1		
Cursor 2			Extra Options				
Cursor 3			Refresh All				
C2-C1			N				
C3-C2			Num. Of Points 100				
C1-C3							

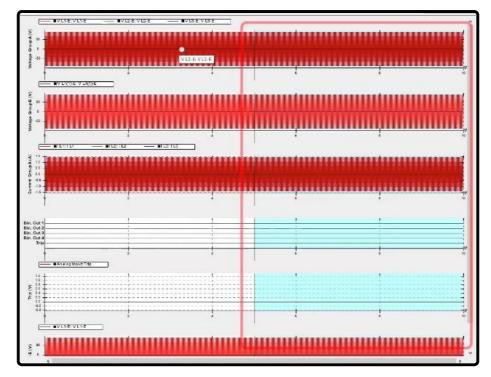
Two options "Period Time" and "Num. Of Period" in this section for the "Actuals" being received from the device.

"Period Time" is used for indicating the time of a period and the default value is set according to frequency, but you should change this manually by changing the frequency."Num. Of Period" is used for calculating the "RMS" value based on the

average number of several periods. As the number groes up, the longer it will take, while the accuracy increases and there will be less fluctuations.

By selecting "Live Scroll", you can easily observe the voltage or current signal changes at any moment of the injection and the instantaneous signal changes. In order to see this, a test will run on the zoomed signal and you can always observe the moment of injecting the signal.

By selecting "Highlight Current State", a part of the signal related to the current "State" is specified. In order to see this, if another State is added, a part of the signal related to the current State will be highlighted. "Show Time On Binary" displays the time related to disconencting or connecting the output and input binaries to "Digital" graph. For observing it, run the test, on which the time is shown by connecting and disconencting the "C3" binary.



In "Show Table", the settings related to "Cursors" and "Data Table" are made. First, you should enable Cursor and Data Table by selecting them at the top of the table. In this table, up to three "Cursors" can be enabled in "Cursor" column and Data Table can be used for analyzing the signals. Remember to show the data in each "Cursor" in "Data Table" the related "Data Table" column should be checked. In addition, three other rows specific to the difference between "C1", "C2" and "C3" cursors can be enabled or disabled in "Data Table" column. After enabling "Cursor" and "Data Table" at the top of the table, you will see a table and two "Trackbars" added to "Signal View" window."Time" column represents the time when the "Cursor" is on it. In "Signal" column, a signal is dedicated to "Cursor". "Value" column represents the signal value, "RMS" column represents the effective signal value, " Phase " column shows the signal angle and in " Frequency "column, the test frequency is displayed.

Cursor 1 0.000 s <		Time	Signal	Value	RMS	Phase	Frequency		
Cursor 2 6.164 s <inn a<="" th=""> n/a n/a C2-C1 6.164 s n/a n/a n/a Cursor 1 Image: Carter of the second /inn>	Cursor 1	0.000 s	< <none>></none>	n/a	n/a	n/a	n/a		
Sursor 1	Cursor 2			n/a	n/a	n/a	n/a		
Dursor 1	C2-C1	6.164 s		n/a	n/a	n/a			
S1: State 1	Cursor 2	-							
									

In "Extra Setting", "Cursor" attaches to the moment of receiving the digital signal and increases the reading accuracy by "Snap" while "Cursor" is enabled and by approaching "Cursor" to the moment of recording the digital signal. In "Extra Options" and "Num. Of Points" field, the number of sampling points from the signal is specified and if you can reduce this value, you will see that displaying the signal will leave the full sinusoidal state. "Refresh All" refreshes all computational sections in "Signal View" window.

59 : "SIGNAL VIEW" SETTING, PART II

The "Operation" part is used when the user decides to conduct a computational operation on the existing signals. At first, the number of the required "Operations" is entered and clicking on "Initiate" creates the "Operations". Here the number 3 was entered. A separate section is opened for each "Operation" and the given "Operation" can be deleted by clicking on the red Cross mark in the corner of the box.

Calculated Settings Number of Operation : 3 Initiate Operation 1 Operation Mode By Signal V Number Of Signal: 2 V Signal 1 < <none>> V Operation 2 Operation Mode By Signal 2 <<none>> V Operation 2 Signal 1 <<none>> V Operation 2 Signal 2 <<none>> V Operation: <<none>> V Operation 3 X</none></none></none></none></none>	☑ Operation	
Operation 1 X Operation Mode By Signal Number Of Signal: 2 Signal 1 <	Calculated Settings	
Operation 1 X Operation Mode By Signal v Number Of Signal: 2 v Signal 1 ccnone>> v Operation: Operation 2 V Operation: Operation Mode By Signal v Number Of Signal: 2 v Signal 1 ccnone>> v Operation: Operation Mode By Signal v Number Of Signal: 2 v Signal 1 ccnone>> v Operation: ccnone>> v Operation 3 X X		
Signal 1 <	Operation 1	×
Operation 2 X Operation Mode By Signal Number Of Signal: 2 Signal 1 <	Operation Mode By Signal V Number Of Signal: 2 V	
Operation Mode By Signal Number Of Signal: 2 Signal 1 <<	Signal 1 Signal 2 Operation: < <	
Signal 1 < <none>> Operation 3 X</none>	Operation 2	×
Operation 3	Operation Mode By Signal Vumber Of Signal: 2 V	
	Signal 1 < Signal 2 < Operation: < <	
	Operation 3	×
Operation Mode By Signal V Number Of Signal: 2 V	Operation Mode By Signal Vumber Of Signal: 2 V	
Signal 1 < <none>></none>	Signal 1 < <none>></none>	

In the "Operation Mode" part, it is found that with what kind of signal the "Operation" is performed, analog or "Dry"! If "By Dry Value" is selected, the active "Binary Inputs" are shown in the table At first in "Hardware Configuration" page binaries "C3" & "C4" are enabled that by using this option you can see the binaries and determine a value for them, here value "5"

is assigned for each of them.For each operation A "Calculated" option is added above "Setting" bar per "Operation". By checking this option, the "Calculated" signal is displayed in "Signal View". In this diagram, the values of the contacts that are connected are aggregated and displayed in the diagram; this is used to test capacitive banks. For example, you can observe that the values are added in staircase by receiving the contacts "C3" and "C4".

)perat	ion Mode	By Dry Value	~
	C3	C4	
	5.0000	5.0000	

In the "Number of Signal" part, the number of signals used in "Operation" shows that 2 or 4 signals can be selected. In the dropdown field related to "Singnal 1" and "Singnal 2", the given signals are assigned to them, and by checking "Advanced" option, a section is opened in which the signal information, such as the signal unit, can be determined. Additionally, by entering a value in "Coef." field, the given signal is affected by a factor, and in the "Name" field, a name can be determined for signal. In the "Operation" dropdown field, the user determines the type of mathematical operation to be performed between signals. In the "Advanced" part of this field, a name can be determined for this action.

Operation	12					
Operation	n Mode 🛛 By Signal 📉	Number	r Of Signal: 2 🗸 🗸			
Signal 1	V L1-E: V L1-E 🔍 🗸	Signal 2	I L1: I L1 🔍	Operation:	Signal1 RMS / Signal2 RMS 🛛 🗸	
Advan	nced	Advar	nced	- Advance	ed	
Coef. 1	1.000 x V ~			1 102	Calculated 03	Current Correction
Name:	VL1-E: VL1-E					
		-		13		

After the "Operation" is specified, the "Add Time" part is added which can determine time intervals on the signal diagram. In order to make it clear, at first, the time state is set at 10 seconds in "detail view", and the same intervals are determined on the signal by specifying a time of, for example, 2 seconds in "Auto Add Time" part. If the user intends to determine non-identical time intervals, by selecting "Add Time" a window with the same name is opened, and some rows are added by right-clicking upon it. The first column determines the "Operations" to be used for calculation of the values of this row. In "Time" column, the given time is selected. In "Value" column, the value of "Operation" in the given time is calculated. The "Slope" column is the gradient column. In "Sig1" and "Sig2" columns, the values of signals at the given time are determined.

Contract of the second	The second second second	
Add Time	Auto Add Time :	0.000 s

dd Time						_		
Calculated	Time	Value	Slope	Sig 1	Sig 2	_		
		Ad	d					
		Rer	move					
						Ok	Ca	nc

In the "Show Signals" part, all parameters corresponding to the voltage and current in test are determined. This part includes some columns and at the beginning of each, the name of the relevant parameter is written. Each column contains some options. By selecting each option, the name of its box is added at the top of the "Setting" tab, and then, by checking this option, the corresponding "RMS" value is displayed in the "Signal View".

Show Signals				
☐ Voltage	Current	Phase	Frequency	No Unit
Voltage: V L1-E Voltage: V L2-E Voltage: V L3-E Voltage: V L1(1)-E Voltage: V L1(1)-E Voltage: V L1-L2 Voltage: V L2-L3 Voltage: V L3-L1 Voltage: V 1 Voltage: V 2	Current: 1 L2 Current: 1 L3 Current: 1 L3(1) Current: 1 L2(1) Current: 1 L3(1) Current: 1 L3(1)	Phase: V L1-E Phase: V L2-E Phase: V L3-E Phase: V L1(1)-E Phase: V L1(1)-E Phase: V L1-L2 Phase: V L2-L3 Phase: V L3-L1 Phase: V L3-L1 Phase: V 1		☐ No Unit: I 2 / I 1

When "Show Actual Value" option of "Binary Inputs" is set, two parts are added to "Setting" and "Signal View", for example by checking "Binary-Input Target" option in the "Hardware Configuration" page and the "Binary/Analog Input" tab, all "Binary Inputs" are enabled. Then "Show Actual Value" option of one of them is set to "AC" (or DC) state and the "Show Actual Value" option of all enabled binaries is set at "AC" state upon right-clicking upon it and selecting "Set all Binary like this" option. You can observe that all "Binaries" have been added to the bar above "Setting". By checking each of them, the corresponding signal can be seen in "Signal View".

In the "Select Graph For Actual Binary" part, you can select other signals in the proprietary graphs of each "Binary Inputs" whose "Show Actual Value" is enabled to be displayed. In addition to displaying their signals, the "Binary Inputs" are also shown in the graph. This way, a comparison can be made between the "Binary Input" signal and other signal. For example, here we determine that in addition to displaying trip signal, Start" and "VL1-E" signals are also shown in "C1" signal diagram. Additionally, the signal name can be changed. Then by selecting the name on the bar above "Setting", the signals can be observed.

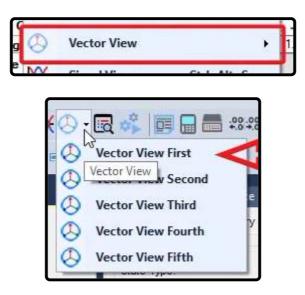
Select Graph For	Actual Binary
Trip	Trip 🗌 Trip L1 🗌 Trip L2 🗌 Trip L3 🗌 Trip L1 only 🗌 Trip L2 only 🗌 Trip L3 only 🗌 Trip 1 phase 🗌 V L1-E 🗌 V L2-E 🗌 V L3-E
Trip L1	□ Trip 🗹 Trip L1 □ Trip L2 □ Trip L3 □ Trip L1 only □ Trip L2 only □ Trip L3 only □ Trip 1 phase □ V L1-E □ V L2-E □ V L3-E
Trip L2	□ Trip □ Trip L1 ☑ Trip L2 □ Trip L3 □ Trip L1 only □ Trip L2 only □ Trip L3 only □ Trip 1 phase □ V L1-E □ V L2-E □ V L3-E
Trip L3	🗌 Trip 🗌 Trip L1 🗌 Trip L2 🗹 Trip L3 🗌 Trip L1 only 🗌 Trip L2 only 🗌 Trip L3 only 🗌 Trip 1 phase 🗌 V L1-E 🗌 V L2-E 🗌 V L3-E
Trip L1 only	□ Trip □ Trip L1 □ Trip L2 □ Trip L3 ☑ Trip L1 only □ Trip L2 only □ Trip L3 only □ Trip 1 phase □ V L1-E □ V L2-E □ V L3-E
Trip L2 only	🗌 Trip 🗌 Trip L1 🗌 Trip L2 🗌 Trip L3 🗌 Trip L1 only 🗹 Trip L2 only 🗌 Trip L3 only 🗌 Trip 1 phase 🗌 V L1-E 🗌 V L2-E 🗌 V L3-E
Trip L3 only	🗌 Trip 🗌 Trip L1 🗌 Trip L2 🗌 Trip L3 🗌 Trip L1 only 🗌 Trip L2 only 🗹 Trip L3 only 🗌 Trip 1 phase 🗌 V L1-E 🗌 V L2-E 🗌 V L3-E
Trip 1 phase	□ Trip □ Trip L1 □ Trip L2 □ Trip L3 □ Trip L1 only □ Trip L2 only □ Trip L3 only ☑ Trip 1 phase □ V L1-E □ V L2-E □ V L3-E

In "Binary (Analog) Transformer" part, the user can aggregate the signal with a constant value, multiply it by a factor, or apply a phase shift to it. The user may intend to introduce another parameter by applying these factors to the given parameter, for example, if the voltage signal is obtained by multiplying the current signal by 2 and aggregating it with value 3, the introduced parameter will be voltage parameter by selecting the "Voltage" option.

Trip	Sum	0.0000	Mul	1.0000	Deg	0.00 °	Unit	Voltage	O Current
Trip L1	Sum	0.0000	Mul	1.0000	Deg	0.00 *	Unit	Voltage	O Curren
Trip L2	Sum	0.0000	Mul	1.0000	Deg	0.00 *	Unit	 Voltage 	O Current
Trip L3	Sum	0.0000	Mul	1.0000	Deg	0.00 *	Unit	 Voltage 	O Curren
Trip L1 only	Sum	0.0000	Mul	1.0000	Deg	0.00 °	Unit	Voltage	O Current
Trip L2 only	Sum	0.0000	Mul	1.0000	Deg	0.00 *	Unit	Voltage	O Current
Trip L3 only	Sum	0.0000	Mul	1.0000	Deg	0.00 *	Unit	 Voltage 	O Current
Trip 1 phase	Sum	0.0000	Mul	1.0000	Deg	0.00 *	Unit	Voltage	O Current

60 : "VECTOR VIEW" WINDOW, PART 1

To open this window, "Vector View" option from the "View" menu should be used and it is possible to open up to five "Vector Views" of simultaneously. By clicking on the right arrow of "Vector View" icon from the toolbar desired number of windows can be opened. Here, the first "Vector View" is opened. To better explain this window, first, we close "Detail View" and "Measurement" view windows. In summary, on this window it is possible to view current and voltage input and output values in different modes.

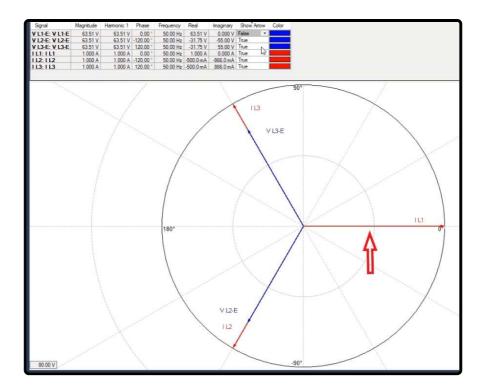


Type: 1	Vormal	~ 0.00	00 s 🗌 Sh	ow VLL fro	m zero		?
Signal		Magnitude	Harmonic 1	Phase	Real	Imaginary	Sho
V L1-E: 1	L1-E	63.51 V	0.000 V	0.00 *	63.51 V	0.000 V	True
V L2-E: N	L2-E	63.51 V	0.000 V	-120.00 *	-31.75 V	-55.00 V	True
VL3-E: V	L3-E	63.51 V	0.000 V	120.00 °	-31.75 V	55.00 V	True
1L1:1L1	1	1.000 A	0.000 A	0.00 *	1.000 A	0.000 A	True
112:112	2	1.000 A	0.000 A	-120.00 °	-500.0 mA	-866.0 mA	True
1L3:1L3	3	1.000 A	0.000 A	120.00 °	-500.0 mA	866.0 mA	True
<		/ 3	113 ^{90°}	7	_		>
<	7	(180°	13 ^{90°} 13-E	V11.	₽1 <mark>₽</mark>	\bigcap	>

"Signal", "Magnitude", the first harmonic, phase, real value, imaginary values are displayed in "Signal", "Magnitude", "Harmonic 1", "Phase", "Real" and "Imaginary" columns respectively. Also, the arrow of signals can be made hidden in the "Show Arrow" column while the color of arrows can be selected from "Color" column. Moreover, to add the frequency column to this table, by right clicking in this area and selecting "Table" from "Show/Hide" option, the frequency column is added to display the frequency of signals. For example, "V L1-E" signal with a 63.51 volt range and a first harmonic value of 63.51, phase value of 0, frequency of 50, real value of 63.51 and imaginary value of 0 is depicted with a blue arrow.

Copy to Clipboard			
Show/Hide	Table 🕨	~	Signal
	Report +	~	Magnitude
		~	Harmonic 1
		~	Phase
		X	Frequency
		J.	Real
1	1	~	Imaginary
\sim /	1	 Image: A start of the start of	Show Arrow
		~	Color

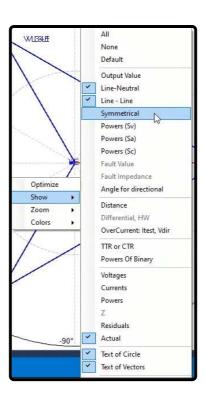
Now, by changing the status of "Show Arrow" to "False", you can see that the vector of this signal is made hidden in "Vector View". To optimize the display of "Vector View" vectors, right click on this section and check "Optimize". If you want to manually optimize the display of vectors, first you need to uncheck "Optimize" option and then optimize the display of vectors from the related fields at the corners of this page.



Also, if you want to add a signal to be displayed in "Vector View", by right clicking on the vector section of this window, you should select or remove your intended mode to be displayed from the "Show" option. By default, only "Output Value" and "Actual" are selected and phase voltage and current values of the device are displayed. By unchecking "Output Value" and selecting "Line-Neutral", you can see that in addition to phase voltage and current values, voltage and current values of neutral point are displayed in table and vector as well.

3	Optimize	
	Show	
	Zoom	•
	Colors	

Also, if you want to display line-line values of output voltage of the device, you should select "Line-Line" from this list and check this option. Then you will see that the values of line-line voltage of the device are displayed in the above table and the vector display of them is displayed in the below vector. If you wish to see the symmetrical current and voltages, select "Symmetrical" option and by doing so you can see that the zero, negative and positive sequence values of voltage and current and their vector view are displayed in the below table.



By selecting any of the "Power (Sv)", "Power (Sa)" and "Power (Sc)" options, the value of power is calculated in accordance with the current and voltage of the test as well as different calculation methods and then displayed in the related rows. For example, by selecting "Power (Sv)", you can see that S1, S2 and S3 quantities are displayed in three rows. In "Magnitude", "Phase", "Real" and "Imaginary" columns, the apparent power value, angle, active power and reactive power are displayed respectively. Now, since here "Power (Sv)" is selected, the power value of "Sv" is displayed according to the formulas in the box and after being calculated according to vector method, it is displayed in "Sv" row. Also, in "PFv" section, the coefficient value of apparent power is displayed.

$$P = P1 + P2 + P3$$
$$Q = Q1 + Q2 + Q3$$
$$Sv = \sqrt{P^2 + Q^2}$$

Now, if the user selects "Power(Sa)", the power value of "Sa" is calculated using the calculation method and according to the formulas in the box and then displayed in "Sa" field. In "PFa" field, the coefficient of power is first calculated using the same method and then displayed.

$$P = P1 + P2 + P3$$

 $Q = Q1 + Q2 + Q3$
 $Sa = S1 + S2 + S3$

If "Power (Sc)" is selected, the value and coefficient of power are calculated using the algebraic method and the displayed formulas and then displayed in "Sc" and "PFc" rows. You should keep it in mind that S1, S2 and S3 quantities are the same in all three methods and displayed on the vector. Also, when the load is unbalanced, "Power (Sc)" method works better than the others and V_{Σ} and I_{Σ} parameters refer to algebraic sum of voltages and algebraic sum of currents respectively. Also, V and I parameters refer to current and voltage of the system which are calculated in a four-phase system using the displayed formulas.

$$Sc = V_{\Sigma} * I_{\Sigma}$$
$$I_{\Sigma} = \sum \sqrt{I_a^2 + I_b^2 + I_c^2}$$
$$V_{\Sigma} = \sum \sqrt{V_a^2 + V_b^2 + V_c^2}$$

61 : "VECTOR VIEW" WINDOW, PART 2

Here we are going to introduce the other sections of the "Vector View" page. To view the values related to current and fault voltage, the "Set Mode" in "Detail View" window must be set on "Fault Values" or other types of faults available in this drop-down list. By selecting "Fault Value", "VFault" and "IFault" rows are added to the table. It is possible to directly determine the value of these rows in "Vector View".

Signal	Magnitude	Harmonic 1	Phase	Real	Imaginary	Show Arrow	Color
VL1-E: VL1-E	10.00 V	0.000 V	0.00 *	10.00 V	0.000 V	True	
V L2-E: V L2-E	63.51 V	0.000 V	-120.00 *	-31.75 V	-55.00 V	True	0
VL3-E: VL3-E	63.51 V	0.000 V	120.00 *	-31.75 V	55.00 V	True	<u>0</u>
I L1: I L1	2.000 A	0.000 A	0.00 °	2.000 A	0.000 A	True	
112:112	0.000 A	0.000 A	0.00 °	0.000 A	0.000 A	True	-
I L3: I L3	0.000 A	0.000 A	0.00 *	0.000 A	0.000 A	True	
V Fault	10.00 V	10.00 V	0.00 *	10.00 V	0.000 V	True	[
l Fault	2.000 A	2.000 A	0.00 *	2.000 A	0.000 A	True	
ZFault .	2.500 Ω	2.500 Ω	0.00 °	2.500 Ω	0.000 Ω	True	8

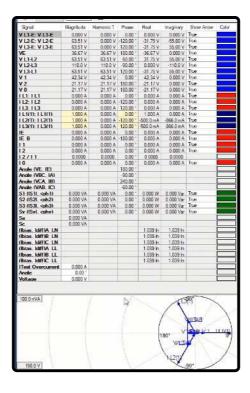
The next option is "Fault Impedance" which is activated by selecting "Set Mode: Distance" in "Detail View" window. By selecting "Set Mode: Distance" in "Detail View" and "Fault Impedance" option in "Vector View", a new row named "ZFault" is added to "Vector View" table. Note that when this row is added, it is no more possible to modify "VFault" and "IFault" and impedance fault is directly entered in "ZFault" row.

"Angle for directional" option shows the angle between currents and line and neutral voltages which is suitable for analyzing directional over current tests. For this information to be displayed, it is necessary to set "Set Mode" on "Overcurrent: I Test" in "Detail View" window.

The next option is "Differential". "HW" in front of this option means that this option is disabled due to "Hardware Configuration". To solve this, go to "Hardware Configuration" and activate all 6 current phases.

Anale (VE. IE)	180.00 *	
Anale (VBC. IA)	-90,00 °	
Angle (VCA. IB)	240.00 *	
Anale (VAB. IC)	-60.00 °	

"Overcurrent: I test Vdir" option is used for showing the current, line voltage and the angle between these two. Note that to display these values in "Vector View", "Set Mode: Overcurrent: I test" needs to be selected in "Detail View". "Voltages" and "Currents" options show output voltages and currents of the device in terms of different parameters including symmetrical voltage and current, neutral etc.



"Powers" option shows the apparent power obtained from different methods. If you want to only view the "Residual" voltage and current in "Vector View", you can use "Residual" option while to view the "Actual" values, "Actual" option is to be used. "Text of Circle" and "Text of Vector" options are used to view the angles of the circle with 90 degrees step by step and the name of each vector in the circle vector respectively.

62 : "VECTOR VIEW" WINDOW, PART 3

Next, we make an increasing "Ramp" "State", from 10 to 60 volts with 2 volts paces and a 1 amp current. Then in "Signal View" window, "Data Table" and 1, 2, 3 cursors are activated and "V L1-E", "V L2-E" and "V L3-E" signals are assigned to "Cursor 1", "Cursor 2" and "Cursor 3" respectively.

0.000 s	V L1-E: V L1-E		0.000 1/	40.0014		7.0000000000000000000000000000000000000
500 0 ms			0.000 V	10.00 V	0.00 °	50.00 H
	V L2-E: V L2-E		-14.70 V	12.00 V	-120.00 °	50.00 H
0.0	V L3-E: V L3-E		12.25 V	10.00 V	120.00 °	50.00 H
	5					
		N	N	N		N

There are 5 states in "Type" field. In "Normal" state, values are displayed in the table while performing the test. By selecting "Orange", an orange "Cursor" appears at the top of the widow which is linked with "Cursor 1" in "Signal View" window and by moving this "Cursor", the time is displayed in "Time" field. You can see that by moving this "Cursor" the signal values of all parameters are displayed in the table of "Vector View" window and as a vector in vector graph of this window. Because this "Cursor" is linked with the "Cursor1" from "Signal View" window and "VL1-E" is selected for "Cursor1" signal, instantaneous and effective values of "VL1-E" signal are displayed in "RMS" and "Value" rows in "Signal View" table respectively.

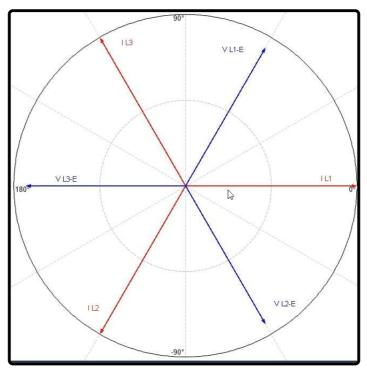
Type: Orange	~ 2.86	50 s Refer	ence Signa	I: None		~ 🗆	Show VLL
State 1		6				į	
o Signal	2 Magnitude	Harmonic 1	Phase	4 Real	Imaginary	6 Show Arrow	Color
VL1-E: VL1-E	20.00 V	20.00 V	0.00 °	20.00 V	0.000 V	True	
VL2-E: VL2-E	20.00 V	20.00 V	-120.00 °	-10.00 V	-17.32 V	True	
V L3-E: V L3-E	20.00 V	20.00 V	120.00 °	-10.00 V	17.32 V	True	
I L1: I L1	1.000 A	1.000 A	0.00 °	1.000 A	0.000 A	True	
112:112	1.000 A	1.000 A	-120.00 °	-500.0 mA	-866.0 mA	True	
I L3: I L3	1.000 A	1.000 A	120.00 *	-500.0 mA	866.0 mA	True	

Now, if the user selects "Blue" from the "Types" available in this field, this "Cursor" turns blue and is linked with the blue cursor which is "Cursor 2" in "Signal View" window. By selecting "Green" as "Type", this "Cursor" turns green and is linked with "Cursor 3" in "Signal View" table. So, it should be noted that in all three "Types" including "Orange", "Blue" and "Green", the values displayed in "Vector View" table are similar and only the "Cursor" link of this window changes along with the "Cursors" in "Signal View" window for viewing the instantaneous and "RMS" values of the intended signal.

If "Time" is selected from the available "Types", a field named "Time" appears at the top of the page and by entering the intended time, values of signals' parameters are displayed in "Vector View" window and their vector is displayed at the bottom of this page.

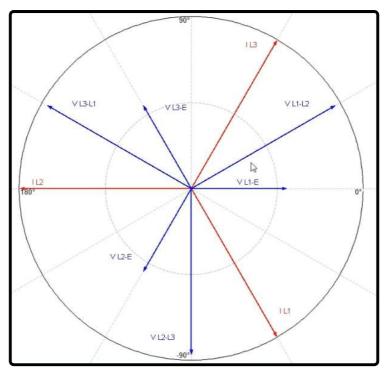


In "Reference Signal" field, it is possible to select a signal as the reference in "Vector View" window. By default, this is set at "None". This means that if the voltage of phase 1 has a 60 degrees angle and the other phases are symmetrical, no signal is considered as the reference and based on what determined in "Detail View", "V L1-E" and "IL 1" begin with 60 and 0 degrees angles respectively and the other signals are displayed with a 120 degrees phase difference. Now, if "Reference Signal" is set at "VL1-E", you can see that "VL1-E" signal begins with a 0 angle and the other signals are displayed in this window with a 120 degrees phase difference. Since there is a 60 degrees phase difference between current and voltage in "Table View", currents are displayed here with a 60 degrees phase difference. Also, if displaying the line is activated in the window, by checking "Show VLL from zero" option, you can see that the vector view of them is displayed from zero in the vector graph of this window.



If you want to perform "Zoom In" or "Zoom Out" on "Vector View" window, after right-clicking on vector section of this window, first you need to uncheck "Optimize" option, then, "Zoom" option is activated and you can "Zoom In" or "Zoom Out" by using this option. Moreover, if you wish to change the color of this page, by using "Colors" option, you can change "Background", "Foreground" and "Helper Line" colors. For example, here, we change the "Background" color to blue,

"Foreground" color to black and "Helper line' to green. To revert the settings to default, select "Default Colors" from this section.



63 : "MEASUREMENT VIEW" WINDOW, PART1

In reletion the "sequencer" windows, the "Measurement View" window would be explained in this video. This window is used to evaluatthe test results and some criteria determineg for the "Pass" or "Fail" of the test. Note that evaluation can be performed before or after the test then the results rvaluated. To explain this section three "states" of "Prefault", "Fault" and "Postfsult" are created in the "TableView" that the followed voltages are injected:" in "Prefault", content voltage of 10 V for two seconds; in the "Fault" state, the voltage will increase from 10 V to 15 V as "continuous Ramp" in 10 seconds and in "Postfault" the 0 V for one second.

Na	ame	Ignore before	Ignore After	Start	Stop	T Nom.	T Dev	T Dev.+	T Act.	T Dev.	Assessment	User Comment
▶1												
_												
e Assess	sment	Level As 3: Not T	ssessment		Ramp Assessment 1: Not Tested	i.	Value Assessme 1: Not Tested	nt	Calculated Ass 1: Not Tested	sessment	Transient / 1: Not Test	ssessment
ot Tested												

	□s1	<u></u> \$2	S 3
Name	Prefault	Fault	Postfault
VL1-E: VL1-E	10.00 V	10.00 V	0.000 V
V L2-E: V L2-E	10.00 V	10.00 V	0.000 V
V L3-E: V L3-E	10.00 V	10.00 V	0.000 V
I L1: I L1	1.000 A	1.000 A	1.000 A
112:112	1.000 A	1.000 A	1.000 A
1 L3: 1 L3	1.000 A	1.000 A	1.000 A
Bin. Out	ee		(444)
Trigger	2.000 s	10.00 s	1.000 s
Туре	Normal	Continu	Normal
Comment			
	сз О	C3 O	C3 O
	C4 O	C4 ()	C4 ()
Bin. Input			

"Time Assessment" tab

The "Measurement View" window has some tabs that each one evaluates a special item. In the "Time Assessment" tab, an event time is evaluated in the test this event is received by a signal from "Trip" or "Pick Up" from a relay or logic with a combination of various conditions. In this tab, some rows is "added" and multiple time evaluations can be performed. In the "Name" column, a name, for example, "Trip Time" can be inserted for evaluation. Since it's possible that a "Trip" signal can be recorded in different times, in the "Ignore before" and "Ignore after" a General range from the test "States" are selected so the time evaluation of these events are performed in this range. For example, by selecting the "State :Fault", all the events before the "Fault" "state" would be ignored in the "Ignore before" column. In the same way, by selecting the "State" in the "Ignore after" column, all the events after the "Fault" "state" are ignored.

In the "Start" column, the time reference and in the "Stop" column, the event that is meant to be evaluated is specified. Here, receiving the "start" signal are selected from binary 4 as the reference and receiving the "Trip" contact as the binary3 would be selected as the intended event for time evaluation. Note that, there exists an option named as "Logic" in the "Start" and "Stop" columns that by right-clicking on it and selecting the "View Custom Setting", a logic with the combination of various conditions for evaluation start time reference and final conditions of evaluation time calculation would be specified. In the "TNom" column, the expected nominal time of "Start" and "Stop" enters and in the "TDev+" and "TDev-" columns, the positive and negative tolerances are entered that could be different from each other.

rigger Logic :		O AI	ND OR	
Not Used :		~	Not Used :	.4
Not Used :		14	Not Used :	
C3:Trip:	×	~	Not Used :	9
C4:Start :	x	~	Not Used :	

Here, to evaluate the test, a nominal time of three seconds, a positive tolerance of two seconds and a negative tolerance of one second are entered. After running the test and recording the results in the table, the real-time of the event is specified in the "TAct" column that is about 3.623 seconds and its deviation from the "TNom" is recorded as a percentage in the "TDev" column. In the "Assessment" column, the evaluation is performed that if the "Tact" time is in the defined range of (Tnom)-(TDev-) to (Tnom)+(TDev+), the evaluation is "Passed" and if it is not in this range the evaluation is "Failed". Here, because the 3.623 seconds are located in the range of 2 to 5 seconds, the test is passed. In the "user comment" column, you can enter your desired notes.

	Name	Ignore before	Ignore After	Start	Stop	T Nom.	T Dev	T Dev.+	T Act.	T Dev.	Assessment	User Comment
▶1	Trip Time	S2: Fault	S2: Fault	C4: Start 0>1	C3: Trip 0>1	3.000 s	1.000 s	2.000 s	3.623 s	20.76 %	N +	
2											13 0	

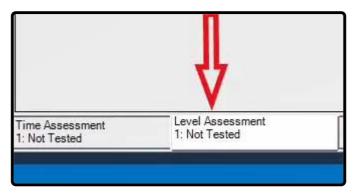
In the right-clicks of this section, by selecting the "Copy" option, the information of an evaluation row could be copied and by "Pasting" it, a new row with the information is created. By selecting the "Add" option, a blank row is added to the evaluation table. By selecting the "Insert before" and "Insert After" a blank row is added before and after the selected row and other time evaluations can be defined in these rows. The "Delete" will delete the selected row.

	Сору	
hs	Paste	
	Add	
	Insert Before	
	Insert After	
	Delete	
	Show/Hide	•

The last option in this section is the "Show/ Hide" option that is composed of two "Table" and "Report" options. There exists a list in the "Table" and "Report" sections that are exactly the same as the evaluation table columns. By unchecking each of them, that column would be deleted from the "Table" in the "Measurement View" or the "Report" section.

64 : "LEVEL ASSESSMENT" TAB

One of the tool for evaluating the binary inputs that should be preserved during the test is "level assessment". In "level assessment" tab, the binary situation of the device inputs can be assessed at the start of a "state". An example is provided for this process.



First three "states" are created in the window "table view". Then, the range of voltage signals are inserted as "30" v in "state1". The value of "4" seconds is inserted in the "trigger" field. Then, the value of "10" v is inserted in "state2" and its time is set as "3" second. The value of "30" v is inserted in "state3" and its time is set as "4" seconds.

		\$1			?
Name	State 1			State 2	
V L1-E: V L1-E	30.00 V	0.00 *	50.00 Hz	63.51 V	1
V L2-E: V L2-E	30.00 V	-120.00 °	50.00 Hz	63.51 V	1
V L3-E: V L3-E	30.00 V	120.00 °	50.00 Hz	63.51 V	1
I L1: I L1	1.000 A	0.00 °	50.00 Hz	1.000 A	1
112:112	1.000 A	-120.00 °	50.00 Hz	1.000 A	1
I L3: I L3	1.000 A	120.00 *	50.00 Hz	1.000 A	1
Bin. Out	B1 B2	J- B3	B4. ┛-	B1 B2	2.
Trigger	(Ì		>4.000 s	Q	
Туре	Normal		с С ~	Normal	

In the following, by clicking "hardware configuration" in the tab "analog out", current signals become deactivated. The binary inputs 3 and 4 can be activated in the tab "binary/analog input" in "binary-input target"; then, they are assigned a name. Here, the type of binary inputs is set as "dry".

1		Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
C	1	Not Used	Not Used	Dry		False	None	True		
C		Not Used	Not Used	Dry		False	None	True		
C		Trip	Trip	Dry		False	None	True		(Short)=>(input=1)
c		Trip L1 🔹	Trip L1	Dry		False	None	True		(Short)=>(input=1)
C	5202	Not Used	Not Used	Dry		False	None	True		
C		Not Used	Not Used	Dry		False	None	True		
C		Not Used	Not Used	Dry		False	None	True		
C		Not Used	Not Used	Dry	5	False	None	True		
9		Not Used	Not Used	Shunt 1 Ohm			None			
1(0	Not Used	Not Used				None			>
	0	Not Used	Not Used					Ç₹		,

Then in the window "measurement view", click on the tab "level assessment". In this tab by clicking "state name", the names of the existing "states" are inserted in "table view". This name is uneditable. Note that in this tab, you cannot add a line manually. In the "level assessment" tab, the right click tool is deactivated, and for every "state" in the window "table view", a line has been created in this tab. So, the number of assessments in this section depends on the number of "states" existing in the "table view" window.

	State Name	Assessment	Tolerance	Trip	Trip L1	User Comment
1	State 1	٠		х	X	
2	State 2	0	i i	Х	X	
3	State 3	•		Х	X	· · · · · · · · · · · · · · · · · · ·

The result of assessment is presented in the "assessment" column. The value of time tolerance for assessment of the zero or one level of the binary input is entered into the column "tolerance". It can be simply stated that assessment of the level of each signal at the right and left sides of the starting point of each state depends on the value of time tolerance specified in this part. Suppose that the value of 30 ms is inserted as the tolerance of a binary input, the figure presents the schematic level assessment of the signal of this binary input. As it is obvious, level assessment at the two sides of state2 is done by a time tolerance of 30 ms in order to check the condition specified for this assessment; for example the level of the binary input should be equal to 1. As assumed, if the considered condition is that the level of Trip signal should be equal to 1 for state2, the result of assessment will be passed.

س



Specifying the binary levels

In the "level assessment" tab, the number of binaries defined in "hardware configuration", column is added with the same name. In this part, you can set the level one or zero regardless of the binary level condition that is X.

In this film, the goal is the assessment of the level one of the binary 3 (Trip) in "state2". Suppose that the level of binary 3 before and after the second "state" is equal to one for "40" ms and assessment result is pass. For this purpose, the value of "40" ms is inserted in "state2" in the field "tolerance", and the level one is inserted in the field "Trip" (binary 3). A comment about the assessment can be inserted in "user comment" that is also used in the output report. Then run the test. After the test, assessment is done and the result is presented in "assessment". As seen in "signal view", before and after the "state2", binary one has been preserved for at least "40" ms. So, the result of assessment is "pass".

	State Name	Assessment	Tolerance	Trip	Trip L1	User Comment
1	State 1	+		Х	X	
2	State 2	+	40.00 ms	1	X	12
3	State 3	+		X	X	

65 : "RAMP ASSESSMENT" TAB

The "Ramp Assessment" tab is used for evaluating a signal in case special condition in the test. For example, if a relay picks up, the current amplitude is assessed and evaluated. Note that this evaluation is used only for the "States" of the "Ramp" type. For better explanation, three states are generated in such a way that the first state is adjusted as "Normal" with the voltage of 5 V for two seconds, the second "State" is adjusted as "Step Ramp" from 5 V to 20 V with 1 V steps and the third "State" is adjusted as "Step Ramp" from 30 V to 50 V with 2 V steps. In addition, in the first column a name, for example, Ramp will be entered for evaluation.

M	easurement View	×												
	Name Ra	mp State	Condition	Signal	Signal Type	Nom.	Dev	Dev+	Act.	Dev.	Assessment	T Act.	T Act. Final Step	User Comment
▶ 1											•			

In the "Ramp State", the intended "State" is selected from the "states" of the "Ramp". Note that because this evaluation is only for the "Ramp" type "States", the first "State" that is as "Normal" type is not shown in this field and from the states of two and three, the "State 2" will be selected for evaluation. In the "condition" column, a condition is specified for evaluation that here, the intended condition is specified as receiving the "Trip" signal from one binary. Also, in the "Signal" column, the intended parameter for evaluation is selected. For example, the "VL1-E" is selected. It means that the "VL1-E" voltage is evaluated when the trip signal is received. If you want to evaluate other signals simultaneously, you have to the right-click, select the "Add" option and create other columns and define another evaluation. Other existing options in the right-click section has been explained in previous videos.

In the "Signal Type" column, you have to set the evaluation to be performed on what parameter of the selected signal. Here, the "Amplitude" is selected. In the "Nom" column, the intended value of the amplitude in the time of term happening is specified. For example, this value is set to be 40 V. in the "Dev+" and "Dev-" columns, the positive and negative tolerances are entered in which can be different from each other. Here, to observe the performance of this section, the positive and negative tolerances of 2 V and 3 are, respectively.

	Name	Ramp State	Condition	Signal	Signal Type	Nom.	Dev	Dev+	Act.	Dev.	Assessment	T Act.	T Act. Final Step	User Comment
•	ramp	S3: State 3	C3: Trip 0>1	V L1-E: V L1-E	Amplitude	40.00 V	3.000 V	2.000 V	42.00 V	5.00 %	. +	3.39	399.2 ms	
1	2										6			

By running the test, in the time of receiving the "trip 0->1" signal by third binary of the device, the actual value of amplitude of the "VL1-E" signal is shown in the "Act" column in which its deviation from the nominal value in the "Dev" column is about 42 In the "Assessment column, the evaluation result specifies that if the "Act" value is located in the allowable range i.e. (Nom)-(Dev-) to (Nom)+(Dev+), the assessment result will be "Passed", otherwise it would be "Failed". Here, because the value of 42 is in the range of 37 V to 42 V, this evaluation will be "Passed". In the "T Act" column, the "Trip" signal receiving time is specified and recorded by the device that here, this time is about 3.39 seconds. Also, in the "T Act Final Step" column, the receiving time of the "Trip" signal is recorded from the last step of the "Ramp", which here is about 399.2mili seconds. In addition, if you want to define a "comment" for your assessment, you can enter your intended comment in the "Use Comment" column.

(nom)-(Dev-) to (nom)+(Dev+)

66 : "VALUE ASSESSMENT" TAB:

In this tab, you can evaluate a parameter from the intended signal in a specified time first a "Step Ramp" with voltage from 55 V to 65 V with 1 v and 40msecond steps has been created. In the "Name" column, you can select a name, for example, "Voltage", for assessment. you Also, have to select the "State" in the "Reference State" column, and the intended signal in the "Signal" column for assessment, which "State 1" and "VL3-E" will be selected, respectively.

Name	Reference State	Signal	Signal Type	Time	Nom.	Dev	Dev+	Act.	Dev.	Assessment	User Comment
1										0	
me Assessment	Level Ass		Ramo A	ssessment	Valu	e Assessment	Calaut	ated Assessmen		Transient Assessm	ont I

In the "signal Type" column, you have to adjust which parameter should be evaluated. Here, this parameter will be selected as "Amplitude" so the amplitude of the "V L3-E" signal in the assessment time will be measured and evaluated. Now, the specified time for assessment should be entered in the "Time" column that here, 200 ms will be selected.

In the "Nom" column, the expected value for the amplitude of the selected parameter is specified, which here, the expected value for the "V L3 E" phase voltage should be adjusted. For example, here, the voltage is set to be 60 V. in addition, in the "Dev+" and "Dev-" columns, the positive and negative tolerances are entered. Note that these tolerances

can be different from each other. Therefore, the positive tolerance and negative tolerance are entered as 1 V and 0.5 V, respectively then "run" the test.

Name	Reference State	Signal	Signal Type	Time	Nom.	Dev	Dev+	Act.	Dev.	Assessment	User Comment
1 voltage	S1: State 1	V L3-E: V L3-E	Amplitude	200.0 ms	60.00 V	500.0 mV	1.000 V	60.00 V	0.00 %	+	

After completing the test, the actual value of the "V L3 E" signal amplitude is shown in the "Act" column. Also, its deviation from the expected value is specified in the "Dev" column in percentage, which here is zero percent. In addition, the assessment result will be specified in the "Assessment" section. If the "Act" value is in the allowable range of tolerance, i.e. (Nom) - (Dev-) to (Nom) + (Dev+), the assessment result is passed. Otherwise, it is "failed". You see that because the "Act" value is in the range of 60.5 V to 61 V, this assessment has been considered as "Passed". In addition, if you want to define a "comment" for your assessment, you can enter your intended comment in the "Use Comment" column.

(Nom)-(Dev-) to (Nom)+(Dev+)

67 : "CALCULATED ASSESSMENT" TAB

In the "Calculated Assessment" tab of the "Measurement View" window, the mathematical operation can be performed between the assessments to create a new assessment and evaluate the test. It means that in this tab, a new parameter can be created in the specified mathematical operation that is performed for the "Actual" values of the assessments, and the parameter can be evaluated by the "Act" values that are selected from the "Ramp Assessment" and "Value Assessment" tabs. After specifying the name for the assessment, the intended mathematical operation in the "Calc" column will be selected. In the "X" and "Y" columns, one of the performed assessments will be selected in the "Ramp Assessment" and "Value Assessment" and "Value Assessment" and "Value Assessment" and "Value Assessment" and "Y" columns are in fact, the "Act" value of the performed assessments entered in these columns. For simpler separation of the evaluation names, the two letters of "V" and "R" that represent the "Value Assessment" are used.

Name	Calc.	X	Y	Nom.	Dev	Dev+	Act.	Dev.	Assessment	User Comment
1									0	
		Assessment					* Calculated Ass		Transient Asse	

In the "Nom" column, the expected nominal value and in the "Dev+" and "Dev-" the positive and negative tolerances will be entered. The true result of the selected mathematical operation in the "Calc" column will be shown in the "Act" column and its deviation from the expected value will be shown in the "Dev" column and in percent. In the "Assessment" column, the result of the created assessment will be specified. If the "Act" value is in the allowable range, the result of the assessment will be "Passed" with a green-colored sign. Otherwise, it will be "Failed" with a red-colored cross. In the "User Comment" column, you can enter your comment if you have any.

In this test, in the "Ramp Assessment" tab, an assessment with the name of "Voltage" is performed for the "V L1-E" voltage that will be entered in the "X" column. In addition, in the "Value Assessment," an evaluation with the name of "Current" is performed for the "IL1" that will be entered in the "Y" column. In the "Calc" column, the "X/Y" operation is selected. As you know, by dividing the voltage to current, resistance will be calculated. Therefore, the mane of this assessment is entered as "Resistance". After specifying the "X" and "Y" columns values, the "Act" value is shown. In the "Nom" column, the nominal values are 15.7 and the "Dev+" and "Dev-" values are entered as 0.5. you can see that the "Act" is about 0.26 percent different from the nominal value specified by the user and the assessment is "Passed".

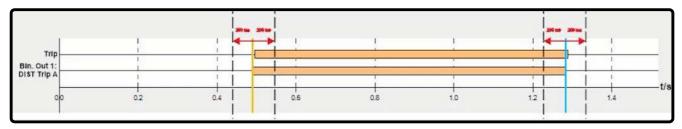
	Name	Calc.	X	Y	Nom.	Dev	Dev+	Act.	Dev.	Assessment	User Comment
▶ 1	Resistance	X/Y	R (01): Voltage	V (01): Current	15.7000	0.5000	0.5000	15.7416	0.26 %	+	

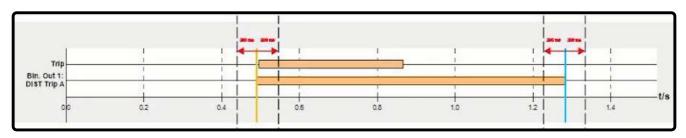
68 : "TRANSIENT ASSESSMENT" TAB

The "Transient Assessment" section is used to assessing the "States" that are designed for testing the "Transient". In this section, a received contact by the device from the relay can be time-compared to the binary signal in the "Comtrade" file. A sample of the application of this "Assessment" is to compare the performance of the relay while applying the signals of transient file so the user would understand that whether or not the relay has a similar function while a fault occurs.

Se M	leasurement View	×									
	Name T	ransient State	Signal Ref	erence Signal	T Dev T	Dev.+	Assessement	User	Comment		
▶1							•				
								Ł		Transient Assessment	
Time As 1: Not T	ssessment ested	Level As 1: Not Te	sessment ested	Ramp Ass 1: Not Tes	essment ted	Value As 1: Not Te	sessment sted		Calculated Assessment 1: Not Tested	1: Not Tested	

In the "Measurement View" window, the "Transient Assessment" tab, a name is inserted for assessment in the "Name" field so better feedback is obtained from the specified item. In the "Transient" field, the intended "State" is selected. Remember only the name "States" which are "Transient" type are displayed in this field. In the "signal" field, a binary signal is selected for comparison with the reference signal from the "Comtrade" signal. In this field, the list of all the binaries activated in the "Hardware Configuration" is displayed that one of them should be selected. In the "Reference Signal" field, the reference signal is selected from the "Comtrade" file. By clicking on this field, all the existing binary signals in the loaded "Comtrade" file are displayed. In the "T Dev. -" field, the negative time tolerance related to the digital signal edge is specified and imported in the "Comtrade" file. In the "T Dev. +" field, the positive time tolerance related to the digital signal edge is specified and imported in the "Comtrade" file. The result of the assessment after running the test will be displayed in the "Assessment" field. The green color means the test is "Passed" and the red color meant that the test is "Failed". In the "User Comment" field, a message can be written about the test, before and after the test which is used in the output report. By right-clicking on the "Transient Assessment" the tabs and options are displayed that are similar to right-clicking on the "Time Assessment" tab, which was comprehensively explained in the previous educational videos (Time Assessment). The assessment in this tab is defined according to the comparison of the signal with the reference signal. For assessment, if both the signals are identical in the specified time period and have a similar status, then the assessment will be "Passed". Otherwise, the assessment is "Failed" showing that the relay didn't have a similar performance while importing error and had another status.





To do this at first, some adjustments should be performed in some windows. In the following, an example of the test will be discussed. At first, the "Transient" state will be selected in the "Detail View" window and by clicking on the "Import Comtrade..." file, the transient state of the "Micom P441" relay is loaded. Then, by clicking on the "Current State" option from the toolbar, all the active and inactive binaries existing in the "Comtrade" file and the voltage and current signals are displayed. In the following, by checking the "Calculate RMS ...", the software calculates the effective values and the phases of the signals.

Transient	~	State 1
Transient Setting		
Comtrade File	Errors	6
Import Comtrade	No E	
Import Comtrade from list		
Calculate RMS, Phase a	nd Othe	r
Select All Channel		22
Limit voltage and current	of trans	ient file to set

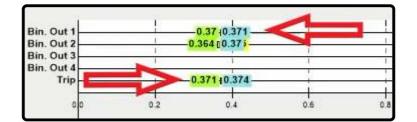
Signal	Channel	Scale	Min	Max	Prim. factor	Sec.factor	PS
VL1-E	VA	100.0 %	-33.47 kV	33.53 kV	1.000 V	1.000 V	Primary
VL2-E	VB	100.0 %	-25.22 kV	25.22 kV	1.000 V	1.000 V	Primary
VL3-E	VC	100.0 %	-34.40 kV	35.12 kV	1.000 V	1.000 V	Primary
IL1	IA	100.0 %	-160.2 A	157.4 A	1.000 A	1.000 A	Primary
112	IB	100.0 %	-477.9 A	477.9 A	1.000 A	1.000 A	Primary
113	IC	100.0 %	-196.1 A	193.4 A	1.000 A	1.000 A	Primary

Subsequently, from the "Detail View" window and "Binary out" tab, each of the existing signals in the "Comtrade" file that should be tested and assessed should be ascribed to a "Binary Output" and selected as the reference signal. In this video, two "ZONE1" and "ANY TRIP" signals are ascribed to "binary out" 1 and "Binary Out" 2, respectively and the reception of trip signal from the relay signal is compared to "ZONE1" signal to be assess.

Out	Display Name	Transient
1	Bin. Out 1	ZONE 1
2	Bin. Out 2	ANY TRIP
	and the second	

In the "Hardware Configuration" window, "Binary / Analog Input" tab, binary 1 with the name of "Trip" is connected to the relay trip contact for comparison with the active reference signal. In the "Transient Assessment" tab, in the "Name" field a name for example "trip1" is inserted for assessment. The "State1" that is a transient state is selected in the "Transient State". In the "Reference Signal", the reference signal that is selected in the "Binary Output" is inserted (ZONE1) and the "Trip" signal is selected in the "Signal" field for comparison. In the "T Dev. -" and "T Dev. +" time tolerance "3" is inserted. In order to observe the "Binary Input" status, the "All State" option are selected from the toolbar and the test is executed so the fault is applied to the relay. Finally, in the "Signal View" the relay has the same performance as the reference signal, which is defined as the "Binary Output1", and the assessment result is "Passed".

	Binary-Input Targe	et	Binary-Input Label	Binary-Input Type
C1	Trip	•	Trip	Dry
02	Notligad		Not liead	Dev



	Name	Transient State	Signal	Reference Signal	T Dev	T Dev.+	Assessement	User Comment
> 1	trip1	S1: State 1	C1: Trip	ZONE 1	0.0030	0.0030	+	

69 : RUNNING THE TEST

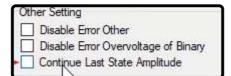
After designing the test in each room, run the test. Here, the "Pick up", "Drop off" test is designed for the three-phase state in the "overcurrent" relay. In this test, the "CT"s turns ratio is set to be 1/1000 and the "Pick up" current of the relay is set to be 2 A. In addition, binary inputs 1 and 2 of the device are activated to receive the "Trip" and "Pick up" signals of the relay. To perform the "Pick up" test, a "State" with the name of "Pick up" and as increasing "Ramp" type is designed, in such a way that the three-phased current increases from 800 mA to 3 A each 500 ms with the 50 mA steps in the stepwise state. To end the "Pick up" test, in the "Trigger" tab, the binary condition of "C2:Start", "0->1" is adjusted. The intended "State" for the "Drop off" test is designed as a decreasing "Ramp" type from 3 A to 800 mA in such a way that it decreases 50 mA each 500 ms in the stepwise state. In this "State", the condition for the test end is adjusted to be "C2:Start", "1->0" so if the relay "Drops" the test would end. Remember that in the "Detail View" window from the state related to the "Drop off" test, you can check the "Continue Last State Amplitude" so immediately after the first state ends the current amplitude of the second state would start from the previous value in the first state as "Ramp" type until the relay drops. By doing this, the test duration decreases.

I nom(secondary) :	1.000 A
I primary :	1.000 kA

	Binary-Ir	nput Target	Binary-Input Label		
C1	Trip	-	Trip		
C2	Start	Start	Start		

State Type State Type:		State Name:		Simple mode	<u></u>			Step Ramp Set Step Time	ting 500.0 ms
Step Ramp	~	Pick up		Signal	Amplitude	Phase	Frequency	Enable Res	set
				1 L1: I L1	50.00 mA	0.00 *	0.000 Hz	Reset Time	500.0 ms
Set Mode and Fa	aultType			112:112	50.00 mA	0.00 °	0.000 Hz	Ramp Descripti	on(Emore)
Set Mode :				1 L3: 1 L3	50.00 mA	0.00 °	0.000 Hz	Number Of Ster	
General: Direct	~			Final Value	5			Total Time: 22. No Error In Step	50 s
Start Value	1	Co	n. in Freq Step	Signal	Amplitude	Phase	Frequency		
Signal	Amplitude	Phase	Freque	IL1: IL1	3.000 A	0.00 *	50.00 Hz	◯ Trigger ◯	Reset Value
1 L1: I L1	800.0 mA	0.00 °	50.00 Hz	112:112	3.000 A	-120.00 °	50.00 Hz	Offset Valu	Je
112:112	800.0 mA	-120.00 °	50.00 Hz	113:113	3.000 A	120.00 *	50.00 Hz		
1 L3: 1 L3	800.0 mA	120.00 °	50.00 Hz	1 60. 1 60	5.000 / 1	120.00	00.00112	Signal	Amplitude

State Type Start Time Ref. From This State				Simple mode	(L1-L2-L3)		Step Ramp Settin	g	
State Type:		State Name:		Step Value	s		Step Time 500.		
Step Ramp	~	Drop off		Signal	Amplitude	Phase	Frequency	Enable Reset	3
				1 L1: 1 L1	-50.00 mA	0.00 *	0.000 Hz	Reset Time	500.0 ms
Set Mode and Fa	ultType			112:112	-50.00 mA	0.00 °	0.000 Hz	Ramp Description	(Errors)
Set Mode :				I L3: I L3	-50.00 mA	0.00 °	0.000 Hz	Number Of Step F	
General: Direct	~							Total Time: 22.50 No Error In Step F	s
Start Value		Co	n. in Freq Step	Final Value	Amplitude	Phase	Frequency		
Signal	Amplitude	Phase	Freque	IL1: IL1	800.0 mA	0.00 *	50.00 Hz	◯ Trigger ◯ F	leset Value(
111:111	3.000 A	0.00 *	50.00 Hz	112:112	800.0 mA	-120.00 *	50.00 Hz	Offset Value	1
112:112	3.000 A	-120.00 °	50.00 Hz	112:112	800.0 mA	120.00 *	50.00 Hz	-	
113:113	3.000 A	120.00 °	50.00 Hz	1 20. 1 20	000.0101	120.00	00.00112	Signal	Amplitude



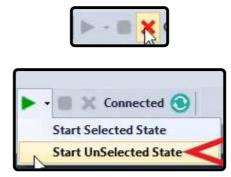
For this test, in the "Measurement View" window, several assessments are designed for analyzing the actual values of "pick up" and "Drop". In the first row, the actual value of the "Pick up" current related to the first phase is evaluated. To do this, in the "Ramp State", the "S1: Pick up" is selected, the intended condition for assessment is "C2: Start 0->1", the intended signal is "I L1", and the parameter type for assessing this signal is selected in the "Signal Type" as "Amplitude". Now, because the "Pick up" current is 2 A, two is inserted in the "Nom" column that the relay should pick up this current in ideal condition. In addition, the "Dev+" and "Dev-" columns the 100 mA tolerances are selected for assessment. The assessment of phase two and three picks up current is performed in the same way in the second and third-row only with this difference that in the "Signal" column related to these two assessments the "I L2" and "I L 3" signals are selected.

	Construction of the		I Development work	1.0007030000000	I ARREST THE REPORT OF	1.2055-04	1.0096.75	Location - C	neces.	1.5525552	1	IT SS IN TINS		
	Name	Ramp State	Condition	Signal	Signal Type	Nom.	Dev	Dev+	Act.	Dev.	Assessment	T Act.	T Act. Final Step	User Comment
► 1	pickup 1	S1: Pick up	C2: Start 0>1	TL1:TL1	Amplitude	2.000 A	100.0 mA	100.0 mA						
2	pickup 2	S1: Pick up	C2: Start 0>1	1 L2: 1 L2	Amplitude	2.000 A	100.0 mA	100.0 mA						
3	pickup 3	S1: Pick up	C2: Start 0>1	1L3:1L3	Amplitude	2.000 A	100.0 mA	100.0 mA						
4	drop out 1	S2: Drop off	C2: Start 1>0	1 L1: I L1	Amplitude	1.900 A	50.00 mA	50.00 mA		1	۲			
5	drop out 2	S2: Drop off	C2: Start 1>0	1L2:1L2	Amplitude	1.900 A	50.00 mA	50.00 mA						
6	drop out 3	S2: Drop off	C2: Start 1>0	1L3:1L3	Amplitude	1.900 A	50.00 mA	50.00 mA			0			

Also, in the fourth row, the actual "Drop" current of the phase one is assessed. For this reason, the "Ramp State" is adjusted on "S2: Drop off" and in the "Condition" column, the "C2: Start 1->0" condition, is selected for "I L1" signal. For this assessment, the intended parameter in the "Signal Type" has been selected as "Amplitude". Now, because the current amplitude of the relay "Drop" is 1.9 A, in the "Nom" column, the 1.9 A with 50 mA as positive and negative tolerances is adjusted. Remember that the current drop assessment in phases two and three are performed in the same way with this difference that in the "Signal" column, the "I L2" and "I L3" phases are selected.

To run the test, you have to click on the "Start" icon in the "Toolbar" section of the software. You can then see that at first, the first state that is designed for "Pick up" test is executed and after applying the trip signal and meeting the specified condition in the "Trigger" tab, the second state is executed and tested. Besides, you can use the "Test" menu or "F5" key on the keyboard to run the test.

In order to apply the changes in the designed states and also re-run the test, you have to "Clear" the previous test results using the "Clear Test" icon in the "Toolbar". Now, by clicking on the red-colored cross icon you see that this test is "Cleared" and the icon related to "Start" is activated. Furthermore, using the "F4" on the keyboard the test can be "cleared". If you want some specified "States" to be executed from the designed "States" in the "Table View", you have to check them in the "Table View" window or by clicking on the right-side arrow of the "Start" icon, by selecting the "Start Selected State", run the selected "States". By selecting the "Start Unselected State" option the unselected "States" are executed. In addition, if you want to stop the test while its performing, you have to click on the "Stop Test" or press "F6". For example, by checking the second "State" by clicking on the right-side arrow of the "Start" icon, the "Start Selected State" is selected and you see that only the second "State" is executed. Now, by clicking on the "Stop Test" icon, this "State" end and the current injection is halted before meeting the specified conditions in the "Trigger" tab.



70 : START-CONDITION-REPETITION" WINDOW

By clicking on the "View" menu and selecting the "Start-Condition-Repetition" option, or by clicking on its icon from the toolbar this window opens. In the "Start Condition" tab, the test conditions can be specified. If you want the test to be run immediately after clicking on the "Start" icon, you have to select the "Immediately" radio button. After selecting this option in Status bar, the St. Cond. is set on the "Immediately" and after running it the test stars immediately there is no delays exist between clicking on "Start" and "Run". Please remember that the software default is this option.



Start Condition Repetition Meter Start Test Condition Immediately Immediately Immediately On Binary Input C1. Trip On GPS Immediately Immediately 05" Second	N	er
Immediately On Binary Input On GPS	Start Test Condition	
O On Binary Input C1. Trip		
O On GPS	Immediately	
	On Binary Input	C1: Trip 🚽
Next Full 05" Second	O On GPS	
	🖂 Next Full	05" Second
Start time 00:00:00	Start time	00:00:00

If you want the test to be run after receiving the contact by one of the binaries, you have to select the "On Binary Input" option. By selecting this option, its right side option is selected that you have to select the intended binary in it to start the test. In this field, the activated binaries are shown in the "Hardware Configuration". For example, the "C2: Start" is selected, now in the statusbar, the "St. Cond." has been set on the BI.2-Start. After clicking on the "Start" icon, you see that because not receiving the contact by the "C2" binary, the test has not been executed, now by receiving the contact by this binary, the test runs.

The third method to start and run a test is the use of a "GPS" antenna. By selecting the "On GPS", a test could run according to the "GPS" clock. One of the applications of this option is in the longitudinal differential or "End to End" tests. To run the test using this option, the socket of the "GPS" antenna should be connected to the rear part of the "AMT105" device and the antenna is located in open space. By clicking on the "Start Sync" option, the "sync" process of the device with the satellite begin and in the "GPS Status:" field (shown in the figure) the "GPS" status is shown. By "Syncing" of the device and software in the "GPS Status:" field, the "GPS is Sync" term is shown. In addition, in status bar, the St. Cond. is set on the GPS (Sync). Also, in the status bar, GPS time error is displayed in the "Time Error" section. Please remember that this number should be less than 1000 ns. The tester time is displayed online in this toolbar. In the "Satellite Signal Level History" section, the number of satellites and the strength of each signal is shown. If the number of satellites and the signal strength is proper, the phrase "Detected" is displayed in the "Time Pulse" field and the device receives the "GPS" signals. Then, the device should be able to synchronize its time with the received signals from the "GPS". The date and time of the tester are specified in the "Date and Time Tester" section that this time should be identical with the time of the "GPS" in the "Data and Time GPS" field.

Start Test Condition		
🔿 Immediately		
🔿 On Binary Input	C2: Stat	
🖲 On GPS		GPS Status: GPS is during sync: Code is 377
Next Full	05° Second V	Start Sync
Start time	00:00:00	Set Windows Time With GP5(Win x86)
Data		Satellite Signal Level History
Date and Time GP5:	2020/01/25 17:27:47	Satellite Name: USA-47
Date and Time Tester:		Elevation Degrees. 72 Azimuthal Degrees. 177
Lattude:	36,30105" N	
Lonaitude:	50.01228° E	Satelite Name: USA-71 Elevation Degrees: 21
Attude:	1367.5m	Azimuthal Degrees: 312
Fix Mode	3D.Fix	Satalile Name: USA-50 Elevation Degrees: 45
PDOP:	2.76	Azimuthal Degrees 49
HDOP:	2.25	Satelite Name: USA-120
Satelites	5	Elevation Degrees: 31 Azimuthal Degrees: 124
Time Pulse	Detected	Azimuthal Degrees 124 Satellite Name: USA-47
		Elevation Degrees: 72
Satellite Sign	al Level	Azimuthal Degrees 177
1. 1		Satelite Name: USA 71 Elevation Degrees: 21
		Azimuthal Degrees 312
		Satelite Name: USA-80
		Elevation Degrees: 45 Azimuthal Degrees: 49
		Azimuthal Degrees: 49 Satellis Name, USA-128
		Elevation Deorees, 31
	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	
2		Satelite Name: OPS 5111 Elevation Degrees: 11
3.5	10 N N N N N N N N N N N N N N N N N N N	Azimuthal Degrees: 44
34		Satalile Name: OPS 5118 Elevation Degrade: 15
		Azimithal Degraes 15 Azimithal Degraes 154
		Satelite Name: USA-49
		Elevation Degrees: 74 Azimuthal Degrees: 70
	Satellite	Azimuthal Degrees: 70



St. Cond.: on GPS(Sync) {Tester Time: 17:28:25} {Time Error = -300ns} CT: Dir. line Running Room: None

In the 32 bits windows, if the tester time is not the same as the time of your personal computer, you can use the Set Windows" "Time GPS (Win X86) so the time of your computer become identical with the "GPS" time.

Using the "Next Full" and "Start Time" options, how and when the test run are selected. Using the "Next Full", after selecting this option, you have to specify the time between the sequential tests for the "Shot test" from the drop down list. For example, if you have several test points in the differential test, by selecting the "10 Second", the GPS, by considering the injection time of the device, starts to count down in 10 s cycles and in case of existence of untested point, when the inverse counter reaches zero, the next point is tested. Using this option, the start time for the "End to End" tests might not be the same. To solve this problem, you have to start the test using the "Start Time". Remember this time is the time that the device adjusts with the "GPS". Remember in this method, only the first point is tested and the rest won't. For these kinds of tests, the "Next Full" and "Start Time" should be simultaneously checked so the first point start with the "GPS" clock and the next points would run with the "Next Full" method.

For example, if in the differential room and for "End to End" test you have got four test points and want to run the test at the same time with another point, you have to set the "Start Time" on a special time, for example, 17:47:30 and also, set the "Next Full" on 10 seconds. The first point is tested in the specified time and the next points are tested during the specified time period in the "Next Full". You also see that in the status bar, the test time of each point and the remaining time until the next intended test point will be displayed in the "Start" and "Left Time" sections, respectively.

In the "Data" section, the data about the "GPS" time, test location, etc. are shown. In the "Data and Time GPS" field, the time and data received from "GPS" are displayed. In addition, after that the "Sync" ends, the tester time is recorded in the "Date and Time Tester" field. Remember this time should be identical with the time recorded in the "Date and Time GPS".

Also, the geographical width and length of the test location are displayed in "Latitude" and "Longitude" fields, respectively and added to the test report to be used, the exact location of the test could be found on the map. In addition, in this section, in the "Altitude" section, the "GPS" amplitude with respect to the base level are displayed. In the "Fix Mode", "PDOP" and "HDOP" fields, various models of the location, location precision and altitude precision are displayed. In the satellite field, the number of satellites used for settings are displayed. If the device receives the sent pulses from the "GPS", in the "Time Pulse" field the word "Detected" is displayed. But if these signals are not received, the word "Not Detected" is displayed. In addition, in the "Satellite Signal Level" window, the signals receiving level from the "GPS" are displayed and in the "Satellite Signal Level History", the number of satellites and the signal strength related to various satellites are displayed.

"Repetition"Tab

Since this tab is active only in the "AMT Sequencer" room and inactive in other rooms, at first, the "AMT Sequencer" room opens and the descriptions related to this section are presented in the "Start Condition-Repetition" window. This tab is active only in the "AMT Sequencer" room and is inactive in other rooms. This tab is used for repeating a test for the desired number of times. The number of test repetitions are inserted in the "Number of Repetition" field that the test can run for a maximum of 1000 times. For example, here, the number five is inserted so the test would be repeated five times. Also, if the user wants to make a delay between each test repetition, he can enter this time as a delay in the "Time between Repetitions". For example, here, the 1 second is inserted and the test "RUN". You see that the intended test runs five times and with the time intervals of 1 second.

tart Condition	Repetition	Meter	
Test Repetiti	on 63		
Number of Re	epetitions :		0 x
Time betweer	n repetitions	:	0.000 s

71 : "REPORT VIEW" WINDOW PART 1

After performing the test, the results of the test need to be saved in form of an output file through "Report View" window. To open "Report View" window, you need to click on "Report View" option from "View" menu or click on the icon of this window from the toolbar. On this window, the report is viewable in two forms of "HTML" and "PDF" and as default the report is displayed as "HTML".



eport 🛛 💙					ų.
Export Report @ HTML () I	PDF				Fer.
AMPro Sequencer	AMTSequend	cer			2
1) Abstract:					
1-1) Test State Passed					
1-2) Date and Time					
Туре		Date	Time		
Report Date and Time(Peosian)		398/11/27	09:56 12 72 AM		
Name: AMT Sequen User Name: vebko Equipment: AMT105 2) Test Settings: 2-1) State Group;	uer		Version: Computer N Berial Numb	98111501 sme DESKTOP-54217AM er 338	
State	PREFAULT	FA	ULT1	FAULT2	
State type	Normal		CertituousRamp	Normal	
Analog Output Mode	Direct		Direct	Direct	
	57.74 V		57.74 V	- 52.74 V	
V L1 E: V L1 E	0.02 * 50.00 Hz		0.00 * 50.00 Hz	0.00 * 50 00 Hz	
	0.00 * 50.00 Hz 57.74 V -120.00 * 50.00 Hz		50.00 Hz 57.74 V -120.00 * 50.00 Hz	0.05 * 50.00 Hz 57.74 V 129.00 * 50.00 H2	
V12-E:V12-E	0.02 * 50.00 Hz 57.74 V -120.00 * 50.00 Hz 57.74 V 100.00 Hz 100.00 * 50.00 Hz		50.00 Hz 57.74 V -120.00 * 50.00 Hz 57.74 V 120.00 * 52.00 * 50.00 Hz	0.00 * 50.00 Hz - 57.74 V 120.00 * 50.00 Hz - 57.74 V 120.00 * 50.00 Hz	
V124:V124 V134:V134	0.00* 50.00 Hz 57.74 V 120.00* 50.00 H2 57.74 V 120.00* 50.00 H2 57.74 V 0.00* 50.00 H2		50.00 Hz 57.74 V -120.00 ' 50.00 Hz 57.74 V 120.00 ' 50.00 Hz 57.74 V 0.00 ' 50.00 Hz	0.00 50.00 Hz - 57.74 V - 57.74 V - 50.00 Hz - 57.74 V - 57.74 V - 57.74 V - 5.774 V - 5.774 V - 5.74 V - 5.00 Hz	
V124:V124 V134:V134 V134:V134 V134:V134 I14:11	0.00* 50.00 ftz 57.74 V -1/20.00* 50.00 ftz 57.74 V 120.00 ftz 57.74 V 120.00 ftz 57.74 V 0.00 ftz 50.00 ftz 50.00 ftz 50.00 ftz 50.00 ftz		50.00 Hz 57.74 V -120.00 * 50.00 Hz 57.74 V 120.00 * 50.00 Hz 57.74 V 6.00 *	0.00* 90.00 Hz - \$7.74 V -f20.00* 50.00 42 - 57.74 V 123.00* 00.00 Hz - \$7.74 V 00.00 Hz - \$7.74 V 0.00*	
V 12-E: V 12-E V 13-E: V 13-E V 14(1)-E: V 14(1)-E 114:: [14 Mux. State Time	8.0.0* 50.00 ftz 57.74 V 120.00 ftz 50.00 ftz 0.74 v 120.00 ftz 57.74 V 6.00 ftz 57.74 V 8.00 ftz 58.68 50.00 ftz 50.00 ftz 20.00 ftz 20		50.00 Hz 57.74 V 120.00 * 50.00 Hz 57.74 V 120.00 * 50.00 Hz 57.74 V 0.00 * 50.00 Hz 50.00 Hz 5.000 Hz 5.000 Hz	0.05 50.00 Hz - 57.74 V - 72.00 50.00 Hz - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 50.00 Hz - 57.74 V - 50.00 Hz -	
V 12-E: V 12-E V 13-E: V 13-E V 13(1)-E: V 13(1)-E IL4: [L1 Max. State Time Trigger Termination Type	0.00* 50.00 ftz 57.74 V -1/20.00* 50.00 ftz 57.74 V 120.00 ftz 57.74 V 120.00 ftz 57.74 V 0.00 ftz 50.00 ftz 50.00 ftz 50.00 ftz 50.00 ftz	TimeQu	50,00 Hz \$7,74 V 1/20,00 ' \$0,00 Hz \$0,00 Hz \$7,74 V \$0,00 Hz \$7,74 V \$0,00 Hz \$0,00 Hz \$0,00 Hz \$3,858 ' \$0,00 Hz \$3,000 Hz \$3,000 s	0.05* 90.00 Hz 	
V12-E:V12-E V13-E:V13-E V13(1)-E:V13(1)-E I14:(14) Max. State Time Trigger Togic Trigger Logic	8.0.0* 50.00 ftz 57.74 V 120.00 ftz 50.00 ftz 0.74 v 120.00 ftz 57.74 V 6.00 ftz 57.74 V 8.00 ftz 58.68 50.00 ftz 50.00 ftz 20.00 ftz 20	TimeOu	50.00 Hz 57.74 V 120.00 * 50.00 Hz 57.74 V 120.00 * 50.00 Hz 57.74 V 0.00 * 50.00 Hz 50.00 Hz 5.000 Hz 5.000 Hz	0.05 50.00 Hz - 57.74 V - 72.00 50.00 Hz - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 50.00 Hz - 57.74 V - 50.00 Hz -	
V11EV11E V12EV12E V12EV12E V12EV12E V13E1V12E V13(1)E IL1(1) Max.StateTime Trigger Fomination Type Trigger Logic Binary Input C2: Trip11 C2: Star1	8.0.0* 50.00 ftz 57.74 V 120.00 ftz 50.00 ftz 0.74 v 120.00 ftz 57.74 V 6.00 ftz 57.74 V 8.00 ftz 58.68 50.00 ftz 50.00 ftz 20.00 ftz 20	TimeQu	50,00 Hz \$7,74 V 1/20,00 ' \$0,00 Hz \$0,00 Hz \$7,74 V \$0,00 Hz \$7,74 V \$0,00 Hz \$0,00 Hz \$0,00 Hz \$3,858 ' \$0,00 Hz \$3,000 Hz \$3,000 s	0.05 50.00 Hz - 57.74 V - 72.00 50.00 Hz - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 50.00 Hz - 57.74 V - 50.00 Hz -	
V12+V12+ V13-EV13-E V13(E)-E-V13(E)-E ILE:L1 Mux. State Time Trigger Termination Type Trigger Logic Binary Input C2: Trip1.1	8.0.0* 50.00 ftz 57.74 V 120.00 ftz 50.00 ftz 0.74 v 120.00 ftz 57.74 V 6.00 ftz 57.74 V 8.00 ftz 58.68 50.00 ftz 50.00 ftz 20.00 ftz 20	TineQu	00.00 Hz 57 7 4 V H20.00 50.00 Hz 50.00 Hz 120.00 Hz 50.00 Hz 50.00 Hz 50.00 Hz 50.00 Hz 50.00 Hz 50.00 Hz 50.00 s 50.00 s 50.00 s 50.00 s 50.00 s 50.00 s 50.00 s	0.05 50.00 Hz - 57.74 V - 72.00 50.00 Hz - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 57.74 V - 50.00 Hz - 57.74 V - 50.00 Hz -	

	View Test	Parameters
	New	•
D	Open	•
8	Save	Ctrl+S
	Save As Ctr	l+Shift+S
	Recent	•
	Security	
	Export Report.	
	Exit	

To view the report as a "PDF" file, you should click on "PDF" radio button. To export the output from this window you need to click on "Export Report" option or save the report as a "PDF" file on your computer by clicking on "Export Report" from "File" menu.

Right-click options of "Report View" window

Using the "Export Report" option you can extract the report from the software as a "HTML" or "Doc" file and save it in your desired directory. By clicking on "Report Setting" option, a window with the same name opens. From "AMProStateSequencer" tree diagram, you can specify what to be included in the "Report". You can select from "Short", "Long" and "Custom" options for the mode of the report in the field at the top of the window.

3	Export Report	
	Report Setting	
	Start Auto Update	
	Stop Auto Update	5

ong	~	Advanced >>
⊞ ☐ Test Object ⊞ ☐ Hardware Co	-General Dat onfiguration DReferences s	^

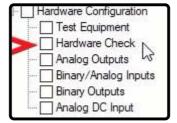
In "Short" mode, the software provides the user with a short output file containing the test parameters. For example, you can see that in "Abstract" subcategory, only the results of the test and "Test Module" information which is the test device information are included in the "Report". But in "Long" mode, the user is provided with a "Long" report of the test. You can see that by selecting this mode in the "Abstract" subcategory, in addition to "Test State" and "Test Module", "Comment" and "Tested By" options are checked which refer to the comment written in the "States" of the software and the name of the performer of the test respectively. Also, if the user manually selects any of the parameters to be included in the report, they enter the "Custom" mode.

In summary, in the "Abstract" subcategory, a summary of the information regarding the "State" specified for the test including the result of the test, day, date and location of the performed test, test device information, comments and the name of the performer of the test which can be selected to be added to the "Report". Also, in "Test Object – General Data" subcategory, information regarding the "Device" section and the parameters specified in "CB Configuration" from the "Test Object" window are available to be selected.

For example, you can see that by checking "Other RIO Function" option, the values specified in "CB Configuration" section are added to "Report" window. Also, in "Test Object" subcategory the information related to the system including parameters of the system, time tolerances and grounding factor from distance block as well as protective zones of distance block settings etc. are available to be selected. For example, by checking "System Setting", you can see that system parameters, tolerances and grounding factor specified in "Test Object" window, are added to the report.

72 : "REPORT SETTING" WINDOW PART 2

In "Hardware Configuration" subcategory, name of the device, hardware status of the device, binary and voltage output status, "Input" binaries status, "Output" binaries status and "AUX DC" voltage status are selected to be added to the "Report". For example, by checking "Analog Outputs" option, you can see that the wiring and activeness or inactiveness status of every voltage and current output is added to the "Report". By checking "Link XRIO References" option, if the value of a parameter in a "State" is linked to a specific parameter in "XRIO", it is mentioned in the "Report". "I L1" current is linked to "CT" secondary current in "Device" section and then "Link XRIO References" option is checked. You can see that its information is added to the "Report".



🖷 Link to XRio	5 	×
Filter by sender unit Search:		
Script Functions Custom RIO Device Custom RIO Device Name Plate Custion Nominal Values Nominal Values Nom Y prim L-L Nom V nom		~
Alias name : In		
(1.0000 x 1.000 + 0.000		
=1.000	0 A	

By opening "Test Setting", you can see that its three subcategories including "State Group", "Type Details" and "Start Test Condition" which are the settings related to "States", their types and test start conditions are located in this section. "State Group" subcategory includes items related to "Detail View" window. If type of any of the "States" is something other than "Normal", in "Type Detail" section it is possible to add their details to the "Report". To do this, by opening any subcategory of this section, for example "Ramp Detail", you can select any section of "State Type" settings to be displayed in the "Report". In "Start Test Condition" section, it is possible to select the specified start condition of the test to be displayed in the "Report".

E Test Settings
🖨 🔳 State Group
🔽 Analog Outputs
Fault Calculator
- Binary Outputs
Trigger Details
🗄 🗍 Ramp Details
🗄 🗍 Transient Details
⊞ Harmonics Detail
Quick Details
Start Test Condition

In "Test Result" section, you can select the results of your test which may include assessments, time of the test, signal waveform status in "Signal View", vector view of device voltages and currents in "Vector View" etc. to be displayed in the "Report". Note that in "All State" subcategory you can specify the items you wish to be displayed in the "Report" for all of the "States". Before selecting the options available in "Current State", first you need to determine the intended "State" and then by going to this subcategory, select the items of this "State" that you wish them to be displayed in the "Report".

🗄 🔳 Test Results
🚊 🔳 Assessment
Trip Time
🚊 🗍 All State
🗄 🗍 Current State
Cursor Data
Signal View
🗄 🗌 Vector View
👜 🗍 Quick

If extra items such as "Operation" are specified for the test, you can select them to be displayed in the "Report" from "Extra Test Result" section. In "Show Calculated" subcategory, you can select the items related to the "Operations" specified in

"Signal View" settings to be displayed in the report. If you have specified a lissajous diagram for the test, by selecting "Knee point" and "lissajous" and its subcategories, you can add them to the report.

	Extra Test Result
- <u>i</u>	Extra Test Result Show Calculated Signals Value Table Calculated Graph Selected Signals Knee Point Lissajous

73 : ADVANCED SETTINGS OF "REPORT" PART I

On "Report Setting" window, it is possible to change the view type of "Report View" window by using "HTML" and "PDF" options. Also, by using the "Scroller" of this section, it is possible to navigate through different pages of the report and view the applied changes. Note that "Scroller" is only available in "HTML" mode.



By clicking on "Advanced" button, the advanced settings page opens on the right side of this page. By using "Export Settings", you can save an output "sqrs" file containing the settings and if necessary, it is possible to "Load" the setting in the software by using "Import Settings" button and have an output report with the saved settings. This feature is useful when you intend to perform a "Clear Cache" on the software because by doing so, the current settings are removed and "Reset" to default settings of the software. So, before clearing the "Cache", you can export your settings and after clearing the cache import it to the software.

Advanced <<	Export Settings	Import Settings	Reset to Default		
HTML	Load from Tem	plate S	ave to Template		
O PDF	General Setting	I.			
	✓ Font Setting Font Size of Tables Headers : 12 px Body : 11 px				
	Margins Setting	Images Setting Margins Setting			
	Document Sett	ing			
	Header/Footer	Setting			

🕆 📴 > This PC > Local Disk (C:) > Users >	vebko > Documents > vebko >		-Sequencer Report Settings Files	v ℃	Search AMPro-Sequencer Re	مر
Organize 👻 New folder		63				6
A Name	Date modified	Туре	Size			
📥 OneDrive		No items match y	our search.			
This PC						
🗊 3D Objects						
E Desktop						
🗄 Documents						
🖶 Downloads						
b Music						
E Pictures						
Videos						
Local Disk (C:)						
🕳 Local Disk (E:) 🗸						
File name: Untitled						
Save as type: AMPro-Sequencer Report Settings Files(*.	sqrs)					

By using "Save to Template" button, it is possible to save the current settings as a "Template" in the software and when necessary "Load" it by using the "Load from Template" button. Also, if any changes have been made to the report, to reset the settings to default settings of the software, you should click on "Reset to Default" button.

In "General Setting" section, the general settings including numbering headers, showing the characteristics curve guidelines, framing of the texts in the report, showing tolerances, as well as showing the binaries which have been set on condition "X" are adjusted. For example, you can see that by checking "Show border", a dotted line border is added around the texts of the report in "Test State" and "Test Module" sections.

🗹 General Setting	
Include Numbers	
Show grid lines in graphs	
Show border	
Show border Show tolerand lines	
Show Binary input trigger when is X	

In "Font Setting" section, the font sizes of "Header" and "Body" are adjusted in pixels. "Header" and "Body" are, by default, set on 12 and 11 pixels here. In "Image Setting" section, it is possible to add size of the characteristics curve of the test, size of "Signal View" picture diagrams and size of "Vector View" diagrams in "Characteristics" field, "Signal" field and "Vector View" field respectively.

leaders :	12 px	
lody :	11 px	
Imager Set	ting	
Images Set		
Images size(v		Signal: 600 px
Images size(v	width)	Signal: 600 px

For example, here the picture size of "Signal View" is set on the half of its default size which is 300 pixels. Now, you can see that the size of the picture is changed to half of its previous size on this window. Moreover, if you intend to change the format of the pictures added to the report, you can select your intended format from the list available in "Image Type" section.

74 : ADVANCED SETTINGS OF "REPORT" PART II

In "Margin Setting" section, it is possible to set all four margins of the text. In "Document Setting" section, by checking "Insert page number", you can insert page numbers on report pages. Also, by checking "Insert page break before main heading", every "HEADING" of the report is added to the beginning of every new page.

op : 50 px	Bottom : 50 px
ght : 50 px	Left : 50 px
Document Setting	
age Number	
Document Setting age Number Ins page number age Break	
age Number Insex page number	

By selecting "Fit width to max length data" in "Page Size" section, size of the tables in the report is adjusted according to the page size while by selecting "Fix width", the page size remains fixed. If size of the table is larger than the page, some parts of the table goes beyond the page boundary.

In "Header/Footer setting", by checking "Header", "Header text" field appears which enables you to enter your desired text. Also in "Header height" section, you can specify your desired height for the "Header".

Header Header	Setting	
	30 px	
	Logo	
Footer		
Footer Footer text : [Footer Height: [Show pers	30 px	

By clicking on "Logo" and opening "Import logo for report" window, you can insert a picture or the logo of the company in the "Header" of the report.

By checking "Footer", "Footer text" field appears which enables you to enter your desired text. Also in "Footer height" section, you can specify your desired height for the "Footer".

By checking "Show persons sign" and selecting "Setting", "Persons sign" window opens where you can add up to four signs to your report. By clicking on "Add persons sign" and clicking on "Signature" and selecting "Signature" you can add a "Signature" to your report. In "Title" and "Value" sections, title and name of the person are entered respectively.

Add to	sign p	ersons							
Title: Value:			 	-	Ŧ	>5	ligna	ture	
] Add to	sign p	ersons							
Add to	sign p	ersons							
Add to	sign p	ersons							
Settings Title:					Repeat I Shou Shou Shou	v in All p			

In "Title" of the "Setting" section, you can enter a general title for all four signatures and add a box for every signature by checking "Show border in report". Also, in "Repeat mode" section, by selecting "Show in all pages" the entered signatures are displayed in all pages. But, by selecting "Show in last page", these signatures are displayed only in the last page.

In "Extra setting" section and in "Tested by", "Approved by", "Company", and "Comment" fields, you can enter the name of the performer of the test, the supervisor, and the company as well as comments respectively. Note that to show these items in the output report, other than checking their options in this section, you need to check their options in the tree diagram under abstract branch as well.

Extra Setting	
Report view set	ting
Tested By	
Approved By	
Company	
Comment :	
₽	
	Browse custom
Browse	Excel File (METANIR)

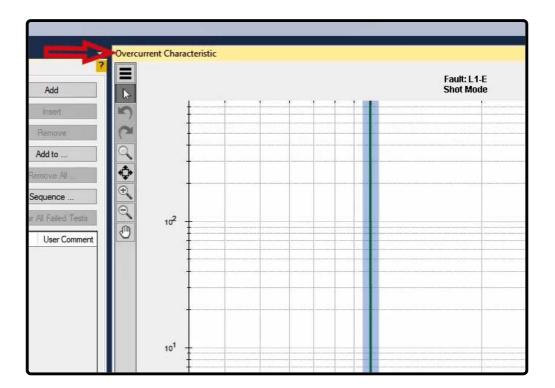
By selecting "Browse custom", you can display specific information of the "Xrio" file in the report by checking their corresponding option. For example, to display "Name plate" and "Location", you should check these options from the "Test object" tree diagram of the "Device" section in "Browse custom" and "Xrio block report setting" page so that the intended information is specifically displayed in the report.

	om Report KRio /KIO/Device/Name Plate KRio/RIO/Device/Location Rio/RIO/Device/Location Rio/RIO/Device/Location KRio/RIO/Device/Inst KRio/RIO/Device/Mac Mo/RIO/Device/Mac				
	KRID KIID Device Allame Patel KRID KID Device Allamina KRID (ROU Device Allamina) Values KRID (ROU Device Allamina) Factors KRID (ROU Device Units KRID (ROU Device) Protected Object				
	KRa/(RIO/Device/Location) KRa/(RIO/Device/Realitual Factors KRa/(RIO/Device/Lanits KRa/(RIO/Device/Mac KRa/(RIO/Device/Mac				
	KRo./RO/Device/Nominal Values KRo./RO/Device/Residual Factors KRo./RO/Device/Inste KRo./RO/Device/Inste KRo./RO/Device/Protected Object				
	KRio/RIO/Device/Residual Factors KRio/RIO/Device/Limits KRio/RIO/Device/Misc KRio/RIO/Distance/Protected Object				
	KRio/RIO/Device/Limits KRio/RIO/Device/Misc KRio/RIO/Distance/Protected Object				
	KRio/RIO/Device/Misc KRio/RIO/Distance/Protected Object				
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	A NOT THE DISLETCET TO COLO TO				
	KRio/RIO/Distance/Protection Device/Tolerances				
	KRio/RIO/Differential				
	KRio/RIO/Differential/Winding				
	KRio/RIO/Differential/Winding2				
	KRio/RIO/Differential/Winding3				
	KRio/RIO/Differential/Diff Bias				
	KRio/RIO/Differential/Diff Bias/Diff				
	KRio/RIO/Differential/Diff Bias/Bias				
	KRio/RIO/Differential/Diff Bias/Bias/Harm. Char.				
	KRio/RIO/Differential/Diff Bias/Bias/Harm. Char./Char. Table/Point				
	KRio/RIO/Differential/Diff Bias/Bias/Harm. Char./Char. Table/Point2				
	KRio/RIO/Differential/Diff Bias/Bias/Harm. Char.2				
	KRio/RIO/Differential/Diff Bias/Bias/Harm. Char.2/Char. Table/Point				
	KRio/RIO/Differential/Diff Bias/Bias/Harm. Char.2/Char. Table/Point2				
	KRio/RIO/Differential/Diff Bias/Trip Char. Table/Point				
	KRio/RIO/Differential/Diff Bias/Trip Char. Table/Point2				
	KRio/RIO/Overcurrent/General				
	KRio/RIO/Overcurrent/CT				
	KRio/RIO/Overcurrent/VT				
	KRio/RIO/Overcurrent/Neutral CT				
	KRio/RIO/Overcurrent/Residual VT				
	KRio/RIO/Overcurrent/Overcurrent Elements/Timed Overcurrent Element				
	KRio/RIO/Overcurrent/Overcurrent Elements/Timed Overcurrent Element/Pick-up Cur	rent			
	KRio/RIO/Overcurrent/Overcurrent Elements/Timed Overcurrent Element/Drop-off/Pio		io		
	KRio/RIO/Overcurrent/Overcurrent Elements/Timed Overcurrent Element/Min Operate				
	KRio/RIO/Overcurrent/Overcurrent Elements/Timed Overcurrent Element/Max Operat				
	KRio/RIO/Overcurrent/Overcurrent Elements/Timed Overcurrent Element/Min Operate				
	KRio/RIO/Overcurrent/Overcurrent Elements/Timed Overcurrent Element/Max Operat	e Curren	t		
					>
			OK	Car	ncel

75 : INTRODUCING "OVERCURRENT" ROOM

This room and other test relay rooms which were introduced by the name of "Medium" rooms before are used to test high current functions and "Over Load". This room includes three windows of "Test View", "Over Current Characteristic" and "Medium Detail View" which are used to enter the test points and display them in the intended characteristic curve.

ile View	Test Para	meters H	ardware
D 🎝 re	abs)[[0 -	- -
TestView		-	
hot Test Pic	kUp-DropOff S	ettings Trigg	er Binary Ou
Test Poi		Angle:	0.00 *
ITest Re		raigic.	0.00
Factor:	1.000 x		
Relative to:	Inom ~		
Detail -			
	100.0 ms	t act: [3
t min:	60.00 ms	t max:	No-Trip
A	Tested		
State: Not			



Medi	um Detail	View									
S	hot Da	ta									
	State	Assessment	ITest	Angle	I Pick Up-Relative	Factor	Unit	t nom.	t act.	Dev.%	Dev.se
-	1	Not Tested	1.000 A	0.00 °	No	1.000 x		100.0 ms			14

To test a relay, the first thing to do is to enter the relay information and settings in the software. To do this, first, select "Test Object" from the toolbar and from the tree diagram in "Device" section enter "I primary" and "I secondary" information which are the "CT" turn ratio. Note that any mismatch between the setting of this section and the relay will lead to wrong responses in relay test.

General Test Object	
File View	🔡 Device Settings
🔁 🔂 🔭 Resize Co	Device Settings
	Device
lative to ti	Name/Description :
	Manufacturer :
	Device Type :
	Device Address :
	Serial/Model Number :
	Additional Information1 :

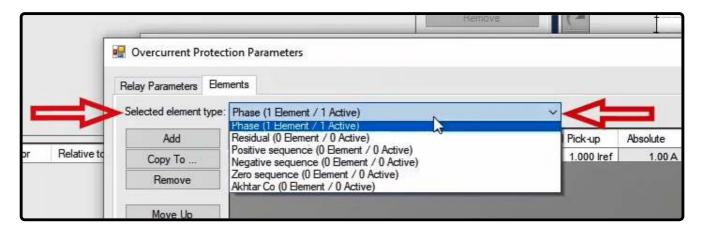
Next, you need to enter the relay setting from the tree diagram in "Over Current" block. By double-clicking on this block, "Overcurrent Protection Parameters" page opens which includes "Relay Parameters" and "Elements" tabs. In "Relay Parameters tab, in "Relay Behavior" section, first you need to determine whether the relay is "Directional" or "Non-Directional". Then, in "Tolerance" section and "Current", "Time" and "Angle" sections, current and time tolerances and for "Directional" tests, angular tolerance are entered.

	Overcurrent Protectio	n Parameters		Remove	(**
	Relay Parameters Elemen	nts			
ctor Relative to	Relay behavior Directional behavior: Non-directional Directional) At p	nection: protected object t at protected object	CT starpoint co	
			Time Relative :	5.00 % Angle 0.00 ms Angle T	

	1	Overcurrent Protection P	arameters
-	=>	Relay Parameters Elements	
		Directional behavior:	VT connection:
tor	Relative to	Non-directional	At protected obje
		 Directional 	 Not at protected
		T 1	

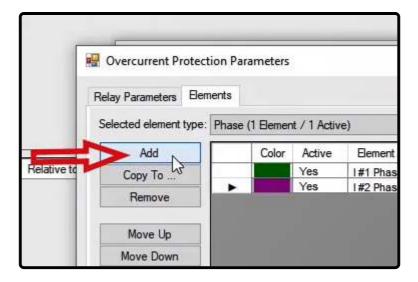
In "Elements" section, you need to determine the relay characteristic curve and its characteristics. To do so, first the type of intended current protection should be selected in "Selected Elements Type". Then, you need to specify the characteristic curve information in the table in this page and create the relay "Curve".

Overcurrent Pro	tection	Para	meters		
elay Parameters	Element	s		_	
elected element ty	ype: Ph	lud lase (1 Elemer	t / 1 Activ	e)
Add			Color	Active	Element Name
Copy To		•		Yes	1#1 Phase
Remove					
Move Up					
Move Down					
	elay Parameters elected element ty Add Copy To Remove Move Up	elay Parameters Element elected element type: Ph Add Copy To Remove Move Up	elay Parameters Elements elected element type: Phase (Add Copy To Remove Move Up	elay Parameters Elements elected element type: Phase (1 Element Add Color Copy To Remove Move Up	elay Parameters Elements elected element type: Phase (1 Element / 1 Activ Add Copy To Remove Move Up

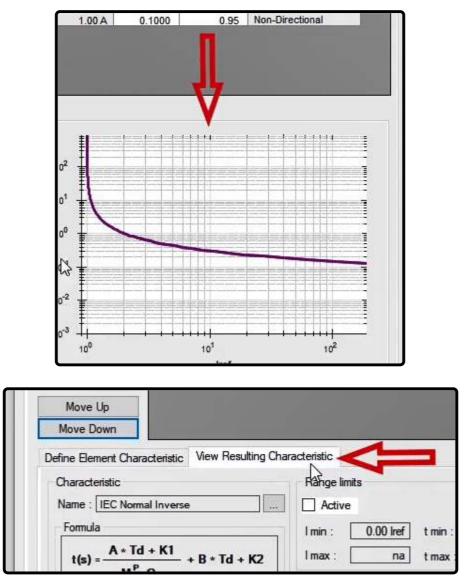


Overcurrent Prote	ction Par	ameters								<u>_</u> 22	×
lelay Parameters Ele	ements										?
Selected element type	Phase	(1 Elemen	nt / 1 Active	e)		~					
Add		Color	Active	Element Name	Tripping Characteristic	l Pick-up	Absolute	Time	Reset Ratio	Direction	
Copy To	•		Yes	I#1 Phase	IEC Definite Time	1.000 lref	1.00 A	0.1000	0.95	Non-Directional	
Remove											

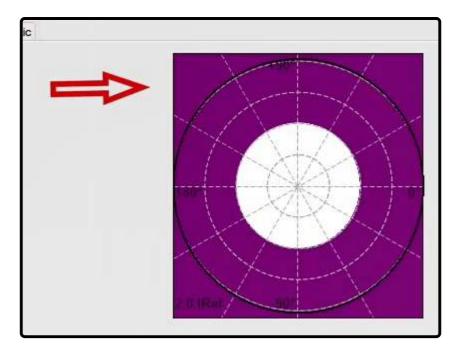
By using "Add", you can add more rows to the table and if there are multiple "Stages", create another "Curve". Also, "Copy to" and "Remove" options are used to use the curve created in different protections and remove the created row respectively. "Move Up" and "Move Down" options are used to move a "stage" up or down respectively.



In "Define Element Characteristic" tab and in "Characteristic" section, the type of characteristic curve and in "Range Limits" section, current and time ranges which are protected by the intended "Stage" should be specified. Also, if a characteristic curve is specified for "Dropping" the relay, you can enter its setting in "Reset Characteristic" section. The "Curve" of every "Stage" is displayed separately in the diagram at the right side. In "View Resulting Characteristic" section, you can view the characteristic curve resulted from specified "Stages".



If in "Relay Behavior" page, the relay is specified as a "Directional" one, another tab named "Define Element Directional Behavior" is added where the setting related to the unit protected by the relay is entered. Moreover, a polar diagram is added in which the angle protected by the relay is specified schematically.



After entering the relay characteristic and confirming the changes, it is possible to specify some points on the characteristic curve and run the test in "Test View" and "Over Current Characteristic". In future videos, each of the mentioned sections will be explained in greater detail.

By selecting any of the "Element Versions" in the "Compatibility" section, the pickup current coefficients change for each element. By selecting "Advanced Element", the coefficients for the specified characteristics is change into what can be seen in the picture. This means that the pickup current determined for that characteristic is multiplied by the displayed coefficient and "Fault Type" is applied for it. As an example, if you determine an element in negative sequence and you wish to test this element in "L1L2" mode, this characteristic can be tested by multiplying square root of 3 in pickup current. These coefficients are extracted from negative, positive and zero sequence matrix. One example is provided about how to calculate these coefficients and other coefficients can be achieved by following the same procedure.

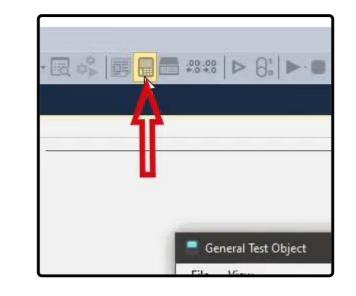
$$\begin{split} I_{0} &= \frac{1}{3} \left(I_{a} + I_{b} + I_{c} \right) \\ I_{0} &= \frac{1}{3} \left(I_{a} + \alpha I_{b} + \alpha^{2} I_{c} \right) \\ I_{0} &= \frac{1}{3} \left(I_{a} + \alpha^{2} I_{b} + \alpha I_{c} \right) \\ I_{0} &= \frac{1}{3} \left(I_{a} + \alpha^{2} I_{b} + \alpha I_{c} \right) \\ \end{split}$$
Fault "L1L2" => $I_{Fault} \begin{cases} I_{L1} = Ia \angle 0 \\ I_{L2} = Ia \angle 180 \\ I_{L3} = 0 \end{cases}$
 $I_{0} &= \frac{1}{3} (Ia \angle 0 + Ia \angle 180) = 0 \\ I_{1} &= \frac{1}{3} (Ia \angle 0 + (e^{i\frac{2\pi}{3}} Ia \angle 180)) => I_{1} = \frac{Ia}{3} (1 + (1\angle 120 * 1\angle 180)) => I_{1} = \frac{Ia}{3} (\sqrt{3} \angle -30) => Ia = \sqrt{3} I_{1} \angle 30 \\ I_{2} &= \frac{1}{3} (Ia \angle 0 + (e^{-i\frac{2\pi}{3}} Ia \angle 180)) => I_{2} = \frac{Ia}{3} (1 + (1\angle -120 * 1\angle 180)) => I_{2} = \frac{Ia}{3} (\sqrt{3} \angle 30) => Ia = \sqrt{3} I_{2} \angle -30 \\ \end{cases}$

But in "Simple Fault Loop" which is an algorithm used by older relays, these coefficients are, as you can see, different. To facilitate analyzing the effects of coefficients on characteristics, there is a section named "More Details" on "Test View" page by double-clicking on which another section opens where the information regarding the characteristics along with their coefficients are displayed. The difference between "Advanced Element" and "Zero-Sensitive Elements" is in the "310" characteristic coefficient; one of these two should be selected in accordance with the relay algorithm.

76 : RELAY SETTING IN OVERCURRENT ROOM, PART1

As mentioned before, to test a relay, the first step is to enter the relay characteristic in the software. To do this, first how to enter the setting for a "Non-directional" relay is going to be explained. Enter "General Test Object" window and after changing the "CT" turns ratio to 500/1 in "Device" block, by double-clicking on "Overcurrent" block, "Overcurrent protection parameters" page opens where you can enter the relay setting. In "Relay behavior" section, the setting related to relay protection, placement of "VT"s as well as wiring of "CT"s are specified. Since here our relay is "Non-directional", "Non-directional" should be selected in this window. Note that the setting related to "VT Connection" and "CT Connection" are only active in "Directional" mode and in "Non-directional" relays, these options are disabled.

lay Parameters Elements		
Relay behavior		
Directional behavior:	VT connection:	CT starpoint connection:
Non-directional	At protected object	To protected object
O Directional	O Not at protected object	O From protected object
Tolerances		
Current	Time	Angle



	Overcurrent Protection Par	
5	Relay Parameters Elements Relay behavior	
Factor Relativ	Directional behavior: e to Non-directional	VT connection: At protected object
	O Directional Tolerances	 Not at protected object

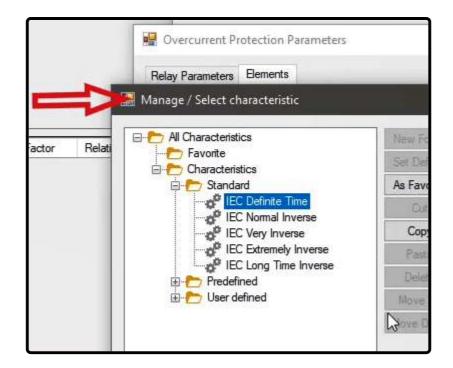
In "Directional" relays, current, time and angular tolerances are set in "Tolerances" section. To set current tolerance, you need to enter your intended tolerance as a percentage of the test current in "Relative" field. You can see that this tolerance is set at 5 percent by default. Also, in "Absolute" section, it is possible to enter this tolerance as a coefficient of "CT"

nominal current in this field and view its actual value in the front field. Moreover, it is possible to enter the numerical value of tolerance and view its related coefficient in the previous field. For example, in this field 40 mA is entered as the tolerance. You can see that the coefficient related to this current, changes in the corresponding field. Note that the software picks the maximum tolerance between the two tolerances specified for the characteristic curve. For example, if the test current is set at 1 amp, with a 5 percent tolerance, the current is calculated between 1.05 and 0.95 amp but if a 40 milliamp tolerance is used, the pickup current is calculated between 1.04 and 0.96 amp. The software picks the highest values which is between 1.05 and 0.95 amp. In "Time" section, the time tolerances are specified in percentage and actual forms and the angular tolerance is specified in "Angle" section.

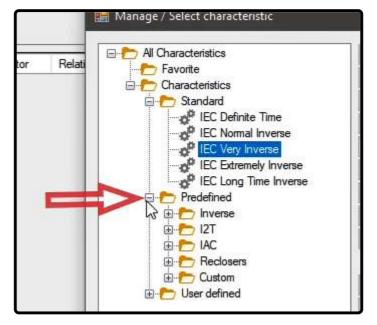
	Relay behavior	
11.	Directional behavior:	VT connection:
Relative to	Non-directional	At protected object
	O Directional	O Not at protected obje
	Tolerances	
	Current Relative : 5.00 % Absolute : 40.00	
	Absolute . 40.00	

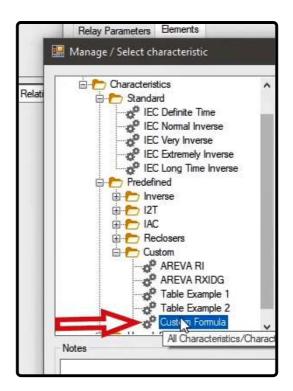
To specify the characteristic curve, you need to enter "Elements" tab. In "Element Name" column, a title for the specified "Stages" is entered. For example, here "Stage1" is selected. In "Tripping Characteristic" column it is possible to specify the type of the characteristic curve which is set at "IEC Definite Time" by default. To change the intended characteristic curve, double-click on "IEC Definite Time" or click on three dots sign from "Characteristic" section to open "Manage / Select Characteristic" window. In "Standard" section, you can view the available characteristic curves in "IEC" standard and by selecting any of these you can view its formula and coefficients in "Characteristic" section. Note that it is necessary to select the same characteristic curve as the one specified for the relay.

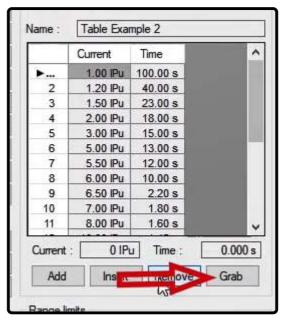
	V N	
ent Name	Tripping Characteristic	l Pick-up
e1	IEC Definite Time	1.000 Iref
	2008-000-000 2	



If you cannot find the characteristic curve specified for the relay here or the coefficients of the formulae are different, by entering "Predefined" folder, you can find the relay characteristic curve from "Inverse", "I2T", IAC" and "Reclosers" folders and then select it. Also, if you cannot find the relay formula in any of the folders, in "Custom" folder, by selecting "Custom Formula" it is possible to specify your intended formula according to the coefficients specified in this section as well as the value of "Itest/Ipickup" and "Time dial" which are indicated by "M" and "Td" respectively. After doing so, you can save and use the formula. Moreover, if the relay characteristic curve is based on the points table, you can add the characteristic curve point by point and view its curve by selecting "Table Example 2" and using the "Grabber" tool available in the software. This window will be fully explained in future videos.



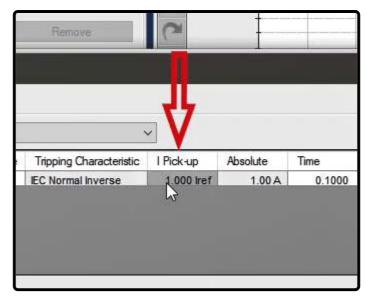


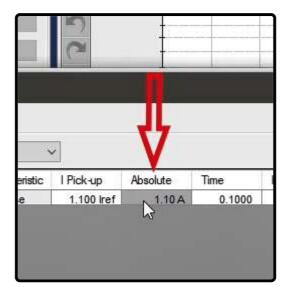


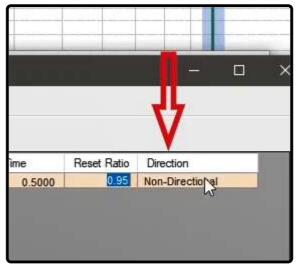
If the characteristic curve formula is available in the software, but the used coefficients are not the same as the ones in the relay's manual, you need to select the intended formula and by "Copying" and "Pasting" it in "User defined" section, change its coefficients and use the formula according to the coefficients specified in the relay's manual. To facilitate doing this, "Copy to user defined" option has been made available and you can use it. For example, here the formula related to "Basler I2T-46N" curve is copied and pasted in "User defined" section. Now, by selecting it, you should enter your intended coefficients and by saving the new curve with the selected coefficients, it is saved in the software and can be used.

To continue the process, the "IEC Normal Inverse" curve is selected here. You can see that in "Elements" tab, an "Inverse Normal" "Stage" is entered. Now in "I Pick-up" column, you should set the pickup current of the relay according to a coefficient of "CT" secondary nominal current which, here, is set at 1.1. Also, it is possible to set the pickup current from "I Pick-up" field at the bottom of this tab. After setting the pickup current, its value is displayed in "Absolute" column. In "Time" column, "TMS" or "Time dial" of the relay is entered. This value can also be entered in "Time Index" field at the bottom of this tab and 0.5 is entered here. In "Reset Ratio" column, "Drop Out" coefficient of the relay is entered which is set at 0.95 by default. Also, you can see that in "Direction" column, the type of this curve is set at "Non-Directional".

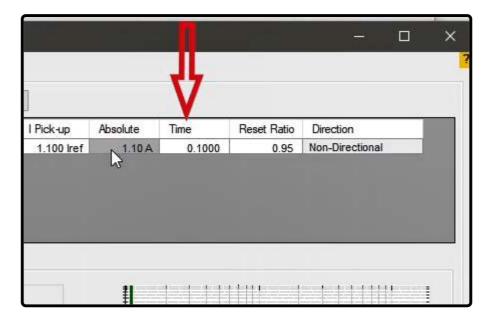
Um den Vorgang fortzusetzen, wird hier die Kurve "IEC Normal Inverse" ausgewählt. Sie können sehen, dass auf der Registerkarte "Elemente" eine "Inverse Normale" "BühneStufe" eingegeben wird. Sie können sehen, dass auf der Registerkarte "Elemente" eine BühneStufe ("Inverse Normale") eingegeben wird. Nun sollten Sie in der Spalte "I Pick-up" den Aufnahmestrom des Relais nach einem Koeffizienten des Sekundärnennstroms "CT" einstellen, der hier auf 1.1 eingestellt ist. Außerdem ist es möglich, den Pickup-Strom im Feld "I Pick-up" unten auf dieser Registerkarte einzustellen. Nach dem Festlegen des Abholstroms wird sein Wert in der Spalte "Absolute" angezeigt. In der Spalte "Time" wird "TMS" oder "Time dial" des Relais eingegeben. Dieser Wert kann auch im Feld "Time Index" unten auf dieser Registerkarte eingegeben werden, und hier wird 0.5 eingegeben. In der Spalte "Reset Ratio" wird der Koeffizient "Drop out" des Relais eingegeben, der standardmäßig auf 0.95 eingestellt ist. Außerdem können Sie sehen, dass in der Spalte "Direction" der Typ dieser Kurve auf "Non-Directional" festgelegt ist.







	ē.	2				
naracteristic I Pick-up Absolute Time Reset Ratio Direction						- 1
		~			♥	
Inverse 1.100 Iref 1.10 A 0.5000 0.95 Non-Directional	naracteristic	l Pick-up	Absolute	Time	Reset Ratio	Direction
	Inverse	1.100 lref	1.10 A	0.5000	0.95	Non-Directional
				C	3	



77 : RELAY SETTING IN "OVERCURRENT" ROOM, PART 2

After specifying a "Stage" for the relay characteristic curve, it is possible to specify the characteristic curve time and current range limits in "Range limits" section. To do this, you need to activate this section by checking "Active" option and enter the required ranges in according fields. For example, here, "I min" equals 1.2 times "Iref" and "I max", 100 times "Iref" is entered. At the right side of this window you can see that the characteristic curve of the relay is specified to be between 1.2 and 100 times of the reference current which is the same as "Iref" or "CT" secondary. Also, the minimum time is entered in "t min" field and here "1.5" second is entered. In "t max" field, on the other hand, the maximum time is entered which, here, is 40. Now you can see the effect of these changes on the characteristic curve.Moreover, for relays that act in "Definite Time" mode from currents higher than a specific amount, "Limit t from I" option can be used. For example, for relays that act from 1.1 time of the determined "Pickup" current and act in "Definite Time" mode from 20 times of the "Pickup" current, the settings are entered as can be seen.

	Range lin	nits		
	Active	•		
-	l min :	1.20 Iref	t min :	0.000 s
	I max :	100 Iref	t max :	na

Range limits	±11		
Active	10 ²		
l min : 1.20 lref t min : 1.500 s	10- 11		
I max : 100.00 lref t max : 40.00 s	101		
Reset Characteristic	\$ 10 ⁰ ∎		
● Off	10-1	stage1	

In "Reset Characteristic" section, you can specify the setting related to "Drop out" characteristic curve of the relay which is set at "Off" by default. This means that as soon as the fault current falls below the relay "Drop" current, the pickup contact must be removed from the relay. By selecting "Definite time", "tr" field is activated and you can specify a time for "Drop out" of the relay. For example, if 1.5 second is entered here, when the fault current falls below the specified value, the pickup contact must be removed from the relay after 1.5 second. Also, by selecting "Inverse time", "R" and "T" fields are opened and it is made possible to specify an "Inverse" curve for "Drop out" time of the relay according to the formula displayed in "Formula" section and by specifying "R" and "T" values. Note that it is possible to manage "Reset Characteristic" and "Range limits" sections from "manage / select characteristic" page as well.

tr:	1.500 s
R:	1.000 s
Τ:	2.000 s
	R:

If the characteristic curve of the relay comprises of multiple "Stages", it is necessary to use "Add" button to specify the required number of "Stages" and by specifying their parameters, test the intended relay. For example, here, another "Stage" of "Time Definite" type is created and the pickup current is set at 1.5 times "I ref" and its operation time is set at 200 milliseconds in "Time" column. You can see that by clicking on any "Stage", its corresponding characteristic curve is displayed in the right side window. Now, in "View Resulting Characteristic" tab, it is possible to view the final characteristic curve created. You can see that this curve is the result of both "Stages" specified in the table on this window. In "Color" column, a color is selected for each "Stage". In "Active" column, it is possible to activate or deactivate any intended "Stage" by using "Yes" and "No" options. For example, here, the second "Stage" is deactivated and removed from the characteristic curve.

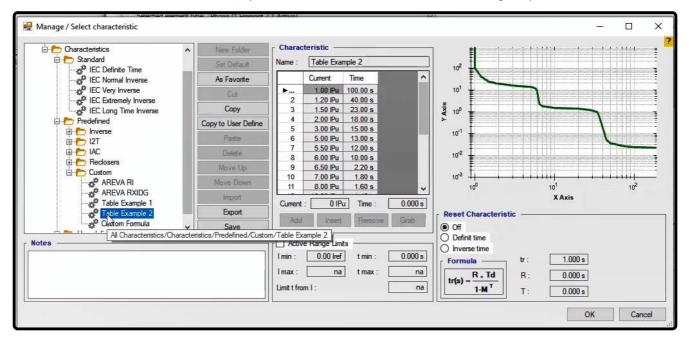
	~				
Bement Name Tripping Characterist	c I Pick-up	Absolute	Time	Reset Ratio	Direction
	Bement Name Tripping Characteristic taoe1 IEC Normal Inverse				

By using "Save as User-defined" option from "Manage / select characteristic" window, it is possible to add the characteristic curve created in each "Stage" in "User defined" folder and use when necessary. For example, here, the first "Stage" is selected and by clicking on "Save as User-defined", the "Manage / Select Characteristic" window opens. Then, by clicking on "Ok" button and returning to this window, you can see that this curve and its setting are added to this folder with the name of IEC Normal Inverse2.

E 🎦 All Characteristics	New Folder
	Set Default
🚊 🗁 Standard	As Favorite
⊕ Predefined ⊕ Predefined	Cut
IEC Normal Inverse	Сору
IEC Long Time Inverse	Paste
IEC Long Time Inverse2	Delete
Basler 12T-46N2	Move Up
All Cha	racteristics/Chara
	Import
	Export
	Save

78 : RELAY SETTINGS IN "OVERCURRENT" ROOM, PART III

As mentioned before if the relay characteristic curve is provided as a table of points, the user needs to manually enter these points into the software. To do so, first, "Table Example 2" is selected from "Custom" folder in "Manage/Select Characteristic" window. You can see that, by default, a curve is created in this section using the points table.



To specify a new curve, by clicking on "Copy to User Define" option, this curve is copied to "User Define" folder and after selecting this curve in "User Define" folder, by clicking on "Grab" the window related to the "Grabber" opens. In this diagram the "X" axis is the current axis, and the "Y" axis is the time axis. In "Axes" section, to show the curve, the current range is specified in terms of "IPu" and the time range is specified in terms of seconds. For example, here the current range is specified between 1 "IPu" and 100 "IPu" and the current axis is displayed between 1 and 100 "IPu". "IPu" is the CT secondary nominal current. Also, by unchecking the "Logarithmic" option, it is possible to change the diagram display from logarithmic to regular. Also, by using "Open" and "Save" options it is possible to save the created file in this section and open it again on this page and edit or use it if necessary.

D						
		3				
xes			r Time			
	ant			Start: 1.000		
Start:	t: [1.00 IPu]				1.000 s	
End: 100.00 IPu			End:	60.00		
			Logarithmic			
	/gana imic			10		
able						
lame	Table Examp	ble 2				
	Current	Time		Add		
▶	1.00 IPu	100.00 s		Insert		
2	1.20 IPu	40.00 s		#1sen		
3	1.50 IPu	23.00 s		Remove		
4	2.00 IPu	18.00 s				
5	3.00 IPu	15.00 s		3		
6	5.00 IPu	13.00 s				
7	5.50 IPu	12.00 s				
8	6.00 IPu	10.00 s				
9	6.50 IPu	2.20 s				
10	7.00 IPu	1.80 s				
11	8.00 IPu	1.60 s				
12	10.00 IPu	1.45 s				
13	20.00 IPu	1.30 s				
14	30.00 IPu	1.10 s				
15	35.00 IPu	0.90 s				
	40.00 IPu	0.20 s				
16	45.00 IPu	0.05 s				
16 17	50.00 IPu	0.04 s				
		0.03 s				
17	60.00 IPu					
17 18	60.00 IPu 80.00 IPu	0.02 s				
17 18 19		0.02 s 0.02 s				

Now, from the toolbar click on "New" to open a new blank page for the new curve. In "Point" section, enter the current in "Current" field and time in "Time" field and then "Add" them to the points table of the intended characteristic curve so that it is displayed in the diagram at the right side. Also, by clicking on the related diagram and selecting "Add" or by using the "Ctrl" key and clicking on the diagram, it is possible to create the characteristic curve. By using "Add" and "Insert" buttons, it is possible to add the point entered in "Point" section to the last row of the table and before the selected row respectively.

Fi		e1 11
1	xes —	
	Vew ent	
	Start:	1.00 IPu
	End:	100.00 IPu
	🗹 Logarith	mic
	able —	
- 1	Name Table	e Example 2
	1. 1.	

Current :	N 1 IPu
Time :	0.000 s

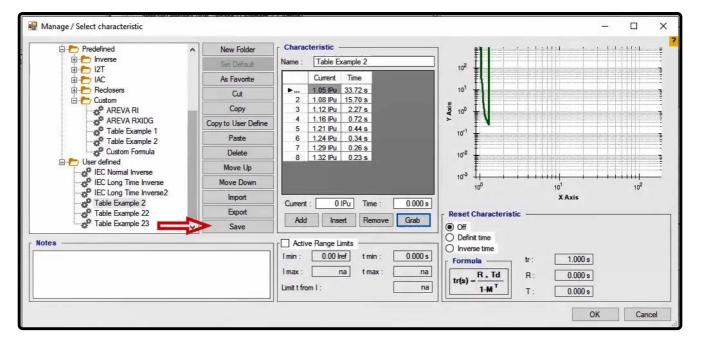
Name New User-defined Characteristic			
	Current	Time	Add
▶	1.00 IPu	2.00 s	L. Barris
2	2.76 IPu	7.86 s	Insert
3	5.71 IPu	5.23 s	Remove
4	11.33 IPu	3.51 s	nemove
5	23.82 IPu	2.53 s	

If the user has a logarithmic image of the relay characteristic curve, it is possible to "Load" it in this window by using "Load Image" option and create the relay characteristic curve for the test by adding the point on the entered curve. Now, here we enter an image of the "7UT63" relay overcurrent characteristic. Then it is necessary to equalize the "Scales" of the diagram in this page with the "Scales" of the entered diagram. To do so, first, by using Alt+left click combination key the current and time axes of the entered image are equalized with the current and time axes of the "Grabber" window. Then, the "Start" and "End" values are specified in "Current" section as 1.05Pu1 and 1.45 respectively. Also, the "Start" and "End" values are specified in "Time" section as 0.05 and 200 seconds. You can see that both diagrams are completely overlapping. Note that these numbers are different for images with different sizes and they need to be specified by the user in a way that the two diagrams overlap in terms of values and size.

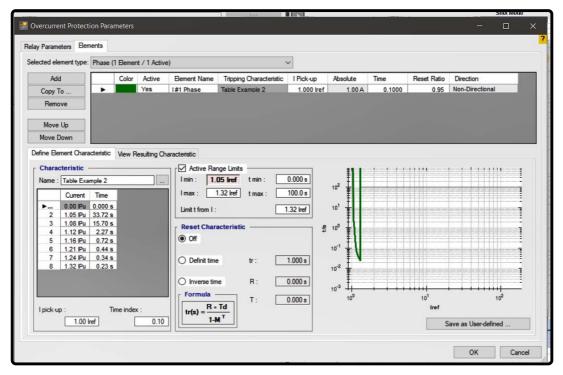
💀 Grabber		
File		
i D 🖻 🖻	212	
Axes —	743	
Current	Load Image	[T
Start:	1.00 IPu	S
End:	100.00 IPu	E
Logarit	thmic	

😼 Grabber		
<u>F</u> ile		
00000		
Axes Current Start: 1.05 IPu End: 1.45 IPu Logarithmic Table		10 ²
Name New User-defined Chara	acteristic	20000
Current Time	Add	1[300
	Insert	4000
	Remove	2000

Now, by holding down the "Ctrl" key and clicking on the curve with "Dial Setting=0.1", this characteristic curve is created and approved. If you wish to save this curve in the software for future tests, you need to copy it using the "Copy" button and "Paste" it in "User Defined" folder. Now, by selecting "Save", the intended characteristic curve is saved in this folder and is usable for next tests.



Note that if a later version of the software is installed, this saved file is removed from the "User Defined" folder. So before installing the new version of the software, it is necessary to make an output "Xml" file by using the "Export" button from "Manage Select Characteristic" page and then "Import" it to the new version. This characteristic curve is displayed in the diagram at the right side of the "Overcurrent Protection Parameters" window. Note that for the characteristic curves created using this method, the time entered in "Time" column of the characteristic table of the characteristic curve is a coefficient which is multiplied by the times entered in the characteristic points table and as a result it influences the characteristic curve time and relay operation time.



79 : RELAY SETTING IN "OVERCURRENT" ROOM, PART IV

To perform "Overcurrent Directional" test, first select "Test Object" from the toolbar and then enter "I Primary" and "I Secondary" information which is the Turns ratio of "CT" in the tree diagram in "Device" section. Note that any mismatch between these two sections will result in incorrect responses.

• 🗟 🐝 📑 🗖	
	Test Object Parameters
L	

Device	Nominal Values	
		[
Name/Description :	f nom :	50.00 Hz
Manufacturer :	V nom(secondary) :	110.0 V(L-L)
Device Type :		63.51 V(L-N)
Device Address :	V primary :	230.0 kV(L-L)
Serial/Model Number :		132.8 kV(L-N)
	I nom(secondary) :	1.000 A
Additional Information1:	I primary :	1.000 kA
Additional Information2 :	Residual Voltage/Curr	ent Factors
Substation	VLN/VN :	1.730
lame :	IN/I nom	1.000
Address :	Limits	
Bay	V max :	132.0 V
lame :	I max :	64.00 A
Address :	Debounce/Deglitch Fi	iters
	Debounce Time :	3.000 ms
	Deglitch Time :	au 400.0 عبر

After double-clicking on "Overcurrent" block in "Relay Parameters" page, select "Directional" option in "Relay Behavior" section. Then, specify the directions of "VT" and "CT Start Point" in "VT Connection" and "CT Start Point Connection" respectively. Note that mismatch between this section and the relay setting will result in a 180 degree phase difference between the device and relay settings.

Overcurrent Protection Par	ameters		
Relay Parameters Elements			
Relay behavior			
Directional behavior:	VT connection:	CT starpoint connection:	
Non-directional	At protected object	To protected object	
O Directional	 Not at protected object 	 From protected object 	
Tolerances			
Current	Time	Angle	
Relative : 5.00 %	Relative :	5.00 % Angle Tol. : 5	
Absolute : 50.00	50.00 mA Absolute : 40	.00 ms Angle Tol. : 5	

After entering the intended "Stages" in "Element" section, whether the protection direction of relay is "Forward" or "Reverse" should be entered in "Direction" field. Then, enter "Maximum Torque Angle" and "Sector Opening" of the relay in "Define Element Directional Behavior" tab. The calculation method for these parameters will be explained in the videos related to protective functions test. In "Directional" mode, a "Directional Plane" is added to this page where you can view the range of relay protection. In "View Resulting Characteristic" tab, you can view the general characteristic curve and

"Directional Plane" diagram. Note that if you have multiple directional "Stages" with different "Pick Ups" and performance times, each "Stage" is depicted with a different color specified in the table at the top.

Relay Parameters	Elements					
Selected element ty	pe: Phase	e (1 Elemer	nt / 1 Activ	e)		~
Add		Color	Active	Element Name	Tripping Characteristic	I Pic
Copy To	•		Yes	1#1 Phase	IEC Definite Time	1.
Remove						
Move Up						
Move Up	haracteristi	c Define	Element D	irectional Behavior	View Resulting Characte	eristic

To display the "Directional" characteristic curve or "Directional Plane" and add test points, select "Medium Detail View" from the toolbar and specify your test points on the curve.

Another way to make a characteristic curve is to use an "XRio" file. To do this, first, select "Test Object" from the toolbar and check "Import from List" option and specify the relay "Template" type in "Search" section. For example, here, "7UT" relay is selected. Then, select "XRio" format from "File", "Load Relay Setting", "Relay Config Type" and import your "XRio" file in "Config File Path". To make sure that the imported information is correct, you can review the entered parameters from the tree diagram of this section. If necessary, you can examine the parameters effective on every other parameters of the relay by using "Reference Map" and modify it if there is any mismatch with the relay setting.



80 : "TEST VIEW" WINDOW

As mentioned previously, one of the windows in "Overcurrent" room is "Test View". This window comprises of 5 tabs of "Shot Test", "Pick Up-Drop Off", "Setting", "Trigger" and "Binary Output". Specifying the test points is done in "Shot Test"

and "Pick Up-Drop Off" tabs.

Shot Te	st PickUp	-DropOff	Settings	Trigger	Binary Output
Test Point ITest: 1 ITest: 1 ITest Relati Factor: 1 Relative to:	.000 A ive 1.000 x	Angle	: <u>0.00</u>	00000	IIt Type L1-E L3-E L1L2 L2L3 L3L1 L1L2L3
	No-Trip 54.49 s ested	t act: t max:			L1 L2 L3 J0

In "Shot Test" tab, you can select fault type and the points for the test and after the test is performed, you can view the results of the evaluation. In this tab, in "Test Point" section the fault current and in "Fault Type" section the fault type are determined. In "Test Point" section, the fault current and the angle between current and voltage are specified in "I Test" and "Angle" fields respectively. Note that this angle is only useful for performing "Directional" tests.

Test Point	1.000 A	Angle: 0.00	Fault Type
ITest Re	lative	S	O L1-E O L3-E
Factor:	1.000 x		0 L1L2
Relative to:	Inom	~	0 L2L3 0 L3L1
Detail -			
t nom.:	No-Trip	t act:	- ŏ i2
t min:	54.49 s	t max: No-7	
State: Not	Tested		0 12 0 310

If you want to specify the fault current in terms of a coefficient of "CT" nominal current or "Pick Up" current of one of the specified "Stages", you need to check "I Test Relative" option and specify the coefficient in "Factor" field and then, from "Relative to" drop list select the base current to specify the fault current. This base current can be a "Pick Up" current of one of the "Stages" or "CT" secondary nominal current. After specifying the test current, you need to select the fault type from the standard faults available in "Fault Type" section. These faults include different types of phase to earth, two phase, three phase, inconsistency, "310" and "L1", "L2" and "L3" faults.

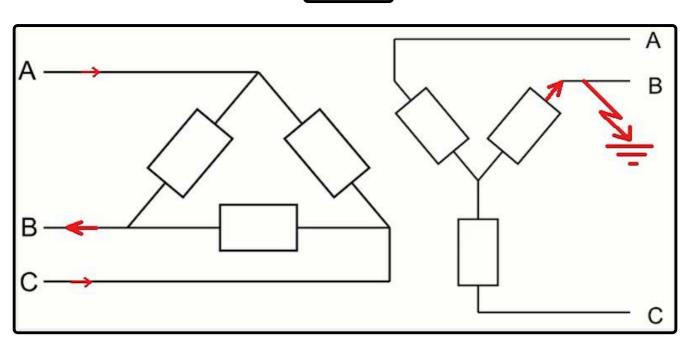
Test Poi	nt		Fault Type
ITest:	1.000 A	Angle: 0.00 *	U 1-E
ITest	Relative		0 L1-E
Factor:	1.000 x		Q L1L2
Relative to	o: Inom	~	O L2L3 O L3L1
Detail -			
t nom.:	No-Trip	t act:	
t min:	54.49 s	t max: No-Trip	
State:	Not Tested		

To better understand "L1", "L2" and "L3" faults, suppose that in a line, there is a transformer with a delta connection on the first side. When a fault occurs in the secondary side, the fault phase corresponding current will flow in the first side and this fault current is provided by other phase or phases. "Negative Sequence" or inconsistency faults test is available by selecting "I2". Since relays detect inconsistency fault by using the value of negative sequence current, by selecting this type of "Fault

1

Type", the entered fault current will merely be negative sequence current. "3I0" fault is useful for "Earth Fault" in "Summation" mode while "L-E" fault is useful in "Measuring" mode.

\bigcirc	L1	
0	L2	
0	L3	
0	12	
0	310	



By clicking on "Add", the selected test point is added to the table in this window. Regarding the test points, note that if you check the "I Test Relative to" option and make the test stream dependent to a parameter and "Add" that point, that test point is always dependent on the value of that parameter and by changing the value of that parameter, the amount of the test current also changes. To clear the subject, check the "I Test Relative to" option and the test current is defined twice the rated current, and this point is added to the test table. Now if you change the rated current to 5 amps you will see that the test current changes from 2 amps to 10 amps. By selecting one of the rows and clicking on "Insert" option, the selected row is repeated in the table and by clicking on "Remove" option, the selected point is removed. Also, by selecting "Add to" option, it is possible to copy point or points selected for one of the "Fault Types" to another "Fault Type". By clicking on "Remove All" option, all test points entered in the table will be removed.

 Add
inset.
Bemove
Add to
Remove All
Sequence
Clear All Failed Tests

By clicking on "Sequence" option, "Sequence Test Points to" page opens where it is possible to specify test points with equal steps. In "Current Data" section, steps are created in direction of the range. By selecting "Current" in "Sequence Type" field, current steps are directly entered in terms of ampere and by selecting "Factor", the current is entered in terms of the parameter selected in "Relate to" field.

Current Data		Fault Types	OK
Sequence Type: [C]] ITest Relative Relative to: [In	om 🗸	☑ L1-E ☑ L2-E ☑ L3-E	Cancel
itart value: ind value:	1.000 A	L1-L2 L2-L3 L3-L1	
tep size: tep count:	0.000 A	L1-L2-L3	
Angle Data	0.00 *		
ind value: Step size:	0.00 *	□ 12 □ 310	
itep count:	1.000 x	All	
al shot count:	3.000 x		

In "Start Value", "End Value" and "Step Size" fields start point of the current point, end point of the current point and steps are specified respectively. For example, "Factor", "Pick Up" current of the first "Stage", 2 times, 6 times and half of "Pick Up" current are selected as values for "Sequence Type", "Relate to", "Start Value", "End Value" and "Step Size" respectively. You can see that "Step Count" which is the number of current steps or test points equals 9.

Start value:	2.000 x
End value:	6.000 x
Step size:	0.000 x
Step count:	1.000 x

Moreover, in "Angle data" section, the information related to start angle, end angle and step size are entered in "Angle data", "Start Value", "End Value" and "Step Size" respectively. Here 30, 45 and 5 are entered as these values. In "Step Count" field, the number of current steps are specified which is 4 points. In "Total Shot Count" field, the sum total of points is calculated. This value shows that each point in all 4 specified angle "Steps" enters test table with a specified current range. After selecting the "Fault Type" of "L1-E" and "L2-E" and confirming them, you can see that these points are added to the test point table.

- Fa	ult Types
\square	L1-E L2-E L3-E
	L1-L2 L2-L3 L3-L1
	L1-L2-L3
	L1 L2 L3
	12 310
	All

Angle Data	
Start value:	30.00 °
End value:	45.00 *
Step size:	5.00 *
Step count:	4.000 x

If the performed test has "Failed" points, by selecting "Clear All Failed Tests" option, it is possible to clear all these points from the table of this section. In "Detail" section, the information related to "Trip" nominal time, the allowed operation time range, actual time and test point evaluation are entered in "t nom", "t min" and "t max" fields, "t act" and "Stage" field respectively. The test points are entered with detail in the table at the bottom of the page. The details include test evaluation, test current, test point angle, whether the test is "Relative" or not; if it is "Relative", the base coefficient and parameter, nominal time, operation time, fault measure in terms of percentage and seconds and the minimum and maximum operation times are entered. Also, if you wish to add a comment about any of the test points, you can use the "User Comment" cell. At the end of this page, it is possible to select test points table from different "Fault Types".

Detail	Sec. 1	4.012 s	t act:										F	Remove All
t min:		3.559 s	t max:	4.551 s										Sequence
State:	Not Te	ested]								Clea	r All Failed Tiests
	State	Assessment	ITest	Angle	ITest Relative	Factor	Relative to	t nom.	t act.	Dev.%	Dev.sec	t min	t max.	User Comment

81 : "PICK UP-DROP OFF" WINDOW

"Pick Up-Drop Off" test of the relay is performed In this tab. In "Test Point" section, the settings related to test points is adjusted. If you wish to perform a "Pick Up-Drop Off" test in a "Non-directional" relay, you need to select "Current" from "Target type" section and for Angular "Pickup-Drop-off" test select "Angle". At first, "Current" is selected for "Non-directional" test.

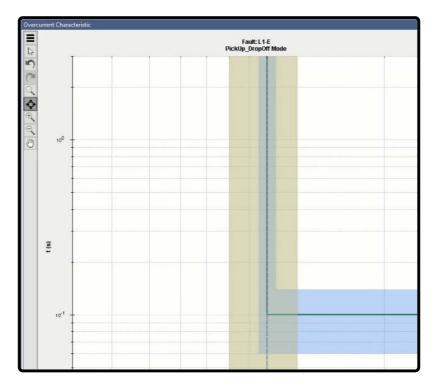
Test Point Target type:	~	ickup Δt:	100.0 ms
Current	~ ~	DropOff ∆t:	100.0 ms
Current Angle	-	ΔI:	20.00 mA
Reset Ratio:	0.9500	Pickup Start:	800.0 mA
DropOff:	950.0 mA	Pickup End:	1.200 A
Angle:	30.00 *	DropOff End:	800.0 mA

In "Pickup" field, the "Pickup" current of the relay is specified. This means that ideally, the relay must "Pickup" at this current and here we enter 1amp for this field. In "Reset Ratio" field, the ratio of "Drop" current to "Pickup" current is specified which here is set at 0.95. Note that by specifying a value for "Reset Ratio", the software calculates the "Drop" current value and displays it in "Drop Off" field. In "Angle" field, the angle of "Pickup" current is specified which is not useful for "Non-directional" relays and depending on the test type, the user can set it at their desired value. Now, since in "Pick Up-Drop Off" tests the software uses increasing or decreasing ramps, the time interval between increasing and decreasing ramps must be entered in "Pickup Δt " and "Drop Off Δt " respectively. By default, these values are set at 100 millisecond. In " ΔI " field, the ramp initial current value in test is specified. Here, this value is set at 20 milliamps. Then, in "Pickup Start" field, the ramp initial current value in test is specified. Here, this value is set at 800 milliamps and increases. Moreover, it is necessary to specify the final values of the ramp current as well. These values are entered in "Pickup End" and "Drop Off End" fields for "Pickup" and "Drop Off" respectively. For example, here, the final current values for "Pickup" and "Drop Off" are set at 1.2 amp and 800 milliamps respectively.

Test Point Target type:		Pickup <u>At:</u>	100.0 ms
Current	\sim	DropOff At:	100.0 ms
Pickup:	1.000 A	ΔΙ:	20.00 mA
Reset Ratio:	0.9500	Pickup Start:	800.0 mA
DropOff:	950.0 mA	Pickup End:	1.200 A
Angle:	30.00 °	DropOff End:	800.0 mA

Now, according to the values set in "Test Point" section, the software applies an increasing ramp from 800 milliamps to 1.2 amp of current with 20 milliamps ramps and 100 milliseconds time interval and then receives the "Pickup" signal. Then, it applies a decreasing ramp with 20 milliamps ramp and 100 milliseconds time interval until the relay "Drops". In "Fault Type" section, as mentioned before, it is possible to determine the fault type. Now, by using "Add" button, this test line is added to the characteristic curve of the relay on "Overcurrent Characteristic" window. Also, the related row is added to the table at the bottom of the "Pick Up-Drop Off" page. In "Detail" section, after the test is finished, the real "Pickup" current value of the relay and the relay "Drop Off" current value of the relay are displayed in "Pickup act" and "Drop Off act" fields respectively.

Test Point				Fault Type		Add
Target type:		Pickup At:	100.0 ms	€ L1-E	1/0/0/0/1	Add
Current	~	DropOff ∆t:	100.0 ms	O L2-E O L3-E		Insert
Pickup:	1.000 A	ΔI:	20.00 mA	O L1L2		Remove
Reset Ratio:	0.9500	Pickup Start:	800.0 mA	O L2L3		Renove
DropOff:	950.0 mA	Pickup End:	1.200 A	O L3L1 O L1L2L3		Add to
Angle:	30.00 °	DropOff End:	800.0 mA	Q L1		Remove All
Detail				0 12		
PickUp act.:		DropOff act.:		O L3 O 12		Clear All Failed Tests
State	lot Tested			Ō 310		Pause before start



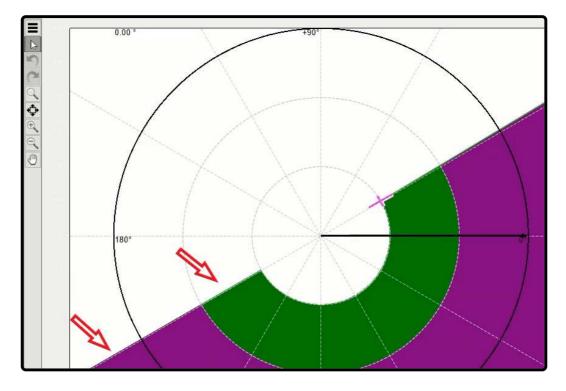
For each "Fault Type", this test is performed only in one point.

Immediately after receiving "Pickup" contact, the ramp starts decreasing from "Pickup-End" point. If you wish the ramp to start decreasing from the same point as the relay "Pickup" point, you need to check "Last state Amplitude" option.



For "Directional" tests, here the settings for a "Directional" relay is in a way that the "Direction" is "Forward" and "Maximum torque angle" and "Sector opening" are set at -60 and 180 degrees respectively. Then, open "Medium Detail View". In this window, the operation range of the relay is displayed in green and purple. You can see that this range is set between (-90+60) 30 degrees and (-60-90) -150 degrees. In "PickUp-DropOff Data" section, the test lines selected from the created test lines are displayed in the table at the left side. In the left sidebar of this window, there are some tools used for diagrams which have been explained previously.

ected element type:	Phase (2 Ek	ment / 2 Acti	ve)		,						
Add		lor Active	Element Name	Tripping Characteristic	I Pick-up	Absolute	Time	Reset Ratio	Direction	-	
Copy To		Yes	1#1 Phase	IEC Definite Time	1.000 lref	1.00 A	0.1000	0.95	Forward		
Remove		Yes	1#2 Phase	IEC Normal Inverse	2.000 lref	2.00 A	0.4000	0.95	Forward		
Move Up Move Down											
efine Element Chara	cteristic De	îne Element [)irectional Behavior	View Resulting Characte	ristic						
efine Element Chara Trip sector definitior		fine Element [•	View Resulting Characte	ristic				·	,	7
efine Bement Chara Trip sector definition Start : -150.0	1	fine Element [Naximum torqu	6	View Resulting Characte	ristic	Π		F90		_	1
Trip sector definition	0° ^ N		e angle :		ristic			-190		$\overline{\langle}$]
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	ristic			490	R	5	
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	ristic			490	R	\mathbf{i}	
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	ristic			F90	B	\mathbf{i}	
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	ristic		180°	190	B		
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	nstic		180°	490	B		
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	ristic		180°	+90	B		
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	ristic		180°	Jet J	B		
Trip sector definition Start :	0° ^ N	laximum torqu	e angle :	50.00 °	ristic		180°		R		



Now, "Angle" is selected from "Target type" and "States" of the "Ramp" created by the software are put on the angle. In this mode, the value of the current and the fault current angle are entered in "Current" and "Angle" fields respectively. Also, the amount of angular changes in each ramp, the amount of start angle value for ramp "State" and the final value of this angle are entered in " $\Delta \phi$ ", "Pickup Start" and "Pickup End" fields respectively. In "Drop Off End" field, the final angle value for decreasing ramp "State" is specified.

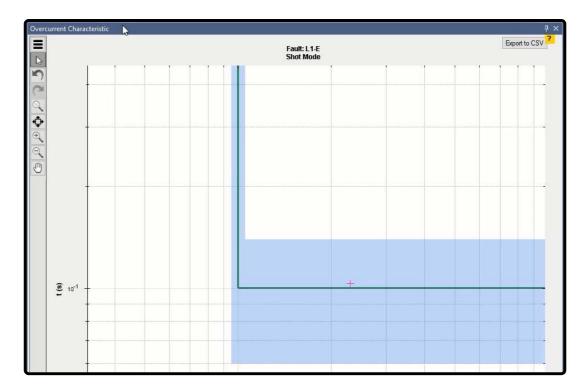
Test Point Target type:		Pickup <u>At</u> :	100.0 ms
Angle	~	DropOff At:	100.0 ms
Current:	1.000 A	ΔΦ:	1.00 °
		Pickup Start:	45.00 °
		Pickup End:	15.00 °
Angle:	30.00 °	DropOff End:	45.00

For example, here you should make two search lines in border points. The first search line is set with a 1 amp "Pickup" current and a 30 degree angle. You can see that the fields related to this test line are adjusted at the right side by the software. Note that these values can be specified by the user. Also, in graphic diagram of "Medium Detail View" window, the angular range of the intended test is turned pink. Now, we add this test line to "Pick Up-Drop off" test table. Now, to create the next test line, -150 is entered as the angle value in "Angle" field and this lined is also added to the test lines. You can see that by selecting any of the created test lines, its information is displayed in "PickUp-DropOff Data" window. Note that in performing this test, in "Pickup" current, you should perform the test once at the highest limit of the angle and once at the lowest limit of the angle.

Test Po	int				Fault Type		8 18							¥.
Target t	ype:		Pickup Δt:	100.0 ms	● L1-E	3/0/	/0/0/3						Ado	3
Angle		~	DropOff Lt:	100.0 ms	O L2-E O L3-E								Inse	ert
Current:		1.000 A	ΔΦ:	1.00 °	O L1L2								Remo	
			Pickup Start:	-165.00 °	O L2L3								neme	ove
			Pickup End:	-135.00 °	O L3L1 O L1L2L	3							Add to	o
Angle:		-150.00 *	DropOff End:	-165.00 °	O L1								Remove	All
Detail Pick Up a	act.:		DropOff act.:		O L2 O L3 O I2								Clear All Fa	led Tests
State:	N	lot Tested			O 310								Pause bef	ore start
1	State	Assessment	t Target type	lTest	Angle	Reset Ratio	Pickup ∆t	Dropoff ∆t	∆var	Pickup Start	Pickup End	Dropoff End	PickUp act.	DropOff
1		Not Tested	Current	1.000 A	30.00 °	0.9500	100.0 ms	100.0 ms	20.00 mA	800.0 mA	1.200 A	800.0 mA		
2		Not Tested	Anale	1.000 A	30.00 *		100.0 ms	100.0 ms	1.00 *	45.00 °	15.00 °	45.00 °		
		Not Tested	Anale	1.000 A	-150.00 *		100.0 ms	100.0 ms	1.00 °	-165.00 *	-135.00 *	-165.00 *		

82 : "OVERCURRENT" CHARACTERISTIC CURVE

To continue explaining "Overcurrent" room, in this video we are going to explain characteristic curve or "Overcurrent Characteristic". In "Overcurrent Characteristic", the inverse current curve is displayed in terms of time. This window is designed in a way that it is connected to other windows in this room and it is possible to add points to the table and perform the test more quickly by using some combination keys.



To add test points to "Test View" table, you can click on the characteristic curve and select "Add" button to add points to the table for test. Also, by holding "Ctrl" key and clicking on the curve, you can add your intended points to the test table more quickly. The third method for adding points to the test table is to enter "I test" current in "Test Point" section and click on "Add" button. This method has been explained in previous videos.

Test ITest: Test: Factor: Relative Deta	st Relat	2.300 A	Angle:	0.00 *	Emilie Even © L1-E O L2-E O L3-E O L1L2 O L2L3 O L3L1 O L1L2L3	3/0/(0/0/3							Add Insert Remove Add to
t nom.:		00.0 ms	t act:										Re	move All
t min:	6(0.00 ms	t max:	140.0 ms	0 L3 0 I2								Se	quence
State:	Not T	ested			0 310								Clear/	VI Failed Tests
	State	Assessment	ITest	Angle	ITest Relative	Factor	Relative to	t nom.	t act.	Dev.%	Dev.sec	t min	t max.	User Comment
1		Not Tested	2.280 A	0.00 *	No	2.280 x	Inom	100.0 ms				60.00 ms	140.0 ms	
2		Not Tested	4.047 A	0.00 *	No	4.047 x	Inom	100.0 ms	-			60.00 ms	140.0 ms	
▶3	0	Not Tested	2.300 A	0.00 *	No	2.300 x	Inom	100.0 ms				60.00 ms	140.0 ms	

After adding test points to the table, by clicking on "Start/Continue Test" from the toolbar, all test points are tested one after the other. But, if you wish to test each point individually, you can either click on "Start Single Test" or right-click on your intended row or then click on "Apply & Start Test" to run the test. Also, if you wish to test a test point without adding it to the test table, click on the intended test point on the characteristic curve and then click on "Start Single Test".

	rel abs 0 (()()()()()()()()()()()()()()()()()()			→ P		T		+.0 +.0	▶ 8		X Connec	cted 💿
ITest:		An ta		0.00 *	Extiliation Image: Constraint of the system Ima	• 1 = 3/0/1	0/0/3					
	State Assessment	ITest		Angle	ITest Relative	Factor	Relative to	t nom.	t act.	Dev.%	Dev.sec	t min
	Show/Hide Apply & Start Test		80 A 47 A 00 A	0.00 * 0.00 * 0.00 *	No No No	2.280 x 4.047 x 2.300 x	Inom	100.0 ms 100.0 ms 100.0 ms				60.00 m 60.00 m 60.00 m
	Remove Clear Result Recalculate Point											

In "Overcurrent Characteristic" window, it is possible to apply more settings for better analysis by clicking on the cog at the bottom of the page. Each case is explained in the following.

		Secondary I (A)			ŝ
Optimize All Pan Mode(alt+mouse click)	Show row number Show all Zone Show selected Zone	Show all tAct point Show selected tAct point	Snap to Grid	Ş	

"Zoom during Test" to zoom on the characteristic curve

"Optimize All" for optimal display of the characteristic curve

"Pan Mode" For moving the characteristic curve

"Horizontal Axis" to display horizontal axis of the characteristic curve in relative form

"Show Row Number" for showing number of the row whose information is entered

"Show All Tact Point" for displaying the operation time of the entire test points on the characteristic curve

If the selected test points are close to each other, you can use "Show Selected Tact Point" for better display of the operation time of each row.

Note that if "Show All Tact Point" and "Show Selected Tact Point" are selected simultaneously, the operation time of the entire test points on the characteristic curve is displayed.

If you wish to add the test point exactly on current lines, you can use "Snap to Grid" option.

Note that it is, also, possible to activate "Pan Mode" by holding "Alt + Mouse Click".

If "Show Cursor Value" is checked, by hovering the cursor over any point, the current value and nominal time of that point is displayed.

Also, if you wish to have the information regarding every curve, you can check "Show Curve Information" option.

Optimize All	Show row number	Show all tAct point Show selected tAct point	☑ Snap to Grid
Pan Mode(alt+mouse click)	Show all Zone		
	Show selected Zone		

Moreover, there are some features available in the right-click menu of this page which are going to be explained.

"Shot" option shows the coordinates of the shot point. "Add shot" option shows the point added to the table and "Shot at" option shows the coordinates of the point "Shot" on the curve. If "Snap to Grid" is not checked, these two coordinates will be the same.

Zoom	•	Add Shot (3, 0.166
Show	- F	45
Color	- R	
Other	- F	

Explanations of "Zoom Mode", "All", "In", "Out" options are available in "Sequencer" section videos. "Characteristic" and "Test Points" options show Characteristic curve and range of shot points on the curve zoomed, respectively.

In "Show" section, "Curve", "Test" and "Grid" options are used to display or hide tolerance, "Shot" points and characteristic curve lines respectively. In "Color" section, it is possible to change the background color, "Grid" color of the lines by using the "Background" option. By using "Default Color" it is possible to change the colors to default settings. "Other" Options are the same as those available by clicking on the cog icon at the bottom of the page which were explained in the beginning of this video.

	Zoom Mo All In Out Character Test Point	istic		Shot Zoon Show Color Other		• • •
	Shot Zoom Show Color Other	• • •	Ð	Curve Tests Grid	•	
Shot Zoom Show Color Other	· · · ·	Show	all t/	ted tAct Act point number i		poir

83 : "SETTINGS" TAB OF "OVERCURRENT" MODULE, PART 1

Snap to grid

To continue with explaining "Overcurrent" room, in this video we are going to explain "Setting" tab. In this tab, you can adjust some of the test settings. In "Fault Inception" section, the angle in which the fault occurs is specified. But this angle is not the angle between current and voltage but it equally shifts the current and voltage values. To better understand this, select "Signal View" from the toolbar and check "Voltage Group A" in "Setting". Then, by changing the "Angle" value, you

can see the current and voltage signals. Note that to determine the angle between current and voltage, you need to use the "Angle" field in "Shot test" tab.

Shot Test Pick Up-DropOff (3/0/0/0/3) Settings	Trigger Binary Output
Fault Inception	Time
Model : Fixed angle	Prefault Time 1.000 s
Contract Contract	Ramp in Prefault
Angle : 0.00 *	Max Fault Time
	Max Fault Time (Abs) 6.000 s
Voltage Output	Max Fault Time (Rel)
Enable Voltage Output	
LN Voltage(LE Fault) 31.75 V	
LL Voltage(LL Fault) 55.00 V	
Pick Up DropOff Contact	
Trigger on C2: Start ~	PostFault Time 500.0 ms
Space Key Press	Delay after trigger 50.00 ms
Add Signal	Time Reference :
DC decay	Fault Inception
Amplitude: 15.00 % 1/ T: 5.000 1/s	Load Current (Prefault Current)
Hamonic	Amplitude Phase (∠V, I)
Number: 2 ~	Based On Current Based On Degree
Amplitude: 10.00 % Phase: 0.00 °	O Based On Ifault O Same as Fault Angle
Pick Up DropOff Information	0.000 A 0.00 °
Show Panel	Other Settings
	First run PickUp-DropOff
	Continue Last State Amplitude
	Passed Settings
	Pass if get any trip

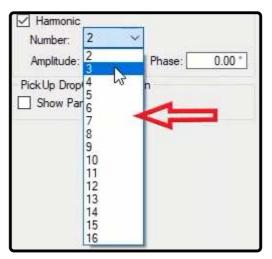
"Voltage Output" is used in "Directional" tests but if, for any reason, you wish to activate your voltages in a "Non-Directional" test and see the influence of changing voltages on "Overcurrent" test, you can use this section.

In "Trigger On" field in "Pick up Drop off Contact" section you can determine the "Contact" to be used for doing "Pick up Drop Off" test. This option is used in cases where the relay does not have "Pick up" contact. In these relays, by reducing the trip time to zero, it is possible to find the approximate pickup current.

Pick Up Drop	Off Contact	
Trigger on	C2: Start	~
Space K	C1: Trip	
	C2: Start	AT

But if you do not wish to change the relay settings, if the relay has "LED" or "Flag" pickup, you can manually issue a "Pick Up" or "Drop Off" command by checking "Space Key Press". You can perform the test by pressing the "Space" button once at the time of "Pick up" and once at the time of "Drop Off".

If you wish to create a transient state for the current waveform in "Add Signal" and test the transient state "Overcurrent", you can do so by checking "Dc decay" (decaying Dc) and specifying the "Amplitude" value in terms of percent and time coefficient in "1/T" and then you can view the changes resulted in the waveform in "Signal View". Now, if you wish to add "Harmonic" to the transient state, you can do so by checking "Harmonic" and specifying the order of the "Harmonic" in "Number" field and specifying the "Amplitude" in terms of percent and phase angle. Note that by unchecking the options in this section, the signal returns to "Normal" state.



3/0/0/0/3	Pickup and Drop Out Inf. Prefault Time 0000 s Pickup Time :3.100 s Number of Pickup Step: 31 Drop off Time :3.100 s Number of Drop off Step: 31
-----------	--

84 : "SETTINGS" TAB OF "OVERCURRENT" MODULE, PART 2

In "Time" section, first, the injection time before fault in "PreFault Time" is entered. In tests such as "Directional" where by injecting voltage, "PTs" draw inrush current, by checking "Ramp in Prefault" you can create a "Ramp" voltage and prevent device errors. Note that checking this option is only possible for "Directional" tests or in conditions determined in "Voltage Output" section.

Time	1
Prefault Time	1.000 s
Ramp in Prefault	

In "Max Fault Time", the maximum fault injection time is specified in the form of "Abs" or "Rel" which itself includes three sections. Note that if the time specified in "Max Fault Time" is shorter than time of the "Trip" time of the shot point, result of the evaluation will be wrong.

Max Fault Time	
Max Fault The (Abs)	100.0 ms
Max Fault Time (Rel)	

If you are using "Max Fault Time (Abs)" field, you need to enter a time in terms of seconds for the maximum fault signal injection time (for all points). But, to increase the speed of the test, you can use "Max Fault Time (Rel)". By checking this option, three other options appear. By entering a number in "Add%ofTnom", the fault signal injection time in each point equals the test point nominal time plus a percentage of the nominal time entered in this field. This means that if the test point nominal time is 10 seconds and 5 percent is entered in this field, the maximum fault injection time (1.05) equals the test nominal time which is 10.5 seconds. But in "Add Absolute" field, the fault injection time is entered as a sum of the test point trip nominal time plus the time entered in this field. For points which are in "No Trip" area, it is possible to enter a separate time in "No-Trip Time" field. If you enter the time in these four fields, the software will consider the longest time.

Ramp in Prefault Max Fault Time Max Fault Time (Abs) Max Fault Time (Rel)	6.000 s	77	10 + (0.05*10) = 10.5 🗹
Add %of TNom.	5.00 % 100.0 ms		10 + 0.1 = 1.1

"Post Fault" time is entered in "Post Fault Time". "Delay After Trigger" is used for specifying the trigger time of the intended key and by right-clicking on the related field and selecting "Go To Linked Value", you can see that it is linked to "CB Trip Time" and if necessary, by selecting "Remove Link" you can enter your desired value instead.

PostFault Time	500.0 ms	
Delay after trigger	50.00 m ⁻	
Time Reference :		Link to XRio
● Fault Inception ○ Starting		Remove Link
Load Current (Prefault Current)		So to Linked Value

By selecting "Fault Inception" in "Time Reference", the "Trip" time from the fault injection time is calculated. But, by selecting "Starting", the "Trip" time is calculated from when the "Pick-up" contact is received from the relay.



In "Load Current (Prefault Current)" section, it is possible to adjust the settings related to "Prefault" phase and current. By selecting "Based on Current" radio button in "Amplitude" section, the "Prefault" current is entered in ampere which is the same for all other test points. But, by selecting "Based on IFault", the "Prefault" current is entered in fault current which is different for every "Shot" point. You can use "Phase" section for the angle between current and voltage in "Prefault". By selecting the "Based on Degree" radio button, it is possible to specify the voltage current angle in degrees which is the same for all other test points. But, by selecting "Same as Fault Angle", the angle between current and voltage in "Prefault" will be the same with "Fault" which is different for every "Shot" point.

Load Current (Prefault Cu Amplitude	urrent) Phase (∠V, I)
● Based On Current ● Based On IfaNt	 Based On Degree Same as Fault Angle
0.000 A	0.00 *

In "Other Setting" section, by checking first run "PickUp-DropOff", if you have multiple "PickUp-DropOff" and "Shot Test" points, first, the "PickUp-DropOff" test is performed otherwise "Shot Test" is performed first. By checking "Continue Last State Amplitude", in "PickUp-DropOff" test, instead of starting from "Pickup End" the decreasing ramp will start from where the relay performed the pick-up".

Other Settings	
First run Pick Up-DropOff	
Continue Last State Amplitude	

85 : COMPLEMENTARY EXPLANATION OF "OVERCURRENT" MODULE

To continue explaining "Overcurrent" room, here are some additional explanations. By checking "Pause before Start" in "Pick Up-Drop Off" tab, by running the test using the "Start/Continue Test" method, before testing any point, a message appears and by pressing "Ok", the software tests that point.

Test Point — Target type:		Pickup <u>At</u> :	100.0 ms	Fault Type		 			Add	
Current	~	DropOff At:	100.0 ms	O L2-E					Insert	
Current:	1.086 A	ΔI:	22.00 mA	O L3-E					Remove	
Reset Ratio:	0.9500	Pickup Start:	868.4 mA	O L2L3					memove	
DropOff:	1.031 A	Pickup End:	1.303 A	O L3L1 O L1L2L	3				Add to	
Angle:	0.00 °	DropOff End:	868.4 mA	0 L1 0 L2					Remove All	
Detail	1.000.1		1.000.4	O L3					Clear All Failed	Tests
Detail PickUp act.:	1.066 A	DropOff act.:	1.066 A							

By selecting "Fault Inception" In "Time Reference", the "Trip" time is calculated since the fault injection time. This option is used for testing the relays which do not have the "Pick Up" contact. But by selecting "Starting", the "Trip" time is calculated since when the "Pick Up" contact is received from the relay. This option helps to increase the measurement accuracy of the operation time in relays with "Pick Up" contact.

	Max Fault Time (Abs)	6.000 s
31.75 V		
~	PostFault Time	500.0 ms
	Delay after trigger	50.00 ms
	Time Reference :	

In fact, when you select "Fault Inception", it is like that you are putting the "trigger" on "Trip" signal. But if you select "Starting", first you need to make sure that the relay gives a "Pick Up" signal. Selecting this option is like putting the "Trigger" on "Trip", "Pick Up" and "Trigger Logic" in "And" mode.

Binary trigger condition Trigger Logic :	AN	D () OR		-63
C1:Trip:	~	C2:Start :	1	~
Trigger Logic Minimun	n Time :		0	.000 s

In "Binary Output" tab, if it is necessary for the relay to see the key condition, by using the "A" or "B" group voltages or "Aux DC" it is possible to take any needed voltage to the "Binary Input" of the relay through "Binary Output" of the device. This tab has three "PreFault", Fault" and "Post Fault" modes and you can specify the settings of each one separately.

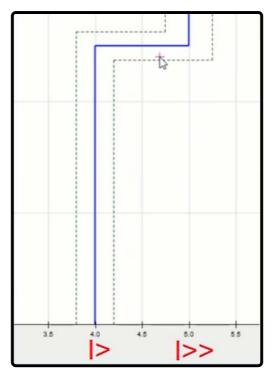
hot Test	Pick Up-DropOff ((2/0/0/0/2)	Settings	Trigger	Binary Outpu	t		
Prefault								
Out	Display Name	First State	1st ch.	2nd ch.	3rd ch.	4th ch.	Trigger	Toggle
1	Bin. Out 1	<i></i>	0.000 s	0.000 s	0.000 s	0.000 s	•	
Fault -			E la sinas					
Out	No Display Name	First State	1st ch.	2nd ch.	121-21121123	4th ch.	Trigger	11.1.2
	S Display Name Bin. Out 1	First State	1st ch. 0.000 s	2nd ch. 0.000 s	121-21121123	4th ch. 0.000 s	Trigger •	
Out	Bin. Out 1	1111111111		-	121-21121123	222.20.30		1000
	Bin. Out 1	1111111111		-	s 0.000 s	222.20.30		Toggle

86 : INTRODUCING "VI STARTING" ROOM

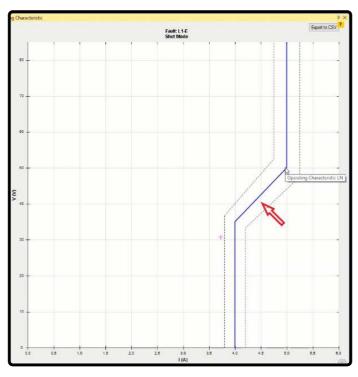
"VI Starting" room is designed to test "51V" function. In this function, the pickup of overcurrent unit depends on the voltage drop. In fact, "VI Starting" is a current function whose "Pickup" is linked to voltage. Note that in "51V" function test, evaluation of detecting or not detecting fault is performed based on the test voltage and current amount which can be "Voltage-Controlled" or "Voltage-Restrained" and is used as generator-differential protection backup as well as for

coordinating high-current relays in power systems. To explain the difference between these two functions, characteristic curve and examples are used.

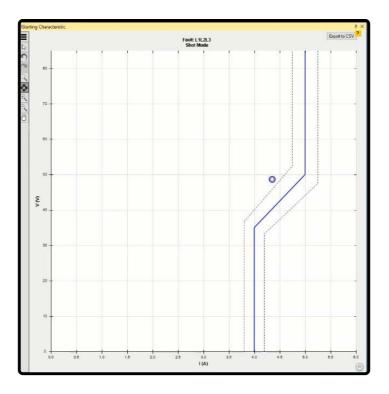
If the "51V" function is "Voltage-Controlled", its characteristic curve will look like what you can see in this picture. For a relay with this characteristic curve, the relay performs the pickup in currents higher than "5A" and for currents lower than "4A" the relay does not perform the pickup. But if the current is between "4A" and "5A", the relay performs the pickup only if the voltage is lower than "50V". In the settings of this function, "4A" and "5A" currents are specified as "I>" and "I>>" respectively.



In the second mode, if the characteristic curve is "Voltage-Restrained", like the previous mode, the relay detects a fault if the current is higher than "5A" and in currents lower than "4A" it does not perform the pickup. The difference is that between "4A" and "5A", the pickup voltage value has a linear increase.



In this function, it is possible to specify the settings for phase to phase and phase to earth voltage faults separately. This is also considered in the characteristic curve page of this function so that if you add a shot on the characteristic curve in single-phase "Fault Type", the specified voltage is the voltage of the phase and if you select two-phase or three-phase "Fault Type", the specified voltage is line-to-line voltage in which case the device produces the corresponding voltage to produce the line-to-line voltage.



Shot Test (2/0/0/0/2)	Check	Test	Search Test	Settings	Trigger	Binary Output
Test Point Voltage: 48.73 V Current: 4.348 A	Phi [Fault Ty O L1-E O L2-E O L3-E O L1L O L1L O L1L O L2L O L3L	pe1 2 3	/0/0/0/1	
Detail t nom.: No-Trip t min: No-Trip State: Not Tested	t act: [t max: [No-1	Inip	2L3 1	/0/0/0/1	
State Assessment Vo	oltage	Current	Phi Us	er Comment		
▶1 Not Tested	48.73 V	4.348	8 A 0.00 *			

Signal	Magnitude	
V L1-E: V L1-E	28.13 V	
V L2-E: V L2-E	28.13 V	$\frac{48.73}{28.13}$
V L3-E: V L3-E	28.13 V	
V L1-L2	48.73 V	√ 3
V L2-L3	48.73 V	
V L3-L1	48.73 V	<u></u>

"Test View" and "VI Starting Characteristic" are the two main windows of this room. In "Test View" window, the three main tests of this function are performed in "Shot Test", "Check Test" and "Search Test" tabs which will be explained in future videos. In "VI Starting Characteristic" window, the characteristic curve of the function is displayed according to the current and voltage. To specify the settings of this function, select "Test Object" from the toolbar and double-click on "VI Starting" from the tree diagram and then enter your desired settings to be displayed in "VI Starting Characteristic" characteristic curve in "VI Starting Parameters" page.

🔚 General Test Object		-	
File View	×	Tree :	?
🔭 🛅 🛛 Resize Columns : 🛛 Auto	🝷 🚜 📴 Recalculate Disabled Formula(s) 🗲 Quick Access Ok Cancel		
	VI Starting - VI Starting function block		
Custom	VI Starting parameters -	o x	Max F 10.00
È ⊕ RIO È ⊕ ⊕ Device	VI Starting Parameters	2	10.00
EBConfiguration	Characteristic	_	
	I>> : 5.000 A		
	v 1		
	VLL(I>>) : [50.00 V	
	VLN(0>>) :	50.00 V	
	VLL(>): 35.00 V		
	VLN(l>): 35.00 V		
			>
2	I>: 4.000 A		
Auto Scroll			💢 Clear
	Vtolerances		
	Currents : 5.00 % Voltages : 5.00 %		
Process Log Error / Warning Formula Refer	OK	Cancel	Show/Hide 🗹
L		ОК	Cancel
			11

Relay settings in "VI Starting" Room

In VI Starting Parameters page, you can enter the characteristic curve information in characteristic section. In I> and I>> fields, the lower and upper limits of the pick-up current are entered. In this protection, for currents lower than I>, the function does not give a pick-up regardless of the voltage. Also, for current higher than I>>, this function gives a pick-up regardless of the voltage. Also, for current higher than I>>, this function gives a pick-up regardless of the voltage and the voltage value is influential for the performance of the function. Voltage settings of this function is entered in VLN and VLL fields. As mentioned before, this function needs different settings for phase to earth and phase to phase faults.

VLN is used for specifying phase to earth faults settings; VLN (I>) and VLN (I>>) are used for specifying the voltage value of lower and upper limits respectively. VLL (I>) and VLL (I>>) have the same function for phase to phase faults. Note that for VI Starting-Controlled function, the same value must be entered for the lower and upper limits of VLN and VLL. But for Restrained mode, the lower limit must be lower than the upper limit. Also, current and voltage tolerances of this function are entered in "Tolerances" section.

87 : "SHOT TEST" TAB

As mentioned previously, one of the windows in "VI Starting" room is "Test View". This window has 6 tabs including "Shot Test", "Check Test", "Search Test", "Setting", "Trigger" and "Binary Output". Specifying the test points is done in "Shot Test", "Check Test" and "Search Test" tabs.

Shot Test Check Test Search Test Settings Trigger Binary Output	
Test Point Fault Type Voltage: 0.000 V Phi 0.00 L1-E	Add
Current: 0.000 A	inset
O L1L2 O L2L3	Remove
O L3L1	Add to
Inom.: No-Trip t act:	Remove A
t min: No-Trip t max: No-Trip	Sequence
State: Not Tested	Clear All Failed Tests
State Assessment Voltage Current Phi User Comment	

In "Shot Test" tab, you can select fault type and the points for the test and after the test is performed, you can view the results of the evaluation. In this tab, in "Test Point" section the fault current and voltage and in "Fault Type" section the fault type are determined. Voltage, fault current and the angle between voltage and current are entered in "Voltage", "Current" and "Phi" tabs respectively. After specifying the current and voltage of the test, it is necessary to select the fault type from the standard faults available in "Fault Type" section. These faults include different fault types of phase to earth, two-phase and three-phase.

Shot	Test	Check Tes	st Searc	h Test	Setting	gs Trig	ger	Binary Outpu
Test Point Voltage: Current: Detail t nom.:	0.000 0.000 No-Tr No-Tr	A ip	Phi t act: t max:	0.0 No-1		ault Type) L1-E) L2-E) L3-E) L1L2) L1L2) L2L3) L3L1) L1L2L		
State: No	ot Tested							

By clicking on "Add", the selected test point is entered in the table in this window. By selecting one of the rows and then selecting "Insert" option, the selected row is repeated in the table and by clicking on "Remove", the selected point is removed. By selecting "Add to" option, it is possible to copy point or points selected for a "Fault Type" to another "Fault Type". By clicking on "Remove All", all test points entered in the table are removed.

D	Add
N	Insert
	Remove
	Add to
R	emove All
S	equence
Clear	All Failed Tests

By clicking on "Sequence" option, "Sequence Test Points to" page opens where it is possible to create test points with equal steps. In "Step" section, steps are created toward the range. By selecting "Angle" in "Step On" field, angular steps are entered directly in terms of degrees. This means that the test points are entered according to the origin point specified in "Origin" section in a way that the required angles are resulted in accordance with the horizon. For example, if 45 and 90 degrees are entered as start and end point with 5 degrees steps and 5 volts and 5 amps as origin point, by confirming this settings and "Zooming All" you can see that there are some points added on the "VI Characteristic". For example, the last point is selected. By doing the calculations mentioned in the picture you can see that the resulted angle is 85 degrees and not 90 which is because the "Origin" point is considered as one of the points as well and the last point of this "Sequence" is removed.

Step	Fault Types	т ок
Step On: Angle	☑ L1-E	Cancel
Start Angle:	✓ L2-E ✓ L2-E ✓ L3-E	Cancer
End Angle:	45.00 °	
Step Size:	0.00 * L2-L3	
Number of steps:	1 L1-L2-L3	
Point		
Origin Voltage : 1.000 V		
Current : 1.000 A		
	AI	

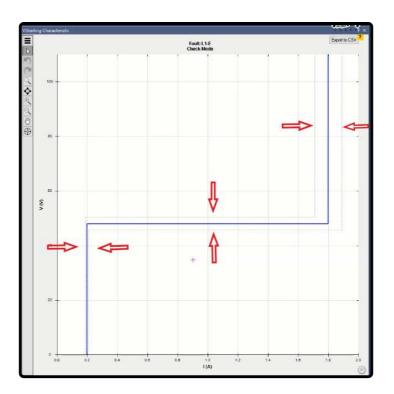
But by selecting "Direction", an angle is specified in "Angle" field and in this angle from the "Origin" point, with the length entered in "Length" field and by steps specified in "Step Size", some points are shot on the curve. Note that the length and the steps of the points are specified according to nominal current which is the same as the "CT" secondary current entered in "Device" block on "Test Object" page. For example, if 45 degree, 5 and 0.5 times the nominal current, 0 And 0 are entered as angle, length, step and origin point, by confirming this setting and "Zooming All", you can see that some points are created in 45 degrees in the characteristic curve with 0 Volts and 0 Amps as the point of origin.

Sequence Test Points to			× ?
Step	Y	Fault Types	ОК
Step On:	Direction \checkmark		Cancel
Angle :	0.00*	🗌 L3-E	
Length :	0.000 ln	L1-L2	
Step Size:	0.000 ln	L3-L1	
Number of steps:	ks' 1	L1-L2-L3	
Origin Voltage : 7.044 V Current : 616.3 mA		Al	

If the performed test has "Failed" points, by selecting "Clear All Failed Tests" option, these points are cleared from the table in this section. In "Detail" section, the information related to "Tip" nominal time, the allowed operation time range, the actual time and evaluation of test point are entered in "T nom", "T min" and "T Max", "T act" and "State" fields respectively. In the table at the bottom of the page, the test points are entered with various details. The details include test evaluation, test voltage, test current, the angle between voltage and current of the test point. Also, if you wish to enter a comment for any of the points, you can select "User Comment" from the cell. At the end of this page it is possible to select the test point table in different "Fault Types".

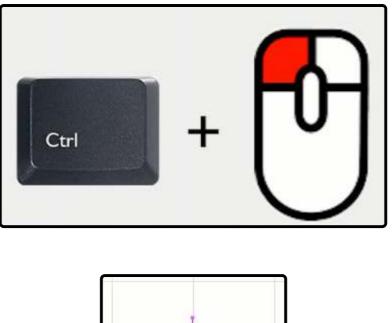
88 : "CHECK TEST" TAB

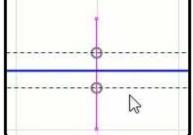
After performing the "Shot Test" in "VI Starting" room, it is time to perform "Check Test" and "Search Test". In "Check Test" the upper and lower tolerances of the relay that are displayed as dotted lines in "VI Starting Characteristic" are tested and evaluated. To perform the "Check Test", first it is necessary to draw some lines named "Check Line" in different sections of the diagram. To draw this line, first in "Origin" section from "Check Line" section, the start point of this line is specified. In "Voltage", "Current", "Phi" and "Angle" fields, origin point voltage, origin point current, the angle between voltage and current and the movement angle of the "Check Line" are specified respectively. In "Length" section, the length of the "Check Line" is entered in the intended cell.



Shot Tes' Check Test	Search Test	Settings	Trigger	Binary	Output
Crigin Voltage: 0.000 V Current: 0.000 A Angle: 0.000 * Length 0.0000	Phi 0.00		P-E P-E PL2 PL3		
State Assessment Vol	tage Current	Phi An	gle l	Length	User Comment

Note that the drawn "Check Lines" must cross at least one of the tolerance lines of the point characteristic curve. Then click on "Add" option to add the "Check Line" to "Check Test" lines table. Another way to draw a "Check Line" is to hold down "Ctrl" button and left-click in "VI Starting Characteristic" window and then move the cursor in your desired direction on the characteristic curve. You can see that the information of the drawn "Check Line" is displayed in the "Check Test" lines table. After drawing the "Check Line", the software evaluates the crossing point of the "Check Line" and the tolerance lines as a "Shot" test in accordance with the performance of the relay. Here, after performing the test, the relay performs a "PICK UP" in the lower tolerance and has no performance in the upper tolerance; so the test is "Passed". Other parts of this section such as "Fault Type" and "Remove All", "Sequencer" options etc. are similar to "Shot Test" section which has been explained in previous videos. The only additional option in this section is "Copy to Search". By marking one of the test lines and selecting this option, you can copy the selected line to "Search Test" and by selecting "Add" in "Search Test", this line is entered in the "Search Test" lines tables.





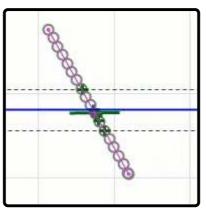
After "Check Test", the last test performed on the "VI Starting" characteristic curve is "Search Test". The purpose of this test is to find the characteristic curve line and drawing method of the "Search Line" is the same as the two previous methods explained for "Check Line".

By performing the test, the software starts interpolating the characteristic curve by testing some points on the search line and determines the exact location of the characteristic curve. The number of points on the "Search Line" which are tested by the software is specified by the user in "Setting" tab in "Search Setting" section (which is in fact the resolution of the "Search Test"). There are three "Relative", "Absolute" and "Max Point Number" options in this section which determine the ending condition of the "Search Test". The first condition is "Relative" meaning if the difference between the test point value and previous test point is less than the value specified in this field, this point is the response of the test. The second condition is "Absolute" meaning if the difference between the test point and previous point is less than the value specified in this field, this point is the response of the test. And the third condition is "Max Point Number" meaning the test cannot be performed more than the number of points entered in this field and the last point is the response of the test.

Search Line		Fault Type -	1/0/0/0	2 A A							Add
Voltage: 57.60 V Phi	0.00 *	0 L2-E 0 L3-E									Reiniove
Current: 427.7 mA Angle: -89.29 *		0 L1L2 0 L2L3									
Length		0 L3L1 0 L1L2L3									Remove All
Length: 17.2274											Sequence
Search Interval											Copy To Check
Ignore: 0.0000										1	Clear All Falled Test:
State Assessment Voltage C	Current Ph	i Angle	Length	Pickup	Deviation	DropOff	Reset Ratio	Ignore	Reach	User Com	ament

Relative	1.00 %
Absolute 🔓	0.5000
Max Point Number	12 point
Ignore Nominal Chara	cteristics —
Search Interval: 0.	2000 Apply To Al

"Ignore" field in "Search Interval" section is used when you want to ignore the characteristic curve specified for the intended search line. By entering a number in this section, some points are added on the "Search" line with the specified value as the distance between them. For example, by entering 0.4 in this field, you can see that some lines are added on the "Search Line" with a 0.4 distance. If the test is performed, the points added on the "Search Test" are tested one after the other so that the exact location of the characteristic curve is determined. This option is used when the characteristic curve that you have for the test seems wrong or you have no characteristic curve at all. If you wish to do this for all of the test lines, you can use "Ignore Nominal Characteristic" section located in the "Setting" tab. To do this, by entering the value for "Search Interval" and selecting "Apply to all", you can apply this settings to all of the test lines and find the relay characteristic curve.



89 : "VI STARTING" ROOM SETTING

To continue with explaining "VI Starting" room, in this video we are going to explain "Setting" tab. you can adjust some of the test settings. In this tab, In "Time" section, first, the injection time before fault in "PreFault Time" is entered. In "Max Fault Time", the maximum fault injection time is specified in the form of "Abs" or "Rel" which itself includes three sections. Note that if the time specified in "Max Fault Time" is shorter than time of the "Pick up" time of the shot point, result of the evaluation will be wrong.

Shot Test Check Test	Search Tes+	Settings	Trigger	Binary Output
ime refault Time	100.0 ms			
Max Fault Time		é		
Max Fault Time (Abs)	1.500 s		\square	
PostFault Time Delay after trigger	100.0 ms			
.oad Current (Prefault Curr	ent)	<u>.</u>		
	se (∠V,I) —— ased On Degree			
	ame as Fault Angle			
Search Setting				
Relative	0.5000			
lax Point Number	12 point			
Ignore Nominal Characteri	stics	1		
Search Interval: 0.2000	Apply To All Disable All			
	Disable All			
Passed Settings Pass if get any trip				
_ rass i get any trip				

If you are using "Max Fault Time (Abs)" field, you need to enter a time in terms of seconds for the maximum fault signal injection time (for all points). But, to increase the speed of the test, you can use "Max Fault Time (Rel)". By checking this option, three other options appear. By entering a number in "Add%ofTnom", the fault signal injection time in each point equals the test point nominal time plus a percentage of the nominal time entered in this field. This means that if the test point nominal time is 10 seconds and 5 percent is entered in this field, the maximum fault injection time (105) percent of the test nominal time which is 10.5 seconds. But in "Add Absolute" field, the fault injection time is entered as a sum of the test point trip nominal time plus the time entered in this field. For points which are in "No Trip" area, it is possible to enter a separate time in "No-Trip Time" field. If you enter the time in these four fields, the software will consider the longest time.

"Post Fault" time is entered in "Post Fault Time". "Delay After Trigger" is used for specifying the trigger time of the intended

key and by right-clicking on the related field and selecting "Go To Linked Value", you can see that it is linked to "CB Trip Time" and if necessary, by selecting "Remove Link" you can enter your desired value instead. In "Load Current (PreFault

Current)" section, it is possible to adjust the settings related to "PreFault" phase and current. By selecting "Based on Current" radio button in "Amplitude" section, the "PreFault" current is entered in ampere which is the same for all other test points. But, by selecting "Based on IFault", the "PreFault" current is entered in fault current which is different for every "Shot" point. You can use "Phase" section for the angle between current and voltage in "PreFault". By selecting the "Based on Degree" radio button, it is possible to specify the voltage current angle in degrees which is the same for all other test points. But, by selecting "Same as Fault Angle", the angle between current and voltage in "PreFault" will be the same with "Fault" which is different for every "Shot" point.

Script Functions	State	- Circuit breaker Name	ID	Description	Value	Туре	Min	Max	Form
	1.111.111	CB trip time	TRIPTIME	CB trip time	0.05 s	Contraction of the local distance of the loc	0.02	0.50	
	0	CB close time	CLOSETIME	CB close time	0.10 s	Real	0.02	0.50	
🕀 🗂 Device	0	52a/b %	P52AB	52a/b %	20.00 %	Real	0.00	45.00	
⊕ ────────────────────────────────────									

In "Search Setting" section, the settings related to "Search Test" are specified. As mentioned before, "Search Test" gives a result when one of these conditions are met.

The first condition is "Relative" meaning if the difference between the test point value and previous test point is less than the percentage specified in this field, this point is the response of the test.

The second condition is "Absolute" meaning if the difference between the test point and previous point is less than the value specified in this field, this point is the response of the test.

And the third condition is "Max Point Number" meaning the test cannot be performed more than the number of points entered in this field and the last point is the response of the test.

But, if for any reasons, the nominal characteristic specified for the test is not available, you can use the "Ignore Nominal Characteristic" section. By doing so, the software ignores the current characteristic. Then, according to the steps entered in "Search Interval", shots are added to the "Search" line. For example, in "Search Test" section, a line is drawn. Then, 0.5 is entered in "Search Interval" and "Apply to all" is selected. You can see that points with this step are shot on the "Search" line. By performing the test, you can see that it starts from the lowest point and when one of the three mentioned conditions is met, the test gives a result. If necessary, it is possible to disable this option by selecting "Disable all."

In "Trigger" tab, you can select your intended binary to receive the "Pick up" signal ,cutting the injection of current and voltage. The explanation and settings of this section are the same as those for "Trigger" in "Sequencer" room .In "Binary Output" tab, if it is necessary for the relay to see the key condition, by using the "A" or "B" group voltages or "Aux DC" it is possible to take any needed voltage to the "Binary Input" of the relay through "Binary Output" of the device. This tab has three "PreFault", Fault" and "Post Fault" modes and you can specify the settings of each one separately.

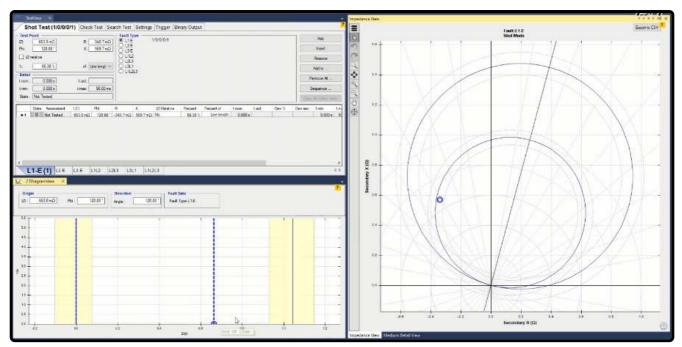
TestView	×					
Shot Test	Check Test	Search Test	Setting	Trigger	Binary Output	
Binary trigger Trigger Logic : C1:Start :		D 🖲 OR				
Trigger Logic I	Mir 0->1 : 1->0 0->1,1->0 X		0.000 s			

Sho	t Test Check	Test Sear	ch Test	Settings	Trigge	Bina	n Out	out
Prefau	it							
Out	Display Name	First State	1st ch.	2nd ch.	3rd ch.	4th ch.	Trigger	Toggle
	Bin. Out 1	1-	0.000 s	0.000 s	0.000 s	0.000 s	•	
iout!								
Out	Display Name Bin. Out 1	First State	1st ch.	2nd ch. 0.000 s	3rd ch. 0.000 s	4th ch. 0.000 s	Trigger •	Toggle
Out		0.0000	100100-02	100-00000000	22122112424	1.528 ** 9.785		Toggle
Out	Bin. Out 1	0.0000	100100-02	100-00000000	22122112424	1.528 ** 9.785		Toggle
Fault Out Postfa Out	Bin. Out 1	0.0000	1001000-02	100-00000000	221201034644	1.528 ** 9.785		Toggle

90 : INTRODUCING "DISTANCE" ROOM, PART 1

The relays impedance characteristic test is performed in "AMT Distance" room. The most important use of this room is to test distance relays and "Under Excitation". Distance relays and "Under Excitation" are used to protect the transmission lines and generators respectively. For example in this video two "Mho" zones are drawn which are displayed in "Impedance View" window. Distance room consists of 4 main windows including "Test View", "Impedance View", "Z-T Diagram" and "Medium Detail View". "Shot Test", "Check Test" and "Search Test" are performed in "Test-View" window. In "Impedance View" window the impedance characteristic of the relay is displayed according to the information entered in "Test Object" in

terms of "X" and "R" and based on "CT" and "PT" secondary values. This is why in this window the horizontal and vertical axes are named "Secondary R" and "Secondary X". To view the impedance characteristic based on the primary you can select "Primary Values" from the toolbar. In "Z-T Diagram" the time-impedance curve is displayed. If this window is open along with "Impedance View" and "Test View" windows, by adding a shot on the curve or selecting a point from the table, the location of that point is displayed on "ZT" curve. In "Medium Detail View" window the characteristics of the shot point and protective zones are displayed.



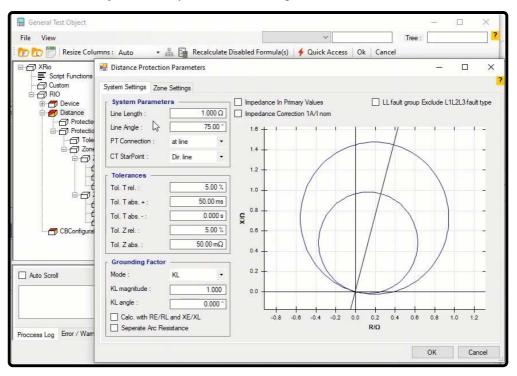
As mentioned before, to test the relay first it is necessary to enter its information in "Test Object" window. Information such as nominal information of the relay, serial number, operation location of the relay, "CT" and "PT" characteristics are entered in "Device" block. This section has been thoroughly explained in previous videos. But the main block in this room is "Distance" by double-clicking on which, the "Distance Protection Parameters" window opens. Two tabs of "System Settings" and "Zone Settings" where the settings is entered are available in this window.

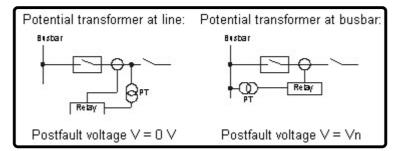
-	
f nom :	50.00 Hz
V nom(secondary) :	110.0 V(L-L)
	63.51 V(L-N)
V primary :	230.0 kV(L-L)
	132.8 kV(L-N)
I nom(secondary) :	1.000 A
] I primary : 😽	1.000 kA
Residual Voltage/Cur	rent Factors —
VLN/VN : [1.730
IN/I nom	1.000
Limits	
	132.0 V
] I max : [64.00 A
Debounce/Deglitch F	ilters
Debounce Time :	3.000 ms
Deglitch Time :	400.0 µs
	V primary : [I nom(secondary) : [I primary : [Primary : [Residual Voltage/Cur VLN/VN : [IN/I nom [Limits [V max : [I max : [Debounce/Deglitch F

"System Settings" Tab

The characteristics of the power system are entered in "System Settings" tab. In "System Parameters" section, the length of the line is entered in terms of ohm in "Line Length" field while the angle of the line is entered in "Line Angle" field. In "PT Connection" field, the installation method of the voltage transformer is selected from among "at line" and "at Busbar" states. The installation method of the (PT) Voltage transformer specifies whether the voltage exists in "PostFault" which

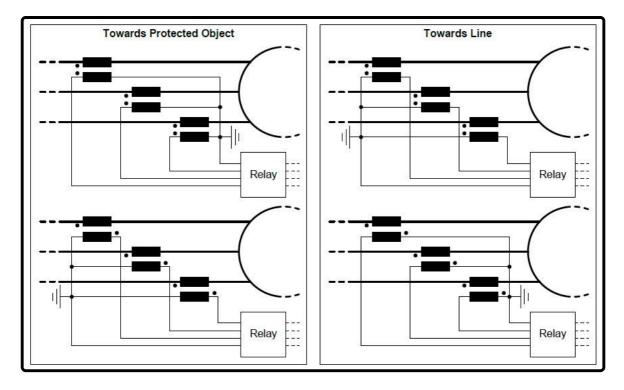
refers to the time after the fault. If "at Line" option is selected, after switching the circuit breaker, the input voltage line of the relay equals zero and the "AMT" device will not make any voltage into the relay in "PostFault". But by selecting "at Busbar" option, after switching the circuit breaker, the input voltage line of the relay keeps its nominal value and consequently, the "AMT" device injects the relay with nominal voltage in "PostFault".





In "CT StarPoint" field, the direction of the connection is selected from among "Dir. Line" and "Dir.Busbar" states. If the connection is "Dr. Line", the current flows from device to the relay. If the relay connection is "Dir. Busbar", it is only enough that the current angle is changed as much as 180 degrees.

System Settings	Zone S	ettings	
System Para	meters		
Line Length :	[1.000 Ω
Line Angle :	[75.00 °
PT Connection	1: 4	at line	•
CT StarPoint :	1	Dir. line	•
То		Dir. line Dir. busbar	
	1		F 00 0



Then, in "Tolerance" section, time and impedance tolerances are specified. In this field, first the time tolerances are entered in terms of percentage and time in "Tol.T rel" and "Tol.T abs" respectively. Then impedance tolerances are entered in "Tol.Z rel" and "Tol.Z abs" fields in terms of percentage and ohm respectively.

Tol. T rel. : 🖌 🛛	5.00 %
Tol. T abs. + :	50.00 ms
Tol. T abs :	0.000 s
Tol. Z rel. :	5.00 %
Tol. Z abs. :	50.00 mΩ

"Grounding Factor" Section:

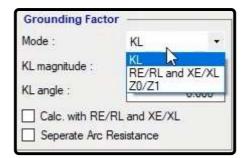
In this section, the grounding factor for phase-to-ground fault is specified. In phase-to-ground faults, specifying this number in accordance with the relay algorithm is so important. If this factor is wrong, the calculations of the phase-to-ground fault will be wrong as well. So, one of the methods mentioned is this section should be selected in accordance with the algorithm used by the relay to calculate the single phase-to-ground fault. The output voltage and current fault of the device will change in accordance with the selected checkbox in the "Mode" field. Any of these options should be selected considering the type of the relay being tested. The used algorithms can be divided into three groups of "Type A", "Type B" and "Type C" in accordance with the different types of relays and algorithms used to calculate the fault impedance. If none of the checkboxes is selected, "Type A" is selected by default. If you do not know the type of algorithm being used by the relay you are testing, it is better to use trial and error method.

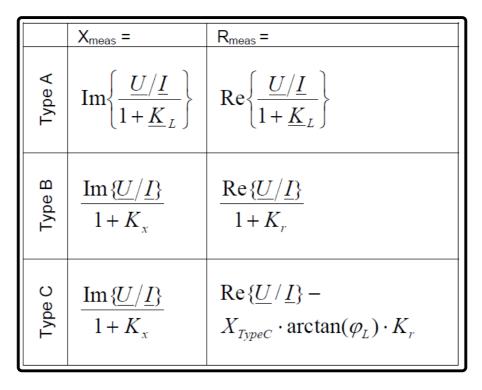
•
1.000
0.000 *

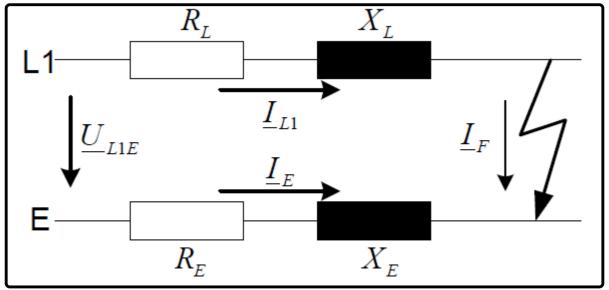
"Mode" Field

There are various modes to enter the grounding factor values in this section. It is only necessary to select a mode and enter the values accordingly. By entering the grounding factor in this section, the software calculates the impedance for

phase-to-ground fault. If in the relay being tested, the grounding factor is indicated by "KL", the "KL" value should be entered in "KL Magnitude" cell and its angle should be entered in "KL Angle" cell. But if the grounding factor is indicated by "RE/RL" and "XE/XL", you can select this mode and enter the required values in "RE/RL" and "XE/XL" fields. "RE" and "XE" stand for true and imaginary values of the ground impedance from to the relay location to the fault and "RL" and "XL" stand for the true and imaginary values of line impedance from the relay location to the fault. If in the relay being tested the ground factor values is indicated by "Z0/Z1", you can select this mode and enter the "Z0/Z1" value and its angle in "Z0/Z1 Magnitude" and "Z0/Z1 Angle" fields respectively. "Z0" indicates the zero sequence impedance while "Z1" is indicator of the positive sequence impedance of the faulty line.







"Calc. With RE/RL and XE/XL" Option

If this option is checked, "Type B" formulae are used to calculate the ground factor and its effect on the current and voltage produced by the device. In these relays, to calculate the impedance in phase-to-ground fault, "Kr" and "Kx" factors are used which are "Kr=RE/RL" and "Kx=XE/XL".

Mode : Z	0/Z1 🗸
Z0/Z1 magnitude :	4.000
Z0/Z1 angle :	0.000 *
Calc. with RE/RL ar	

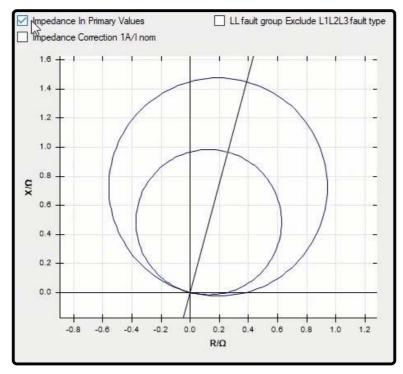
"Separate Arc Resistance" Option

Mode :	Z0/Z1 ·
Z0/Z1 magnitude :	4.000
Z0/Z1 angle :	0.000 *

"Impedance in Primary Values" Option

In some relays, the characteristic is based on the primary values. But since it is necessary to enter the characteristics in the

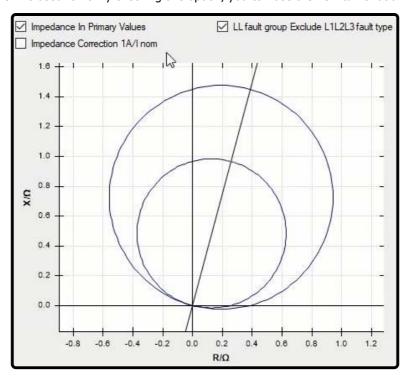
software based on secondary values so that the device can apply the voltage and current in accordance with the relay characteristic, you should enter the primary values in the software and check "Impedance in Primary Values" option. By doing so, the values are multiplied by the turns ratio of current and voltage transformers.



"LL Fault Group Exclude L1L2L3 Fault Type" Option

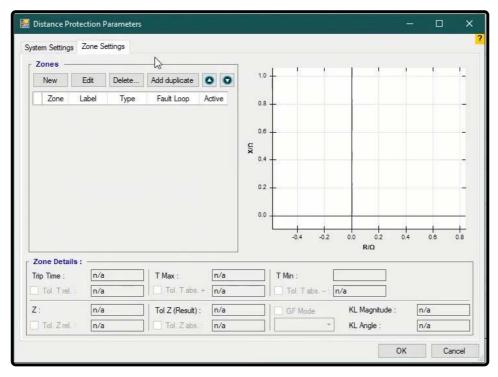
This option is used to separate two-phase fault from three-phase fault. Generally, because of "Grounding Factor" in relays, there is difference between the characteristic curves of "L-E" and "LL" faults. But it is possible that in some relays there is also difference between two-phase and three-phase faults in which case, this option should be used. By checking this option, it is necessary to specify the three-phase fault zones in "Fault Loop" column. More explanation on this section will

be provided in future videos. "Impedance Correction 1A/1nom" option is used when the relay's "CT" is "5 amps" but in the calculations a "1 amp" "CT" is used for it. By checking this option, you can use the new turns ratio.



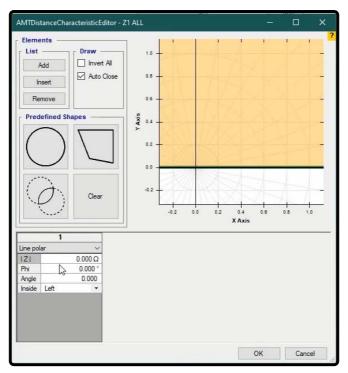
91 : INTRODUCING "DISTANCE" ROOM, PART 2

In "Zone Setting" tab and in "Zones" section, the information is entered to each "Zone". By using the "New" option, it is possible to add a row or "Zone" to the table of this section and to repeat a zone, delete a zone or enter the characteristics of each "Zone" you can use "Add Duplicate", "Delete" and "Edit" options respectively.

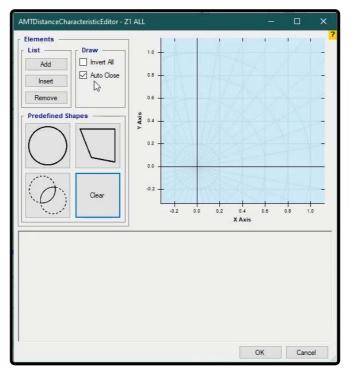


To enter the characteristics of a "Zone", by clicking on "Add" add one or several rows and specify your zone. Using this table, you can draw the desired characteristics. For polygon characteristics you need to use several "Lines" and enter the characteristics of each of the sides. For each line, "R", "X", "Angle (angle of the line)" and "Inside (the inside area)" should be specified which includes "Left" for the area of the left side (and above the line for horizontal lines) and "Right" (and below the line for horizontal lines). In using "Line polar", the line characteristics are specified with its impedance magnitude and angle which means "Z" and "Phi". If you wish to draw radial characteristics, you need to use "Arc". In "Arc" mode, you need to enter the center of the circle, the radius of the circle, the start angle of the curve and the end angle of the curve in "R" and "X", "Radius", "Start angle" and "End angle" respectively. Moreover, you can select the rotation direction of the

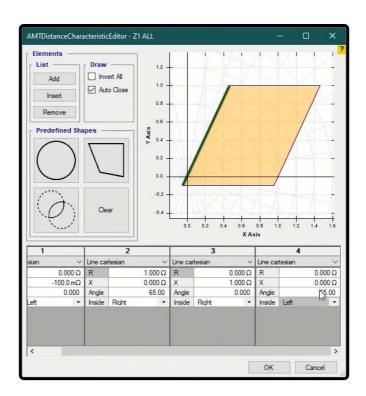
curve from among "Clockwise" and "Counter clockwise" options. If you are using "Arc Polar", instead of "R" and "X", you need to enter impedance and angle.



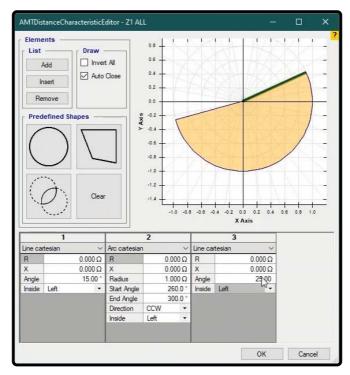
As an example, we are going to show you how to draw a "Quad" characteristic and in future videos we will provide you with explanations for other characteristics. Before starting to design the zones, it is important to note that intersection of successive lines with each other, meaning the intersection of the first and second lines, second and third lines, and third and fourth lines so one. make the zone. Finally, if you check "Auto Close" option, the intersections of the first and last lines will be considered as well and the zone will close automatically.



To begin an element, "Add" "Line Cartesian" and set its "R" and "X" at "0" and "-0.1" respectively with a "0" angle. By adding the next line, the intersection point of these two lines determines the zone area. "R" and "X" of the second line are "1" and "0" with a "65" angle. Since "Left" has been selected, the inside area of the left side is selected. By selecting "Right", you can see that the right side of the line from the intersection point is considered as a part of the zone. To specify the line above the characteristic, a line with "0" as "R" and "1" as "X" with a "0" angle and "Right" (to select below the line) is entered. In the final step, a line with "65" as its angle and "-1" and "0" as its "R" and "X" are entered.



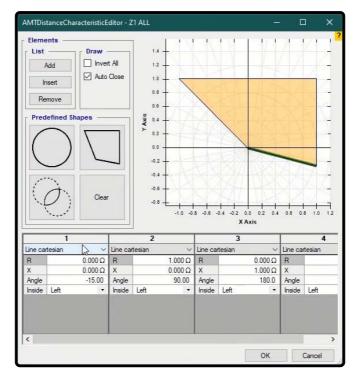
As another example, if you wish to make a radial zone, you need to use "Arc Cartesian". If you just want to make a circular zone with a specified center and radius, you need to enter the center of the circle and its radius in "R" and "X" and "Radius" fields respectively. Here, as an example, "1", "0" and "1" are entered as the center and radius. "Start Angle", "End Angle" and "Direction" fields have no effect in this mode. In "Inside" field, by selecting "Left" or "Right" you can select inside or outside the circle as the zone respectively. If you wish to specify a part of the circle as the zone, first you need to specify a line and then a circle. If you enter "15" degrees as the angle of the first line, and set the rotation direction of the circle at "Counter Clockwise", the software starts moving in counter clockwise direction and picks the first intersection of the line and the circle which is close to the "Start Angle" as the start angle and picks another intersection which is close to the "End Angle" and the end angle. To complement the explanation, another line is added. This line determines the end angle and the first line of the start angle. Like before, the rule is that the intersection which is close to the "End Angle" is considered as the end angle. For example, "25" degrees is entered. According to the provided explanations, if you wish to select a part of the circle as the zone, you need to specify the circular element between the two line where the first line is the start angle and the second line is the end angle.



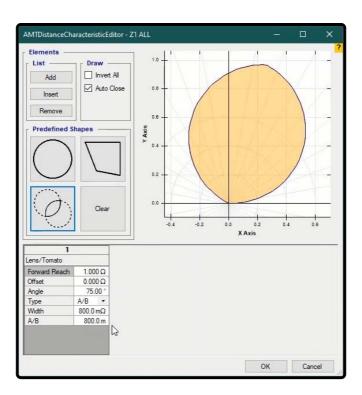
92 : INTRODUCING "DISTANCE" ROOM, PART 3

To simplify drawing the zones you can use "Predefined Shapes". In this section, some patterns are predefined for three types of characteristics. Circle is used to draw "MHO" characteristic curves. In "Forward Reach" field, the maximum forward

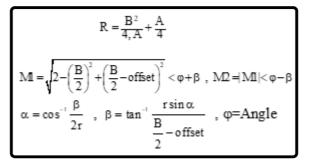
protective area is specified which is in "R" positive direction. If the characteristic is in a way that covers a part of the back of the relay, by using the "Offset" field, you can apply this item as well. About the mentioned subject, note that applying offset does not cause "Forward Reach" to change. Moreover, it is also possible to apply negative offset, which causes the <u>characteristic to distance from the origin of the coordinates</u>. By entering the angle in the "Angle" field, the center of the circle moves in counter clockwise direction as much as the value mentioned in this field. For example, if "5" and "1" are entered as "Forward Reach" and "Offset" respectively, in "0" degree you can see that "R=-1 to "R=5" is the area that is covered. Now, if "45" is entered as the angle, you see that the center of the circle rotates as much as "45" degrees. In this case, the radius and center of the circle can be obtained using "r=(forward Reach + Offset)/2"And "M=(forward Reach + Offset)/2"formula respectively. "Polygon" characteristic are made of four line Cartesians. To change any of the sides, first you need to select the intended line and enter the characteristics. Explanations for this matter are the same as the explanations provided for line Cartesian.

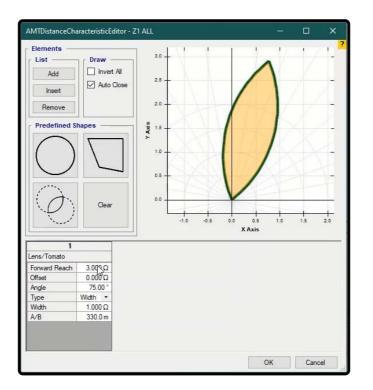


The last characteristic is "Lens/Tomato". The use of "Forward Reach", "Offset" and "Angle" fields is the same as "MHO" characteristic. Parameters "A" and "B" stand for "Width" and "Forward Reach" respectively and in "A/B" field the proportion of these two is entered. If "A/B" is bigger than "1", smaller than "1" or equalls "1", the characteristic will be in tomato form, lens form and MHO form respectively. If "A/B" is selected in the "Type" field, by changing the "Forward Reach", the proportion of "A/B" remains the same and the "Width" changes. For example you can see that if "A/B" equals "0.5", by changing "Forward Reach" the value of "Width" changes. However, if "Width" is selected as "Type", by changing "Forward Reach", you see that the "Width" remains the same and "A/B" changes.



Practically this characteristic curve is made of "2" circles and the radius of these circles is shown as the "R" formula, the center of the first circle is shown as "M1", and the center of the second circle is in the form of "M2" where " α ", " β " and " ϕ " are as illustrated.

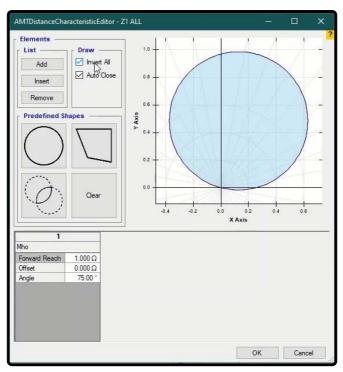




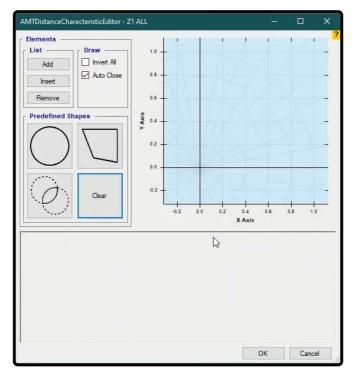
In the end, some points about this section is mentioned:

By selecting any element, any information entered earlier will be deleted.

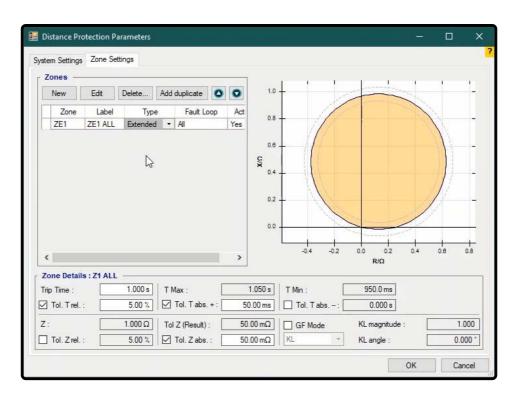
By checking "Invert all" option, the selected area inverses. This means that if this option is checked and "1" second is entered as the trip time, on the test page you can see that inside the curve is "NO TRIP" while outside the curve is "Tripping" area.



By clicking on "Clear" on this page, all information will be deleted.



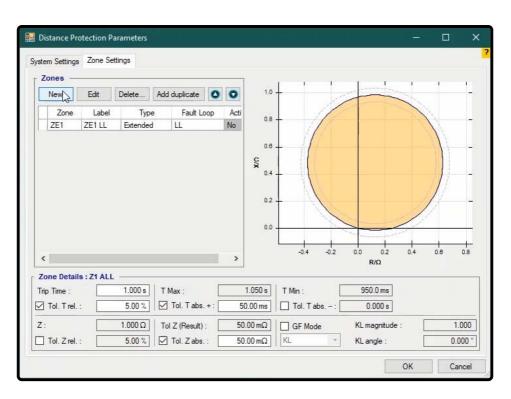
After specifying the zone, the type of the zone should be specified in "Type" field. If "Tripping" is selected, its trip time and time and impedance tolerances should be entered in "Zone Details" and for changing any tolerance, its checkbox should be checked and then the changes can be made. Generally, starting zones are very big, which contain tripping zones, and the condition which the relay performs a trip is that the fault impedance is located not only in the tripping area but also inside the starting area. "Extended" zones are those that are activated by receiving a specific signal from the network and usually cause the zone cover a bigger part of the line.



In "Fault Loop" field you can specify the type of faults that the defined zone can be used for. To specify that a zone is to be used only for two-phase faults you need to select "LL" in "Fault Loop" field and check "LL Fault Group Exclude L1L2L3 fault Type" in "System Setting". You can use "Active" column to activate or deactivate a zone.

ystem Settings	Zone Set	tings								
Zones	Edit	Delete	Add duplicate	0	1.0	+		1	1	1_
Zone	Label	Туре	Fault Loop	Act	0.8			1		
ZE1	ZE1 ALL	Extended	All	Yes	0.8	1 //		1	1	1
					0.6	- //			11	
			LL L1N		UX					
			L2N L3N		0.4	+			11	
			L1-L2 L2-L3		0.2				11	
			L3-L1 L1-L2-L3		0.2			/	2	Ĩ
			- HERITAGE		0.0			1		_
						-0.4 -0.2	0.0 0.2	0.4	0.6	1
<				>		-0.4 -0.2	0.0 0.2 R/Ω	0.4	0.0	0.8
Zone Details	: Z1 ALL	-					C. 1899			
Trip Time :		1.000 s	T Max :		1.050 s	T Min :	950.0 ms			
☐ Tol. T rel. :		5.00 %	☑ Tol. T abs. + : [5	0.00 ms	🔲 Tol. T abs :	0.000 s			
Z :		1.000 Ω	Tol Z (Result) :	50	.00 mΩ	GF Mode	KL magnitude :		1.	.000
		5.00 %	Tol. Z abs. :	50	Ωm 00.	KL *	KL angle :		0.0	000

"Up" and "Down" options at the top of the table are used to move the defined zones. At the bottom of the page there is a box including grounding factor by which makes it possible to specify a different single-phase grounding factor for each zone. However, this section is in progress and is not ready for use yet.



93 : INTRODUCING "TEST VIEW" WINDOW IN "DISTANCE" ROOM, PART I

As mentioned before, one of the windows of "Distance" room is "Test View". This window consists of 6 tabs of "Shot Test", "Check Test", "Search Test", "Setting", "Trigger" and "Binary Output". In "Shot Test" tab, it is possible to specify fault type and test point and after performing the test, you can view the results of the evaluation. In "Test Point" section in this tab, the test point can be specified using two methods: first, the impedance magnitude is entered in "IZI" field in terms of ohm and in "Phi" field the impedance angle is entered in terms of degree. Then, by clicking on "Add" the values are entered and the software displays the real and imaginary values of this impedance in "R" and "X" fields respectively. In the second method, it is possible to directly enter the real and imaginary values in "R" and "X" fields and by selecting "Add" select your intended point. If you wish to enter your test points in terms of a percentage of length of the line, you should use "%" field.

Tes	tView	×													
Sh	ot Te	est (2/0/0/0	/2) Check	k Test Sea	arch Test	Settings	Trigger	Binary Output							?
Test P [Z]: Phi: [] IZI n %: Detail t nom.: t min: State:	elative	50.00 % 0.00 ms 3.50 ms	R: [X:] of: [t act: [t max:]	300.0 mΩ 400.0 mΩ ine lengt ∨ 80.00 ms	Fault Ty © L1-E O L2-E O L3-E O L1L2 O L2L3 O L3L1 O L1L2	2	/0/0/2						5	Insert Remove Add to emove All fequence	
	State	Assessment	Z	Phi	R	x	Z Relativ	e Percent	Percent of	t nom.	t act.	Dev.%	Dev.sec	All Failed Ter	t m.
1 ▶2		Not Tested Not Tested	500.0 mΩ 500.0 mΩ	65.00 ° 53.13 °	211.3 mΩ 300.0 mΩ	453.2 mΩ 400.0 mΩ	No	50.00 %	Line length	30.00 ms 30.00 ms	- uot.		207.300	28.50 ms 28.50 ms	80 80

By checking "Z Relative" option, the test point is made dependent on the length of the line and recorded in the table. By changing the length of the line from 1 to 3 ohms, in "Test Object" section, in "Distance Parameters" window in "System Settings", the entered impedance value is changed in accordance with the length of the line. But, if this option is not checked, by changing the length of the line, the entered values in the table do not change. In fact, each test point consists of three "States" which simulate "Prefault", "Fault" and "Post Fault" states. By default, in "Prefault", "Fault" and "Post Fault", nominal voltage and ocurrent, 0 voltage and current and voltage and a current based on the test point are injected respectively. To change "Prefault" and "Post Fault" states you should use "Setting" tab and "Time" section. More explanation about this section will be provided in "Setting" videos. Just note that if PT connection is wired, as at busbar, in "Post Fault" the zero current and nominal voltage will be available.

TestView X	H			-						
Shot Test (2/0/0/0/2) Check Test Sea	arch Test Settings	Trigger Bi	nary Output							?
Test Point [Ζ]: 500.0 mΩ B: 300.0 mΩ	E L1-E	2/0/0/0/2							Add	
Phi: 53.13 ° X: 400.0 mΩ	O L2-E O L3-E								Insert	
	O L1L2 O L2L3								Remove	
%: 50.00 % of: Line lengt ✓	O L3L1 O L1L2L3								Add to	
t nom.: 30.00 ms t act:								F	emove All	
t min: 28.50 ms t max: 80.00 ms									iequence	
State: Not Tested								Clea	All Failed T	esto
	R X	Z Relative	Percent	Percent of	t nom.	t act.	Dev.%	Dev.sec	t min	tm
	211.3 mΩ 453.2 mΩ 300.0 mΩ 400.0 mΩ		16.67 % 16.67 %	Line length Line length	30.00 ms 30.00 ms				28.50 ms 28.50 ms	
L1-E (2). L2-E . L3-E . L1L2 . L2 W SignalView ×	L3 L3L1 L1L1	2L3 .			_					> 4 Þ
Signal View 💮 Setting Test State: Not Tested								Exp	ort Comtrade	?
Cursor 1										
S1: Pr <mark>e</mark> fault							S3: Po	st Fault		
	S2: Fat									
	2-E: V L2-E	- TVL3-E: VC	3-E							^
€ 50						daar		d .		
66 in the contract of the cont										t/

The Fault Type is specified in "Fault Type" section. These Faults include phase to ground, two-phase and three-phase faults. Before specifying the fault type and fault current, it is necessary to select the test model from among Constance test current, Constance test voltage and Constance source impedance. In Constance test current model the injection current is fixed and the voltage changes in accordance with the test impedance. In Constance test voltage model, the test voltage is fixed and the fault current changes in accordance with the test impedance. In Constance source impedance method, the source impedance includes the impedance from the origin to fault plus the impedance of ground to the fault point, angle and the grounding factor.

Shot Test (2/0/0/0/2) Check Test S	earch Test Settings Trigger Binary Outp					
Fault	Time					
Test Model - LL Same as LE	Prefault Time 1.000 s					
Constant test current	Ramp in Prefault					
Constant test current	- Max Fault Time					
Constant test voltage	Max Fault Time (Abs) 2.000 s					
Constant Source imp.	Max Fault Time (Rel)					
Maximum Fault Impedance						
L-E 15.88 Ω						
L-L 27.50 Ω L-L-L 31.75 Ω						
	PostFault Time 500.0 ms					
Allow Reduction of ITest	Delay after trigger 50.00 ms					
	Time Reference :					
Fault Inception	Fault Inception Starting					
Model : Fixed angle 🗸	Load Current (Prefault Current)					
Angle : 0.00 *	Amplitude Phase (∠V, I)					
	Based On Current Based On Degree					
	O Based On Ifault O Same as Fault Angle					
Voltage Output	0.000 A 0.00°					
Enable Voltage Output (VB)	Search Setting					
Amplitude 63.51 V	Relative 1.00 %					
Phase 0.00 *	Absolute 50.00 mQ					
	Max Point Number 12 point					
	r Ignore Nominal Characteristics					
	Search Interval: 200.0 mΩ Apoly To All					
	Disable All					
	Other Settings					
	Extended Zones Active Shot Passed Only Act In Main Zone					
	Test Passed Only Act In Zones					
	Passed Settings					
	Pass if get any trip					

By selecting "Add", the selected test point is added to the table in this window. By selecting any of the rows and clicking on "Insert" option, the selected row is repeated in the table and by clicking on "Remove", the selected point is removed. By selecting "Add to" option, it is possible to copy the point or points selected for one of the "Fault Types" to another "Fault Type". By selecting "Remove All" option, it is possible to remove all of the test points added to the table. By clicking on "Sequence" option, "Sequence Test Points To" page opens where it is possible to create test points with equal steps. By selecting "Angle" in "Step On" field in "Step" section, the angular steps are directly entered in terms of degrees.

Sh	ot T	est (7/0/0/0/7)	Check	Test Se	arch Test	Settings	Trigger	Binary Output							1
Test F	Sector Sector	0.0 mΩ	R:	211.3 mΩ	E L1-E		/0/0/0/4							Add	
Phi:	-	65.00 °	X:	453.2 mΩ	O L2-E	1	/0/0/0/1							Insert	
🗌 IZI	relative				O L1L2	1	/0/0/0/1							Remove	
%:		16.67 %	of: Li	ne lengt 🗸	O L3L1		/0/0/0/1							Add to	
Detail t nom.:	-	0.00 ms	t act:		1								R	lemove All	
t min:	2	8.50 ms	t max:	80.00 ms]								9	Sequence	
State:	Not T	ested											Öéa	All Failed Ter	
	State	Assessment	ZI	Phi	R	x	Z Relativ	e Percent	Percent of	t nom.	t act.	Dev.%	Dev.sec	t min	t m
1	0	Not Tested 5	00.0 mΩ	65.00 °	211.3 mΩ	453.2 mΩ	No	16.67 %	Line lenath	30.00 ms				28.50 ms	8
2		Not Tested 5	Ωm 0.000	53.13 °	300.0 mΩ	400.0 mΩ	No	16.67 %	Line lenath	30.00 ms				28.50 ms	8
3	0	Not Tested 5	Ωm 0.000	53.13 *	300.0 mΩ	400.0 mΩ	No	50.00 %	Line lenath	30.00 ms				28.50 ms	8
▶4		Not Tested	00.0 mΩ	65.00 °	211.3 mΩ	453.2 mΩ	No	16.67 %	Line length	30.00 ms				28.50 ms	15

This means that the test points are specified according to the "Origin" point entered in "Origin" section in a way that the required angles resulted in proportion to the horizon. For example if the start and end angles equal "45" and "90" degrees with "5" degrees as their steps and the origin points are entered for "Z" and "Phi" or "R" and "X", after selecting "5" ohms as impedance and "36" degrees as the origin and by applying this settings, you can see that multiple points are added on the "Impedance View". For example the last point is selected; you can see that the resulted angle is "85" degrees not "90" degrees. This happens because the "Origin" point is also considered as one of the points.

Fault Types	OK
Je ✓ L1-E ✓ L2-E	Cancel
65.00°	
65.00° ⊻ L1-L2	
0.00*	
1 ☑ L1-L2-L3	
211.3 mΩ 453.2 mΩ	
Ali	
e length V	
	jle ✓ L2-E 65.00° □ L3-E 0.00° □ L2-L3 1 ✓ L1-L2 1 ✓ L1-L2-L3 211.3 mΩ

But by selecting "Direction", an "angle" is specified in "Angle" field where from the "Origin" point with the length entered in "Length" field and with steps specified in "Step Size", some points are shot on the characteristic curve. Note that the length and the steps of the points are in terms of ohm. For example if the angle is "45" degrees, the length is "5", the step size is "0.5" ohm and the origin point is "0" ohm, by applying this settings you can see that some points are created in "45" degrees with "0" origin in "Impedance View". Note that in both states of "Angle" and "Direction", it is possible to make the origin dependent on the length of the line and specify it in form of a percentage of it in "Z Relative" section.

tep		Fault Types	ОК
Step On:	Direction ~	∠L1-E L2-E	Cancel
Angle :	45.00 °	L3-E	1
Length :	5.000 Ω	🗆 L1-L2	
Step Size:	500.0 mΩ	L2-L3	
Number of steps:	11	L1-L2-L3	
oint			
Origin Ζ: <u>0.000 Ω</u>	R: Ν 0.000Ω		
Phi: 0.00°	10 ²		
171 Ballation			
Z Relative		IIA 🗌	
<pre>k: 0.00%]</pre>	of : Line length 🗸		
· · · · · · · · · · · · · · · · · · ·			

If the performed test has "Failed" points, by selecting "Clear All Failed Tests" option, it is possible to clear the results of all these points. In "Detail" section, the information related to "Trip" nominal time, the allowed operation time range, actual time and test point evaluation are entered in "T nom", "T min" "T max", "T act" and "State" fields respectively. The test points are entered with detail in the table at the bottom of the page. The details include test evaluation, test current, nominal time, operation time, fault value in terms of percent and seconds and the minimum and maximum operation time. Also, if you wish to add a comment about any of the test points, you can use the "User Comment" cell. At the bottom of this page, it is possible to select test points table from different "Fault Types". To test, a point is shot in "L1-E" "Fault Type". By using "Add to" option, this point is also added to "L1L2" and "L1L2L3" "Fault Types". Note that if "L1-E" option remains checked, the point added for the "L1-E" "Fault Type" will be repeated in this "Fault Type". Then, open the "Signal View" window and run the test. You can see how the voltage and current signals are injected for every test point. After testing each point, its evaluation is recorded in the table as well as the "Impedance View".

TestView × Shot Test (3/0/0/3) Check Test Sea	arch Test Setting	s Trigger Binary Output				
Test Point	Fault Type	1/0/0/0/1	107			Add
2: 1.033Ω R: 563.0mΩ	0 L24E 0 L24E 0 L34E	170M04071			-	
h: 56.59 X: 866.4πΩ	O LIL2	1/0/0/0/1				inset
	0.00	1/0/0/0/1				Remove
at: Line lengt ~	0 131	1/0/0/0/1				Add to
etali non : 30.00 mi tect .						Renove Al
min 28.50 ma 1 max 80.00 mar					1	Second
kate: Not Tested						
	11		112/11/05/11/07/0			
X (2) Relative Percent • 1 3.0 nG 895.4 nG No 34.44 %	Percent of through the terror to the terror	on, tact. Dev.% 100 ms	Devised timin	t max 11es 90.00 ms 2.		User Comment

94 : "CHECK TEST" TAB

After performing "Shot Test" in "Distance" room, it is time to do "Check Test" and "Search Test". In "Check Test" the upper and lower tolerances of the relay which are displayed as dotted line in "Impedance View" are tested and evaluated. To

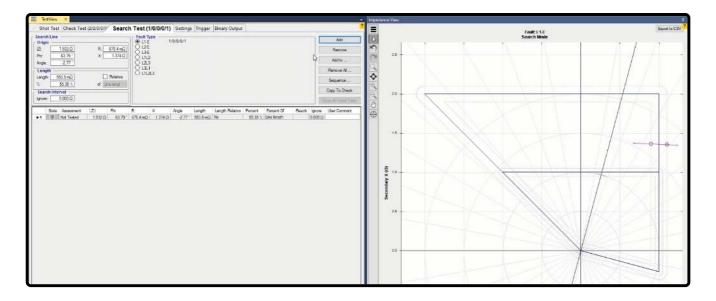
perform a "Check Test", first it is necessary to draw lines named "Check Line" in different parts of the diagram. To draw this line first from "Check Line" section, the origin point of this line is specified in "Origin". In "|Z|" field the test impedance value is entered as a number. Note that if a negative number , for example -2.5 is entered, since there is no negative impedance, this negative value will influence the angle; this means that it will be subtracted from 180 degrees angle in "Phi" field. The impedance angle is entered within the range of -180 to 180 in "Phi" field and if in this cell a number higher than this range is entered, automatically that number will be displayed in the specified range. For example if 455 degrees is entered in this field, 95 degrees will be displayed.

TestView X		. ž
Shot Test Check Test Search Test Se	ettings Trigger Binary Output	?
Check Line	Fault Type	Add
IZI: 2.500 Ω R: -2.500 Ω	0 L2-E 0 L3-E	Renove
Phi: -180.00 ° X: 0.000 Ω Angle s 0.00 °	O L1L2 O L2L3	Add to
Check Line Origin Z : 2.500 Ω Phi: -180.00* Angle ∞ 0.00* Length 0.000 Ω %: 0.00 % of: Line lengt ∨	O L3L1 O L1L2L3	Remove All
Length: 0.000 Ω Relative %: 0.00 % of: Line lengt ∨		Sequence
		Copy To Search
		Clear All Failed Tests

In addition to using |Z| &" Phi" filed, you can specify origin impedance using "R" &" X" fields. "R" &" X" are real and imaginary of impedance. In fact the four fields of "|Z|", "Phi", "R" and "X" are linked and by changing the value of one of them, the others change accordingly. In "Angle" field the angle of the "Check Line" and In the cell of the "Length" section the length of the "Check Line" is entered. In "%" field it is possible to specify the length of "Check Line" in terms of a percentage of the length specified in "Test Object" by default. By enabling the "Relative" option, you can make the length of the line dependent on the parameter specified in "of" field. The value of the parameter specified in "of" field is multiplied by the value of the "%" field and the length of the line is formed. If "Relative" is checked, by changing the value of the "of" parameter, the value of the "%" cell does not change and the new value of the "Length" is calculated. If "Relative" checkbox is not enabled and the value of "of" parameter is changed, the value of "Length" field remains fixed and the value of the "%" changes. Note that the drawn "Check Lines" need to have an intersection with at least one of the tolerance lines of the characteristic curve. Then, click on "Add" option so that the "Check Line" is added to the "Check Test" lines table.

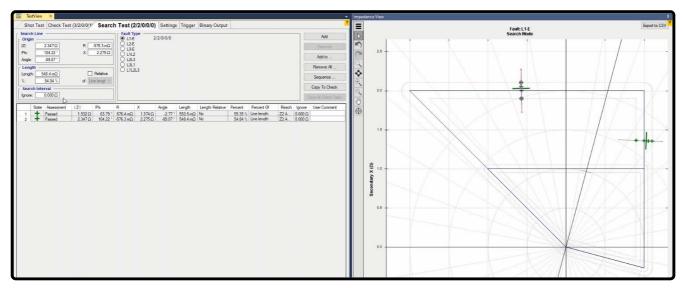
	ot Tes	Check T	est (1/0/0	0/0/1) Se		Le cost de E	Trigger	Binary Ou	tput				
heck: Origin	Line n —				Fault Ty		1/0/0/0/1						Add
ZI:		2.500 Ω	R:	-217.9 mΩ	0 L2-E								Remove
Phi: Angle:	-	95.00 *	X:	2.490 Ω	O L1L2 O L2L3								Add to
Leng					O L3L1 O L1L2						N		Remove All
Length %:	1	1.000 Ω 00.00 %		Relative ne lengt ~		20					\square		Sequence
re.		00.00 **]	01. [1	ic longe									Copy To Search
													Clear All Falled Test
	State	Assessment	Z	Phi	R	x	Angle	Length	Length Relative	Percent	Percent Of	User Comment	
1	0	Not Tested	2.500 Ω	95.00 °	-217.9 mΩ	2.490 Ω	-90.00 °	1.000 Ω	No	100.00 %	Line length		

Another method for drawing the "Check Line" is to hold down the left-click and "Ctrl" key on "Impedance View" window and then move the cursor in the desired direction on the characteristic curve. You can see that the information of the drawn "Check Line" is displayed in "Check Test" lines table. After drawing the "Check Line", the software evaluates the crossing place of "Check Line" and tolerance lines as "Shot" test in accordance with the performance of the relay. Here, after performing the test, the relay does not perform in upper tolerance and performs a trip in the lower tolerance so the result of the test is "Passed". Other parts of this section such as "Fault Type" and "Remove All" and "Sequence" etc. options are the same at those of "Shot Test" section which have been explained in previous videos. The only additional option in this section is "Copy to Search". By marking any of the test lines and selecting this option, it is possible to copy the selected line in "Search Test" and by selecting "Add" option in "Search Test", add this line to the "Search Test" test lines table.

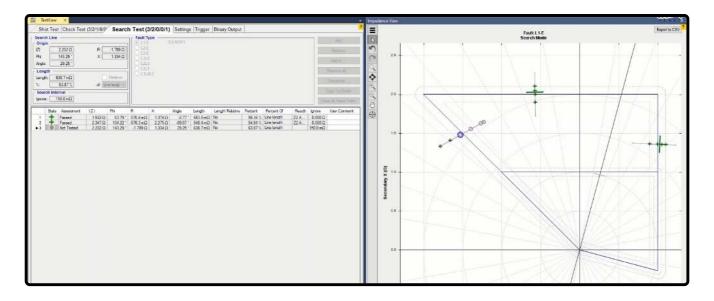


95 : "SEARCH TEST" TAB

After performing "Shot Test" and "Check Test" in "Distance" room, it is time to do "Search Test". The purpose of this test is to find the Exact location of characteristic curve line .To perform a "Search Test", first it is necessary to draw lines named "Search Line" in different parts of the diagram which is the same as the method explained for "Check Line". And all of mentioned notes for check line is true for search line too. After drawing the "Search Line", the software evaluates the crossing place of "Search Line" and tolerance lines as "Shot" test in accordance with the performance of the relay. By performing the test, the software interpolates the characteristic curve by testing some points on the search line to find the exact location of the characteristic curve. Other parts of this section such as "Fault Type" and "Remove All" and "Sequence" etc. options are the same at those of "Shot Test" section which have been explained in previous videos. The ignore field in the "Search Interval" is used when defined characteristic curve is not considered for the search line.



By entering a number in this section, some points are added on the "Search" line with the entered number as their distance. For example, by entering " $150m\Omega$ " in this field, you can see that there are points added on the "Search Line" with as much as "150m" of distance. If the test is performed, the points added on the "Search Line" are tested one after the other so that the exact location of the relay is specified. This option is used when there is no characteristic curve for the test or the current characteristics seem to be wrong. If you want to do this for all drawn test lines, you can use the "Setting" tab in "Ignore Nominal Characteristic" section. To do so, by entering the value of "Search Interval" and selecting "Apply to all" option, you can apply this settings to all test lines and find the relay characteristic.



96 : "DISTANCE" ROOM SETTINGS, PART I

In "Settings" tab it is possible for you to manage settings related to "Shot Test", "Check Test" and "Search Test". In "Fault" section, the method of the test is specified. In addition to the test method, the amount of current or voltage of the test is specified as well. Generally, there are three methods to calculate the test current and voltage and all of these methods are available in the drop-down list in "Test Model". The first method is "Constant test current". After specifying the fault impedance, the test voltage can be easily calculated in a fixed current. Some of the parameters are set in accordance with the option selected in this field about which more be discussed later.

TestView ×	
Shot Test Check Test Search Test	Settings Trigger Binary Output
Fault	ſ Time
Test Model - LL Same as LE	Prefault Time 1.000 s
Constant test current ~	Ramp in Prefault
Constant test current Constant test voltage	Max Fault Time
Constant test voltage Constant Source imp.	Max Fault Time (Abs) 2.000 s
Maximum Fault Impedance	Max Fault Time (Rel)
L-Ε 15.88 Ω	
L-L 27.50 Ω	
L-L-L 31.75 Ω	
	PostFault Time 500.0 ms
Allow Reduction of ITest	Delay after trigger 50.00 ms
Fault Inception	Time Reference : Fault Inception Starting
Model : Fixed angle V	Load Current (Prefault Current)
Angle : 0.00 *	Amplitude Phase (z V, I)
DC-offset	Based On Current Based On Degree
	O Based On Ifault O Same as Fault Angle
Voltage Output	0.00 A 0.00 *
Amplitude 63.51 V	search Setting
Phase 0.00°	Relative 1.00 %
0.00	Absolute 50.00 mΩ
	Max Point Number 12 point
	Ignore Nominal Characteristics
	Search Interval: 200.0 mΩ Apply To All
	Disable All
	Other Settings
	Shot Passed Only Act In Main Zone
	Test Passed Only Act In Zones
	Passed Settings
	Pass if get any trip

The amount of test current is specified in "I Test" field. As you can see this cell is in Purple which means that its value is

dependent on a parameter in "Test Object" and is calculated using the relation defined for it. By right-clicking on this option and selecting "Link to XRio" you can see that the amount of test current is resulted from multiplying the nominal current by 2. You are allowed to change this number to any desired value. By manually changing this value, the cell turns pink (if "XRio" file is loaded) which means that the formula of calculating the test current is disabled. You can also enter the test current value manually by right-clicking on this cell and selecting "Remove Link" option.

TestView × Shot Test Check Test Search Test	Settings Trigger Binary Output
Fault Fault Test Model LL Same as LE Constant test current Test 2000.6 Maximum Fault Impedance	Time 1.000 s Prefault Time 1.000 s Max Fault Time 2.000 s Max Fault Time (Rel) 2.000 s
L-E 15.88.0 L-L 27.50.0 L-L-L 31.75.0 Allow Reduction of ITest	PostFault Time 500.0 ms Delay after trigger 50.00 ms Time Reference :
L Date Verage Verage Verage 63.51 V Phase 0.00 *	Search Setting Relative 1.00 %] Absolute 50.00 mΩ] Max Point Number 12 point Ignore Nominal Characteristics Search Interval: 200.0 mΩ Search Interval: 200.0 mΩ Disable All Disable All
	Other Settings Other Active Extended Zones Active Shot Passed Only Act In Main Zone Test Passed Only Act In Zones Passed Settings Passed Settings Pass if get any trip

"LL Same as LE" option enables the user to test either of phase to ground and phase to phase fault types with different currents. If this option is checked, all phase to ground and phase to phase fault types are tested with the same current and if this option is unchecked, you can specify a test current for each of fault types. When using the Constant test current test method, in "Maximum Fault Impedance" section, the maximum fault impedance in phase to ground, two-phase and three-phase "Fault Types" is calculated by using these formulae and are displayed.

TestView ×	
Shot Test Check Test Search Test	Settings Trigger Binary Output
Fault Test Model LL Same as LE Constant test current I Test LE 3.000 AI I Test LL 2000 A Maximum Fault Impedance	Time 1.000 s Prefault Time 1.000 s Max Fault Time 2.000 s Max Fault Time (Rel) 1.000 s
L-L 10.58 Ω L-L 183 Ω L-L 21.17 Ω Alow Reduction of ITest Fault Inception Model : Fixed angle ∨ Angle : 0.00* DCoffset	PostFault Time 500.0 ms Delay after trigger 50.00 ms Time Reference : 50 © Fault Inception O Starting Load Current (Prefault Current) Amplitude Ø Based On Current Ø Based On Degree
Voltage Output Enable Voltage Output (VB)	O Based On Ifault O Same as Fault Angle
Anplitude (ve) (ve) (s) (ve) (s) (s)	Search Setting Relative 1.00 % Absolute 50.00 mΩ Max Point Number 12 point Ignore Nominal Characteristics Search Interval: Search Interval: 200.0 mΩ Disable All Disable All
	Other Settings
	Passed Settings

If in constant current, the test voltage is more than the nominal value of the relay a prompt saying "Out Of Range" is displayed which means that the selected point is out of the allowed range. By checking "Allow Reduction of I Test" option, the software considers the voltage as the nominal value to calculate the intended impedance current and voltage and decreases the current value so that the shot point is placed in the injection range of the device. By checking "Allow Reduction of I Test" option, "V Max (L-L)" field is displayed which is the same as the nominal line voltage. You can see that

this cell is in Purple which means its value is related to another parameter. By right-clicking on this field and selecting "Go

to Linked Value", you can see that this field is linked to "V nom" parameter and by changing this parameter the value of this field changes accordingly. Also, by right-clicking on this cell and selecting "Remove Link" option, you can enter this value manually. For example, in "Shot Test" tab, a point with a "30" ohm impedance is added to the points table. This point is located in the "Out Of Range" area and by opening "Vector View" window, the voltage and current values for this impedance are displayed. By checking "Allow Reduction of I Test" option, you can see that the voltage value changes to nominal voltage and the current value is reduced so that this point is placed in the injection range of the device. Note that

when you are testing a wide range of the zone, the injected current must be bigger than the minimum "Pick up" current of the relay. If the relay uses the voltage dependent on the inception current, make sure that the test voltage is always smaller than the "Pick up" voltage set for the relay.

TestView ×	
Shot Test (1/0/0/0/1) Check Test Se	arch Test Settings Trigger Binary Output
Fault	Time 1.000 s Prefault Ramp in Prefault Max Fault Time 2.000 s Max Fault Time (Abs) 2.000 s Max Fault Time (Rel) 2.000 s
I-E 10.58 Ω I-L 18.33 Ω I-L 21.17 Ω V Max(I-L) 110.0 V ✓ Alow Reduction of ITest - Fault Inception Model : Proof angle Angle : 0.00° D C-offset 0.00° - Usage Output 63.51 V Phase 0.00°	PostFault Time 500.0 ms Delay after trigger 50.00 ms Time Reference : Stating Load Current (Prefault Current) Phased on Tauk Based On Tauk © Based on Dayree Dased On Tauk Same as Fault Angle 0.000 A Same as Fault Angle Search Setting 1.00 % Relative 1.00 % Max Point Number 12 point Ignore Nominal Characteristics Search Interval: 200.0 mΩ Search Interval: 200.0 mΩ
	Other Settings

The second method is "Constant test voltage". By specifying the fault impedance value and keeping the voltage fixed, the test current can easily be calculated. Some of the parameters are set in accordance with the option selected in this section about which more is going to be said. The test voltage value is specified in "V Test" field and the value entered in this section is considered to be fixed throughout the test. When you are using the Constant test voltage test method, in "Minimum Fault Impedance" section, the minimum fault impedance in phase to ground, two-phase and three-phase "Fault Types" is calculated using these formulae and displayed.

Single phase Fault	Two Phase Fault	Three Phase Fault
$Z_{L\min} = \frac{V_{test}}{\sqrt{3}, 1 + K_L , I_{\max} }$	$Z_{L\min} = \frac{V_{max}}{2, I_{\max}}$	$z_{lown} = \frac{V_{test}}{\sqrt{3}, I_{max}}$

Constant test volta	ige 🗸 🗸
/Test	50.00 V
Minimum Faul	Impedance
L-E	781.2 mΩ
L-L	The state states
L-L	781.2 mΩ
15.55	

TestView ×		Vector View First (S2 Fault)
Shot Test (1/0/0/0/1) Check Test	Search Test Settings Trigger Binary Output	7 Type: Normal ~ 0.000 s Show VLL from zero 2
Fault Test Model Context test voltage VTest 50 00 V Minimum Fault Impedance LE 781.2 mG	Time 1.000 ± Prida& Time 1.000 ± Mar Finit Time (Hot) 2.000 ± Mar Finit Time (Hot) 2.000 ±	Sprif Mognitude Hermonic 1 Phase Read Imaginary Store Areas Color V LEE VLLAE 0.000 / 0.00
UL 781.2 mL LLL 1.582.0 V Mex(LL) 110.0 V ☑ Alow Reduction of VTest	PostFauk Time 500.0 ms Delay after togor 500.00 ms	ZCN 138/40 138/41 120.00 Time ZME 192/20 192/20 192/20 Time ZME 192/20 192/20 Time Time ZME 192/20 192/20 Time Time ZME 192/20 192/20 Time Time ZME 192/20 192/20 Add Month Time ZME 192/20 192/20 Add Month Time ZME 192/20 192/20 Add Month Time
Fault Inception Nodel : Fixed angle Angle : 0.00° D Coeffeet Votage Output Enable Votage Output (VB)	Coals Current (vertical Current) Phone (xv i) Amplitude Phone (xv i) Based On Curret Based On Degree O Based On Search Same or Search right 0 000 A 0 000"	VIJE
AndRude 63.51 V Phase 0.00 *		
	Ober Settings Ender Zureis Active Description Christian Constantiant Description Christian Constantiant Passed Settings Pass of Settings Pass of Settings	

The third method is "Constant Source Impedance". In this method, it is possible to specify the fault impedance source so that the test current value is calculated by using a constant impedance. You can use various modes available in "Mode" drop-down list to determine the fault Source type. By clicking on this field a list opens where you can select your impedance model and enter the value of the required parameters in "Source Type" table in accordance with the selected model.

Shot Test (1/0/0/0/1) Check Test S	earch Test Settings Trigger Binary Ou
Fault	Time
Test Model	Prefault Time 1.000 s
Constant Source imp.	Ramp in Prefault
Mode ZS and KS	r Max Fault Time
Mode ZS and KS V ZS and KS	Max Fault Time (Abs) 2.000 s
ZS and ZS0	Max Fault Time (Rel)
Source Type RS, XS, RSE, XSE	
ZS mao SIR and KS SSC and X/R	
ZS angle ISC and X/R	
kS mag 1.0000	
kS anole 0.00 *	
	PostFault Time 500.0 ms
kS=kL	Delay after trigger 50.00 ms
Fault Inception	Time Reference :
	Fault Inception Starting
Nodel : Fixed angle ~	Load Current (Prefault Current)
Angle : 0.00 °	Amplitude Phase (ZV, I)
DC-offset	Based On Current Based On Degree
_ DC-onset	Based On Ifault Same as Fault Angle
Voltage Output	0.00 A
Enable Voltage Output (VB)	
mplitude 63.51 V	Search Setting
hase 0.00 *	Relative 1.00 %
	Absolute 50.00 mΩ
	Max Point Number 12 point
	r Ignore Nominal Characteristics
	Search Interval: 200.0 mΩ Apply To All
	Disable All
	Other Settings
	Extended Zones Active
	Shot Passed Only Act In Main Zone
	Test Passed Only Act In Zones
	Passed Settings
	Pass if get any trip

In "Zs and KS", "ZS1 and ZS0", "RS, Xs, RSE, XSE" and "SIR and KS" modes, magnitude and angle of the source impedance and the grounding factor of the impedance, magnitude and angle of the source impedance in zero and positive sequence, real and imaginary sections of the source impedance as well as the relation of mentioned real and imaginary parameters, and magnitude and angle value of real and imaginary sections of the source impedance are entered respectively. In fact, in this section, "SIR" is "ZS/ZL". In "Ssc and X/R" and "Isc and X/R" modes, the short circuit apparent power for three-phase and phase to ground mode and the "X/R" parameter relation in single-phase mode, and the short circuit current for three-phase respectively.

Constant Sou	irce imp.		Y
Mode	ISC and X/R		~
X/R L-L-L		0.5774	
ISC L E		31.25 A	
X/R L-E	N	1.3032	2

If "KS=KL" option is checked, in the models mentioned in "Mode" field numbers 1, 2, 3, and 4 only the first two parameters are adjustable and the other two parameters are disabled. This option is disabled in modes 5 and 6. By setting the parameters of any of the selected models, the software calculates the current or voltage value for the test which can be viewed in "Vector View" window.

Mode	ZS a	ZS and KS					
		ZS and KS ZS and ZS0					
Source Type	RS, XS, RSF, XSE						
ZS mao	100 200 200	and KS by					
ZS anole		and X/R					
kS mao	Co Courter	1.0000	_				
kS anole		0.00 °					

In "Fault Inception" section, the fault inception angle can be determined in three ways. To better understand this, open "Signal View" window. If "Fixed Angle" is selected from "Model" slide field, you can enter the desired fault inception angle value in "Angle" field and view the angle changes in "Signal View". By entering this angle, current and voltage phases shift at the same amount. By selecting "Maximum Offset" option, the software picks the maximum "DC Offset" value in the fault inception moment for the current waveform. The maximum positive "DC Offset" value occurs when the fault inception angle is equal to the impedance angle ±90 degrees. By selecting "Zero offset" option, a zero "DC offset" is applied to the current output. By checking "DC offset" option, in "Fixed Angle" it is possible to specify a "DC offset" value for the current output in the fault inception moment in any desired angle.

TestView ×		Signat/New	× * * * #
Shot Test (1/0/0/0/1) Check Test Se	earch Tes* Settings Trigger Binary Output	Sunal Verw (c) Setting Test State Not Tested	Export Contrade
Failt LLServe es LE Conteret tost cament V Thest I 2,000-61 Thest LL 2,000-61 Maximum Pault Impedance L-6 L-6 18,33.0 L-6 21110	Time Perda Tree 1990 s Perda A Tree 1990 s Mar Tray Trac Perda A Mar Tray Tree (Pers) 2000 v Mis Fault Tree (Pers) 2000 v Mis Fault Tree (Pers)		
V Merili Li Thillov V Merili Li Thillov Joor Relacion of Flat Freet Incoption Rice Societa Occinent	PostFail: Time 500.0ms Extly: Ahr logar 500.0ms Time Reference: 500.0ms Brail Fourpetime Stating Load Current (IPPalant Current)		
Brade Voltage Oxford (169) Angelaude Angelaude Oxford Oxford Oxford Oxford	Instruct Setting 100.31 Packare 100.71 Variation 500.011 Variation 12.0011 Ignores Ricemand Characterations 58eerbit Instruct Search Instruct 200.9421 Double: Al Double: Al		
	Cliber Lettings Diorded Zores Attive Diorded Zores Attive Diorded Zores Attive Diorded Zores Attive This Faced Core Pass / get uny trp		15 10 21

If for any reason you wish to use the group B voltage output in "Distance" test, you can do so by checking "Enable Voltage Output (VB)" in "Voltage Output" section and entering the intended voltage and angle values. You can view the waveform related to this voltage output in "Signal View" window.

Voltage Output	
Enable Voltage Outp	ut (VB)
Ampflkude	63.51 V
Phase	0.00 *

97 : "DISTANCE" ROOM SETTINGS, PART II

In "Time" section, first the injection time before the fault is entered in "Prefault Time". In cases where the "PTs" draw inrush current, by checking "Ramp in Prefault" option, it is possible to increase the waveform of the voltage signal in prefault in form of a ramp to prevent stop applying voltage because of the drawn inrush current. In "Max Fault Time", the maximum fault injection time is specified in form of "Abs" or "Rel" which itself consists of three parts. Note that if in a "Shot" point, the "Max Fault Time" is shorter than maximum allowed "Trip" time, the result of the evaluation will be wrong. If you are using the "Max Fault Time (Abs)" field, you need to enter a time in seconds for the maximum fault injection time (For all points); but to increase the test speed, you can use "Max Fault Time (Rel)" option.

TestView ×	
Shot Test Check Test Search Test	Settings Trigger Binary Output
Fault	Time
Test Model - LL Same as LE	Prefault Time 1.000 s
Constant test current V	Ramp in Prefault
ITest 2.000 A	Max Fault Time Max Fault Time (Abs) Ax Fault Time (Abs) Max Fault Time (Rel)
L-E 15.88 Ω L-L 27.50 Ω L-L-L 31.75 Ω	
	PostFault Time 500.0 ms
Allow Reduction of ITest	Delay after trigger 50.00 ms
Fault Inception	Time Reference :
Model : Fixed angle v	Fault Inception Starting Load Current (Prefault Current)
Angle : 0.00 * DC-offset	Amplitude Phase (∠V, I) ● Based On Current ● Based On Degree ● Based On Fault ● Sane as Fault Angle 0.000 A 0.000 -×
Amplitude 63.51 V	Search Setting
Phase 0.00 *	Relative 1.00 %
	Absolute 50.00 mΩ
	Max Point Number 12 point
	Ignore Nominal Characteristics
	Search Interval: 200.0 mΩ Apply To All
	Disable All
	Other Settings Extended Zones Active Shot Passed Only Act In Main Zone Test Passed Only Act In Zones
	Passed Settings
	Pass if get any trip

By checking this option three other options appear. By entering a number in "Add %of Tnom", the fault injection time in every point equals the test point nominal time plus percentage of the nominal time entered in this field. This means that if the test point nominal time is 10 seconds and 5 percent is entered in this field, the maximum fault injection time equals 105 percent of the test nominal time which is 10.5 seconds. But in "Add Absolute" field, the fault injection time is entered as the sum of test point nominal trip time plus the time entered in this field. If time is entered in these 3 fields, the software picks the highest value. For points that are in "No Trip" zone, it is possible to enter a separate time in "No-Trip Time" field.

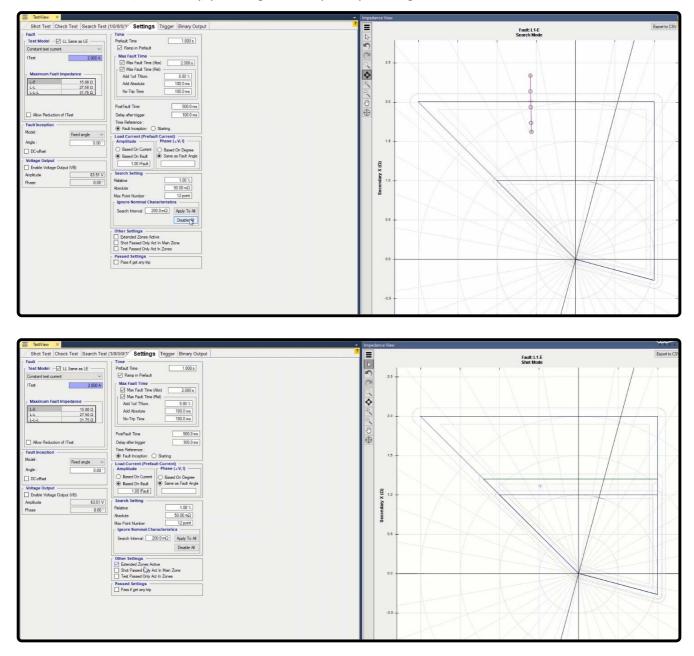
Settings	Trigger	Binary (Dutput	
Time				
Prefault Tim	e		1.00	0 s
Ramp	in Prefault			
Max Faul	t Time —	20		
and the second second	Fault Time (20036	2.000	s
1000000	Fault Time (Rel)		
	f TNom.	_	5.00 %	=
Add Ab	001010		100.0 ms	- 11
No-Trip	N		100.0 ms	
1	h	3		
PostFault Ti	me		500.	0 ms
Delay after t	rigger		50.0	0 ms
Time Refere				
Fault In	ception () Starting		
Load Curre Amplitude	•	Phase	(∠V, I) -	
Based (Deced (d On Degr e as Fault /	
O Based (0.000 A	O Same	0.0	<u> </u>
-	0.000 A]		0.0	
Search Set	ting —			_
Relative			1.00 %	-
Absolute			50.00 mΩ	2
Max Point N			12 poin	t l
Ignore No	minal Cha	racteristi	cs —	
Search Inte	erval: 2	00.0 mΩ	Apply To	o All
			Disable	All
0				
Other Setti	ngs 1 Zones Act	ive		
	sed Only A	72366	Zone	
	sed Only Ad			
Passed Se	ttings —			
Pass if g	et any trip			
				-

In "Post Fault Time", the injection time after the fault is entered. "Delay after Trigger", is used to enter the key trigger time. By right-clicking on the related field and selecting "Go to Linked Value", you can see that it is linked to "CB Trip Time" and if necessary, you can replace it with your desired value by selecting "Remove Link". In "Time Reference", by selecting "Fault Inception", the "Trip" time is calculated from when the fault is injected. But by selecting "Starting", the "Trip" is calculated from when the "Pick-up" contact is received from the relay. In "Load Current (PreFault Current)" section you can specify the settings for the phase and current related to "PreFault". In "Amplitude" section, by selecting "Based on Current" radio button, the "PreFault" current is entered in terms of Ampere which is the same for all test points. But by selecting "Based on IFault", the "PreFault" current is entered according to the fault current which is different for every "Shot" point. In "Phase" section, by selecting "Based on Degree" radio button, the current angle in "Prefault" is entered which is the same for all "Shot" point but by selecting "Same as Fault Angle" radio button, the "Prefault current angle" is the same as the fault current angle which is different for every "Shot" point.

Settings Trigger Binar	y Output
Time	
Prefault Time	1.000 s
Ramp in Prefault	
Max Fault Time	
Max Fault Time (Abs)	2.000 s
Max Fault Time (Rel)	
Add %of TNom.	5.00 %
Add Absolute	100.0 ms
No-Trip Time	100.0 ms
PostFault Time	500.0 m
Delay after trigger	100.0 m
Time Reference :	
0	
O Based On Current Based On Current	-
Load Current (Prefault Curr Amplitude Phase O Based On Current 🕑 Ba	ent) se (∠V, I) —— ised On Degree
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting	ent) se (∠V, I) ised On Degree me as Fault Angl 0.001
Load Current (Prefault Curr Amplitude Based On Curent Based On fault 1.00 IFault Search Setting Relative	ent) se (
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting	ent) se (∠V, I) ised On Degree me as Fault Angl 0.001
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting Relative Max Point Number	- ent) se (∠V, I)
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting Relative Absolute Ignore Nominal Characteric	ent) se (∠V, I) ised On Degree me as Fault Angl 0.00 ° 1.00 % 50.00 mΩ 12 point stics
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting Relative	ent) se (∠V, I) ised On Degree me as Fault Angl 0.00 ° 1.00 % 50.00 mΩ 12 point stics
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting Relative Absolute Ignore Nominal Characteric	ent) se (∠V, I) ised On Degree me as Fault Angl 0.00 ° 1.00 % 50.00 mΩ 12 point stics
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting Max Point Number Ignore Nominal Characteri Search Interval: 200.0 mΩ	ent) se (∠V, I) ised On Degree me as Fault Angl 0.00 ° 1.00 % 50.00 mΩ 12 point stics [Apply To All
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 (Fault Search Setting Relative Max Point Number Ignore Nominal Characteri Search Interval: 2000 mm2 Other Settings Extended Zones Active	ent) se (< V, I)
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting Relative Absolute Ignore Nominal Characteri Search Interval: 200.0 mQ Other Settings Stor Pased Only Act In Mai	ent)
Load Current (Prefault Curr Amplitude Based On Current Based On fault 1.00 IFault Search Setting Relative Absolute Ignore Nominal Characteri Search Interval: 200.0 mQ Other Settings Cother Settings Shor Pased Only Act In Zon	ent)
Load Current (Prefault Curr Amplitude Phan Based On Current B Based On fault 1.00 IFault B Composition Search Setting Relative Absolute Max Point Number Ignore Nominal Characterit Search Interval: 200.0 mQ Other Settings Extended Zones Active Shot Passed Only Act In Mai	ent)

In "Search Setting" section, the settings related to "Search Test" are specified. As mentioned before, a "Search Test" arrives at a conclusion only if one of the three conditions of this section is met. The first condition is "Relative" which means that if the difference between the test point value and the previous point is less than the percentage specified in this field, this very point is the result of the test. The second condition is "Absolute" which means that if the difference between the test point and the previous point is less than the value specified in this field, this very point is the result of the test. The third condition is "Max point number" which means that the test is to be performed as many times as the number of points entered in this field at max and the last point is the result of the test. But if for any reason, the nominal characteristic determined for the relay is not available, you can use "Ignore Nominal Characteristic" section. By doing so, the software ignores the existing characteristic. Then, based on the step entered in "Search Interval", it adds shots on the "Search" line.

For example, a line is drawn in "Search Test" section. Then, " $200m\Omega$ " is entered as the value for "Search Interval" and "Apply to all" is selected. You can see that some points with the same step are added on the "Search" line. By running the test, you can see that the test starts from the lowest point and once one of the three mentioned conditions is met, the test comes to result. Also, if necessary, you can ignore this option by selecting "Disable all".



By selecting "Shot Passed Only Act in Main Zone" option, only if the performance time of the relay in the shot point is located in the allowed range of the main zone the test "Passes". For example, if this option is checked and a shot is added to tolerances of zone 2, the test "Passes" if the relay operates only in the time of zone 2 which is "95" ms to "150" ms; otherwise, with any other performances by the relay, the test "Fails". But if this option is not checked, the allowed performance time of the relay is "95ms" to "No Trip" and if the relay does not give a trip in this point, the test "Passes". "Test Passed Only Act in Zones" option is used for "Search", "Check" and "Shot" tests. By checking this option, the test "Passes" when the relay performance in the tolerances, is only the time of one of the two zones. For example, if this option is checked and a shot is added to zone 1 and zone 2 tolerance area, if the relay operates in "28.5" to "80" ms or "95" to "150" ms the test "Passes"; otherwise the test "Fails". This can also be done for "Check" and "Search" tests.

Times		
Prefault Time		1.000 s
Max Fault Time Max Fault Time (Abs) Max Fault Time (Rel) Add %of TNom. Add Absolute No-Trip Time		2.000 s 5.00 % 100.0 ms 100.0 ms
PostFault Time	[500.0 ms
Delay after trigger	[100.0 ms
Time Reference :	arting	
		d On Degree as Fault Angle
Search Setting	-	
Relative		1.00 %
Absolute		50.00 mΩ
Max Point Number	orieti	12 point
Search Interval: 200.0		Apply To All
		Disable All

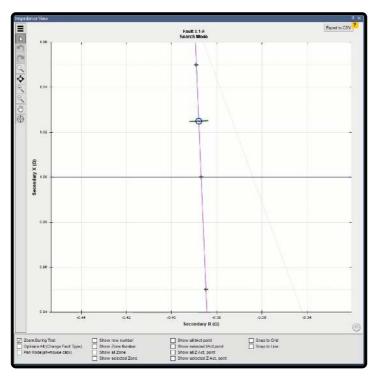
In "Trigger" tab you can specify the desired binary to receive the "Pickup" and "Trip" signals of the relay as well as stopping the current injection. The settings and explanation of this section are exactly the same as mentioned for "Trigger" room and "Sequencer". In "Binary Output" tab, if it is necessary for the relay to view the conditions of the key, it is possible to take any needed voltage to the "Binary Input" through "Binary Output" of the device by voltages of "B" or "Aux Dc" groups. This tab has three modes of "Prefault", "Fault" and "Post Fault" and it is possible to manage each of them separately.

Shot Test (2/0/0/0/2)	Check Test	Search Test (1/0/0/0/1)	Setting	Trigger	Binary Cutput
	AND OR				
C1:Trip : <u>1</u> ~ Trigger Logic Minimum Time	C2:Start :	X ~			

0110	t Test (2/0/0/0/2)	Check I	est Sea	rch Test	(1/0/0/0/*	I) Settu	ngs Ing	ige I	Binary Outpu
Prefau	lt						_		
Out	Display Name	First State	1st ch.	2nd ch.	3rd ch.	4th ch.	Trigger	Toggle	e
1	Ext. Zone Active	1-	0.000 s	0.000 s	0.000 s	0.000 s	•		•
2	Bin. Out 2	<i></i>	0.000 s	0.000 s	0.000 s	0.000 s	•		*
Fault -		First State	1st ch.	2nd ch.	3rd ch.	4th ch.	Trigger	Toggle	•
0.4						Hun Gri.	myyer	roggie	
Out	Display Name	CINES (EXERCIT)	200202-92	10000000000		0.000 -	-		
Out 1 2	Display Name Ext. Zone Active Bin. Out 2		0.000 s 0.000 s	0.000 s 0.000 s	0.000 s 0.000 s	0.000 s 0.000 s	•		•
1 2	Ext. Zone Active Bin. Out 2		0.000 s	0.000 s	0.000 s		-20232		•
1	Ext. Zone Active Bin. Out 2		0.000 s	0.000 s	0.000 s 0.000 s	0.000 s			•
1 2 Postfa	Ext. Zone Active Bin. Out 2	J_ 	0.000 s 0.000 s	0.000 s 0.000 s	0.000 s		-20232	Toggle	•

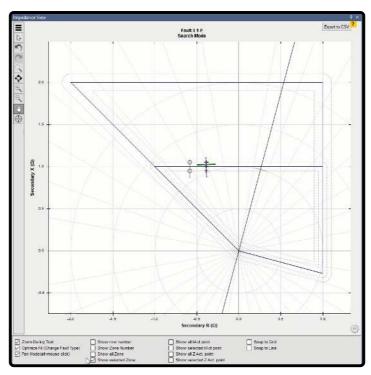
98 : IMPEDANCE VIEW WINDOW

As mentioned before, one of the main windows of Distance room is "Impedance View". This window shows the relay characteristic curve based on the settings entered in "Test Object" window. This window has some shared and some unique features. The features available by right or left clicking on this window are common to all rooms and it is not necessary to explain them here but at the bottom of this window there is a gear by clicking on which some other useful options are displayed. By clicking on "Zoom During Test", if one or multiple "Search" lines are drawn on the characteristic curve, by running the test you can see that the software zooms on the areas where the test points are located and shows the found zone line.

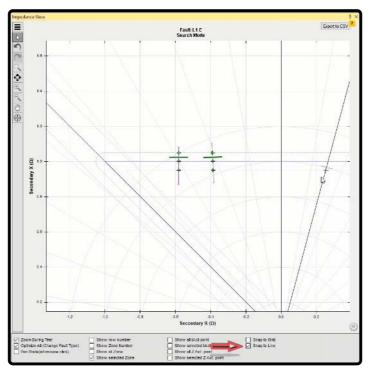


If you select "Optimize All" option, by changing the "Fault type", the characteristic curve display is "Optimized". By using "Pan Mode" you can move the characteristic curve diagram as desired. By using "Show row number" you can view the row number of any test point or test line on the characteristic curve. If you wish to see which "Zone" is the "Main Zone" of every point on the characteristic curve, you can check "Show Zone Number" option. By using "Show Zone number" the zone number of any test point or test line will be shown on the characteristic curve. By using "Show all zone", test zones of

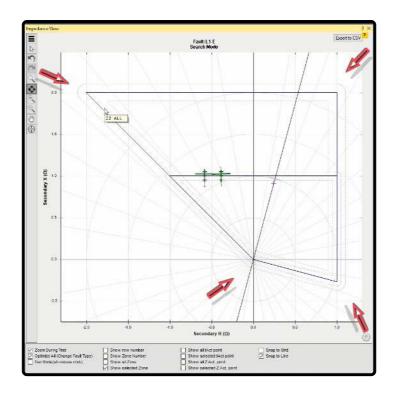
all "Search" points are marked with a circle to find the characteristic curve line. By selecting "Show selected zone", only the points of the line selected from "Search line" table are marked with a circle.



By clicking on "Show all t act point", the operating time of the tested points is shown. Since maybe the points are close to each other and it is not possible to view the times clearly, you can use "Show selected t act point" option which shows the time of the row selected from the test points table. "Show all Z act Point" and "Show selected Z act Point" options are used to show all result of "Search Test" and the points related to the row selected from the "Search Test" table respectively. By selecting "Snap to grid" option, the points on the characteristic curve that are shot close to the grids snap to the grids of this page. By selecting "Snap to characteristic curve" option, the points on the characteristic curve that are "Shot" close to the characteristic curve grid snap to it.



About polygon or "Quad" zones tolerances it should be noted that the rounding of the tolerances occurs where the zone lines intersect. The reason for this is related to the definition of tolerance. Suppose a %5 tolerance; the tolerance is the geometric location of all points which have a %5 distance from the zone line. According to this definition, the tolerances turns into a semicircle where the zone line ends. In sections where the tolerances of a zone overlap, the union of tolerances are considered as the tolerances of zone. Therefore, based on the angle of the two intersecting sides of the zone, a part of the external tolerance zone turns into a curve.



99 : "ZT DIAGRAM" AND "MEDIUM DETAIL VIEW" WINDOWS

Test points and their characteristics in "Medium Detail View"

To start first open "Medium Detail View" window from the toolbar and move it to an appropriate location. Characteristics of every point are displayed in "Medium Detail Window" with details. This window consists of two tables of "Shot data" and "Zone data". In "Shot data" table, the information related to time, impedance, test point as well as current and voltage of the test point are shown. "Zone data" table is composed of two main parts. In the first part, general information related to relay zones along with the allowed operation time for each one is displayed and it is the same for all selected points. But the second part of this table changes according to the selected test point.

Name Label Type Fault Loop Trip Time Tol- Tol+ Is In Zone Is In Tol Zone Index Result 1 Zone Z1 ALL TRIPPING ALL 30.00 ms 28.50 ms 80.00 ms Yes - Main Zone - 2 Zone2 Z2 ALL TRIPPING ALL 100.0 ms 95.00 ms 150.0 ms Yes - - - 3 No Trip No Trip All No Trip No Trip No Trip - - -	88.60 %	812.5 mΩ	R -353.4 mΩ	Phi 113.51 *	Z 886.0 mΩ	t max. 80.00 ms	t min 28.50 ms	t nom. 30.00 ms	Dev.sec	Dev.%	and the second	Assessme Not Tested	State	1
Name Label Type Fault Loop Trip Time Tol- Tol+ Is In Zone Is In Tol Zone Index Result 1 Zone 21 ALL TRIPPING ALL 30.00 ms 28.50 ms 80.00 ms Yes - Main Zone - 2 Zone2 22 ALL TRIPPING ALL 100.0 ms 95.00 ms 150.0 ms Yes - -							ļ							
2 Zone2 Z2 ALL TRIPPING ALL 100.0 ms 95.00 ms 150.0 ms Yes		t	lex Result	Zone Inc	ls in Tol	ls In Zone	Tol+	Tol-	Trip Time	Fault Loop	Туре	00	1	one
				Main Zon	•									
			-			tes								

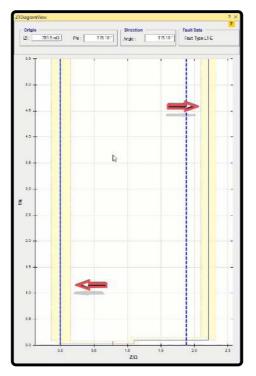
For example, if a point in zone 2 is selected, the general information of the zones will be displayed in "Zone Data" table without any change. But in "Is in Zone" column in the second table, it is specified that in which zones the selected point is located. In "Is in Tol" column it is specified whether the selected point is located in the tolerance zone or not. In "Zone Index" column, the main zone related to the selected test point is specified. If the point is located in only one zone, that zone will be considered as the main zone but it should be noted that if the point is located in multiple zones, the zone with the shortest nominal time will be considered as the main zone.

1	State	Assessm Not Teste		Dev.%	Dev.sec	t nom. 100.0 ms	t min 95.00 ms	t max. 150.0 ms	Z 1.878Ω	Phi 115.18 *	R -799.2 mΩ	X 1.700 Ω	Z Relative	Percent 187.82 %	Pen
															;
_	_														
ne	e Data	a													
	Name	Label	Туре	Fault Loop	Trip Time	Tol-	Tol+	ls In Zone	ls In Tol	Zone In	idex Resu	łt			
1	Zone	Z1 ALL	TRIPPING	ALL	30.00 ms	28.50 ms	80.00 ms	-	4	-3					
2	Zone2	Z2 ALL	TRIPPING	ALL	100.0 ms	95.00 ms	150.0 ms	Yes	-	Main Zor	ne -				
3	No Trip	No Trip	No Trip	All	No Trip	No Trip	No Trip	-	8	12					

"ZT Diagram" window and points related to "Check Line" and "Search Line"

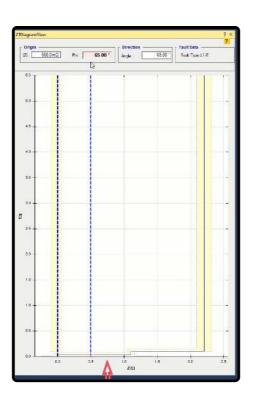
To open "ZT Diagram" window, "View" menu or the toolbar should be used. On this window the time diagram based on impedance, according to the operation characteristic of the relay zones along a specific angle is displayed which the most

important application of this in the software is finding the test points for "Search Test" and "Check Test". Note that the diagram on this window is linked with "Impedance View" and any point that is "shot" on one of these two windows will be "shot" on the other window accordingly. In the curve of this window, the vertical lines are the border of zones and between the two vertical lines, the time-impedance characteristic of the zones in the angle specified by the user is displayed. On this window, tolerances are displayed with dotted lines and zones.

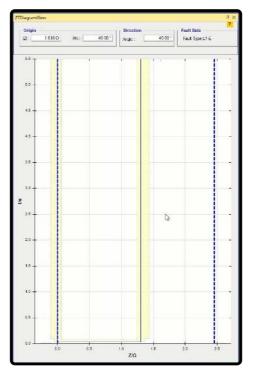


Let us use an example to explain how this diagram works. If "Test View" is on "Shot Test", and 0.5 ohm and 65 degrees are entered in "Z" and "Phi" fields in "ZT Diagram" window respectively, you can see that the point corresponding to this "Shot" is displayed on "Impedance View". Note that in "Shot Test", the values of "Angle" and "Phi" are the same because "Angle" refers to the angle of the line drawn from the point specified in "Origin", with "X-R" diagram as its origin. By specifying it, the variation of time – impedance curve in "Angle" is displayed in "ZT Diagram" window. This means that if the "Angle" is

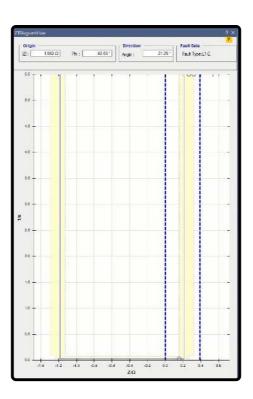
65 degrees, "ZT Diagram" shows the time variation based on the impedance in this angle. In this angle, the impedance moves from zone 1 with 30 ms to zone 2 with 100 ms and then moves from zone 2 up to "No Trip" zone. By moving on this diagram and clicking on its different sections, you can see the movement of "Magnet Cursor" in "Impedance View".



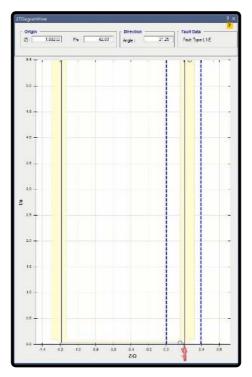
To make it clear, if in "ZT Diagram" window, the "Angle" is changed to 40 degrees, you can see that the "ZT Diagram" changes because in 40 degrees angle, the impedance only changes from zone 1 to "No Trip". In fact, by changing the angle, the "ZT" curve changes according to the zones available on its impedance course. In this diagram, you can see two blue dotted lines which the left side line indicate the "|Z|=0" line which is the minimum allowed impedance value. As you already know, impedance cannot be smaller than zero. The right side line indicates the selected point.



But in "Search Test" and "Check Test", "Angle" is there angle of the drawn line "Phi" is the origin impedance angle of "Search Line" or "Check Line", and values of them are different. For example, if in "Check Test" a "Check Line" is drawn from zone 1 to "No Trip", you can see the time based on impedance diagram in "ZT Diagram" window in the angle where the line is drawn. In this diagram you can see two blue dotted lines where the first line indicates the start point and the second line indicates the end point of the "Check Line". Note that in this state, the "|Z|=0" line is the start or origin point of the "Check Line" and the other blue line is the end point of the "Check Line" and the distance between these lines is the length of the "Check Line".



An important point for understanding the concept of "Check Test" is that when a "Check Line" is drawn, the software starts moving on the line and adding a "Shot" on places where the tolerance is broken on the "ZT Diagram". Here, as you can see, since there are three fractures along the "Check Line" in "ZT Diagram", three "Shots" are added. In this case, the difference between "Search Test" and "Check Test" is that in "Search Test" the software does not add a "Shot" on all tolerance fractures on the "Search Line" but from the zone line towards both ends, it only adds a "Shot" to the first tolerance fracture.



Another point is that if you draw a "Search Line" or "Check Line" like this figure, you can see that in addition to adding "Shots" on places where the tolerance is fractured on the "ZT Diagram", the software adds a "Shot" inside the zone and in the middle of the "ZT" characteristic accordingly. To explain this, if the line drawn from within a zone crosses a zone with different operation time but no point is "Shot" from that zone, the software adds a "Shot" to a point on "Search Line" or "Check Line" in the middle of its characteristic in "ZT Diagram" and "Impedance View".

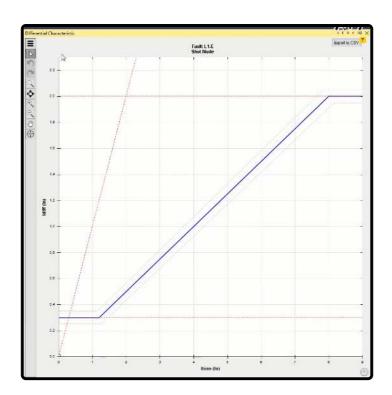
ZTDiagramView	TestView X	Impedance View	Y E B K OF X
Corigin Fault Data	Shot Test Check Test' Search Test Settings Trigger Binary Output	Fault: L1.E Search Mode	Export to CSV 7
(Z): 2.859 Ω Phi: 128.67* Angle: -103.44* Fault Type L1-E	• Drigin	Search Mode	1
	121 2.859 Ω R. 1.786 Ω 0.12E	5	
55	Phi 128.67" X: 2.232.0 O L1L2	28-	
	Ange: -103.44 O L2L3		
	C Langua		
so	Length: 6495 mΩ Relative O L12L3 % 64 95 % of: Line lengt ∨		1
	64 35 5 of: Line lengt Copy To Oheok	2	
40		C 22 - /	
	State Assessment (Z) Phi R X Angle Length Length Relative B	⊕	
40		20	
3.5		18	
	L1-E L2E L3-E L1L2 L2L3 L3L1 L1L2L3 4.		
3.0	Medium Detail View X		
8	Let Medium Detail View X		
	Shot Data		
25	State Assessment tact. Dev.% Dev.sec triom, tmin timax, IZI Phi		
	1 Not Teated No-Tino No-Tino No-Tino 1.618Ω 4		
20		12	
	< > >		
	Zone Data		
1.5	Name Label Type Fault Loop Trip Time Tol- Tol+ Is In Zone Is In Tol	10-	
	1 Zone Z1 ALL TRIPPING ALL 30.00 ms 28.50 ms 30.00 ms		Contraction of the second
	2 Zone2 22 ALL TRIPPING ALL 100.0 ms 95.00 ms 150.0 ms 3 No Trip No Trip No Trip All No Trip No Trip Yes Yes N		NO.
1.0 + -			
0.5		08-	
0.0 🔨 0.5 1.0 1.5 2.0 2.5 3.0 3.5		-2.0 -1.8 -1.6 -1.4 -1.2 -1.0	-0.8 -0.0
ti	< >>	Secondary R (Ω)	٢
	7		

100 : RELAY SETTINGS IN "DIFFERENTIAL" ROOM, PART 1

In "AMT Differential" room, differential relays and longitudinal differential ("End to End") test is performed. Differential relays work by comparing the currents in both sides of the equipment and measure and compare the current in both sides of the protected equipment which is used to protect power transformers, motors, generators and busbars. Note that to perform this test, both Current group A and B are activated and if you intend to use Neutrik cable for the test, you need to select "Current" as "Combination Cable" in "Preferences" section in "Hardware" section.

"Differential" room consists of two main windows of "Test View" and "Differential Characteristic". In "Test View" window, "Shot", "Check", "Search" and "Stability" tests are performed. In "Differential Characteristic" window, the relay characteristic curve is displayed according to the information entered in "Test Object" based on "I bias" and "I diff".

Shot Test Check Test Search Test S							
	tability S	Settings	Trigger	Binary Output			
Test Point Idiff: 0.000 ln Ibias: 0.000 ln	Fault	-E -E -E L2 L3 L1					
Detail t nom.: No-Trip t min: No-Trip t max: No-Trip State: Not Tested							
State Assessment Idiff Ibias	t nom.	t act.	Dev.3	Dev.sec	t min	t max.	User Comment



Test Object	Room	Directory	Cache	۱ <u> </u>						
	17. C.	IP	Port	Subnet Mask	Gateway	DNS 000.000.000.000	Serial Number	Firmware Version	Firmware Minimum Version	Mac Address 00:00:00:00:00:00
nnection & Firmware	Hardwar			100.50	- Check RA				No Error	
an Mode —— Silent O	Max. Pow			fter Test 5.000		1x	Che		RAM	
Smart Delay		Delay		5.000	-	Temperature -				
in. Temperature :	45	5.00 ° Max.	Tempera	ture : 55.00		emperature Value:	60.00 °			
eviation			pere		Earth —		Switches -			
bsolute Voltage :	400	0 mV			Enable		CAN BERLEY	ch1 🔽 Enable Sv	vitch2	
bsolute Current :	50	0 mA Relati	ive :	30.00		tion Cable		100	7.	
linary Input Status						e 🕟 Current 🥌				
C1 O C2 O C	30 0	4 O C5 O	C6 C	C7 O C8 O		13				
lisable Error —					Open					
Select all Error Ot	her				Dancing L	.ight				
Select all Error Se	H				- Enable					
Error Thermal					~					
Error Overcurrent	Binary 9									
Select all Error O.	V. Binary				~					
limes for Ignore OV o	of Binary	100.0	ms							

As mentioned before, to test a relay, first it is necessary to enter its information in "Test Object" window. In "Device" block, information such as relay nominal characteristics, serial number, location of the relay as well as "CT" and "PT" characteristics of the relay are entered. This section has been thoroughly explained in previous videos. "Differential" is the main block of this room by double-clicking on which, "Differential Protection Parameters" window opens. This window consists of "Protected Object", "Protection Device", "Characteristic Definition" and "Harmonic" tabs where the settings of differential relay are entered.

Device	Nominal Values	
Name/Description :	f nom :	50.00 Hz
Manufacturer :	V nom(secondary) :	110.0 V(L-L)
Device Type :		63.51 V(L-N)
Device Address :	V primary :	230.0 kV(L-L)
Serial/Model Number :		132.8 kV(L-N)
	I nom(secondary) :	1.000 A
Additional Information1 :	I primary :	1.000 kA
Additional Information2 :	Residual Voltage/Cu	Irrent Factors —
Substation	VLN/VN :	1.730
Name :	IN/I nom	1.000
Address :	Limits	
Bay	V max :	132.0 V
Name :	I max :	64.00 A
Address :	Debounce/Deglitch	Filters
	Debounce Time :	3.000 ms
	Deglitch Time :	400.0 μs

Protected Object Transformer		Vector Gro (YO	up		umber of Winding	s
Nominal Values	Primary		Second	ary	Tertiar	y
Vinding/Leg Name :	Primary		Secondary		Tertiary	
/oltage :	1	15.5 kV		30.00 kV		30.00 kV
ower:	40	00 MVA	4	0.00 MVA	4	0.00 MVA
/ector Group :	Y	•	Y	•	Y	
Connection Number :	0.	*	0	•	0	
Starpoint Grounding :	No	•	No	•	No	.*
Current :		199.9 A		769.8 A		769.8 A
Delta-Connected CT :	No	+	No	*		
CT Nominal Values				1		
Primary Current :		200.0 A		800.0 A		800.0 A
Secondary Current :		1.000 A		1.000 A		1.000 A
Starpoint Grounding :	tow. Prot. Obj.	•	tow. Prot. Obj.	•	tow. Prot. Obj.	*
Ground CT Nominal Val	Use Ground Cu	rrent Measu	rement inputs (CT)			
rimary Current :		200.0 A		800.0 A		800.0 A
econdary Current :		1.000 A		1.000 A		1.000 A
tarpoint Grounding :	tow. Prot. Obj.	+	tow. Prot. Obj.	+	tow. Prot. Obj.	+
	0				1	

"Protected Object" tab

In "Protected Object" tab, the information related to the protected equipment is entered. In "Protected Object" field, first, the type of the protected equipment is selected among transformer, generator, motor and busbar and here transformer is selected. In "Vector Group" section, the transformer vector group which is entered in "Nominal Values" section is displayed. In "Number of Winding" section, the number of windings of the transformer is specified. If the transformer has three windings, a column named "Tertiary" appears in which the information of the third winding is entered. Here two-winding transformer is selected.

In "Nominal Values" section the nominal information of the transformer is entered in "Primary", "Secondary" and "Tertiary" columns for primary, secondary and tertiary sides, but since here the transformer has two windings, the "Tertiary" column is disabled. In "Winding/Leg Name" row, it is possible to enter an English or Persian custom title for the winding. In "Voltage", "Power", "Vector View" and "Connection Number" fields, the nominal voltage of the two sides of the transformer, the nominal power of the transformer are entered respectively. If there is a null point in the star direction of the transformer, select "Yes" in "Star Point Grounding" field. For example, if the transformer vector group is "YND11", after specifying the transformer wiring type in "Vector Group" and its vector group number in "Connection Number", in "Star Point Grounding" field. The select "Yes" is selected in the primary column. In "Current" field, the nominal current of the both sides is calculated by the

software based on the entered voltage and power which is not editable. In "Delta-Connected CT" field, if the "CTs" are wired in delta form "Yes" is selected otherwise "No" is selected.

Then, in "CT Nominal Current" section, nominal information of the "CTs" in the both sides of the device are entered separately. Note that for this section the differential and bias current calculations are done according to the calculated current and the entered turns ratio but if from "View" menu, "Primary" is selected as "Unit", primary currents of the both sides of the transformer in "Vector View" are displayed according to the "CT" turns ratio entered in "Device" block. In "Star Point Grounding" section the turns at which the null point of the "CTs" is located is specified. If the null point is located at the protection equipment (Transformer) side "tow.Pro.Obj" is selected otherwise "Toward Line" option is selected.

"Protection Device" Tab

After entering the characteristics of the protected equipment in "Protected Object" tab, it is necessary to enter the relay characteristics in "Protection Device" section. First, "Ibias" formula is entered from "Ibias Calculation" field which consists of "seven" main formula. One of these formula should be selected form the relay manual and "Factor K1" is entered based on the selected formula. Generally, the characteristic curve is different for single-phase and multiple-phase faults but by checking "No Combined Characteristic" option, the differential characteristic curve will be the same in single-phase and multiple-phase faults mode. After drawing the characteristic curve, the complementary explanations are provided.

rotected Object	Protection Device	Characteristic Definition	Hamonic				
Ibias Calculat	ion —		Reference Winding	g —			1
$({\sf lp} {+} {\sf ls})/$	K1	+	Primary			•	
Factor K1 =	1.000]	Reference Current Protected object n CT nominal current	nominal ci	urrent		
Zero Sequen	ce Elimination —	Primary	Secondary		5	Tertiary]
Elimination T	ype : IL-10	•	None	•	IL-10		
Test Time Se	ttings / Transform	ner Model	Diff Time Settings				-
Test Max :		1.500 s	tdiff>			30.00 ms	
Delay Time :		250.0 ms	tdiff>>			30.00 ms	
Diff Current S	settings	761	Time Tolerances				1
ldiff >		0.30 ln	relative :			3.00 %	
ldiff >>		2.00 ln	absolute :			10.00 ms	
Current Toler	ances						
relative :		2.00 %					
absolute :		0.05 ln					

In "Reference Winding" field, the direction of the reference winding is determined which is selected in accordance with the relay settings. By selecting the reference winding direction, the angle in that end is considered to be 0. Since differential and bias currents are calculated and displayed based on the nominal current, it is necessary to select the nominal current of the relay among "CT" and nominal current of the protected equipment in "Reference Current". For example, if "Current Protected Object Nominal" is selected for "Reference Current", and "Idiff=2In", "In" is the nominal current of the equipment whose information is displayed in "Protected Device" tab, "Nominal Values" section and "Current" field. But, if "CT Nominal Current" is selected, "In" is "CT" nominal current whose information is entered in "Protected Device" in "CT Nominal Values" section.

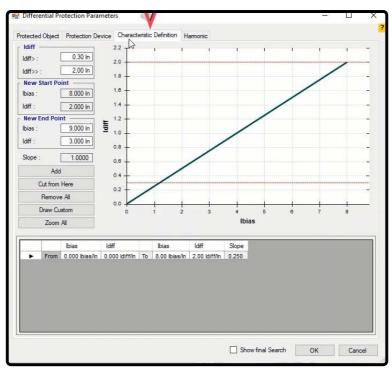
In "Zero Sequence Elimination", if the related relay supports zero sequence elimination in measurements, you can select the zero sequence elimination type in "Elimination Type" field. This feature has been put in relays so that if there is a phase to earth fault outside the protective zone, *the existence of zero sequence current does not stop the relay.* However, this makes the relay less sensitive to phase to earth fault.

In "Test Time Setting/Transformer Model", "Test max" and "Delay Time" fields specify maximum time of fault current injection and delay time after receiving "Trip" contact, respectively. In "Diff Current Setting", "Idiff>" field is related to first stage and "Idiff>>" is related to second stage. Note that for currents lower than "Idiff>", for Every bias current of the relay is stable and does not perform a trip. But currents bigger than "Idiff>" indicate a fault near the transformer wiring and the relay performs an immediate trip without considering the bias current. But, between "Idiff>" and "Idiff>>" currents, the relay operation is based on the characteristic curve and there is no delay in the operation.

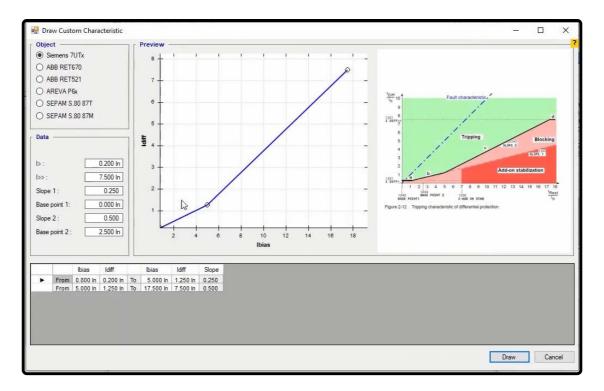
In "Current Tolerances" you can enter the current tolerance in two forms of "Relative" and "Absolute". Note that the software takes into account the highest value between these two. In "Diff Time Setting", "Tdiff" field is the allowed operation time of the operation zone between "Idff>" and "Idiff>>", and "Tdiff>>" is the differential currents bigger than "Idiff>>". In "Time Tolerances" you can enter the current tolerance in two forms of "Relative" and "Absolute". Note that the software takes into account the highest value between these two.

101 : RELAY SETTINGS IN "DIFFERENTIAL" ROOM, PART 2

After entering the information in "Protected Object" and "Protection Device" tabs, it is necessary to enter relay differential characteristic curve in "Characteristic Definition" tab. In this tab it is possible to enter the characteristic curve in two ways.

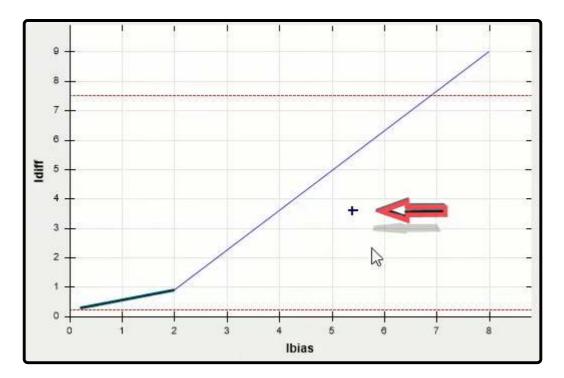


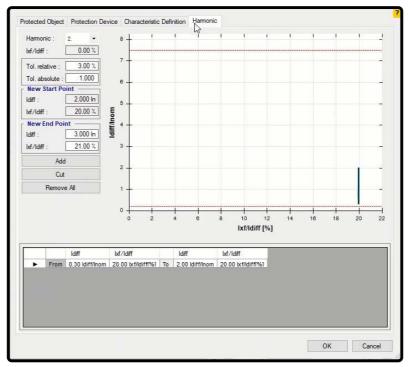
1- By clicking on "Draw Custom" option, "Draw Custom Characteristic" window opens where there are several "Template" of differential characteristic curve for different relays available. The relay type is specified in "Object" section. After selecting the relay type, the information needed to draw the differential characteristic curve is displayed in "Data" section in accordance with the relay settings. For example, by selecting "Siemens 7UTX" relay, the information needed to draw the differential characteristic curve is displayed. In "I>" and "I>>", "Slope1" and "Slope2", and "Base point1" and "Base point2" fields, the minimum and maximum differential current specified in the relay, the slope of the first and second lines, and the crossing point of the first and second lines with "I bias" curve are entered respectively. To better understand the parameters of "Data" section, on the right side of this window the characteristic curve shape of each relay is sourced from its corresponding catalogue and the parameters are determined schematically. After entering this information, the differential characteristic curve of the intended relay is displayed in "Preview" section and in the box at the bottom, the start and end point information are mentioned according to "I bias" and "I diff". Also, the slope of the line is displayed in "Slope" section. By clicking on "Draw" option, the settings are saved and the differential characteristic curve is drawn using the "Template" of the intended relay.



2- The second method to enter the characteristic curve is using the features available in "Characteristic Definition" window and it is necessary to enter the information of every line of the characteristic curve separately. First, the information of "I>" and "I>>" fields are entered. By entering the information of these two sections and closing the "Test Object" window, the differential characteristic curve is displayed in "Differential Characteristic" between the two entered numbers. After returning to "Characteristic Definition" tab in "Differential" block, first, all lines of the characteristic curve are removed by clicking on "Remove All" and then after entering the start point and end point coordinates of the first line of the relay curve in "New Start Point" and "New End Point" sections, "Add" option is selected. The slope of the line is calculated by the software in "Slope" field. Note that the slope of the differential line cannot be negative. Now the end point of the second line is entered and then "Add" option is selected so that the second line is added to the curve. Note that the end point of the second line. By clicking on "Zoom All" option after entering the characteristic curve information, the curve is displayed completely in the box on the right side. In the box at the bottom of the page, the information of each section (line) of the characteristic curve is displayed separately. If you wish to remove a part of the characteristic curve, first, the part that you wish to remove is selected from the table and then "Cut from Here" option is selected. In the end by clicking on "OK", the relay differential characteristic curve is displayed in "Differential Characteristic" window.

By checking the "Show Final Search" option, if you have performed a "Search Test", the result of the last "Search" will be displayed in the differential characteristic curve shape. For example, if you draw a line on the characteristic curve and perform a "Search Test", and after clearing, return to "Characteristic Definition" and check the "Show Final Search" option, you can see that the result of the last "Search Test" is displayed in the form of a green "+" (plus) sign on the curve. By completing the "Differential Characteristic" tab, the "Harmonic" tab is completed as well. In this tab, the information related to harmonic characteristic of the relay for "Differential Harmonic" or "Inrush Blocking" test is entered. This test is performed in "Diff.Harmonics" room.





102 : INTRODUCING "TEST VIEW" WINDOW IN "DIFFERENTIAL" ROOM, PART I

As mentioned previously, one of the windows in "Differential" room is "Test View". This window consists of 7 tabs of "Shot Test", "Check Test", "Search Test", "Stability", "Setting", "Trigger" and "Binary Output". In "Shot Test" tab, you can select fault type and the points for the test and after the test is performed, you can view the results of the evaluation. In this tab, in "Test Point" section "Idiff" and "I bias" currents and in "Fault Type" section the fault type are determined. After specifying the test current, the fault type should be selected from among the standard faults available in "Fault Type" section. These faults include different faults of phase-to-earth, two-phase and three-phase. Before specifying the current and the fault type, you should determine "Supply Direction" in "Setting" section.

	Check Test	Search	Test S	itability	Settings	Trigger	Binary Ou	tput	
est Poີ້ທີ່t ff:0.000 as:0.000					.2-E .3-E .1L2 .2L3				
etail nom.: No-T nin: No-T ate: Not Tested	rip t	tact: tmax:	No-Trip		.1L2L3				

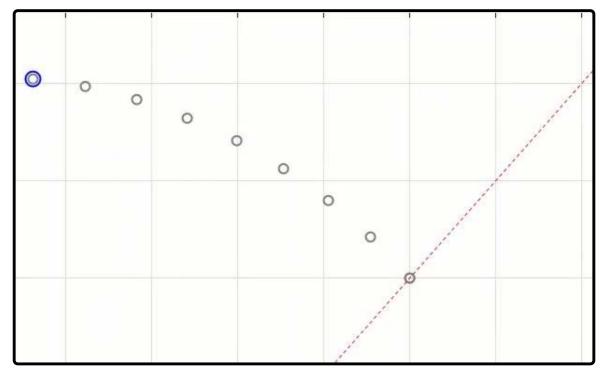


By clicking on "Add", the selected test point is added to the table in this window. By selecting one of the rows and clicking on "Insert" option, the selected row is repeated in the table and by clicking on "Remove" option, the selected point is removed. Also, by selecting "Add to" option, it is possible to copy point or points selected for one of the "Fault Types" to another "Fault Type". By clicking on "Remove All" option, all test points entered in the table will be removed. By clicking on "Sequence" option, "Sequence Test Points to" page opens where it is possible to specify test points with equal steps. In "Step" section and in "Step On" field, by selecting "Angle" it is possible to directly specify the angular steps in terms of angle.

NAdd
N
Insert
Remove
Add to
Remove All
Sequence
Clear All Failed Test

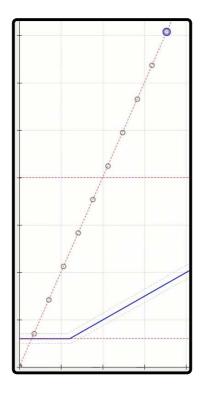
Sequence Test Points to	6		×
Step Step On: Start Angle: End Angle: Step Size: Number of steps: Point	Angle 18.43* 18.43* 0.00* 1	Fault Types ↓ L1-E ↓ L2-E ↓ L3-E ↓ L1-L2 ↓ L2-L3 ↓ L3-L1 ↓ L3-L1 ↓ L1-L2-L3	Cancel
Origin Idiff : 1.000 ln Ibias : 3.000 ln		Al	

This means that the test points are specified in accordance with the origin point and in "Origin" section, they are determined in a way that the required angles are resulted in proportion with the horizon. For example, if the start and end angles are "45" and "90" degrees respectively with "5" degrees steps and origin point for Idiff and I bias equal 5 times In, by approving this settings you can see that some points are added on the "Differential Characteristic". For example, the last point is selected; by doing the mentioned calculation, in the picture you can see that the resulted angle is "85" and not "90" degrees which is because the "Origin" point is considered as one of the points and the last point of this "Sequence" is removed.



But by selecting "Direction", an angle is specified in "Angle" field and in this angle from the "Origin" point, with the length entered in "Length" field and with the steps specified in "Step Size", some points are shot on the characteristic curve. Note that the length and steps of the points are based on nominal current. For example, if the angle is "45" degrees and the length is "5" and the step is "0.5" times the nominal current and the origin point is "0" amp, by approving this settings you can see that some points are added to the characteristic curve at the angle of 45 degrees with the origin of "0" volt and "0" amp.

Step		Fault Types	ОК
Step On:	Direction 🗸	☑ L1-E ☑ L2-E	Cancel
Angle :	0.00 *	🗌 L3-E	
Length :	3.000 In	L1-L2	
Step Size:	0.000 ln	L2-L3	
Number of steps:	1	L1-L2-L3	
Point Origin Idiff : 7.044 lr Ibias : 0.616 lr	= 11		
		🗆 Ali	



If the performed test has "Failed" points, by selecting "Clear All Failed Tests" option, it is possible to clear all these points from the table of this section. In "Detail" section, the information related to "Trip" nominal time, the allowed operation time range, actual time and test point evaluation are entered in "t nom", "t min" and "t max" fields, "t act" and "Stage" fields respectively. The test points are entered with detail in the table at the bottom of the page. The details include test evaluation, test current, nominal time, operation time, fault value in terms of percent and seconds and the minimum and maximum operation time. Also, if you wish to add a comment about any of the test points, you can use the "User Comment" cell. At the end of this page, it is possible to select test points table from different "Fault Types".

t nom .: La	30.00 ms	t act:	
t min:	20.00 ms	t max:	40.00 ms
State:	Not Tested		

	State	Assessment	ldiff	lbias	t nom.	t act	Dev.%	Dev.sec	t min	t max.	User Comment
-1	0	Not Tested	0.000 ln	0.000 In	No-Trip	5			No-Trip	No-Trip	

After performing the "Shot Test", "Check Test" and "Search Test" are performed. In "Check Test" the upper and lower tolerances of the relay, which are displayed as dotted lines in "Differential Characteristic", are tested and evaluated. To perform the "Check Test", first it is necessary to draw some lines named "Check Line" in different parts of the vector. To draw this line, first from "Origin" section in "Check Line" section, the start point of this line is specified. In "Idiff", "I bias", and "Angle" fields, 2In, 3In and -30 degrees are entered as origin differential current, origin bias current and the angle of the check line respectively. Also, 1In is entered as the length of the check line in the cell of the "Length" section. Note that the drawn "Check Lines" must have at least one intersection with one of the characteristic curve tolerance lines. Then click on "Add" option to add the "Check Line" to the "Check Test" test lines table.

Shot Tes	Check Test	Search Test	Stability	Settings	Trigger	Binary Output
lbias: 0 Angle:	.000 ln .000 ln 0.00 *			2-E 3-E 1L2 2L3		

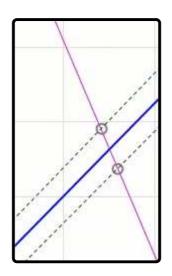
Another method for drawing the "Check Line" is to hold down left-click and "Ctrl" key on "Differential Characteristic" window and then move the cursor in the desired direction on the characteristic curve. You can see that the information of the drawn "Check Line" is displayed in "Check Test" lines table. After drawing the "Check Line", the software evaluates the crossing place of "Check Line" and tolerance lines as "Shot" test in accordance with the performance of the relay. Here, after performing the test, the relay does not perform in lower tolerance and performs a trip in the upper tolerance so the result of the test is "Pass". Other parts of this section such as "Fault Type" and "Remove All" and "Sequence" etc. options are the same at those of "Shot Test" section which have been explained in previous videos. The only additional option in this section is "Copy to Search". By marking any of the test lines and selecting this option, it is possible to copy the selected line in "Search Test" and by selecting "Add" option in "Search Test", add this line to the "Search Test" test lines table.

103 : INTRODUCING "TEST VIEW" WINDOW IN "DIFFERENTIAL" ROOM, PART 2

"Search Test" Tab

After performing "Shot Test" and "Check Test" in "Differential" room, it is necessary to perform "Search Test". The purpose of this test is to find the characteristic curve line. To perform a "Search Test", first some lines named search line should be drawn in different parts of the vector. The method for drawing these lines is the same as the one explained for check line. To draw this line, first the start point of this line is specified in "Search Line" section, "Origin" section. In "Idiff", "I bias" and "Angle" fields, the origin differential current 2In, the origin bias current 3In and search line angle -30 degrees are entered respectively. The length of the check line 3In is entered in the cell of "Length" section. Then, click on "Add" option to add the check line to "Check Test" test lines table.

TestView ×		
Shot Test Check Test Search Test	Stability Settings Trigger Binary	/ Output
Search Line 00 Origin 0.000 ln Idiff: 0.000 ln Ibias: 0.000 ln Angle: 0.000 ° Length Length Search Interval Ignore: 0.000 ln 0.000 ln	Fault Type ● L1-E ○ L2-E ○ L3-E ○ L1L2 ○ L2L3 ○ L3L1 ○ L1L2L3	
State Assessment Idiff Ibias	Angle Length Reach	Ignore User Comment



Another method for drawing the search line is to hold down left-click and "Ctrl" key on "Differential Characteristic" window and then move the cursor in the desired direction on the characteristic curve. You can see that the information of the drawn Search Line is displayed in "Search Test" lines table. After drawing the search line, the software evaluates the crossing place of search line and tolerance lines as "Shot" test in accordance with the performance of the relay. By performing the test, the software interpolates the characteristic curve by testing some points on the search line to find the exact location of the characteristic curve. "Ignore" field in "Search Interval" section is used when you wish to ignore the characteristic curve specified for the search line.

By entering a number in this section, some points are added on the "Search" line with the entered number as their distance. For example, by entering 0.4 in this field, you can see that there are points added on the "Search Line" with as much as 0.4 of distance. If the test is performed, the points added on the "Search Test" are tested one after the other so that the exact location of the relay is specified. This option is used when there is no characteristic curve for the test or the current characteristics seem to be wrong. If you want to do this for all drawn test lines, you can use the "Setting" tab in "Ignore Nominal Characteristic" section. To do so, by entering the value of "Search Interval" and selecting "Apply to all" option, you can apply this settings to all test lines and find the relay characteristic.

"Stability" Tab:

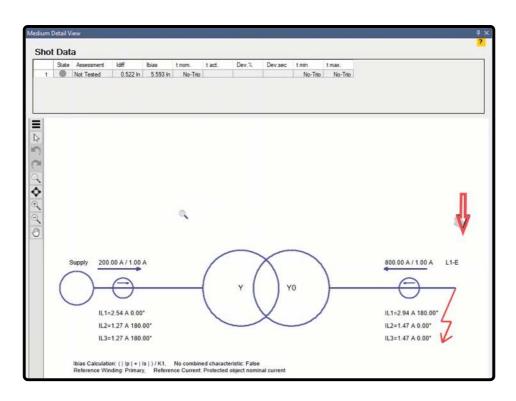
"Stability" test is performed in this tab. In "Stability" test, for zero "I diff" differential current, for every "I bias" the relay must not perform a trip. If you hold down the "Ctrl" key and click on the characteristic curve, you can see that the shot points are located at the bottom of the characteristic curve and on the zero differential current line. In fact, in "Shot Test" you can select different bias currents by zero differential current and perform a stability test. The other explanations for this page are the same as those for "Shot Test" tab and you can watch the video related to that section.

TestView ×			
Shot Test Check Test Search Tes	t (2/0/0/0/2 Stability (4/0/0/0/4)	Settings Trigger	Binary Output
- Test Point Ibias: 3.360 ln Idiff=0	Fault Type L3 ● L1-E 4/0/0/0/4 ○ L2-E 0 ○ L3-E 0 ○ L1L2 0 ○ L2L3 0 ○ L1L2L3 0		
Detail State: Not Tested			

104 : "DIFFERENTIAL" ROOM SETTINGS

In this tab you can manage some of the settings related to performing the tests. In "Supply Direction" section, you can specify the injection and fault direction at the two sides of the protective device. By opening "Medium Detail View" window, you can see that on which side the fault point is located and by changing the "Supply Direction" type you can view that changes. Also, in this section it is possible to view the current amount, fault supplement direction etc. in "Fault Inception" section, the angle where the fault occurs is specified and the currents of the both sides are equally shifted. To better understand this, select "Signal View" from the toolbar and check "Voltage group A" from "Setting" and by changing the value of "Angle", view the voltage and current signal changes. In differential test, if for any reason you wish to activate your voltages, you can use "Voltage Output".

TestView ×			
Shot Test Check Test Search Test (2/0/0/0/2) Stability (7/0/0/0/7 Settings 1		
Supply Direction	Time		
Fault_Secondary_Supply_Primary ~	Prefault Time 100.0 ms		
Fault Inception	Ramp in Prefault		
Model : Fixed angle	Max Fault Time		
Angle : 0.00 °	Max Fault Time (Abs) 1.500 s		
Voltage Output			
Enable Voltage Output			
LN Voltage(LE Fault) 63.51 V			
LL Voltage(LL Fault) 110.0 V			
	PostFault Time 100.0 ms		
	Delay after trigger 50.00 ms		
	Time Reference :		
	Fault Inception Starting		
	Load Current (Prefault Current)		
L.	Based On Current		
12	O Based On Ifault		
	0.000 ln 0.00 *		
	Search Setting		
	Relative 1.00 %		
	Absolute 0.500 ln		
	Max Point Number 12 point		
	Ignore Nominal Characteristics		
	Search Interval: 0.200 In Apply To All		
	Disable All		
	Other Settings Shot Passed Only Act In Main Zone Search Passed Only Act In Zone		
	Passed Settings		
	L		

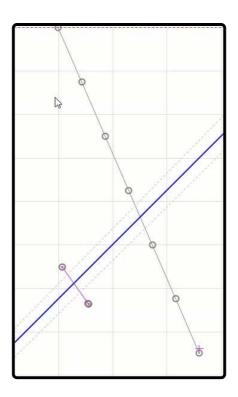


In "Time" section, first, the injection time before the fault is entered in "PreFault Time". In "Max Fault Time" the maximum fault injection time is specified in two forms of "Abs" or "Rel" which consist of three parts themselves. About this time note that if in a "Shot" point the "Max Fault Time" is shorter than "Pick up" time, the result of the evaluation is wrong. If you are using the "Max Fault Time(Abs)" field, you need to enter a time in terms of seconds for the maximum fault signal injection time (for all of the points) but to accelerate the test, you can use the "Max Fault Time(Abs)" option.

By checking this option, three other options appear. By entering a number in "Add %of Tnom", the fault signal injection time in any point, equals the test point nominal time plus a percentage of the nominal time entered in this field. This means that if the test point nominal time is 10 seconds and 5 percent is entered in this field, the maximum fault injection time is 105 percent of the test nominal time which is 10.5 seconds. But in "Add Absolute" field, the fault injection time equals the sum of the nominal time of the test point trip plus the time entered in this field. If all these three fields are filled, the software picks the longest time entered. For points that are located at the "No Trip" zone, it is possible to enter a separate time in "No-Trip Time" field.

In "Post Fault Time", the injection time after the fault is entered. "Delay after Trigger", is used to enter the CB trigger time. By right-clicking on the related field and selecting "Go to Linked Value", you can see that it is linked to "CB Trip Time" and if necessary, you can replace it with your desired value by selecting "Remove Link". In "Time Reference", by selecting "Fault Inception", the "Trip" time is calculated from when the fault is injected. But by selecting "Starting", the "Trip" is calculated from when the "Pickup" contact is received from the relay. In "Load Current (PreFault Current)" you can specify the settings for the phase and current related to "PreFault". In "Amplitude" section, by selecting "Based on Current" radio button, the "PreFault" current is entered in terms of Ampere which is the same for all test points. But by selecting "Based on IFault", the "PreFault" current is entered according to the fault current which is different for every "Shot" point.

In "Search Setting" section, the settings related to "Search Test" are specified. As mentioned before, a "Search Test" arrives at a conclusion only if one of the three conditions of this section is met. The first condition is "Relative" which means that if the difference between the test point value and the previous point is less than the percentage specified in this field, this very point is the result of the test. The second condition is "Absolute" which means that if the difference between the test point and the previous point is less than the value specified in this field, this very point is the result of the test. The second condition is "Absolute" which means that if the difference between the test point and the previous point is less than the value specified in this field, this very point is the result of the test. The third condition is "Max point number" which means that the test is to be performed as many times as the number of points entered in this field at max and the last point is the result of the test. But if for any reason, the nominal characteristic determined for the relay is not available, you can use "Ignore Nominal Characteristic" section. By doing so, the software ignores the existing characteristic. Then, based on the step entered in "Search Interval", it adds shots on the "Search" line. For example, a line is drawn in "Search Test" section. Then, 0.5 is entered as the value for "Search Interval" and "Apply to All" is selected. You can see that some points with the same step are added on the "Search" line. By running the test, you can see that the test starts from the lowest point and once one of the three mentioned conditions is met, the test arrives at a result. Also, if necessary, you can ignore this option by selecting "Disable all".



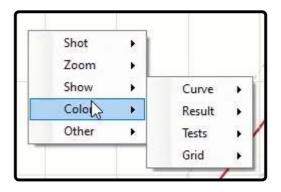
By selecting "Shot Passed Only Act In Main Zone" in "Other Setting" section, the test is passed only if the relay performance time in the shot point is somewhere in the allowed range of the main zone. This means that if this option is checked and a shot is added in the tolerance zone of the bottom of the characteristic curve and the relay gives a trip, the test fails because after checking this option, the relay performance is accepted only if it is at the upper zone of the characteristic curve.

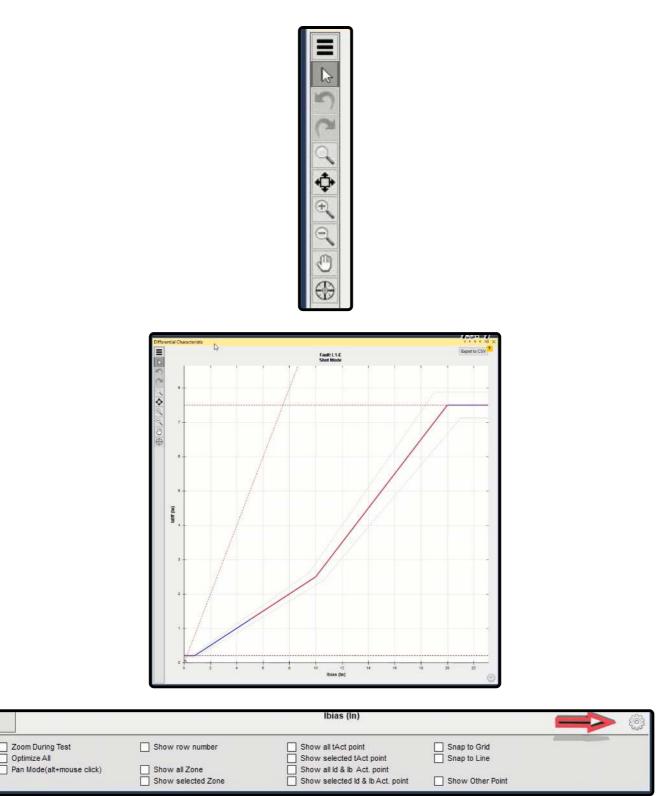
"Search Passed Only Act in Zone" is for "Search Test" and by checking this option, the "Search Test" is passed only if the relay trip is in the "Tripping" zone of the nominal characteristic curve of the relay. In "Passed Setting" section, by checking "Pass if Get Any Trip" option, regardless of the relay performance time, if the relay operates in the "Tripping" zone, the test passes.

In "Trigger" tab you can specify the desired binary to receive the "Pickup" and "Trip" signals of the relay as well as stopping the current injection. The settings and explanation of this section are exactly the same as mentioned for "Trigger" room and "Sequencer". In "Binary Output" tab, if it is necessary for the relay to view the conditions of the circuit breaker, it is possible to take any needed voltage to the "Binary Input" through "Binary Output" of the device by voltages of "A", "B" or "Aux Dc" groups. This tab has three modes "PreFault", "Post fault" and you can configure each section separately.

105 : "DIFFERENTIAL CHARACTERISTIC" WINDOW

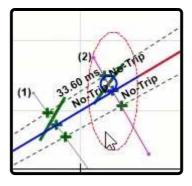
As mentioned before, one of the main windows of differential room is "Differential Characteristic". This window shows the relay differential characteristic curve based on the settings entered in "Test Object" window. The top of the characteristic curve is called "Tripping" area while the bottom is called "Not trip" area. This means that if the test point is located at the top of the curve, the relay gives a trip otherwise it does not. This window has some shared and some unique features. The features available by right or left clicking on this window are common to all rooms and it is not necessary to explain them here but at the bottom of this window there is a gear by clicking on which some other useful options are displayed. By clicking on "Zoom during test", if one or multiple "Search" lines are drawn on the characteristic curve, by running the test you can see that the software zooms on the areas where the test points are located and shows the found zone line.





If you select "Optimize All" option, by changing the "Fault type", the characteristic curve display is "Optimized". By using "Pan Mode" you can move the characteristic curve diagram as desired. By using "Show row number" you can view the row number of any test point or test line on the characteristic curve. By selecting "Show all zone", test zones of all "Search" points are marked with a circle to find the characteristic curve line. By selecting "Show selected zone", only the points of the line selected from "Search line" table are marked with a circle.

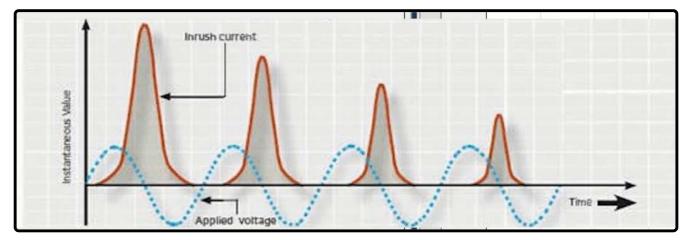
By clicking on "Show all t act point", the operating time of the tested points is showed. Since maybe the points are close to each other and it is not possible to view the times clearly, you can use "Show selected t act point" option which shows the time of the row selected from the test points table. "Show all Id & Ib Act" and "Show selected t act point" options are used to show all tested "Search Test" points and the points related to the row selected from the "Search Test" table respectively. By selecting "Snap to grid" option, the points on the characteristic curve that are shot close to the grids snap to the grids of this page. By selecting "Snap to characteristic curve" option, the points on the characteristic curve that are "Shot" close to the characteristic curve grid snap to it.



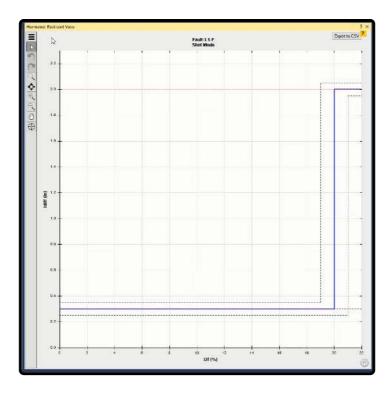
"Show Other Point" option: by selecting this option in single-phase faults such as "L1-E", in addition to the shot points, another point is displayed on the "Differential characteristic" window in the form of a delta which in fact is the indicator of differential and bias current of the two other phases. This option is used in cases where the single-phase fault characteristic curve is different from the phase-to-phase fault. The reason for this difference is that in some areas, the relay does not perform a trip because of the differential and bias current of the two other phases. This means that if you have brought a general trip to the device to test single-phase fault such as "L1-E" and checked "NO COMBINED CHARACTERISSTIC" option, in some of the areas close to the characteristic curve the relay performs a trip for the "L1-E" fault but this trip is not the trip of the "L1" phase but it is related to current of the two other phases which can be also observed by using the characteristic of the delta point on the curve. If in same condition the "NO COMBINED CHARACTERISTIC" option is unchecked, you can see that this point is located at the "TRIPPING" zone.

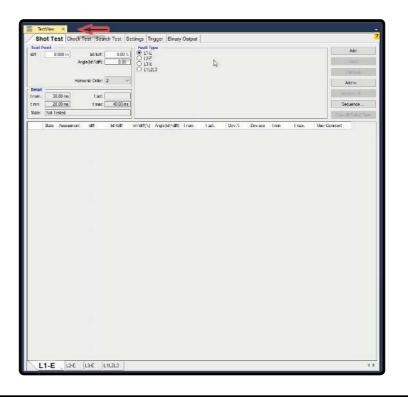
106 : INTRODUCING "AMT DIFF. HARMONICS" ROOM

"Differential Harmonic" test or "Inrush Blocking" test is performed in "AMT Diff. Harmonics" room. This room opens by clicking on "AMT Diff Harmonics" option. At the moment of initiation, power transformer draws a great deal of inrush current named "Inrush". If the transformer is not completely "Demagnetized", and has some residue, it makes it to draw a great deal of inrush current which can damage the transformer. One of the ways for detecting this inrush current at the moment of transformer initiation is to compare the secondary harmonic current with the main harmonic.



"AMT Diff Harmonics" room consists of two main windows of "Test View" and "Harmonic Restraint View". "Shot", "Check" and "Search" test are performed in "Test View" window and in "Harmonic Restraint View" the harmonic differential characteristic curve is displayed. This diagram is based on a percentage of the harmonic current of the "n"th level and "Idiff". Note that in this window it is possible to manage the settings up to 20th harmonic and inject it into the relay. In this room, three current outputs of the device are used to perform the injection into the relay because the transformer turns via, three phases.





Relay settings in "AMT Diff. Harmonics" Room

As mentioned before, before testing the relay, its information must be entered in "Test Object" window. In "Device" block, information such as nominal characteristics of the relay, serial number, location of the relay and "CT" and "PT" characteristics of the relay are entered. This section has been thoroughly explained in previous videos. But the main block of this room is "Differential" by double-clicking on which "Differential Protection Parameters" window opens. This window consists of four tabs of "Protected Object", "Protection Device", "Characteristic Definition" and "Harmonic" where the differential relay settings is entered.

ResizeColu	Protected Object Protection	Device charact					
t Functions	Protected Object		Vector Gro	up		umber of Winding	js —
om	Transformer	•	YYO			2 () 3	
Device	Nominal Values	Prim	ary	Secondar	у	Tertia	ny
Differential CBConfigurati	Winding/Leg Name :	Primary	-	Secondary		Tertiary	
	Voltage :		115.5 kV		30.00 kV		30.00 kV
	Power:		40.00 MVA	40	00 MVA		40.00 MVA
	Vector Group :	Y	•	Y	•	Y	
	Connection Number :	0	*	0	•	0	
	Starpoint Grounding :	No	-	No	+	No	7
	Current :		199.9 A		769.8 A		769.8 A
	Delta-Connected CT :	No	~	No	*		
	CT Nominal Values						
	Primary Current :		200.0 A		800.0 A		800.0 A
	Secondary Current :		1.000 A		1.000 A		1.000 A
	Starpoint Grounding :	tow. Prot. Obj.	-	tow. Prot. Obj.	*	tow, Prot. Obj.	
	Ground CT Nominal Val		d Current Measu	rement inputs (CT)			
	Primary Current :		200.0 A		800.0 A		800.0 A
	Secondary Current :		1.000 A		1.000 A		1.000 A
Error / Warnii	Starpoint Grounding :	tow. Prot. Obj.	-	tow. Prot. Obj.	*	tow. Prot. Obj.	*
		· · ·		S		1	1

"Protected Object" Tab

In this tab the information of the transformer on which the "Inrush Blocking" protection is done is entered. Frist, from "Protected Object" section, the "Transformer" option is selected. Other information of this tab such as the number of coils of the transformer, nominal voltage, nominal power, vector group characteristics and "CTs" characteristic should be entered at the two sides of the relay. This information is the same as that of the "AMT Differential" room and has been explained in previous videos.

Protected Object Transformer		Vector Gro YYD	up		umber of Winding 2 () 3	3
Nominal Values	Primary		Seconda	iry	Tertiar	y
Winding/Leg Name :	Primary		Secondary		Tertiary	
Voltage :		115.5 kV		30.00 kV		30.00 kV
Power :	40	.00 MVA	4	0.00 MVA	4	0.00 MVA
Vector Group :	Y	•	Y	•	Y	~
Connection Number :	0	*	0		0	+
Starpoint Grounding :	No	•	No	-	No	+
Current :		199.9 A		769.8 A		769.8 A
Delta-Connected CT :	No		No	*		
CT Nominal Values						
Primary Current :		200.0 A		800.0 A		800.0 A
Secondary Current :		1.000 A		1.000 A		1.000 A
Starpoint Grounding :	tow. Prot. Obj.	•	tow. Prot. Obj.	-	tow. Prot. Obj.	*
	Use Ground Cu	irrent Measu	rement inputs (CT)			
Ground CT Nominal Valu Primary Current :	es	200.0 A	-	800.0 A	1	800.0 A
Secondary Current :		1.000 A		1.000 A		1.000 A
Starpoint Grounding :	tow. Prot. Obj.	*	tow. Prot. Obj.	*	tow. Prot. Obj.	*

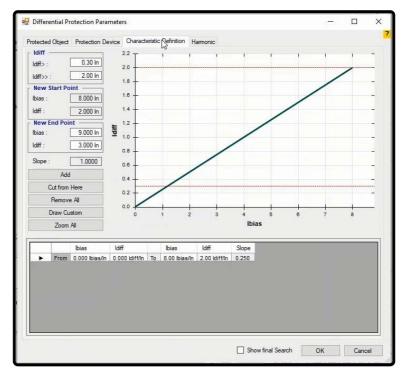
"Protection Device" Tab

After entering the transformer information, the information and differential relay characteristics are entered in "Protection Device" tab. This information includes determining the calculation formula of "I bias" or "I Restraint" current by the relay, determining the reference winding, specifying the maximum fault injection time and delay time after the "Trip", entering the minimum and maximum differential current in the relay characteristic curve, entering the nominal relay operation time and specifying the current and time tolerances of the relay which are the same as "AMT Differential" room and have been thoroughly explained in previous videos.

Ibias Calculation		Reference Winding -			
(lp + ls)/K1	-	Primary			
Factor K1 = 1.000	ß	Reference Current - Protected object nomin CT nominal current	nal current		
Zero Sequence Elimination	Primary	Secondary		Tertiary	
Elimination Type : IL-10	•	IL-10	IL-10	*	
Test Time Settings / Transformer	Model	Diff Time Settings -			
Test Max :	1.500 s	tdiff>		30.00 ms	
Delay Time :	250.0 ms	tdiff>>		30.00 ms	
Diff Current Settings		Time Tolerances			
ldiff >	0.30 ln	relative :		3.00 %	
ldiff >>	2.00 ln	absolute :		10.00 ms	
Current Tolerances					
elative :	2.00 %				
absolute :	0.05 ln				

"Characteristic Definition" Tab

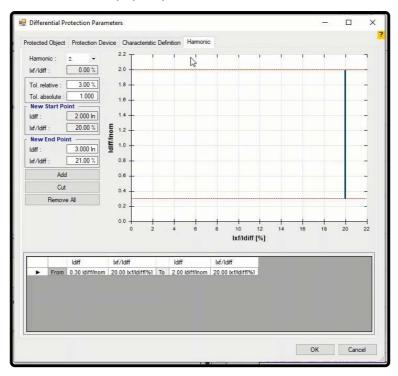
In this tab the information related to the differential characteristic curve is entered. This section is similar to "AMT Differential" room which has been thoroughly explained in previous videos. However, in this room, it is not necessary to enter the differential characteristic curve because in this room only the harmonic characteristic is displayed and "Inrush Blocking" test is performed. This information is mentioned here so that the "Xrio" file is correctly "Loaded".



"Harmonic" Tab

The information related to the harmonic differential characteristic curve of the relay is of entered in this tab. In "Harmonic" field, the harmonic level is specified and it is possible to specify the information second to 20th harmonic and inject it by the device. Note that, "n/a" in front of any harmonic level means that the settings related to that harmonic is not specified. In "Ixf/Idiff" field, which is disabled, the proportion of the "nth" harmonic to the differential current is displayed. In "Tol. Relative" and "Tol. Absolute" fields, the relay tolerances are entered in terms of a percentage of the nominal value or as "Abs" respectively and the software picks the highest tolerance amount as the reference. Next, the differential characteristic curve is entered based on the relay parameters. 20 percent and 45 percent are set on the level 2 and level 5 harmonic current relays. First click on "Remove All" to remove all previous lines. Then, after entering the start point coordination in "New Start Point" section and then end point coordination in "New End Point" section in terms of "Idiff" and "Ixf/Idiff" click

on "Add" to display the information of this line in the table at the bottom of the page and display the characteristic curve in the diagram at the right side. Note that it is also possible to edit the start and end points from the box at the bottom of the page. To enter the fifth harmonic information, select 5 in "Harmonic" field and enter the start point and end point coordinates in the table at the bottom of the page. Then click on "Ok" and close "Test Object". You can see that the second harmonic differential characteristic curve is displayed by default.



107 : "TEST VIEW" WINDOW

As mentioned before, one of the windows of "AMT Diff Harmonic" room is "Test View". This window consists of 6 tabs of "Shot Test", "Check Test", "Search Test", "Setting", "Trigger" and "Binary Output" where in addition to performing "Shot", "Check" and "Search" tests, respectively, some other test settings are managed.

Test Pi	01nh ⁶	bf/diff:	0.02 %	Fault Type				Add
	0.000 m	Angletist/Idits	0.00 *	O L24 O L3E				- with
				0 ulas				PRINTING INC.
		Hamonie Order:	2 v					Add to
nom.	30.00 ms	t ast:						PETUNE 78 -
mm.	20.00 me	t max:	40.00mm					Sequence
tate	Not Tested							Disk Million Int
T	State Accesso	vent kilf	ké/difi	uf/dff[%] Angletiuf/idff) thom	fect. Dev %	Devised 1mm	tmax User	Comment



In this tab, first in "Harmonic Order" field in "Test Point" section, the harmonic level that you wish to test is entered. Meanwhile, you can see that its characteristic curve is displayed in "Harmonic Restraint View" window whose setting are entered in Test Object. Differential current and the proportion of the second harmonic current to the differential current are entered in terms of percentage in "Idiff" and "Ixf/Idiff" fields respectively. In "Angle (Ixf/Idiff)" field, it is possible to specify an angle for the harmonic current. In "Fault Type" section, the fault type is selected from among single-phase to earth and three-phase faults because the transformers are either single-phase or three-phase and only these modes are tested. In "Details" section, the nominal "Trip" time and the maximum and minimum allowed tolerances are displayed. After performing the test, the relay performance time is displayed in "t act" field. By selecting "Add" option, the information of this "Shot" is added to the "Shot Test" table along with its details. The details include test evaluation, differential and harmonic current, test angle, nominal time, performance time, fault value in terms of percentage and seconds and the minimum and maximum performance time. Also, if you wish to add a comment about any of the test points, you can use "User Comment" cell. Also, at the end of this page, it is possible to select test points table in different "Fault Types".

30.00 * 30.00 ms 32.00 ms

6.67 % 2.000 ms 20.00 ms 40.00 ms

0.700 ln

0.070

10.00 %

Passed

By marking one of the rows and selecting "Insert" option, the marked row is repeated in the table and by selecting "Remove option, the marked point is removed. By selecting "Add to" option, it is possible to copy the point or points selected from one of the "Fault Types" to another "Fault Type". By selecting "Remove All" option, all of the test points added to the table are removed. By clicking on "Sequence" option, "Sequence Test Points to" page opens where it is possible to create test points with the same steps. By selecting "Angle" in "Step On" field in "Step" section, the angular steps are directly added in terms of degrees.

Add	
loset	l
Remose	l
Add to	
Remove All	
Sequence]
Clear All Falled Tests	1

This means that the test points are specified in accordance with the origin point and in "Origin" section in a way that the required angles are resulted in proportion with the horizon. For example, if the start and end angles are "45" and "90" degrees respectively with "5" degrees steps and 0.3 and 2 origin points for Idiff and I bias with 0 angle, by approving this settings you can see that some points are added on the "Harmonic Restraint View". For example, the last point is selected; by doing the mentioned calculation, in the picture you can see that the resulted angle is "85" and not "90" degrees which is because the "Origin" point is considered as one of the points and the last point of this "Sequence" is removed.

 $^{-1}(7.044 / 0.6163) = 85$

Sequence Test Points to	W	×
Step Step On: Angle Start Angle: 4!* End Angle: 4.00* Step Size: 0.00* Number of steps: 1	Fault Types ↓ L1-E ↓ L2-E ↓ L3-E ↓ L1-L2-L3	Cancel
Point Origin Idiff : 0.700 In Idiff : 0.700 In Angle(kf/ldiff 0.00 *)	Ali	

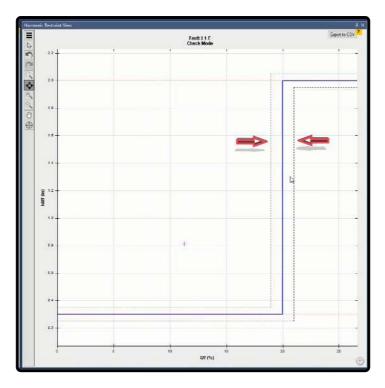
But by selecting "Direction", an angle is specified in "Angle" field and in this angle from the "Origin" point, with the length entered in "Length" field and with the steps specified in "Step Size", some points are shot on the characteristic curve. Note that the length and steps of the points are based on nominal current. For example, if the angle is "45" degrees and the length is "2" and the step is "0.1" times the nominal current and the origin point current and the second harmonic are "0", by approving this settings you can see that some points are added to the characteristic curve at the angle of 45 degrees with the origin of "0". After removing all of the points by using "Remove All" option and adding three new "Shots" to the table, the test runs and the relay performance is analyzed. If the performed test has "Failed" points, by selecting "Clear All Failed Tests" option, the results of these points are "Cleared" from the table and you can test the point again by rightclicking on its row and selecting "Apply Test".

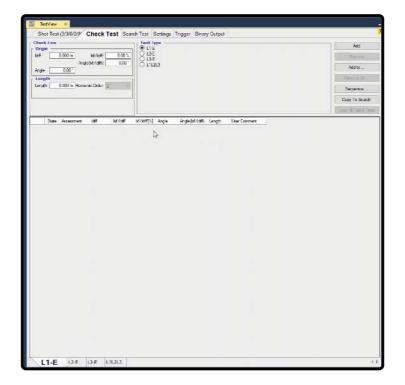
Step		Fault Types	ОК
Step On:	Direction ~	☑ L2-E	Cancel
Angle :	0.00*	□ L3-E	
Length :	45 0.000 ln	🗌 L1-L2-L3	
Step Size:	0.000 ln		
Number of steps:	1		
Point	1 bf/ldiff[%] : 0.18 % Angle(bf/ldiff 0.00 °		
		I AI	

"Check Test" Tab

After performing the "Shot Test", "Check Test" and "Search Test" are performed. In "Check Test" the upper and lower tolerances of the relay, which are displayed as dotted lines in "Harmonic Restraint View", are tested and evaluated. To perform the "Check Test", first it is necessary to draw some lines named "Check Line" in different parts of the vector. To draw this line, first from "Origin" section in "Check Line" section, the start point of this line is specified. In "Idiff", "Ixf/Idiff", "Angle (Ixf/Idiff)" and "Angle" fields, 1In, 17 percent, 0 degree and 0 degree are entered as origin differential current, the proportion of the "nth" harmonic current to the differential current, the angle of the "nth" harmonic current and the angle

of the "Check Line" respectively. Also, 5In is entered as the length of the check line in the cell of the "Length" section. In "Harmonic Order" field, the harmonic level is selected so that its curve is displayed. Note that the drawn "Check Lines" must have at least one intersection with one of the characteristic curve tolerance lines. Then click on "Add" option to add the "Check Line" to the "Check Test" line table.





Another method for drawing the "Check Line" is to hold down left-click and "Ctrl" key on "Harmonic Restraint View" window and then move the cursor in the desired direction on the characteristic curve. You can see that the information of the drawn "Check Line" is displayed in "Check Test" lines table. After drawing the "Check Line", the software evaluates the crossing place of "Check Line" and tolerance lines as "Shot" test in accordance with the performance of the relay. Here, after performing the test, the relay does not perform in lower tolerance and performs a trip in the upper tolerance so the result of the test is "Pass". Other parts of this section such as "Fault Type" and "Remove All" and "Sequence" etc. options are the same at those of "Shot Test" section which have been explained in previous videos. The only additional option in this section is "Copy to Search". By marking any of the test lines and selecting this option, it is possible to copy the selected line in "Search Test" and by selecting "Add" option in "Search Test", add this line to the "Search Test" test lines table.

"Search Test" Tab

After performing "Shot Test" and "Check Test" in "AMT Diff. Harmonics" room, it is necessary to perform "Search Test". The purpose of this test is to find the characteristic curve line. To perform a "Search Test", first some lines named "Search Line" should be drawn in different parts of the vector. The method for drawing these lines is the same as the one explained for "Check Line". To draw this line, first the start point of this line is specified in "Search Line" section, "Origin" section. For example, in "Idiff", "Ixf/Idiff", "Angle (Ixf/Idiff)" and "Angle" fields, 1In, 17 percent, 0 degree and 0 degree are entered as origin differential current, the proportion of the "nth" harmonic current to the differential current, the angle of the "Nth" harmonic current and the angle of the "Search Line" respectively. Also, 6In is entered as the length of the check line in the cell of the "Length" section. In "Harmonic Order" field, the harmonic level is selected so that its curve is displayed. Then click on "Add" option to add the "Search Line" to the "Search Test" test lines table. After drawing the "Search Line", the software tests the intersection location of the "Search Line" and tolerance lines as "Shot" and evaluates them based on the relay performance. Upon running the test, by testing some points on the search line the software starts interpolating the characteristic curve and determines its exact location.

Mit 0.000 h kervalt 0.00 k Angle (MARP) 0.00 k 0.00 k 0.00 k Length 0.000 h 1.00 k 0.00 k Search Interval Copy Tr Copy Tr	Search Line Origin	Fault Type (0) 11-F 1/0/0/0/1	Ade
vigit: 0.00° Model/Artifity 0.00° Model Model	an 0.000 in identif 0.00 %	O LAR	Factoria
Length		Č ŭižus	Addito
Search Interval	Length		Planave /0
strate Assessment koff in/1687 M/AFE(2) Angle Angle/M/AFE Length Thech Ignore User/Comment	ength: 0.000 in Harronic Order 2		Sequence .
State Assessment kiff inf/ldff Mr/Astf[2] Angle Angle(Mr/Astf) Length Reach Ignore UserComment			Copy To Che
	gnore: 0.000 In		The Minkel

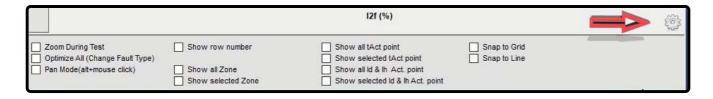
"Ignore" field in "Search Interval" section is used when you want the intended "Search" line to ignore the specified characteristic curve. By entering a number in this section, some points are added on the "Search" line with this number as the distance between them. For example, by specifying "2In" in this field, you can see that some points are added on the "Search Line" with "2In" distance from each other. By clicking on "Add" option, this "Search Line" is added to the "Search Test" lines table. If the test runs, the points added on the "Search Test" are tested one after the other until the exact location of the relay characteristic curve is determined. This option is used when there is no characteristic to test or the characteristic that you have seems wrong.

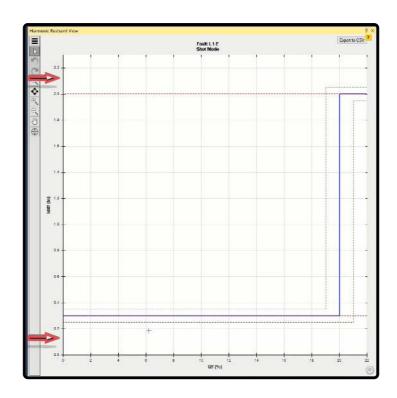
If you wish to do the same for all of the tested lines, you can use "Setting" tab in "Ignore Nominal Characteristic" section. To do this, by entering the value in "Search Interval" and selecting "Apply to All" option, you can apply this setting to all test lines and find the relay characteristic.

Search Interval:	0.400 ln	Apply To All
		Disable All

108 : "HARMONIC RESTRAINT VIEW" WINDOW

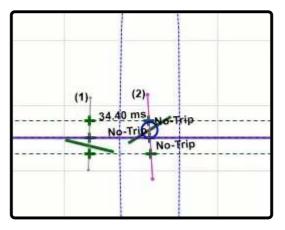
As mentioned before, one of the main windows of diff Harmonics room is "Harmonic Restraint View". This window shows the relay harmonic characteristic curve based on the settings entered in "Test Object" window. The top of the characteristic curve is called "Tripping" area while the bottom is called "No trip" area. This means that if the test point is located at the top of the curve, the relay gives a trip otherwise it does not. This window has some shared and some unique features. The feature available by right or left clicking on this window are common to all rooms and it is not necessary to explain them here but at the bottom of this window there is a gear by clicking on which some other useful options are displayed. By clicking on "Zoom during test", if one or multiple "Shot" or "Search" lines are drawn on the characteristic curve, by running the test you can see that the software zooms on the areas where the test points are located and shows the found zone line.





If you select "Optimize All(Change Fault Type)" option, by changing the "Fault type", the characteristic curve display is "Optimized". By using "Pan Mode(alt+mouse+click)" you can move the characteristic curve diagram as desired. By using "Show row number" you can view the row number of any test point or test line on the characteristic curve. By selecting "Show zones(All Search Lines)", test zones of all "Search" are marked with a circle to find the characteristic curve line. By selecting "Show zones(Selected Search Line)", only the points of the line selected from "Search line" table are marked with a circle.

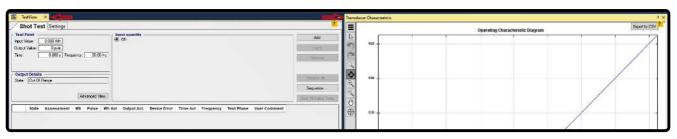
By clicking on "Show all t act point", the operation time of the tested points is showed. If the points are close to each other and it is not possible to view the times clearly, you can use "Show selected t act point" option which shows the time of the row selected from the test points table. "Show all Id & Ih Act" and "Show selected Id & Ih Act point" options are used to show all tested "Search Test" and the points related to the row selected from the "Search Test" table respectively. By selecting "Snap to grid" option, the points on the characteristic curve that are shot close to the grids snap to the grids of this page. By selecting "Snap to Line" option, the points on the characteristic curve that are "Shot" close to the characteristic curve grid snap to it.



about:blank

109 : "OFFLOAD" TEST OF THE METER:

To test Energy Meters, AMT Transducer & Meter room can be used. On "Start" page, the "AMT Transducer & Meter" room software is opened. This room is comprised of the two main windows of "Test View" and "Transducer Characteristic"; in "Test View" window, it is possible to perform a "Shot Test" for various quantities and compare the results with the meter characteristic.

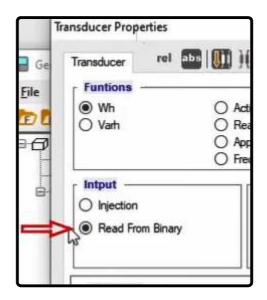


TestView ×		
Shot Test Salange		?
Input Value: 0.000 Wh	│ Input quantity ───────────────────────────────────	Add
Output Value: 0 puls		Inset
Time: 0.000 s Frequency: 50.00 Hz		Remove
Output Details		Remove All
		Sequence
Advanced View		Clear All Failed Testa
State Assessment Wh Pulse Wh	Act Output Act. Device Error Time Act Frequency Test Phase User Comment	

To begin the test, after completing the information in "Device" in "General Test Object" window, double click on "Transducer" option. On "Transducer Properties" page, it is possible to view a set of functions. To test the meter, two functions of "Wh" and "Varh" are used; here, "Wh" is selected. By selecting "Injection" option in "Input" section, it is possible to perform the "Offload" test of the meter by injection from the device. The other option is "Read from Binary" which is used to perform an "On Load" test of the meter. By selecting this option, it is necessary to enter the values into the inputs of the device using the clamps and interface cables.

🖶 General Test Object		×
<u>File View</u>		✓ Tree : 7
💼 🛅 🕅 Resize Columns : Auto	- P. F. Persteulste Dirshled Formulate) 4 Ou	
⊟-⊖0 XHio	P Device Settings	- 🗆 X
Script Functions	Device Settings	Formula
E-CT RIO	C Device	Nominal Values
⊕	Name/Description : MK6] f nom : 50.00 Hz
CBConfiguration	Manufacturer :	V nom(secondary): 110.0 V(L-L)
	Device Type :	63.51 V(L-N)
	Device Address :	V primary : 400(.0k V(L-L)
	Serial/Model Number :	132.8 kV(L-N)
		I nom(secondary) : 1.000 A
	Additional Information 1 :] I primary : 2.000 kA
	Additional Information2 :	Residual Voltage/Current Factors
	Substation	VLN/VN : 1.730
	Name :	IN/1 nom 1.000
	Address :	Limits
	r Bay	V max : 132.0 V
	Name :] I max : 64.00 A
	Address :	Debounce/Deglitch Filters
		Debounce Time : 3.000 ms
		Deglitch Time : 400.0 µs
Proccess Log Error / Warning Formula F		w/Hide
		ancel
	Save to Template Load Template Export	Import OK Cancel

r		
	Transducer Properties -	× 2
🔚 Ge	Transducer rel 🌆 🛄)	
	Functions O Wh O Active Power O Current O Phase [V-V] O DC Current Image: Stress of the stress	Value Pulse Injection
201	Image: Sead From Binary Current Image: Sead From Binary Image: Sea	0 +max Towards Line No Yes
	Tolerance Number of phases Absolute : 1000 mPuls 1-Phase Relative : 0.25 % Image: 1-Phase Characteristic definition 3-Phase Characteristic definition	50
Procce	Varh OK Cance	how/Hide
		di

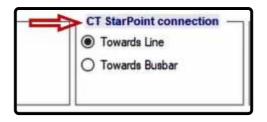


In "Output" section, it is possible to specify the type of the output received from the meter. To test transducers and their corresponding outputs, by selecting "Current" or "Voltage" options, it is possible to take the output current and voltage values to the inputs 9 and 10 for measurement. To test the meter, if only the output values are being displayed on the screen, "Open Loop" option can be used. Here, "Pulse" option is used so that using the light sensor which comes with the device, the number of the output pulses of the meter is recorded.

Î	Current	
	O Voltage	
	O Open Loop	
	Pulse	
	Output	
	Output O Current	
	Current Voltage	
	Current	

In "CT Star point Connection" section, the connection related to the current transformers are specified. Usually and since

the active power flows from the busbar toward the line, "Toward Line" option is selected. Selecting "Toward Line" is in accordance with the injection of the active power from the device to the equipment. If "Toward Busbar" is selected, 180 degrees are added to the angle of the current.



In "Full Scale Error Reference" section it is possible to specify the error recording reference which can be selected from a range of zero to the maximum or negative to the positive maximum. If the characteristic is asymmetrical the range is from zero to the maximum while if the characteristic is symmetrical, it is possible to select both options for error measurement. As for error measurement, suppose that for a transducer with a characteristic with the maximum input of 1 amp and output of 33 milliamperes, for a 0/5 amp current, the output of the transducer equals 16 milliamperes. In such a case, the error percentage is calculated as follows.

$$\frac{1}{.033}$$
*.016 = 480mA

● 0+max
O -max +max

This means that ideally, for a 480 milliamperes input, the output equals 16 milliamperes. Therefore, the absolute error value equals 20 milliamperes and the error percentage equals -4 percent:

480 - 500 = -20 mA
$\frac{480-500}{100}$ *100 = -4%
500

Also, the "Full-Scale" error value of the transducer equals -2 percent.

0.480-0.500	2%
1	- 270

This method is used for cases where "Full Scale Error Reference" is set at "0...+max". If the characteristic is "Symmetrical", the error calculation method should be selected from among "0..+max" and "-max...+max". For the previous example, if the characteristic was symmetrical and "-max..+max" was selected, the following relation is used for "Full Scale Error" calculation.

$$\frac{0.480 - 0.500}{2* 1} = -1\%$$

In "Tolerance" section, it is possible to enter the error value as an absolute or a relative value; the default values are 1 milli

pulse and 0/25 percent. Finally, a comparison is made between these two values and the larger value is selected as the allowed error value. In "Number of phases" section, it is possible to specify whether the meter is single-phase or three-phase.

The test characteristic is specified in "Characteristic Definition" section. Since the meter characteristic is linear, "Linear" option is selected as the "Characteristic Type" and it is uneditable.

Characteristic definition — Characteristic Type :	Linear	~
Symmetrical	Tr-Input	Tr-Output
Minimum value :		
Knee point :		
Maximum value :	727.3 MWh	100.0 puls
Saturation range :		

To specify the energy "Import" and "Export" values, it is possible to check the "Symmetrical" option so that there is a Symmetrical characteristic in both sides available. The "Minimum Value", "Knee Point" and "Saturation range" fields are disabled for meter test but in "Maximum Value" section, it is possible to enter the amount of power and the number of pulses received in exchange for that amount of power. Usually, the meter factor or "c/r" is entered in this section. For example, the factor for a edmi mk6e meter equals 5000 Wh per pulse.

Tolerance Absolute : 1.000 mPuls Relative : 2.00 %	Number of pho 1-Phase 3-Phase	1565	3000
Characteristic definition Characteristic Type :	Linear	~	1000
Symmetrical	Tr-Input	Tr-Output	500
Minimum value :			-1500
Knee point :			-2500
Maximum value :	727.3 MWh	100.0 puls	-3000
Saturation range :			-3000 -2000 -1000 6 1000 2000 3000 In/Wh

Characteristic Type :	Linear	~
Symmetrical	These	
Minimum value :	Tr-Input	Tr-Output
Knee point :		
Maximum value :	5.000 kWh	1 puls
Saturation range :	ſ	

Note that by using "Primary" and "Secondary" options at the top of the screen, it is possible to enter the values as primary or secondary in accordance with the meter type which needs to be done considering the CT and PT conversion ratios.

Ti	ransducer Prope	rties	
e	Transducer	rel	
L	Funtions -		Primary
	Wh		O Active Powe

"Relative" and "Absolute" options are used for displaying the absolute or relative amount of the values. After entering the values, "Ok" is selected to continue with the test.

After completing the information in "Transducer Properties" section, the "Hardware Configuration" settings need to be examined. By opening this window, you can see that the current and voltage outputs are set by default.

Voltage Output][.	Voltage O	utput Signal —		
x150V, 60VA @ 400mArms x150V, 120VA @ 800mArms	A I 2 2 B B I N		Output Target	Output Label	Show Actual Value
x150V, 120VA @ 800mAms x300V, 120VA @ 400mAms	0000 00	X1	V L1-E	V L1-E	False
x450V, 200VA @ 400mAms	X1 YN	X2	V L2-E	V L2-E	False
lot Used		X3	V L3-E	V L3-E	False
	X2	Y1	Not Used	Not Used	False
urrent Output		Current C)utput Signal —		
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms	A 1 2 3 N	Current C	Dutput Signal — Output Target	Output Label	Show Actual Value
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms		X1	Output Target	IL1	False
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms x32A, 200VA @ 32A, 6Vms, 5A, 24Vms x32A, 400VA @ 32A, 12Vms, 5A, 48Vms		X1 X2	Output Target	IL1 IL2	False False
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms x32A, 200VA @ 32A, 6Vms, 5A, 24Vms x32A, 400VA @ 32A, 12Vms, 5A, 48Vms x128A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3	Output Target IL1 IL2 IL3	IL1 IL2 IL3	False False False
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms x32A, 200VA @ 32A, 6Vms, 5A, 24Vms x32A, 400VA @ 32A, 12Vms, 5A, 48Vms x128A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1	Output Target IL1 IL2 IL3 Not Used	IL1 IL2 IL3 Not Used	False False False False
Current Output x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms x32A, 200VA @ 32A, 5Vms, 5A, 48Vms x32A, 400VA @ 32A, 12Vms, 5A, 48Vms x128A, 400VA @ 128A, 3Vms, 30A, 12Vms lot Used		X1 X2 X3 Y1 Y2	Output Target IL1 IL2 IL3 Not Used Not Used	IL1 IL2 IL3 Not Used Not Used	False False False False False
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms x32A, 200VA @ 32A, 6Vms, 5A, 24Vms x32A, 400VA @ 32A, 12Vms, 5A, 48Vms x128A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1	Output Target IL1 IL2 IL3 Not Used	IL1 IL2 IL3 Not Used	False False False False
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms x32A, 200VA @ 32A, 6Vms, 5A, 24Vms x32A, 400VA @ 32A, 12Vms, 5A, 48Vms x128A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1 Y2	Output Target IL1 IL2 IL3 Not Used Not Used	IL1 IL2 IL3 Not Used Not Used	False False False False False
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms x32A, 200VA @ 32A, 6Vms, 5A, 24Vms x32A, 400VA @ 32A, 12Vms, 5A, 48Vms x128A, 400VA @ 128A, 3Vms, 30A, 12Vms		X1 X2 X3 Y1 Y2	Output Target IL1 IL2 IL3 Not Used Not Used	IL1 IL2 IL3 Not Used Not Used	False False False False False False

In "Binary/Analog Input" tab, you see that the Binary number 8 is selected to record the pulses of the meter by default. However, it is possible for the user to use any other binary if necessary. By clicking on "Ok", the applied changes are saved.

	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
C1	Not Used	Not Used	Drv		False	None	True		
C2	Not Used	Not Used	Drv		False	None	True		
C3	Not Used	Not Used	Drv		False	None	True		
C4	Not Used	Not Used	Drv		Faise	None	True		
C5	Not Used	Not Used	Drv		False	None	True		
CEN	Not Used	Not Used	Drv		False	None	True		
C7	Not Used	Not Used	Drv		False	None	True		
►C8	Bin in 8	Pulse	Drv	1.00 V	False	None	True		(Short*)=>(input=1)
9	Not Used	Not Used	Shunt 1 Ohm			None			
10	Not Used	Not Used				None			

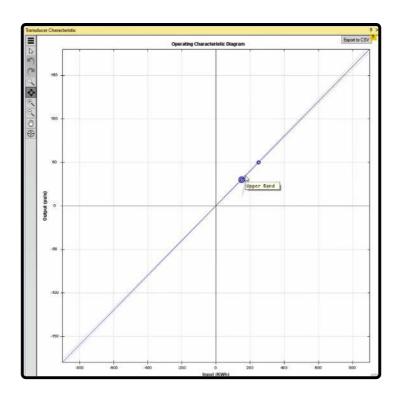
To perform a test, a point on the characteristic must be selected which can be done using two methods:

1- Entering the values in the fields of "Test Point" section which means entering the related parameters including Wh value, number of pulses, test performance time and frequency. Then, by selecting "Add", this point is added to the test table.

Shot 7	Test Settings
Test Point	
Wh	0.000 Wh
Pulse	5 puls
Time:	0.000 s Frequency: 50.00 Hz
Output Det State: Out	Of Range

2- Holding down the "CTRL" key and then clicking on the meter characteristic curve.

|--|



On "Test View" page, by clicking on "Advanced View", a page opens where it is possible to enter the voltage, current and their angle as well as the

Apply to:	Current		8
Sin			
O Sin +	0.00 %	~	Harm.
F	hase Shift:	0.00 *]
() Sin +	0.00 %	Inc	1

Power	L1	L2	L3	3-Phase	
Apparent Power	461.9 MVA	461.9 MVA	230.9 kVA	924.0 MVA	
Active Power	461.9 MW	461.9 MW	230.9 kW	924 OM W	
Reactive Power	0.000 Var	0.000 Var	0.000 Var	0.000 Var	

Senerator Settings	11	L2	L3	Wave Form
V (Magnitude):	63.51 V	63.51 V	63.51 V	Apply to: Current ~
V (Angle):	0.00 *	-120.00 *	120.00 °	Sin
I (Magnitude):	1.000 A	1.000 A	1.000 A	O Sin + 0.00 % Harm.
I (Angle):	0.00 *	-120.00 *	120.00 *	Phase Shift: 0.00 *
cos φ: [1.0000	1.0000	1.0000	O Sin + 0.00 % DC
Max Power for bet	ter Assessm L1	ent: 7.200 kV/ L2	L3	3-Phase
oparent Power	63.51 VA	63.51 VA	63.51 VA	190.5 VA
Active Power	63.51 W	63.51 W	63.51 W	190.5 W
	the second se	0.000 Var	0.000 Var	0.000 Var

After adding the intended points, the test can be started and after the time specified in accordance with the pulses and Wh elapsed, the results are displayed.

In performing this test, some points must be considered:

1- If a test point is specified in Wh mode, zero is entered as the value for reactive power by default and to change this, first the current angle needs to be changed from "Angle" field.

	- Generator Settings	L1
	V (Magnitude):	63.51 V
	V (Angle):	0.00 *
	I (Magnitude):	1.000 A
	I (Angle):	30.00 *
	cos φ:	0.8660
Test Po Wh	1.000 Wh	
		quency: 50.00 Hz

2- The time entered in "Time" field by the user changes in accordance with the characteristic curve of the meter. This change is in a way that the number of pulses changes to integer.

		input (trii)
Zoom During Test Optimize All (Change Fault Type) Pan Mode(Alt+Mouse Click)	Show Row Number Show All Act Point Show Selected Act Point	 ☐ Snap to Grid ☐ Show Cursor Value ☑ Out of Range Aren

3- Being "Out of Range" for the points in this test depends on the required time for performing the test. Since the maximum injection time of the device is 4000 seconds, if a test point needs more time for the test, that point becomes "Out of Range"; to change the state of this point, more voltage or current can be entered in "Advanced View" section.

Shot Test (Settings									?
Test Point Wh Pulse Time:	na na na Freq		50.00 Hz	Input o Wh	uantity ——	2/0/0/1/1					Add Insert Remove
Output Details - State: Out Of Ran	ge	Advanc	ced View								Remove All Sequence
Advanced View											Georgen roled teas
Generator Settin	ngs L1	L2		L3	Wave Form	ı ———					
V (Magnitude):	63.51	and the second	51 V	63.51 V	Apply to: Cu	ment	*				
V (Angle):	0.00			120.00 °	Sin						
I (Magnitude):	10.00	1.0	00 A	1.000 A		0.00 %	Harm.				
I (Angle):	0.00	• -120	.00 *	120.00 °	Pha	se Shift: 0.00)*				
cos φ:	1.0000	1.0	000	1.0000	O Sin +	0.00 % DC					
Max Power for		sment: 7.2	00 kVA								
	L1	L2	1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	L3	3-Phase						
Apparent Power	635.1 V/			63.51 VA	762.1 VA						
Active Power	635.1 V		51 W	63.51 W	762.1 W						
Reactive Power	0.000 Va	r 0.000) Var	0.000 Var	0.000 Var	8					
State A	ssessment	Wh	Pulse	Wh Act	Output Act.	Device Error	Time Act	Frequency	Test Phase	User Comment	
1 🔍 No	t Tested	16.00 Wh	16 puls					50.00 Hz			
▶ O Ou	t Of Rance	na	па					50.00 Hz			

4- If a too large value is entered in "Wh" field, this value is recorded as "na" and by selecting "Add", this point becomes "Out of Range".

Shot Test (2			Input o	uantity						
Test Point na Wh na Pulse na Time: na Frequency: 50.00 Hz			• Wh		2/0/0/1/1					Add Insert Remove
Output Details	1									Remove All
		10000	_							Sequence
		Advanced Vie	w							Clear All Failed Tests
Advanced View — Generator Setting	L1	L2	L3	Wave Form Apply to: Cu						
V (Magnitude):	63.51 V		63.51 V	1.	AIGH.					
V (Angle): I (Magnitude):	0.00 * 10.00 A	-120.00 * 1.000 A	120.00 * 1.000 A	● Sin ○ Sin +	0.00 %	Harm.				
I (Magnitude):	0.00 *	-120.00 *	120.00 °		se Shift: 0.00	and the second second				
cos q:	1.0000	1.0000	1.0000	O Sin +	0.00 % DC					
Max Power for be	tter Assess	sment: 7.200 kV		3-Phase						
Apparent Power	635.1 VA	63.51 VA	63.51 VA	762.1 VA						
Active Power	635.1 W	63.51 W	63.51 W	762.1 W						
Reactive Power	0.000 Var	0.000 Var	0.000 Var	0.000 Var	6					
State Ass	essment	Wh Puls	e WhAct	Output Act.	Device Error	Time Act	Frequency	Test Phase	User Comment	
1 Not 1	ested	16.00 Wh 16 pt	Is				50.00 Hz			
	of Range						50.00 Hz			

110 : OFFLOAD TEST SECOND PART

In addition to the tests that the user can perform by specifying different points on the energy meter characteristic, in the offload section, 5 other tests available in this section are as follows:

-Load Test

-Mechanism Test

-Injection Test

-No-Load Test

-Creep Test

As mentioned in the first part, before performing any of the tests, we enter the information about the energy meter in the Test Object section. First, enter the CT and PT conversion ratio data, and then, in the Transducer Properties section, enter the meter constant. After confirming the entered information, select the test from the Test Mode to be performed and after adding the points, run the test.

Load Test

In this section, the voltage injection and current for a specific time is set to evaluate the number of pulses. Finally, the overall energy performance of the meter can be checked. The purpose of this test is to evaluate the error rate for measuring different elements in the meter.

To execute the test, first go to the Advanced View section, here we need to adjust the active power in the supported range of energy meter. Then, we add three points with 5, 10, 15 pulses to run the test, and we run the test. As you can see in the Test Point section, information about watt-hour, pulses, test duration and time and its frequency can be set.

Mechanism Test

In this section, the injection of rated current and rated voltage is done for a certain period of time to evaluate the amount of transmission energy. The purpose of this test, in addition to evaluating the error rate in the overall measurement, is to evaluate the error rate of the device in measuring various elements. Since the number of pulses is not important, points can be entered for testing based on watt-hour and time elements. The evaluation conditions of this test are based on the use of the Open Loop feature so that at the end of the test, the user can enter the measured value manually.

Injection test

In this test, voltage and current are continuously injected to ensure the accuracy of the wiring as well as the initial function of the meter. Adjustable elements in the Test Point section for this test are: watt-hour, pulses, test duration and time, and frequency. To perform the test, add a dot and run the test.

No-Load Test

The focus of this test is injecting 150^{-/}. of the rated voltage and zero current; to check the performance or non-performance of the meter. The relationship between the minimum test duration is specified as follows:

$$\Delta t = \frac{480 \times 10^6}{R \times P_{\text{max}}} (\text{sec})$$
$$R = Pulses \setminus kwh$$

In this test, to achieve 150% of the rated voltage, the voltage limit should be changed from the Test Object section, if necessary. Then, the test should be performed by setting the voltage to 150% of the rated voltage. As you can see, there is no current injection in this section.

Creep Test

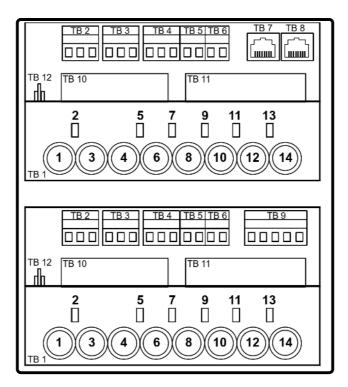
Injecting 0.5% of the rated current with the rated voltage is performed in this section to check the performance or nonperformance of the meter. In this section, you can also add points to perform the test based on the amount of watt-hour, pulse or duration. After each test, you can view the results in the Report window by selecting the Report View option.

111 : "ONLOAD" TEST OF THE METER

An introduction to Edmi Mk63 meter

About "Edmi Mk63" that is the piece of equipment that we are going to test, this should be noted that this meter is basically an energy meter that measures varh, Wh and Vah basic values. Also, it is possible to measure a wide range of values instantaneously. In the picture of the cover of this meter depicted below, terminal blocks for measuring the current and voltage as well as the connectors for the pulse input and output (optionally) can be seen.





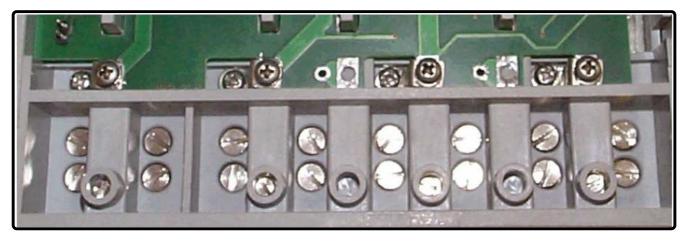
Possible diagrams for meter terminals

Terminal	Description
TB1	Current and voltage inputs as well as the side power supply
TB2	Inputs #1 and #2 (with common end)
ТВЗ	Outputs #1 and #2 (with common end)
TB4	Outputs #3 and #4 (with common end)
TB5	Outputs #5 and #6 (using the TB4 common point)
ТВб	Outputs #7 and #8 (using the TB4 common point)
TB7	RS-485 Port (RJ45)
TB8	RS-232 Port (RJ45) or RS-485 Port (RJ45)
ТВ9	RS-485 (Terminal)
TB10	Development space for future uses
TB11	Development space for future uses
TB12	Battery connector

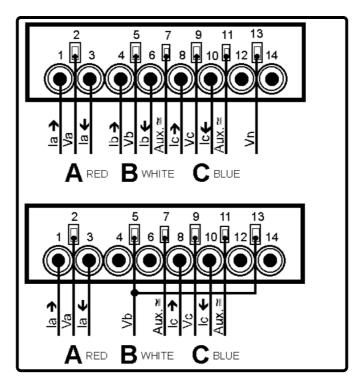
The position of "Config" jumper in "MK6E" meter is displayed in this picture. This jumper is located on the right edge near the "Select" button. This jumper has two states of "Config" and "Secure". To change the settings, the plastic jumper is taken out and placed on another set of pins. Connecting the upper and center pins puts the jumper in the "Secure" state while connecting the lower and center pins puts it in the "Config" state.



All current meters have "CT" to "VT" links between "TB1" terminals and ends number 1,2,4,5,8,9,12 and 13. Also, there is a static link between 12 and 14. To perform some tests, it is necessary for these links to be removed.



Position of CT to VT links



Power supply, voltage and current wiring in 3-wire and 4-wire structures

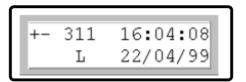
The voltage nominal input differs in accordance with the type of the meter. Also, the current range is in accordance with the meter current range and should be limited to "Imax". In 4-wire mode, the maximum line-to-neutral and the maximum line-to-line voltages are 290 and 500 volts, respectively. In 3-wire mode, the maximum line-to-line voltage equals 290 volts. In higher voltages, the meter cannot function appropriately and might get damaged.

"TB1-1" and "TB1-11" are the two inputs considered for the side power supply voltage. "TB1-11" needs to be considered as the negative input in DC systems and as neutral in AC systems. The voltage input of the side power supply equals 110 VAC/VDC plus-minus 20 percent. Generally, it is possible to consider the following four combinations for the power supply:

• Type I – VT power supply: used for most metering applications, especially in Low Voltage sites where when all the VTs are disconnected, the meter turns off. • Type II – LCD 24 volts side power supply with the local power supply: used in cases where it is necessary to read the meter even if the main power supply is not available. In such cases, a 24-volt battery power supply will be used to read the meter.• Type III – side power supply: for switchyard uses where the meter needs to be always on and there is enough space for the side power supply of the system. If for any reason, this side power supply is disconnected, the meter turns off.

• VT Priority – along with the High Voltage auxiliary power supply with 200 to 240 volts range: in this state, naturally, the meter receives the necessary power from the VT circuits. When all of the VTs are disconnected, the changeover board activates and auxiliary terminals are used. • VT Priority – along with the Low Voltage auxiliary power supply with 57 to 120 volts range: in this state, naturally, the meter receives the necessary power from the VT circuits. When all of the VTs are disconnected, the changeover board activates and auxiliary terminals are used. • VT Priority – along with the Low Voltage auxiliary power supply with 57 to 120 volts range: in this state, naturally, the meter receives the necessary power from the VT circuits. When all of the VTs are disconnected, the changeover board activates and auxiliary terminals are used. This structure is most useful in cases where the VT burden is not problematic but the power supply is always available for protective systems.

Default display screen



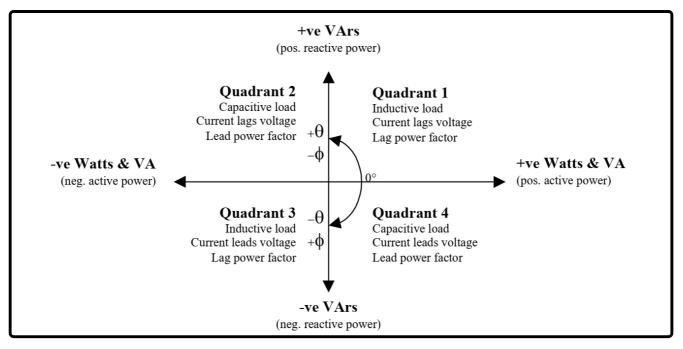
"The structure of the digits and symbols displayed on the screen from the top left are as follows: The two first characters

of the first row of the screen stand for the direction of the var and var, respectively. "+" sign refers to positive energy / output / delivered and "-" sign refers to negative energy / input / received. If the slot for these characters is empty, it means that the amount of energy equals zero.

The third character that resembles a beating heart indicates that the meter is active and the display screen is up to date. The fourth, fifth, and sixth characters show the active rate for W, var and VA values, respectively, in form of numbers from 1 to 8. The seventh character indicates the state of the battery and means that the battery is empty or unrecognized when turning on.

If the Daylight Saving feature that refers to the daylight saving time is active, the letter D is displayed as the eighth character. The current time is displayed on the right side of the screen. The initial three characters at the bottom of the screen show the alarm status. The fifth, sixth and seventh characters at the bottom of the screen show the login state. L

means login through the optical port (Local), M means through the modem port and S means login through SCAD port. In the end, we can see the current date on the right side of the bottom.



Power direction graph

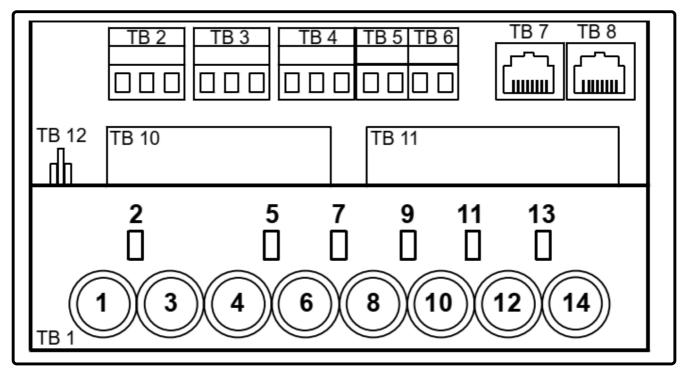
In the above figure:

Refers to voltage impedance angle in relation to the current and

equals current admittance angle in relation to the voltage.

Pulse outputs: The pulse outputs are capable of doing more than only showing the power usage. MK6E has a maximum number of 6 outputs that are directly located inside the meter.

At the bottom of the LCD, there are two LEDs located on the meter that are used to assess the pulses produced in the accuracy test. These LEDs are connected to outputs number 1 and 2. The state of these LEDs is directly reflected on the TB3 outputs. The picture below indicates the state of EDMI MK6E terminals. In fact, TB5, TB4, TB3 and TB6 are the terminals in which the outputs are located. All of the outputs are voltageless contacts. These outputs are completely isolated from the other circuits and in some cases, have common terminals. BOSFET drivers are set at 110 nominal volts.



Terminal	Description
TB3-1	Common Terminal (#1 and #2)
TB3-2	Output #1 (LED #1)
TB3-3	Output #2 (LED #2)
TB4-1	Common Terminal (#3 and #4)
TB4-2	Output #3
TB4-3	Output #4
TB5-1	Output #5
TB5-2	Output #6
TB6-1	Output #7
TB6-2	Output #8

Settings	Description
Inv.	Output polarity
Active Time	The approximate time (in terms of ms) during which the output has an active pulse.
Inactive Time	This time (in terms of ms), needs to be at least between the pulses. If it does not happen, the output of the pulses makes an EFA alarm to warn of the possibility of losing the pulses.
Parameter	This element is the amount of energy stated by every pulse in form of Wh, varh or Vah. Valid settings range from 0.000001 to 100000000000.0.
P/S	The parameter mentioned above may be primary (in VT/CT inputs) or secondary (in meter terminals). P stands for primary and S stands for secondary. S is an appropriate option to test LEDs in laboratory so that the turn ratios do not influence the performance.
Channel	This element determines the source input channels of the energy. "All" is the commonly used option that stands for all of the three phases (2 phases in two-element mode). Phase-to-phase options (B,A and C) are the most commonly used options in three-element mode where it is possible to display every phase separately.
Туре	This element determines the energy type which can be Wh, varh or Vah.
Sign	Abs option here means that the output functions on both sides. + and – options activate "only output" and "only input" state, respectively. The diagram under the installation screen shows the directions of the energy.

An important point is that for Active and Inactive times, the exact time is one percent shorter than the specified value. This amount will be even shorter if the system frequency is more than the nominal value. Therefore, the output will be lower as much as the same amount. Under normal conditions, these factors will not have any noticeable effect on the length of the pulse. It should be noted that this will only change the pulse time duration and the minimum off-time of the LED but not the rate of the pulse.

If during inactive times, the rate of the pulse is zero or less than zero, the output will remain active. If the rate of the pulse decreases, the pulses will be recognizable one more time. If this time is too short, the pulses will not be backed up and will merge into one another. Therefore, to avoid missing the pulses in high load conditions, selecting the appropriate parameter is of great importance.

Using the LED output to test the accuracy of the delivered Wh is a necessity. A 0.01 Wh/p pulse rate will be needed in the meter terminals. The light pulse must be 90ms long with a minimum interval of 50ms between the pulses so that the sensor can appropriately recognize the current process.

The settings and combinations required for the test are as follows: No Inversion, 90ms active time, 50ms inactive time,

parameter 0.01, All channels, W, Export (+)

It should be noted that the EziView software has a built-in calculator for connecting to this meter that can help the user in adjusting the parameters for the pulse output. This tool can be used by clicking on the calculator when configuring the output in form of Pulsing. This calculator enables the user to specify the system characteristic (line-to-line voltage or line-to-neutral voltage, current and the amount of load) and determine the pulse output rate.

Primary Voltage:	415	L-L
	240	L-N
Primary Current:	5	
Load Rating:	120	%
Wh/Pulse	1	
Pulses/kWh	1000	
Pulses/Sec	1.2	
Secs/Pulse	00:00:00.835	

Using the pulse outputs for the test: The easiest way to test the accuracy of the meter is to use the LED pulse (or output pulse). This test is similar to performing a test for meters with spinning disc. Pulse outputs are configured using the EzView software. To achieve the best results, the pulse rate must never exceed 10 pulses per second. Also, the test must be at least 10 seconds long.

Testing the meter and the software settings: To test "Energy Meters" or meters in online mode or under load, "AMR Transducer & Meter" room can be used. As mentioned before, this room is composed of "Test View" and "Transducer Characteristic" main windows. Since the function of each of these options has been explained before, repeating them does not seem necessary.

To begin the test, the user needs to double click on "Transducer" option after completing the information in "Device", in "General Test Object" window. There is a set of "Functions" available on "Transducer Properties" page. To test a meter, two functions of "Wh (watt-hour)" and "Varh (var-hour)" can be used and here "Wh" is selected. To perform an "Onload" test, the user needs to select the "Read from Binary" option in "Input" section. By selecting this option, the values are entered into the "Inputs" of the device using the clamps and interface cables.

The output type of the meter can be specified in the "Output" section. To test the meter, if only the output values of the meter are being displayed on the screen, the "Open Loop" option can be used. Here the "Pulse" option is used so that by using the light sensor that comes with the device, the number of output pulses of the device is recorded. The connection related to the current transformers needs to be specified in "CT Star point connection" section. Since normally the active power flows from the busbar toward the line, "Toward Line" option is selected. In "Tolerance" section, it is possible to enter the fault value in two forms of absolute and relative and the default values are 1 millipulse and 0/25 percent.

Also, in "Number of phases" section, it is possible to select from among single-phase or three-phase in accordance with the meter type. The test characteristic is specified in "Characteristic Definition" section. Since the meter characterisic is linear, the "Characteristic Type" is set at "Linear" and cannot be changed.

"Saturation Range", "Knee Point" and "Minimum Value" fields are deactivated for the meter test but in "Maximum Value" section, it is possible to specify the amount of power and the number of pulses received in return. Usually, the meter factor or "c/r" value is entered in this section. For example, the factor for an edmi mk6e meter equals 5000 watt-hour per pulse.

After completing the information in "Transducer Properties" section, the settings in "Hardware Configuration" need to be examined. By opening this window, the user can see that the current and voltage outputs are configured by default. Also,

in "Binary/Analog Input" tab, the user can see that binary number 8 is selected to record the meter pulses by default. However, it is possible to use a custom "Binary" of the device as well.

" The only difference between onload and offload tests of the meter is that the inputs need to be prepared to record the

values measured using the measurement equipment (clamps). To do this, the user only needs to click on "Test Hardware Configuration" option in the "Binary Input Calibration" section and assign the available binaries to record the values of current and voltage in accordance with the meter characteristic or that it is either single-phase or three-phase. By default, binaries number 2, 1, and 3 are assigned to record the voltage while binaries number 5, 6, and 7 are assigned to record the current values measuring using the clamp.

Using the "Sum", "Mul", and "Deg" parameters, it is possible to edit the measured values in different conditions in accordance with the measurement equipment being used. For example, if a clamp shows 1 volt in the output in return for 10 amps, by measuring a 15 amps current, our binary will receive 1.5 volt. Therefore, by entering factor "10" in "Mul"

section, this value can be edited. As another example, if our clamp has a 0.5 degree phase measurement error, this item can be edited through "Deg" section. In "Sum" section it is possible to perform a "DC" shift that is not of use in this test.

By selecting the option in "Analog Output" section in "Test Hardware Configuration" window and entering the values of current and voltage, it is possible to calibrate the binary inputs. To perform the test, the user only needs to specify the inputs of the intended binary and then, begin the process of measuring the elements of current and voltage to compare with the meter characteristic. It should be noted that in "Online Values" section, the power, voltage, current and other elements related to the meter are displayed and updated instantly.

112 : TRANSDUCER TEST

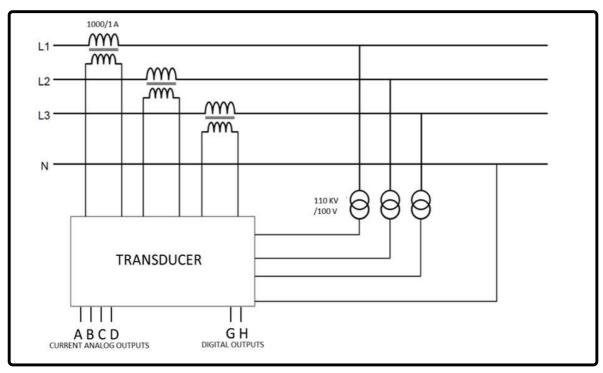
To perform a transducer test, AMT Transducer & Meter room can be used. This room consists of two main windows of "Test View" and "Transducer Characteristic". In this section, it is possible to test single-phase and three-phase transducers with symmetric performance characteristics (such as active and reactive power characteristics) or asymmetrical ones.

To begin the test, the user needs to double-click on "Transducer" option after completeing the data in "Device" section in "General Test Object" window.

On "Transducer Properties" page, it is possible to view a set of "Functions". For a transducer test, the user can select from among functions such as active power, reactive power, apparent power, frequency, current, voltage, power factor, load factor, phase (in degrees), mean current, DC current, DC voltage, DC power and line to line voltage. Some of these parameters can be measured in single-phase state, some in three-phase state while some can be measured in both states. In accordance with the transducer type and its manufacturer company, this equipment can have different inputs and even in some cases, several inputs simultaneously. Finally, these inputs will be converted into analog signals. On the other side, the transducers can also have binary outputs which are activated as soon as the specified characteristic goes past a certain limit. In some other cases, it is possible to use the output binary signals as a counter that produces a pulse based on the measured energy.

The type of output received from the transducer is specified in "Output" section. To test transducers and in accordance with their output, it is possible to take their output current and DC voltage to the inputs of the device for measurement by selecting "Current" or "Voltage" option. Otherwise, "Pulse" option can be selected so that the number of pulses are recorded. "Open Loop" option makes it possible to record the values in transducers that only display the output on the screen that is located in front of the user. So a window asking the user to enter the values manually appears.

The connection related to the current transformers is specified in "CT Starpoint Connection" section. since normally active power flows from the busbar toward the line, "Toward Line" option is selected. Selecting "Toward Line" is in accordance with the injection of active power from the device into the equipment. If "Toward Busbar" is selected, 180 degrees are added to the current angle.



Connection of a sample transducer to CT and PT

In "Full scale error reference" section, it is possible to specify the reference for recording the error which is specified as a range from zero to maximum or from negative to positive maximum. If the characteristic is asymmetrical, the range is from zero to maximum and if it is symmetric, both options can be selected for error calculation. Before this, in the video related to offload test of the meter a complete explanation about error calculation has been provided.

In "Tolerance" section, the error value can be entered in form of an absolute or a relative value and the default values are 1 millipulse and 0/25 percent. In the end, a comparison is made between these two values and the greater value is selected as the allowed error value.

About transducers, before anything, the accuracy class for different characteristics of power, current, voltage to frequency must be specified. This factor is obtained using the calculations and relations that are available in the manual of the transducer.

In "Number of phases" section, it is specified whether the transducer is single-phase or three-phase.

The test characteristic is specified in "Characteristic Definition" section. Since the transducer characteristic can be either linear or non-linear, symmetric and asymmetric options are available for "Characteristic Type". Moreover, it is possible to select the appropriate option in accordance with the features of the transducer from "Linear", "Compound", and "Quadratic".

To specify energy "Import" and "Export" values, "Symmetrical" option can be checked so that a different characteristic from both sides is available. The minimum value for the input and output of the transducer is specified in "Minimum Value" field. If the compound performance characteristic option is selected, Knee Point needs to be specified as well. In fact, this point divides the characteristic into two parts with different ranges. The maximum value for the input and output of the transducer is specified in "Maximum Value" field. Also, the range of the performance characteristic is specified in "Saturation Range" field.

It should be noted that by using "Primary" and "Secondary" options at the top of the page, it is possible to enter the values in form of primary or secondary in accordance with the type of the meter which should be done considering the CT and PT

turns ratio. "Relative" and "Absolute" options are used to display the relative or absolute value of the elements. After

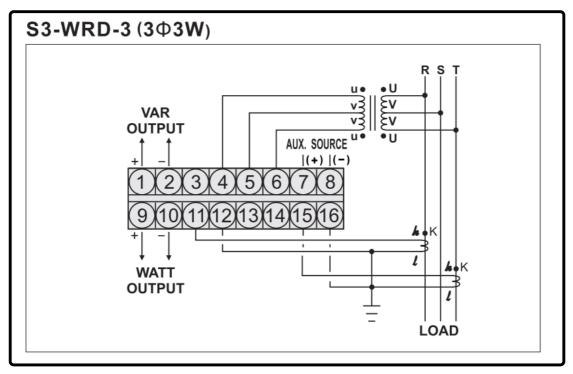
entering the values, "OK" is selected to continue with the test.

"After completing the information in "Transducer Properties" section, "Hardware Configuration" needs to be examined. By

opening this window, the user can see that the current and voltage outputs are adjusted by default. Also, in "Binary/Analog Input" tab it can be seen that binary #9 is considered for measuring the output milliampere by default. However, if necessary, it is possible to use any other binaries of the device. After applying the changes, by clicking on "Ok", the changes are saved. To perform the test, the user only needs to specify the intended binary inputs and then begin the process of measuring the voltage and current elements in order to compare them with the transducer characteristic.

Here we are going to perform the sample test on a transducer. The transducer is of the S3-WRD series which is a sample for reactive/active power measurement or watt/var. This transducer has a 0.2 percent accuracy for the output rate. The S3-WRD series is available in three different models of S3-WRD-1, S3-WRD-3 and S3-WRD-3A. Their difference is in how they are used in single-phase and three-phase systems as well as three-wire and four-wire systems.

Also, it is possible to use these transducers with 1 and 5 amps input currents as well as a vast variety of voltage inputs. The model we are analyzing is S3-WRD-3 and a picture of its wiring can be seen in the following.



For example, for a 230 watt (var) output, this transducer gives a 4 milliampere output with 1 amp of input current and 132 volts of input voltage. If the output power is zero we will have 12 milliamperes and if it is 230 watts, we will have 20 milliamperes in the output. Considering these values and the linear characteristic of the transducer, it is time to test this equipment.

In the first step, by running the AMPro software, we enter the AMT Transducer & Meter environment. Before anything, by clicking on "Test Object Parameters", the information related to the transducer is entered in "Device" section. This information includes the title/explanation for the transducer, the manufacturer company, type of the device, installation location of the equipment and the serial number. In "Nominal Values" section, values related to CT secondary and PT are entered in accordance with how the test is performed.

Now, after accepting these items, by double-clicking on "Transducer", the user enters the "Transducer Properties" window. By selecting the intended function which here is active power, the output is set at Current. By enabling the "Symmetrical" option, it is made possible to also evaluate the negative values.

In "Minimum Value" section, 230 watts is entered as the input value and its corresponding output which equals 4 milliamperes is entered. In "Maximum Value" section, 230 watts is entered in secondary form as the value and the corresponding current for this output is specified to be 20 milliamperes.

After accepting these, it is time to add the points on the characteristic and perform the test. A simple approach is to click on "Sequence" and specify the upper and lower limits of power and the number of test points so that the points are added in certain distances. By performing the test, it can be observed that the output values are recorded in accordance with the applied input.

By enabling the display of Actual Value for binary #9, it is possible to view the waveform of the measured values in "Signal View" window in the software. After the test is finished, the intended elements are selected and the report is prepared.

113 : AN INTRODUCTION TO AMT SYNCHRONIZER

To test synchronizer relays, "AMT-Synchronizer" room can be used. The synchronizer is a piece of equipment that is used to connect the generator to the grid that is being used and uses the voltage of both sides to examine the state of frequency and voltage and if the difference between the generator voltage range and frequency, and the grid is less than the specified limit, the connect command is issued. If the mentioned difference is more than the specified limit, the relay will not issue the command for the connection. In this case, the relay examines the generator frequency and voltage state compared to the grid. If any of these two parameters is lower or higher than the specified limit, the relay synchs the two systems by giving the command for an increase or decrease in the "AVR" and the governor.

The synchronizer room has several pages and exclusive windows. The two main windows of this room are "Test View" and "Synchronizer Characteristic". The "Shot Test" and "Synchronizer" tests are done in the "Test View" window. To perform a "Shot test" in this room, like the other rooms, the user only needs to specify a test point and perform the test. Also, the performance of the relay in synchronizing the two systems is tested in the "Synchronizer" tab. The synchronizer characteristic is displayed in the "Synchronizer Characteristic" in accordance with the information entered in the "Test Object" of this room. The tools available by right-clicking or left-clicking in this window and the cog at the bottom are common in all rooms.

To enter the relay information for the test, the first thing is to enter the nominal information of the relay in "Device". In this section, it is necessary to enter characteristics such as "PT" turns ratio and frequency. In the next step, the relay characteristics are entered after double-clicking on "Synchronizer". Since these relays use voltage, in "Protection Device" tab, it is necessary to select the sequence of phases and the phases that are connected to the relay in "Rotation sense" and "Connected Voltages" for systems 1 and 2. Note that system number one is an infinite bus and system number two is a generator that needs to be connected to the grid. An important point is that when the system phases are wired as ACB, it is necessary to select L1-L3-L2 radiobutton. Also, if "Connected Voltage" on any of the phase-to-ground states is selected, the voltages of systems one and two are displayed in "Test View" in form of phase-to-ground.

The key performance time is entered in the "Setting" section of this part and in the "CB Closing time" field and the phase shift that can come from intermediate equipment or a coupling transformer is specified in the "Transformer Group Phase Shift". The nominal voltage of the system number two is entered in "VNom L-L(Secondary)" field and if this value is different from that of system number one, it needs to be specified. By specifying this value, the voltage difference that is resulted from the test will be in relation to nominal voltage of system number two and not the voltage of system number one. This means that if the nominal voltage of system number one is 110 volts and the nominal voltage of system number two is 100 volts and the allowed difference of these systems is specified to be 2 volts, the minimum and maximum voltage of system number two must be 98 and 102 volts, respectively. When the PT secondary turns ratio of the grid and the generator are the same, "Use Ratio of System 1" is to be used. For example, if the PT turns ratio of the grid is 400KV/110V and the turns ratio of the generator is 15.75KV/100V, since the secondary turns ratio of the two systems is not the same, the user needs to enter the PT secondary voltage of the generator or system number two in the "VNom L-L(Secondary)" field.

The characteristic related to the relay is entered in "Synchronizing Window". The characteristic entered in this section needs to be in accordance with the relay settings. The upper and lower limits of voltage difference and the upper and lower limits of frequency difference are entered in deltaV>, deltaV<, "deltaF>" and "deltaF<" fields, respectively. The relays mostly tend to issue a connect command in the "Dead Zone" range that is located between "deltaFmin" and "deltaFmax" parameters. The allowed angle difference of the system number 2 is entered in "deltaPhi" Nom field and is entered in delta Phi. For example, if the nominal angle of system number 2 is 30 degrees and the allowed difference is 20 degrees, by going to Vector View window, the user can see that the allowed connection range is determined to be between 10 to 50 degrees. Also, the allowed tolerances for different parameters and the minimum allowed connection time are entered in the fields on the right side.

About the voltage that is being used for the test, it should be noted that the relays measure the applied voltage and if the nominal voltage is as much as 110 (or 100), the user only needs to apply "VL1-E" and "VL2-E" for systems number 1 and 2 with the same value to the relay and this can be viewed in the "Hardware Configuration". For example, if in the "Protection Device" in the "Connected Configuration" tab the two systems are set at "L1-L2" mode, by going to the "Hardware Configuration" window and in the "Analog Output" section, it can be seen that considering the selected mode, two sources are specified for the voltage that is being used for the test and that in fact, VL1_E plays the same role as "VL1-L2" of system number one and "VL2-E" plays the same role as "VL1-L2" of system number two. To better understand this, suppose that a 110 volts line-to-line voltage is used for system number 1 and for system number two, a 63.5 volts "VL1-E" phase voltage is used. To enter the information of such a system, it is necessary to enter "L1-L2" and "L1-E" as the

Connected Voltage for systems number one and two, respectively. Also, $63.5^*\sqrt{3}$ or 110 volts is entered as the "Vnom L-L"

for system number two. Now, by opening the "Test View" and "Vector View" pages, it can be seen that 63.5 and 110 volts are entered as the nominal voltage for systems number two and one, respectively. The next point is that only for system number one it is possible to select a three-phase voltage because only the Voltage groupA of the device is three-phase and as for system number two it is only possible to select a single-phase or line-to-line voltage.

114 : TEST VIEW WINDOW IN SYNCHRONIZER ROOM

"Shot test" is the first test that can be performed on "Synchronizer". To perform this test, first you need to enter the system (1) characteristics which is a simulator of the infinite bus and the system (2) characteristics which is a simulator of the generator. The amount of voltage difference, frequency and angle of systems (1) and (2) are entered in "DeltaV_{L-L}", "delta F" and "delta Phi" respectively. The amounts of voltage, frequency and angle are specified in the column at the right side of this box. Note that it is possible to directly specify the voltage, frequency and phase values of the system (2) in which case the amount of difference between the specified values with their nominal values is displayed in the column on the left side of this box.

In performing this test, the characteristics of system (1) is fixed and for every test point, the characteristics of system (2) change. Other methods to add test points include clicking on the characteristic curve and selecting "Add" or holding the ctrl key and clicking on the intended point on the characteristic curve. Finally, after specifying the test point, the test is performed and in accordance with that whether the test point is inside the characteristic or outside it, the relay issues connect or disconnect command. The test point assessment is done in accordance with synchrony or non-synchrony of "Nom" and "Act" columns in "Assessment" section in the test point table. The characteristics of system (2) / the test point is specified in "System2" section. Other options of this section are the same as those of the other previously mentioned rooms. As an example, a point inside the connection zone and another point outside this zone are selected. By performing the test you will see that the relay gives a close command inside the zone and does not connect outside this zone.

The second and the most important performable test is "Synchronizer". To perform this test you need 5 outputs from the relay. In fact, this relay has 5 main outputs and by giving the raiser or lower command for voltage and frequency, the act of "Synchronizing" and connecting the unit to the network is done. These outputs, which should be connected to the device for the test, include "V>", "VM<", "F>", "F<" which are used to raise voltage, lower voltage, raise frequency and lower frequency respectively. In "Trigger" tab in "Binary Setting" section, the settings of related "Inputs" can be specified. In this section, to receive the commands such as receive voltage raise command, receive voltage lower command, receive frequency raise command and receive frequency lower command, "B1:V>", "B2:V<", "B3:F>" and "B3:F<" are used respectively. Also "Close Command" is used to receive the close command from the relay. In performing this test, the inputs are simulators of governor and "AVR" which are commanded by the relay.

This test in this tab is done in the way that when you select a test point and run the test, the relay enters the voltage and frequency of system (2) to the <u>closing</u> zone by giving the voltage and frequency change commands and finally, gives the close command. About performing this test it should be noted that it is necessary to enter "Generator Model" in accordance with the system characteristics because the changes in voltage and frequency are done in accordance with the pulses sent from the relay and the settings entered in this section. For example, if "0.1" is entered as "delta V/delta t", if one one-second pulse is sent from the relay to decrease the voltage, the voltage decreases by 100 millivolts. But if a 500-milliseconds pulse is sent, the voltage decreases by 500millivolts. As an example, here a test point is selected and "1v/s" and "100mHz/s" are entered as "delta V/delta t" and "delta F/delta t" respectively. By running the test you can see that based on the signals received by the inputs from the relay, the characteristic enters the connection zone from the outside.

As the final point, it is necessary to know that the time of each of the tests is specified in "Fault Time" section in "Setting" which, if necessary, can be changed.

115 : AMT VCC ROOM

This room is designed to test different relays in the shortest possible time and in the form of using standard scenarios based on periodic testing regulation of Iranian power grid protection systems.

You will see two windows by entering to the AMT VCC room. VCC Panel, which is actually the main window for selecting functions and test management. VCC Report View, will show you the relay test report. In the first step, simply upload the default template to the desired relay. This will be done by selecting an icon with the letter L.

These templates are available in two categories for each relay. In the Fast Test section, you will see a limited number of tests. For example, in quick tests, there is no transient test. However, by selecting the other option, there will be a complete set of tests in front of you.

As you can see, by loading the template, a variety set of tests for different functions will be in front of you.

In the Nodes section, you'll see available subcategories to test each function. In the Summary column, a summary of the test status and whether it is successful or unsuccessful will be displayed. The three options of Inheriet Xrio, Inherit Hardware Config and Inherit Report Settings by being active, respectively, will make the user's chosen function inherit all settings from Xrio, hardware settings and report settings. However, by disabling them, you can apply the settings to each one and manually as you wish. The Open UI option will also allow you to manage the opening of the related window to each test.

If you select Advanced View from the above section, more elements such as test window status, reporting status, test progress rate, and more will be observed.

In the Root subset, the Xrio file is located first. By selecting this option and clicking the Open option, you can upload the Xrio received from the relay, which actually fits the active functions set.

You can access the details by clicking on any other option and selecting Open. For example, by clicking HardwareConfigFile you can view and edit the default hardware configuration for current and voltage injection, as well as inputs and outputs of the test device.

The Start Note option, which is located before testing each function, also provides the user with explanations to guide the test further. In this section you can enter the information that test man guide during the test. For example, you can place a note in the overcurrent protection function that indicates the overcurrent protection in your relay is an emergency type and can only be activated by blocking distance protection and can be tested.

In the top part of the page, you can add or remove tests by clicking Add Item or Remove. For example, here we remove Switch Onto Fault, Recloser and VTS tests due to the inactivity of these functions in our relay as well as the shortening of the testing process.

In addition, you can make it possible to change settings or points by disabling Inheriet Xrio. For example, for overcurrent protection, we applied settings manually and placed different points on the characteristic curve than those designed in accordance with XRIO.

In the first stage of testing, Wiring Test is designed to check the current and voltage values injected from the device on the relay to ensure the correct wiring.

Electrical Test is another option that, with three state including PreFault, Fault and PostFault, checks the relay conditions in different situations and ensures registering the trip when a fault occurs.

As mentioned above, a set of tests for different functions is designed in the default template but it is possible to remove, add and manage the tests accurately for the user.

In this way, you can determine the priority of performing different tests, disable some tests, and even more precisely, specify which tests to do with what values and in what range.

You can check how the test is designed by clicking on each test and selecting Open. For example, you can view or edit points on the characteristic by selecting Zone Reaches for the Distance function.

By running the test, you can check different functions. Finally, by right-clicking on the VccReportView window, you can have a complete management of the items that are going to be displayed in the report.

For example, here we will perform the Micom P444 relay test in AMT VCC room. In the Configuration section, you can see the active or inactive status of the functions. In the subset group 1 of settings, you can also see details about each function's settings and values. In the PSL relay section, we also configured the inputs, outputs and leds for different functions. Now it's time to save the XRIO settings file.

In the next step, we re-enter the AMT VCC room and first load the template related to the P444 relay. Now we prepare different function tests using the XRIO file that we took from the relay in the previous step. By running the test, you can control the test of different functions step by step.

116 : INTRODUCING "CURRENT TRANSFORMER (CT)" ROOM

One of the instrument which can be tested by "AMT105" is current transformer or "CT". "CTs" are very useful for converting the high current of an electrical system to a current measurable by relays and measurement devices. Generally, there are two types of "CTs" including "Measuring" and "Protection". The difference between these two types is in their ratio accuracy or accuracy class as well as saturation level. Since "Measuring" "CT"s are used in measurement devices, when there is a fault, if the current entered this equipment increases too much, the equipment might be damaged. But "Protection" "CTs" are used in relays and since the performance of a relay is in accordance with the amount of fault current, these "CTs" should be able to move the fault current of the network to the secondary with the least possible error.

In drawing the equivalent circuit of this transformer, the "CT" turns ratio is "1:N". "Rp" and "Xp" equal the "CT" transformed to the secondary while "Xs" and "Rs" indicate the resistance and "CT" secondary leakage flux. In parallel branch, "R_e" and

" R_h " are indicators of losses of eddy current and the hysteresis respectively and "L" indicates the magnetization inductance or "CT" secondary self-inductance. In the equivalent "CT" circuit, unlike normal transformers, the parallel branch is located in the secondary side and this very branch is the reason for core saturation in high currents. Since the primary resistance and leakage flux in "CT" is insignificant, " R_P ", " X_P " and "Xs" can be ignored.

By clicking on "Current Transformer (CT)" on the start page of the software, the "CT" test room opens. In tests performable by the "AMT 105", R_{CT} , saturation curve and the turn's ratio are achieved with two methods of voltage or current. Moreover, measurement test of the burden connected to the "CT" secondary is performable by this device as well. "Test Object" and "Megger" tabs are used to enter the nominal information of "CT" and the results of "Megger" test respectively.

📲 Instrument Test 🛛 🗙				
TesaObject Secondary Burden Resistance Test	Excitation Test	Ratio and Polarity Test (With Current)	Ratio and Polarity Test (With Voltage)	Megger
Row(s) 1 Insert Column(s) 5				
Title Type your Title				

"Test Object" Tab:

Any module to be able to perform a test needs some information about the equipment. This information is entered in "Test Object" section. The general information about "CT" which should be recorded in the report is entered in "General Information" section. The company's title, the country, name and the address of the substation and installation place of "CT", title of the manufacturer of "CT", "Type" of "CT", serial number of "CT", title of the feeder on which "CT" is installed, phase number, "IEC" standard number written on the plaque of "CT", number of cores of "CT", number of taps of "CT" and additional information are entered in "Company", "CT Serial Number", "Feeder/Bay", "Phase", "IEC-ID", "Core Number", Tap" and "Additional Information" fields respectively to be added to the report. In "Extra Data" section, the test date in A.D., the information of the performer of the test and the information of the supervisor are entered in "Date", "Tested By" and "Approved By" fields respectively.

General Informatio	n		200		Extra Data	
Company:	Vebko	Feeder/Bay:	AAA		Date 0	9/05/2020
Country:	IRAN	Phase:	A			VAA
Station:	AAA] IEC-ID:			Approved by	AAA
Manufacturer:	Vebko	Core number:	1		Accessories	
Туре:	Protection] Tap:	1		Easy Mode	
CT Serial Number:	11111-11111-11111	Additional Data:	AAAA			
Test Setting		,			()	
Core Type:	Protection ~					
Class:	5P or 5PR \sim	Class Multiplier:		0.8000		
Applied Standard:	IEC 60044-1 ~					
Nominal Value -					Temperature corre	ection
Primary Current:	1.000 kA	Actual Burden:		15.00 VA	Winding Material	Copper 🗸
Secondary Current:	1.000 A	Ambient Temperatu	ire:	25.00 °	Winding Temp.	20.00 *
Frequency:	50.00 Hz]			Reference Temp.	75.00 *
Burden:	20.00 VA]			R Man.(Ref.Tem	p.) <u>1.000 Ω</u>
	4.000 Ω]			Correction Factor	1.2161
Max Rct:		1			RMS Accuracy —	
Max Rot: ALF:	20.0000	1				

By checking "Easy Mode" option in "Accessories" section, the wiring of the tests changes. This wiring is based on the board designed by Vebko Company for the "CT" test. The mentioned board is located on the front panel of the device and there are some relays placed on it which automatically manage the wirings of the front panel of the device which makes performing the test easier. The main information of the "CT" which has influence on the calculations of knee point and evaluation of the tests are entered in "Test Setting" section. The CT core type is selected from among "Measuring" and "Protection" in "Core Type" field. The accuracy class of the "CT" is specified in "Class" field. If the type of "CT" is "Measuring", the accuracy classes available in drop-down field such as "0.5s" mean that in 100 to 120 percent of the nominal current crossing the primary "CT", there may be measurement fault up to this percentage max. If the "CT" is "Protection" there are different accuracy classes one of which is selected according to the "CT" type and the information required for every "CT" is displayed in "Nominal Values" section.

Test Object	Secondary Burden	Resistance Test	Excitation Test	Ratio and	Polarity Test (With Cu	rrent)	Ratio	and P
General Informatio	n				Extra Data			-
Company:	Vebko	Feeder/Bay:	AAA	-	Date 09/0	05/2020)	-
Country:	IRAN	Phase:	A		Tested By AAA	١		
Station:	AAA	IEC-ID:			Approved by AA/	1		
Manufacturer:	Vebko	Core number:	1		Accessories			
Type:	Protection	Tap:	1		Easy Mode			
CT Serial Number:	11111-1111-11111	Additional Data:	AAAA					
Test Setting								
Core Type:	Protection ~							
Class:	5P or 5PR 🗸 🗸	Class Multiplier:		0.8000				
Applied Standard:	IEC 60044-1 ~	3						
Nominal Value -					F Temperature correct	tion –		
Primary Current:	1.000 kA	Actual Burden:		15.00 VA	Winding Material	Сор	per	~
Secondary Current:	1.000 A	Ambient Temperat	une:	25.00 °	Winding Temp.		20.00	_
Frequency:	50.00 Hz]			Reference Temp.		75.00	1-
Burden:	20.00 VA]			R Man.(Ref.Temp.)		1.000	Ω
Max Rct:	4.000 Ω]			Correction Factor		1.216	1
ALF:	20.0000	1			RMS Accuracy	2.10		
Cos(phi):	0.8000]				-		-
					Number Of Period			1

For example, if "10P or 10Pr" is selected as accuracy class, based on "ALF" in "CT", there may be up to 10 percent error in "ALF" times the primary nominal current. This means that if the "ALF" for a "CT" with an accuracy class of "10P" is "20", in 20 times of the nominal current in the "CT" primary, if the nominal "Burden" is connected to its secondary, there may be up to 10 percent measurement deviation. In "Applied Standard" field, the standard used for the "CT" is determined. In "Class Multiplier" field, a factor is entered between "0.2" and "1" to be multiplied by accuracy class. This factor makes the "CT" accuracy class harder in turns ratio test. This means that if the "CT" accuracy class equals "10P" and its accuracy factor equals "0.8", the maximum "CT" error in "ALF" times the primary nominal current is 8 percent.

- Test Setting				
Core Type:	Protection	~		
Class:	10P or 10 Pr	~	Class Multiplier:	0.8000
Applied Standard:	IEC 60044-1	~		

In "Nominal Values" section, the nominal values are entered according to the type and class of the "CT". Primary current, secondary current, nominal frequency, apparent power and secondary resistance in the temperature specified on its plaque (usually 75 degrees) are entered in their related fields. "Fs" or "Security Factor" indicates the measuring "CT" security factor and is defined as the ratio of instrument limit primary current to the rated primary current. Note that the actual "Fs" value is dependent on the burden of the "CT". If the burden connected to the "CT" is lower than its nominal burden, the "Fs" value is increased and the "CT" is saturated in higher current. For example, when the "Fs" of a "CT" is "5", this "CT" is saturated in 5 times the nominal current.

- Test Setting		13 A.		
Core Type:	Measuring	~		
Class:	0.1	~	Class Multiplier:	0.8000
Applied Standard:	IEC 60044-1	~		
Nominal Value -				
Primary Current:	1	.000 kA	Actual Burden:	15.00 VA
Secondary Current:		1.000 A	Ambient Temperature:	25.00 °
Frequency:	5	0.00 Hz		
Burden:	2	0.00 VA		
Max Rct:	-	4.000 Ω		
Fs:		5.0000		
Cos(phi):		0.8000	2	

"ALF" or "Accuracy Limit Factor" is defined as the proportion of accuracy limit of the primary current to the nominal current. The value of actual "ALF" is dependent to the burden connected to the protective "CT" secondary and its value decreases as the value of the connected "Burden" increases. "CT" Power factor, apparent power of the actual burden connected to the "CT" and the ambient temperature which equals 25C are entered in "Cos (phi)", "Actual Burden" and "Ambient Temperature" fields respectively. If the "CT" accuracy level is "X or PX", "PXR", "TPX", "TPY" and "TPZ", options such as "Exciting Current (I_e)", "K_{ssc}", "R_b", etc. are added to "Nominal Values" section which should be entered from the "CT" plaque. This information is used to estimate the knee point for excitation test. To view how these parameters work you can go to "Excitation Test" tab and by holding the "Mouse" pointer on the estimated knee voltage, view its relation.

Test Setting —			
Core Type:	Protection ~		
Class:	5P or 5PR \sim	Class Multiplier:	0.8000
Applied Standard:	IEC 60044-1 V		
Nominal Value —	F -		
Primary Current:	1.000 kA	Actual Burden:	15.00 VA
Secondary Current:	1.000 A	Ambient Temperature:	25.00 *
Frequency:	50.00 Hz		43
Burden:	20.00 VA		
Max Rct:	4.000 Ω		
ALF:	20.0000		
Cos(phi):	0.8000		

Primary Current:	1.000 kA	Actual Burden:	15.00 VA
Secondary Current:	1.000 A	Ts:	500.0 s
Frequency:	50.00 Hz	Tp:	100.0 s
Rb:	20.00 Ω	Duty:	C-0 ~
Max Rct:	4.000 Ω	t1: لم	40.00 s
Kssc:	20.0000	t2:	40.00 s
Ktd:	20.0000	Tfr:	300.0 s
Cos(phi):	0.8000	Ambient Temperature:	25.00

In "Winding Material" field in "Temperature Correction" section, the material used in the coils is selected from among "Copper" and "Aluminum". In "Winding Temp" field, the current temperature of the "CT" coil is entered. Also, in "Reference Temp." field, the reference temperature is entered to measure the resistance value of the coils so it can be used to correct the values measured in different temperatures. Normally, the reference temperature is written on the "CT" plaque in front of the secondary coil resistance which usually equals 75 degrees. In "Correction Factor" field, the temperature correction factor is calculated in accordance with the ambient temperature, reference temperature as well as the material of the coil which is not editable. In some cases, in the "Test Sheet" which comes with the "CT", the coil resistance, by checking "R Man.(Ref.Temp.)" option, you can enter the resistance. In this case, this resistance and its temperature are considered as the reference and are added to the results table in the "R Man.(Ref.Temp.)" column in "Resistance Test" tab that the temperature which is measured by the manufacturer is based on the resistance and is measured and showed in this test.

• Temperature correctio Winding Material	Aluminum ~
Reference Temp.	75.00 °
R Man.(Ref.Temp.)	1.000 Ω
Correction Factor	1.2245

The number entered in "RMS Accuracy" box in "Number of Period" field, shows the number of cycles used for calculation. By default, this number is set at "1". As the number of cycle's increases, the software uses more cycles in "AC" mode and more time in "DC" mode for calculations. By doing so, the number of calculations increases and the software speed is decreased but the result of the test will be more precise.

RMS Accuracy —	
Number Of Period	1

By clicking "Add to Report" option at the bottom of the page, this information is added to the report and then a message saying "The Report was added to the list" is displayed. By selecting "Report" window from the right side strip, it is possible to **view the report**. By clicking on "Delete Report", the report added from "Report" window is removed from "Delete from Report" window. If "Set as default" option is selected, the entered information is saved and set as default and by opening "Current Transformer (CT)" room, this information is displayed. For the instructional videos of this section, a 10P10 protective CT with 500/1 as turns ratio, 50 Hz as frequency and 15 VA as Burden is going to be tested.

Test Setting -	8	
Core Type:	Protection	~
Class:	10P or 10	Pr 🗸
Applied Standard	IEC 60044	-1 ~
Nominal Value		
Primary Current	:	500.0 A
Secondary Cur	rent:	1.000 A
Frequency:		50.00 Hz
Burden:		20.00 VA
Max Rct:		4.000 Ω
ALF:		20.0000
Cos(phi):		0.8000
Add to Report [Delete Report	Set as default

117 : "SECONDARY BURDEN" TEST

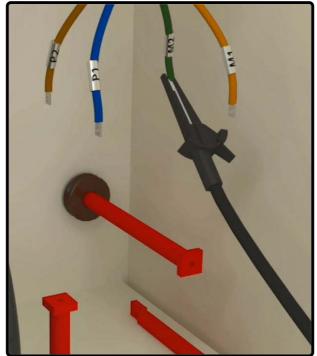
In this test, the "Burden" connected to the secondary "CT" is measured. In this test, by injecting the AC" current, and measuring "AC" voltage by using the "Binary/Analog Input" and dividing voltage by current, the value of "Z" and impedance angle and consequently "R" and "X" of the secondary route are achieved. To perform this test, the time and current of the test are entered in "State setting" section, in "I test" and "State Time" fields respectively. The specified current limitation for this field is "32" amps but a "5" amps current for "5" and "CTs" and a maximum "1" amp current for "1" amp "CTs" would be enough. After entering the "State Setting" information, the wiring should be done in accordance with the illustration shown. Note that by double-clicking on the picture you can maximize it. To perform this test, first, you need to disconnect the "CT" from all parts that connect the current to measurement equipment. In this wiring, you should short circuit "Ia1" and "Ib1" current output phases and connect "Ia2" and "Ib2" phases to the route through which the "CT" current is transferred.

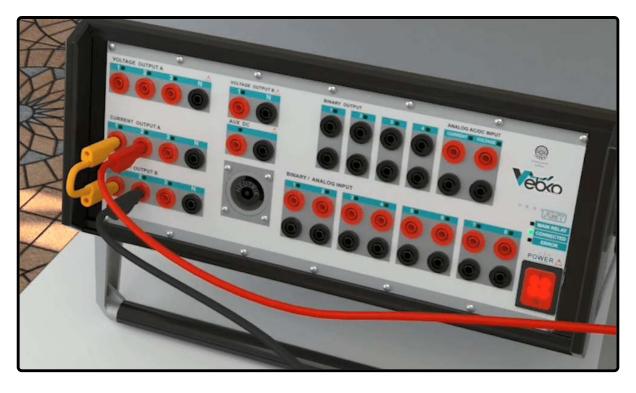
l inj:	V meas:				
0.000 A	0.000 V				
Z:	Angle:	R:	X:	L:	
0.000 Ω	0.00 *	Ω 000.0	0.000 Ω		0.000 H
(Z1^2):		(RI^2):	6		
0.000 VA	@ nominal current	0.000 W	@ nominal current		

Test Object	Secondary Burg
State Setting -	R
ITest:	1.000 A
State Time:	5.000 s
Don't change	hardware settings



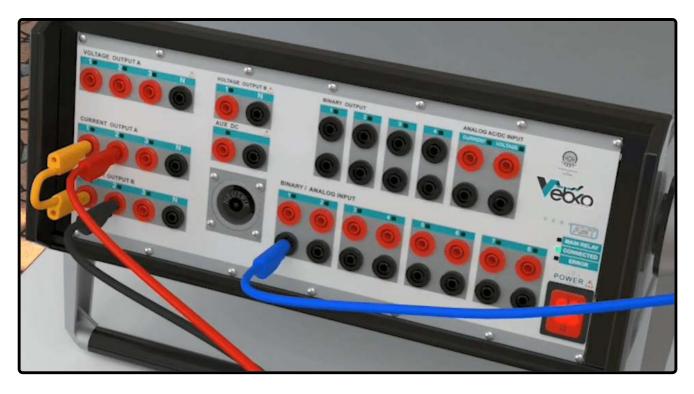


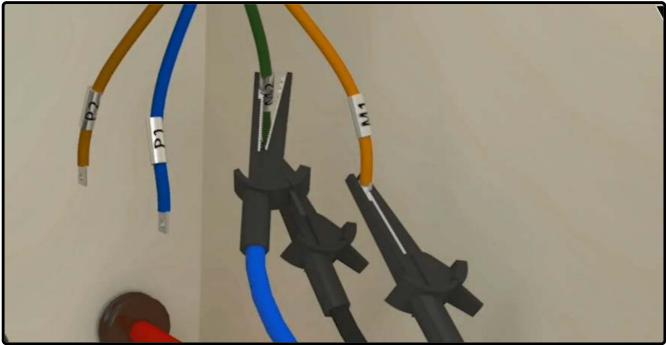


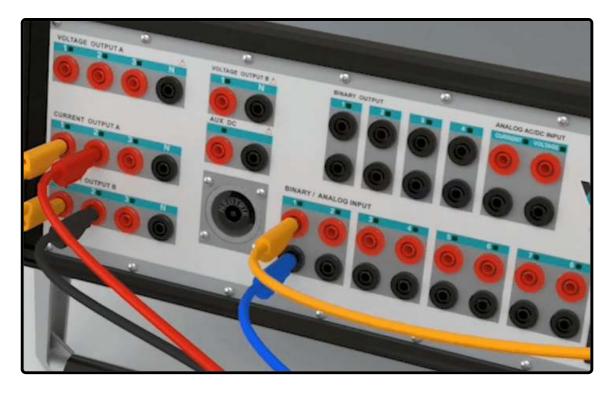




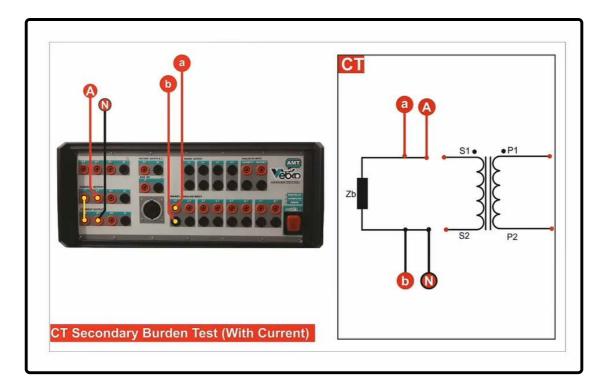
Also, to measure the "AC" voltage, you should connect the "Binary/Analog input"1 to the test route and further than the current injection connectors. Note that before performing the test it is necessary to press "Init Test" so that the device is configured automatically. By clicking on this option, the current and time settings of the test as well as the hardware settings related to "Hardware Configuration" including the device outputs and "Binary/Analog Inputs" are configured by the software automatically. In "Analog Output" tab in "Hardware Configuration" section, you can see that the wiring of the device is set at "32A" with the maximum "Burden" of "400VA" and the "Binary/Analog" inputs 1 is activated for measuring the voltage. To better analyze the test, "Table View", "Detail View" and "Signal View" windows can be used. After opening "Table View" window you can see that a "State" with the frequency of "50Hz" and in accordance with the entered information is made in "State Setting" section. If you wish to view a more complete set of information of "Table View", you need to use "Detail View" window.



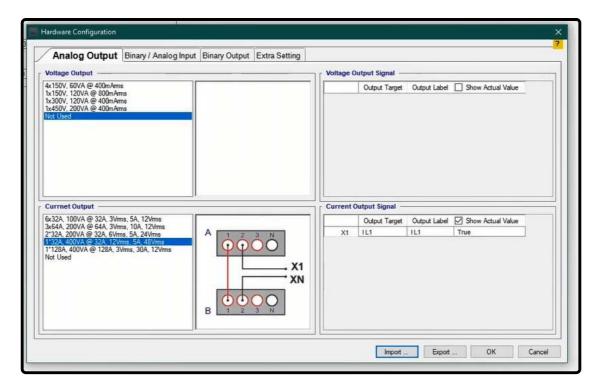








		٦
Add to Report	Init Test	
IA1 C2		



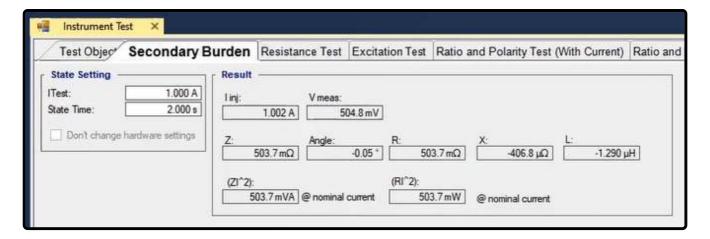
ge Binary-Input Target Binary-Input Type Threshold Reverse Show Actual Value Show Result Apply VDC Description C1 Bin, in 1 ✓ Meas. Voltage 1 Wet Max 30 (V) 30.00 V False AC False 0.000 V (Vin > 30)=>(inpi C2 Not Used Not Used Dry False None False 0.000 V (Vin > 30)=>(inpi C3 Not Used Not Used Dry False None False 0.000 V (Vin > 30)=>(inpi C3 Not Used Not Used Dry False None True C4 Not Used Not Used Dry False None True		Anai	og Output	nary (Analog Input	Binary Output	Extra Setting						
C2 Not Used Dry False None False C3 Not Used Not Used Dry False None True C4 Not Used Not Used Dry False None True C4 Not Used Not Used Dry False None True C5 Not Used Not Used Dry False None True C6 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None Image: State		ge	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show	v Actual Value	Show Result	Apply VDC	Description
C3 Not Used Not Used Dry False None True C4 Not Used Not Used Dry False None True C5 Not Used Not Used Dry False None True C6 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None 10 Not Used Not Used Shunt 1 Ohm None Shut 1 Ohm None Current Output Signal Current Output Signal View Show Actual Value 732A. 400VA @ 32A. SVms. 5A. 12Vms 1728A. 400VA @ 32A. SVms. 5A. 12Vms Not Used Not Used Not Used X1 ILL True	•	C1	Bin. in 1 🔹	Meas. Voltage 1	Wet Max 30 (V)	30.00 V	False	False AC		False	0.000 V	(Vin > 30)=>(input=1
C4 Not Used Dry False None True C5 Not Used Not Used Dry False None True C6 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None Image: State S		C2	Not Used	Not Used	Dry		False	None		False		
CS Not Used Not CS Not Used Not Used CS Not Used Not Used CS Not Used Not Used C7 Not Used Not Used C8 Not Used Nore 7 Not Used Nore 10 Not Used Nore Not Used Nore Nore 10 Not Used Nore Not Used Nore Nore 10 Not Used Nore		C3	Not Used	Not Used	Dry		False	None		True		
C6 Not Used Not Used Drv False None True C7 Not Used Not Used Drv False None True C8 Not Used Not Used Drv False None True C8 Not Used Not Used Drv False None True C8 Not Used Not Used Drv False None True 9 Not Used Not Used Shunt 1 Ohm None Image: Comparison of the		C4	Not Used	Not Used	Dry		False	None	5	True		
C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None True 10 Not Used Not Used Shunt 1 Ohm None Image: Current Output Signal Current Output Stake Output Farget Output Label Show Actual Value 232A, 200VA @ 32A, SVms, 5A, 12Vms A 1 2 N 1128A, 400VA @ 32A, SVms, 5A, 42Vms A Image: Current Output Label Show Actual Value 1128A, 400VA @ 128A, 3Vms, 30A, 12Vms A Image: Current Output Label Show Actual Value		C5	Not Used		- T25			None				
C3 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None C 10 Not Used Not Used Shunt 1 Ohm None None None None None None None None		C6	Not Used	Not Used		1	False	None				
9 Not Used Not Used Shunt 1.0hm None None None None None None None None		C7					index and in the second second			11.9.7		
10 Not Used None 0 Not Used None		C8	when the Party of the local sectors in the	and the second se	and the second se		False			True		
Currnet Output 6x32A, 100VA @ 32A, 3Vms, 5A, 12Vms 3x64A, 200VA @ 32A, 3Vms, 5A, 12Vms 7x32A, 200VA @ 32A, 5Wms, 5A, 24Svms 1128A, 400VA @ 32A, 12Vms, 5A, 48Vms 1128A, 400VA @ 128A, 3Vms, 30A, 12Vms Not Used		9			Shunt 1 Ohm			None	i -			
3x64A, 200VA @ 64A, 3Vms, 10A, 12Vms 2'32A, 200VA @ 32A, 6Vms, 5A, 24Vms 1'32A, 400VA @ 32A, 12Vms, 5A, 42Vms 1'128A, 400VA @ 128A, 3Vms, 30A, 12Vms Not Used	-			iA 12Vms				rent Ou		Ortext labo	CZ Shaw A	et al Vela
1132A. 400VA @ 32A. 12Vims, 5A. 40Vims 1128A. 400VA @ 128A. 3Vims, 30A. 12Vims Not Used					1997					the second s		ctual Value
	1*	128A, 4										

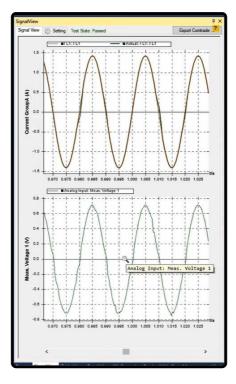
Table View		
ê	🗖 S1	Normal General: Direct
Name	Secondary Burden(V	/ith Current)
I L1: I L1	1.000 A	0.00 * 50.00 Hz
Bin. Out		
Trigger	()	©- 5.000 s
Туре	Normal	2 V
Comment		
Condition	C1 🔴 Meas. Vo	
Bin. Input		

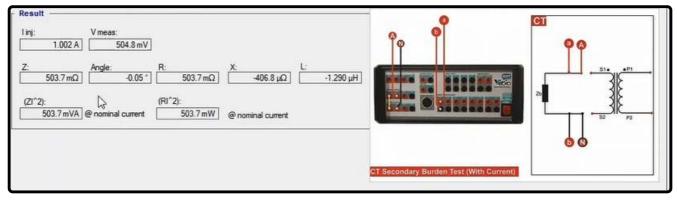
Detail View: (S1: Se	condary Burden	(With Current)	0	₽ × ?
State Type				r Trigger Setting
State Type:		State Name:		Comment
Normal	~	Secondary B	urden(With	State termination
- Set Mode and F	auitType ———			Space Key Press Use binary trigger condition as sp Binary trigger condition Trigger Logic : AND
Analog Output	Channels ——			C1.Meas. X. ~
Signal	Amplitude	Phase	Freque	
Binary Outputs	Trigger Condit	ion] Show Only La	est Change	Trigger Logic Minimum Time : Delay after Binary Trigger DerorTrigger Overcurrent Overcurent Trigger Overcurent Error Percent Threshold
Other Setting Disable Error (Disable Error (Dther Divervoltage of Bina	-	ole Get Actual	

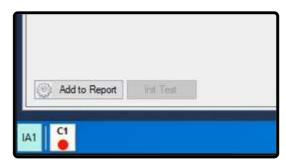
Performing the test and analyzing the results

After doing the wirings, here, "1" amp and "2" seconds are entered as the current and time of the test respectively and after pressing "Init Test" the test will run. In "Signal View", it is possible to view the actual current waveform and the voltage measured by "Binary Input". By using the "Actual" values waveforms and the voltages recorded in "Signal View" it is possible to check the connections of the connectors. The results of the test can be viewed in "Result" section after the test is finished. The results include "linj", the amount of injected current, "Vmeas", the measured voltage, the impedance of the route, angle of the impedance and finally the values of "R" and "X" are displayed using "Z Cos (phi)" and "Z Sin (phi)" relations. In "Actual Burden" field, the amount of power which can be provided by the "CT" secondary in nominal current is measured and the result is displayed in this field by the software. In the end, after the test is finished, it is necessary to add the results of the evaluation to the report, which is done by selecting "Add to Report" in equipment test.









Also, if you wish to add specific parts of the evaluation to the report or edit the report, you need to use "Add to Report" cog. By clicking on this cog, the items that can be added to the "Report" are displayed and you can simply uncheck whichever you wish to remove from the report. Note that after each test, the results are not added to the report automatically and it is necessary to add the results of the performed test to the output report by selecting "Add to Report" after each test and before clearing the Test. Note that if the "Burden" of the route is low and you wish to have a more precise measurement or the "Binary Inputs" number 1 and 2 are faulty, it is necessary to change the specified "Binary/Analog Input". To do this, first press "Init Test", then check "Don't Change Hardware Setting" option and go to "Hardware Configuration" window, specify a different binary for the measurement in "Binary/Analog Input" tab. Here, as an example "Input" number 10 is selected and after adjusting the required settings, the test is performed and the results are viewed. If you wish to select one of the binaries "1" to "8", it is necessary to enter their "Binary Input Target" in accordance with the number of the intended binary. For example, to use the binary number "7", "Bin7" should be selected as "Binary Input Target" while for binary number "5", "Bin5" should be selected.

	Edit & Delete Report
~	Test Setting
17	Wiring
	Assessment
	Cursor Data
IA1 🗸	Signal View

Export Report	(i) HT	ML () PI	DF			1.1.3 Get R	eport Image	e Of Sign	al View - ca	ll Get Im	age of Signal V
AMPro	Curre	nt Tra	nsforme	r:							
1) Abstra	et:										
1-1) Date a	and Tim										
I-IJ Date t		Туре	_		Date	Time	0				
Report Date an	d Time(Per				02/22	10:13:31.88 AM					
1-2) Test I											
Name: User Name:	AM	Sequence	ы			Version		99021	IO1 OP-87MREJ:	2	
Equipment	AM	105				Serial N		26	OP-O/MREJ.	6	
	lete Report					Junun		~~			
2010.00											
2) Test OI	ject:										
Tested By:		_									
D	ate			pproved By	4						
	09/05	/2020 AA		uA :							
Company	Country	Station	Manufacture	Туре	CT Serial Number		Phase	IEC-ID	Core	Тар	Additional Data
					11111			-	number		Data
Vebko	IRAN	AAA	Vebko	Protection			A		1	1	AAAA
					11111	1					
Test Setting:											
Core Type	CI	ass	Class Multiplier	Applied							
Protection	10P or 1	10 Pr		EC 60044-1							
	-										
Nominal Valu]	**********							
Primary Curr				al Burden:	S2	15.00 VA					
Secondary C Frequency:	urrent	1,0		pient Tempe	rature:	25.00 *					
Burden:		15.00				1					
Max Rct			0 0 0			1					
ALF:			0000								
Cos(phi):		0.8	\$000								
Test Conditio	2222										
		10000			_						
Winding Material		iding mp.	Reference Temp.	Correctio Factor	n						
Aluminu		0.00 *	0.00 *	1.0	000						

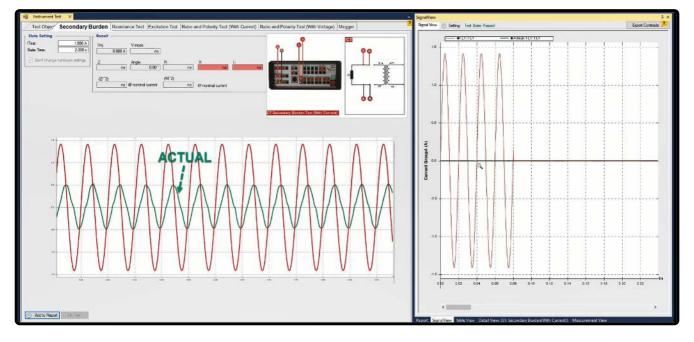
Report
Export Report HTML O PDF
ITest 1.000 A
State Time 2.000 s
3.1-2) Wiring:
ST Sicconducy Bunden To Ja (With Comover)
3-1-3) Assessment:
Linjection 1.002 A
V meas 504.8 mV Z 503.7 mD
Angle -0.05*
R 503.7 mΩ
X -406.8 μΩ
L -1.290 μH
Actual Burden 503.7 mVA
3.1.4) Signal View:
Actual: FL4: FL4
#Analog Input: Meas. Voltage 1
$ \begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$

Test Object	Secondary Bu
State Setting -	11
ITest:	1.000 A
State Time:	2.000 s

/	Analo	g Output Binar	y / Analog Input	Binary Output	Extra Setting	3				
_		Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
	C1 N	Bin, in 1	Meas. Voltage 1	Wet Max 30 (V)	30.00 V	False	AC	False	0.000 V	(Vin > 30)=>(input=1)
	C2 4	Not Used	Not Used	Dry		False	None	False		
	C3	Not Used	Not Used	Dry	8	False	None	True		
	C4	Not Used	Not Used	Dry		False	None	True		
	C5	Not Used	Not Used	Dry		False	None	True		
	C6	Not Used	Not Used	Dry		False	None	True		
	C7	Not Used	Not Used	Dry		False	None	True		
	C8	Not Used	Not Used	Dry		False	None	True		
	9	Not Used	Not Used	Shunt 1 Ohm			None			
	10	Meas. mV	Meas. mV				AC 💌			

	Analo	g Output Binar	y / Analog Inp	ut Binary Outpu	t Extra S	etting				
		Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
	C1	Not Used	Not Used	Dry		False	None	False		
	C2	Bin. in 2	Bin, in 2	Dry		False	None	False		(Short)=>(input=1)
	C3	Not Used	Not Used	Dry		False	None	True		
	C4	Not Used	Not Used	Dry		False	None	True		
•	C5	Bin. in 5 🛛 💌	Bin, in S	Dry		Faise	None	True		(Short)=>(input=1)
	C6	Not Used	Not Used	Dry		False	None	True		
	C7	Bin. in 7	Bin. in 7	Dry		False	None	True		(Short)=>(input=1)
	C8	Not Used	Not Used	Dry		False	None	True		
	9	Not Used	Not Used	Shunt 1 Ohm	;		None			
	10	Meas. mV	Meas. mV				AC			-

Two notable points in performing a test are that "Error Other" means that there is a problem in the connection of the wirings or the resistance of the current route is too high that the device is not able to provide the "Burden" needed to inject the current. Therefore, in case of facing this error, check the "Actual" value of the current from "Signal View". If the current is injected from the device ("Actual Current") but difference with the specified current is too high, the indicator of high resistance of the route and that the "Actual Current" equals zero indicates that the current injection route is open. If the route resistance is too high, the test current should be decreased and if the "Actual Current" equals zero, the connectors' connection should be checked. The other point is that the voltage read by the binaries of the device need to have similar cycles. If the read values have a too high or zero tolerance, this means that the connectors are not connected correctly.



118 : WINDING RESISTANCE TEST

Winding resistance test is performed in "Resistance Test" tab. In this test by injecting "DC" current into "CT" secondary and measuring the voltage through "Binary Input" and dividing the voltage by current, the "DC" resistance or "Rmeas" is calculated. Note that in the software there is a row by default. If the "CT" has more taps, by right-clicking and selecting "Add" you can make as many taps as the rows and test each tap. To perform this test you need to enter the current and time in "State Setting" section in "I test" and "State Time" fields respectively. The current limitation is "32" amps but a "5" amps current for "5" amp "CTs" and a "1" amp current for "1" amp "CTs" would be enough.

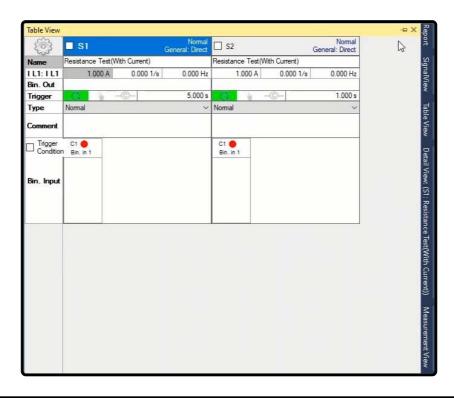
stat	te S	etting		Voltag	e Measurei	ment Mode:		_	<u></u>	
est	2		1.000 A		Measument		ie Max F	esistance		
tate	e Tin	ne:	5.000 s	O Bin	01	up to 8V	R <8.0	000 Ω		
-				🔘 Bin	01	up to 4.5\	R <4.0	000Ω		
11	Jon	t change hard	ware settings	O Bin	10	up to 200r	mV R <20	0.0 mΩ		
		cted row —	0.0001/1 0		4.000		0.000.0	1		
V	DC			nom	4.000	_	0.000 Ω			
V				nom meas	4.000	_	0.000 Ω 0.00 %			
V	DC					_		R dev	Assessment	
V	DC		0.000 A R	meas	0.000)Ω R dev	0.00 %	R dev 0.00 %		

After entering the information, you need to set the wiring according to the figure. Note that by double-clicking on the picture you can maximize it. In this wiring, first short circuit "Ia1" and "Ib1" then parallel "Ia2" and "Ib2" with the capacitor box and here you need to connect "Ia2" to "S1" of the "CT" and connect "Ib2" to "S2" after. The reason for using the capacitor box is to compensate the self-inductor effect of the "CT". There are 3 "1000" microfarad capacitors in this box and the red port is the positive polarity while the black port negative polarity of the capacitor.

To measure the "DC" voltage, you should connect the "Input1" to the "CT" and further from the current connectors. Then, connect the output current which has been paralleled with the capacitor to the "CT". Note that to perform the test you should to right-click on one of the rows and select "Apply Test". By doing this, the current and time settings as well as the hardware settings related to the "Hardware Configuration" including the outputs and "Binary/Analog Inputs" are adjusted automatically. In "Analog Output" tab in "Hardware Configuration" section you can see that the wiring settings is set at "32A" with a "400" Volt-amperes burden and the "Binary/Analog Input1" is activated to measure the voltage. To better analyze the test you can use "Table View", "Detail View" and "Signal View". After opening "Table View", you can see that two zero frequency states are made by the information of "State Setting". The first state is used so that the "CT" current exits the transient state and turns constant. The second state is used to measure the current and voltage and to measure the resistance. Now if you wish to view more information, use "Detail View" window.

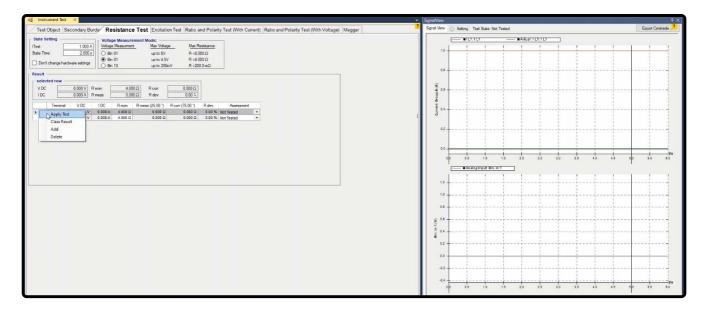
Terminal	V DC	I DC	Rnom	R meas (25.00 °)	R corr (75.00 °)	R dev	Assessment	
61 67	V 000.0	0.000 A	4.000 Ω	Ω 000.0	Ω 000.0	0.00 %		-
Apply Test	٥v	0.000 A	4.000 Ω	0.000 Ω	0.000 Ω	0.00 %	Not Tested	-
Clear Result								
Add								
Delete								

Analog Output Binary / Analog Input	Binary Output	Extra Setting					
Voltage Output		1	Voltage 0	utput Signal —			
4x150V, 60VA @ 400mAms 1x150V, 120VA @ 800mAms 1x30V, 120VA @ 400mAms 1x450V, 200VA @ 400mAms Not Used				Output Target	Output Label	Show Actual Value	
Currnet Output			Current C	lutput Signal —			
6x32A, 100VA @ 32A, 3Vms, 5A, 12Vms				Output Target	Output Label	Show Actual Value	
3x64A, 200VA @ 64A, 3Vms, 10A, 12Vms 2132A, 200VA @ 32A, 6Vms, 5A, 24Vms 1132A, 400VA @ 32A, 12Vms, 5A, 48Vms 11128A, 400VA @ 128A, 3Vms, 30A, 12Vms Not Used		$\xrightarrow{3}_{3}^{N}$	X1	1L1	11.1	True	L



Performing the Test and Analyzing the Results

After wiring, "1" amp and "2" seconds are entered as test current and time and 10 RMS Accuracy is selected as time period and by right-clicking on one of the rows and selecting "Apply Test" the test is initiated. Note that in "Signal View", the waveform of the actual current and the voltage measured by "Binary Input" is viewable. By using "Signal View" and the recorded current and voltage waveforms, it is possible to analyze the test and by using the "Actual" values and the recorded voltages, examine the connection of the connectors.



After the test is finished, by selecting the row in "Result", it is easily possible to view the test results. The results include "Vdc", the injected current, "Rnom" (or "Max Rct"), the resistance measured in the current temperature, the resistance measured in the reference temperature and "Rdev" of the difference between "Rcorr" and "Rnom" in terms of percent. In "Correction Factor", the current ambient temperature and the reference temperature as well as the material of the coil calculate correction factor. The information of this temperature is entered in "Reference Winding" field in "Test Object" and "Rcorr" is calculated by multiplying the "Rmeas" value by the "Correction Factor".

1	/ DC	:	2.315 V	R nom	4.00	0Ω R corr	2.775 Ω			
1	DC		1.001 A	R meas	2.31	3Ω R dev	-30.62 %			
	_	Terminal	V DC	I DC	R nom	R meas (25.00 °)	R corr (75.00 °)	R dev	Assessment	_
								and the second se		_
•	1	S1 -S2	2.315 V	1.001 A	4.000 Ω	2.313 Ω	2.775 Ω	-30.62 %	Passed	

Sometimes it is possible that in the CT test sheet, the resistance is measured in a temperature other than the one mentioned in the plate. If you wish to enter this resistance, you need to check "R Man. (Ref. Temp.)". By doing so, this resistance and its temperature are considered as the reference. By doing this, in "Resistance Test" tab, "Temp. Manufacturer" column is added to the results table. In this column the temperature measured by the factory is calculated. In the end, after performing the test, if "Rcorr" is smaller than "Rnom", the "Assessment" is passed, in otherwise it fails. After the assessment, you should add the results to the report via "Add to Report" in equipment test.

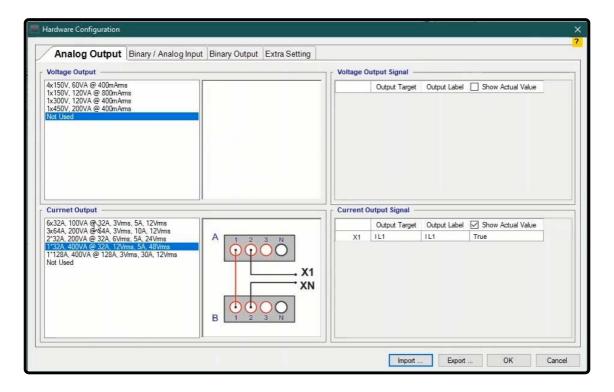
	ult	cted row									
	V DC		2.315 V	R nom	4.00	0Ω R corr	2.775Ω		ΨĻ.		
3	DC		1.001 A	R meas	0.00	0Ω R dev	0.00 %	0	V		
		Terminal	V DC	I DC	R nom	R meas (25.00 °)	R corr (75.00 °)	R dev	Temp. Manufacturer	Assessment	
	1	S1 -S2	2.315 V	1.001 A	4.000 Ω	2.313 Ω	2.775 Ω	-30.62 %	-157 °C	Passed	17
	2	S1 -S3	0.000 V	0.000 A	4.000 Ω	Ω 000.0	0.000 Ω	0.00 %	0 °C	Not Tested	-

Also if you wish to add some specific parts to the report or delete and edit the report, you can use the "Add to Report" cog. By clicking on it, you can check the items that should be added to the report or if you don't need them you can uncheck them. Note that after performing each test, the results are not automatically added to the report and it is necessary to add the results to the output report by selecting "Add to Report" after each test and before clearing the test.

	Edit & Delete Report	
~	Test Setting	
*	Wiring	
4	Assessment	
2	궁 Cursor Data	
~	Signal View	

In performing the test, note that in "Voltage Measurement Mode", you need to select one of the radio-buttons in accordance with the maximum resistance specified in "Max Resistance" column. If during the test in the default mode an over voltage error appears, select "Bin01" with a maximum of "8" volts. If the measured resistance is less than the maximum resistance of the "Bin10", use the "Input" 10 for more accuracy. Also, if you wish to use a different wiring for the current, select "Apply Test" at least one time before. Then check "Don't Change Hardware Setting" and select your desired wiring in "Hardware Configuration" and then select "Apply Test" again.

- State Setting		Voltage Measuremen	it Mode:	
ITest:	1.000 A	Voltage Measument	Max Voltage	Max Resistance
State Time:	2.000 s	O Bin 01	up to 8V	R <8.000 Ω
		O Bin 01	up to 4.5V	R <4.000 Ω
Don't change ha	irdware settings	Bin 10	up to 200mV	R <200.0 mΩ



Two notable points are that "Error Other" shows that there is a problem in the wirings or resistance is too high that the device is not able to provide the "Burden" to inject the current. Therefore, if this error appeared, examine the actual value of the current in the "Signal View". If the current is injected ("Actual Current") but its difference with the set current is too much, the wiring resistance is too high and if "Actual Current" is zero, the route is open. If the resistance is too high, the current should be decreased and if the "Actual Current" equals zero, you need to examine the connections. The other point is that if the measured voltage is zero or has too high tolerances, it means that the connectors are not connected correctly.

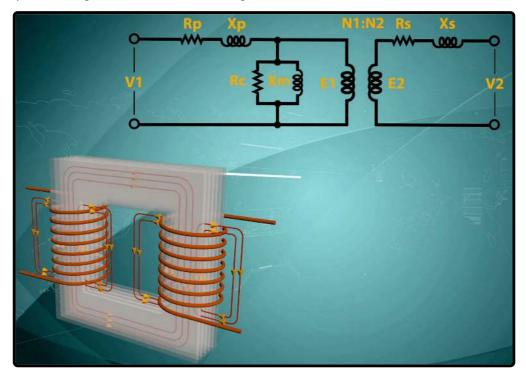
1.0			-	
i	 			
0.1	 No. of Concession, Name			
03				
00				

0.4	
M	
N	

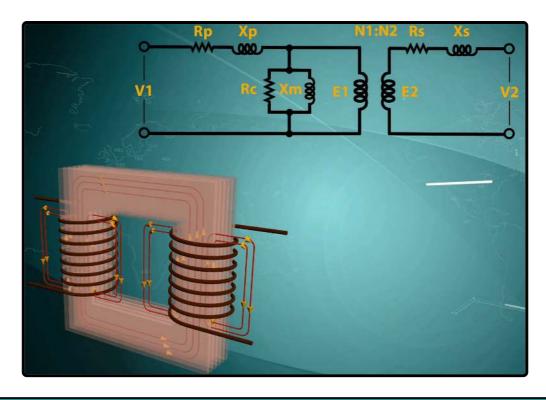
119 : "EXCITATION TEST" TAB, PART I

Transformer Saturation:

Before talking about the Excitation test, it is necessary to review some important subjects related to analyzing behavior of transformers including equivalent circuit and some electric and electromagnetic analyses. You can see a transformer equivalent circuit in the figure. In this circuit, " R_P " and " R_S " refer to the primary and secondary coils resistance respectively which occur as heat loss and increase in the temperature of the coil. " X_P " and " X_S ", on the other hand, indicate a part of the flux whose path is through air and is known as "leakage Flux".



In the parallel branch, "Rc" is the indicator of core loss including eddy current and Hysteresis losses which occur as increase in the temperature of the core. The reason for parallelism of " R_C " is that the losses caused by it are in accordance with the square of the input voltage. "Xm" indicates magnetizing inductance of the wires wrapped around the core of the transformer.



Transformer Loading and Its Effect on Transformer Saturation

When the transformer is put "on-load", it causes the secondary current to increase. When it happens, the flux caused by the secondary coil increases as well. Also, after the secondary current increases, the primary current increases as well which leads to an increase in the flux of the primary side. But since the changes in the secondary side current are bigger, the flux of the secondary side will be more than the primary side. Because of the influence of the opposite side of these two in the equivalent flux of the transformer core, the flux of the transformer decreases.

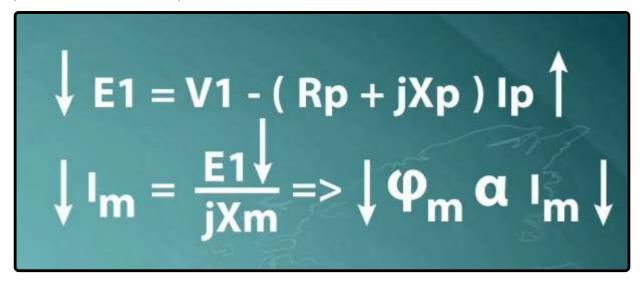
$$\begin{split} \varphi_{s} = L_{s} I_{s} , & \text{if} : I_{s} \uparrow => \varphi_{s} \uparrow \\ I_{s} \uparrow => I_{p} \uparrow \left(\frac{I_{p}}{I_{s}} = \frac{N_{2}}{N_{1}} \right) \\ \varphi_{p} = L_{p} I_{p} => \varphi_{p} \uparrow \\ I_{s} > I_{p} => \varphi_{s} \land \varphi_{p} => \varphi_{eq} \downarrow^{2751} \end{split}$$

As a result, while the load drawn from the terminals of the power transformer increases, the core recedes from the saturation area. Therefore, in full-load it is possible to use a small core for the transformer, but since transformer is not always used in nominal load, by reducing the core, the decrease in the load, leads to the saturation of transformer. Therefore, to avoid transformer saturation in light load and change the waveform from sine wave, it is necessary to extend the transformer core.

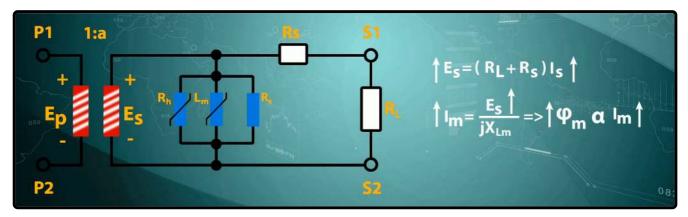
CT Saturation Curve

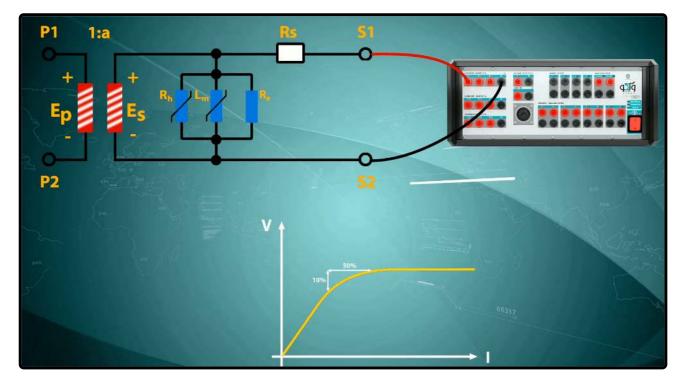
As mentioned before, the power transformer recedes from saturation by increasing the current whereas CT gets closer to the saturation area. The reason for this is related to the voltage of parallel branch where, in the power transformer by

increasing the current, voltage of the parallel branch decrease. However, in "CT", by increasing the current, the voltage of the parallel branch in the secondary side increases and the "CT" saturates.



"CT" saturation in a power system is caused by increase in the primary current because of occurrence of a fault, which disables the "CT" to move the fault current to the secondary with the correct ratio. Since the saturation point of "CT" is related to voltage and parallel branch current, while doing this test, the secondary voltage increases and the point where by increasing the voltage by 10 percent, the drawn current increases by 50 percent is considered as the saturation point. In future videos the ways to enter the values and do the test for different "CT"s will be provided.





120 : "EXCITATION TEST" TAB, PART II

To perform this test, the first parameter to be entered is the "CT" secondary resistance. This resistance is used to estimate the knee point and is selected from "Max R_{CT} " field by default. But if the resistance test has already been done, this resistance is selected from "Rmeas". Note that, since some users skip the resistance test and try to directly perform this test, this field can be edited manually.

		Excitation Re	sult
Actual Rct to test estimation	2.313Ω	Excitation: N	ot Tested 🛛 🗸
		V exc.	na V
Test Estimation	169.1 V	l exc.	na A
E _{ALF}	169.1 V		
State Settings			
-			
Demagnetize		Ratio Table	
Time: 10.00	=		
% of Vend 50.00	%		
Calc. From TestObject			
Frequency	50.00 Hz		
Vend	186.0 V		
Excitation Time Test:	30.00 s		
	nas		
Don't change hardware settir			
Don't change hardware settir Calculation of Iprimary —			
Calculation of Iprimary			
Calculation of Iprimary Vexc. 169.1 V R ct	2.313Ω		
Calculation of Iprimary	2.313Ω 4.000Ω		

In the "Efs" field, the knee point is estimated using the formula. The importance of this number is in calculating "Vend" to determine the final voltage of test evaluation. The assessment of this test is based on the finding of the knee point, so that if the knee point is found, the test is "Passed" and otherwise "Failed". Once the resistance value has been specified, the test settings is entered in "State Setting". If "Demagnetize" option is ticked, before performing the test evaluation, the software once demagnetizes the "CT" with "AC" voltage and current. so that the residual flux caused by theresistance test is removed. In this section, you must enter the time "Demagnetize" and voltage in a percentage of "Vend".

F Test Estimation E _{ALF}	169.1 V
State Settings	2
Rdc	
Demagnetize	
Time:	0.00 s
% of Vend	0.00 %
Calc. From TestObject	
Frequency	50.00 Hz
V end	186.0 V
Excitation Time Test:	30.00 s
Don't change hardware	settings

In the next step if "Calc. from Test Object" is checked, the software calculates the frequency and final voltage of the test by using the information entered in "Test Object". If you wish to enter this manually, you should uncheck this option. In "Excitation Time Test" field, the test time is entered. Note that, it is possible to show the saturation curve with less fluctuation by increasing the test time. In "Choose Current Measurement Mode" section, it is possible to specify the maximum current from among "Low Current" with maximum 500 milliamps and "High Current" with maximum 800milliamps. Note that by selecting any of these options, the wiring changes.

- State Settings -	
Rdc	
Demagnetize	
Calc. From Test	Dbject
Frequency	50.00 Hz
V end	128.3 V
Excitation Time Tes	t: 30.00 s
Choose Curren	t Measurement Mode: –
Low Current	l exc < 500mA
O High Current	500mA < I exc < 800mA

Performing the Test and Analyzing the Results

In this test, the test information is entered is this page in accordance with the information entered in "Test Object" and the performed resistance test. Also, the wiring is done according to the CT specifications which are different for different models of "CTs". Note that in this wiring, output voltages is connected to the capacitor positive output and it is necessary that the two negative polarities of the capacitors are connected to each other. Then the positive polarity of the second capacitor is attached to the "S1" "CT" and the "S2" is connected to the device. It should also be noted that series capacitors are used to filter the "DC" voltage of the device.

By pressing "Init Test", the needed "States" are created in "Table View" and the necessary changes are automatically applied in "Signal View". Note that the voltage is displayed in "Signal View" in form of "RMS" and it is possible to change the view to sine by selecting "Instantaneous" option. After performing the test, in "Signal View" you can see that first the "CT" is demagnetized and then the excitation test begins. In "Lissajous" tab, the saturation curve can be viewed in terms of voltage and current. In this curve the linear area between the two plus signs is depicted in pink. After finishing the test, the knee point and the saturation point are depicted with green and the results and the evaluation are recorded in "Excitation Result" section. Since in performing this test the saturation curve points are of significance too, by selecting "Add to Report" option, the points used for the test are added to the report.

High Instrument Test X	SignalView	
Test Object Secondary Burden Resistance Tey Excitation Test Ratio and Polarity Test (With Current) Ratio and Polarity Test (With Voltage) Megger	Signal View (Setting Text State: Not Texted	Export Contra
r Pre test r Excitation Result	Voltage GroupA Actual Current of Voltage Voltage All VL1-E	
Actual Rct to test estimation 2313Q Excitation: Not Tested ~	General Setting	
Vex. naV	Show Table Extra Setting Show Type	
Test Estimation less: na A	Data table Data table Cursor Urve Scroll RMS	
State Settings	Show All Currery III Data Table Highlight Current State Period Sime: 20.00 ms	
Rdc	Cursor 1 Show Time On Binary Num. Of Period 10	
Demognetize	Cursor 1 Cursor 2 Cursor 2 Cursor 3 Cu	
Time: 10.00 s	Cursor 3 C2-C1 Refresh All Recalculate	
1. of Vend 50.00 %	C3 - C2 Num. Of Points 1200	
Frequency 50.00 Hz	C1-C3	
Vend 196.0.V	2 Operation	
Excitation Time Test: 30.00 s	Calculated Settings	
	Number of Operation : 1 Initiate	
	Operation 1	
	Operation Mode By Signal V Number Of Signal 2 V	
Characteria control of primary	Signal 1 Actual Current: V L1-E V Signal 2 Actual: V L1-E: V L1-E	~
Vexc. ne V Rdt 2313Q	Advanced Advanced	
lexc. ns A RL 4,000 Ω	Coef. 1 1.000 x A v Coef. 2 1.000 x V v Title: Calculated 01 Al State	4
CTR 500.0000 pm 13.39 kÅ	Name: Name: Show Point Calculate Knee point	Start voltage:
	¢	
Add to Report Int Test Int Test	Show Signals	

Another important point in an excitation test is the current which passes the primary of "CT" and causes the saturation. Since this current is related to the CT connected resistance, in "Calculation of Iprimary" section, the connected resistance should be entered in " R_L " field and then view the current that causes the CT saturation in "Iprim" field. Here you can see the formula used to calculate this current.

V exc.	159.6 V	Rct	2.313 Ω
l exc.	19.84 mA	RL	.5 Q
CTR	500.0000	l prim	12.64 kA

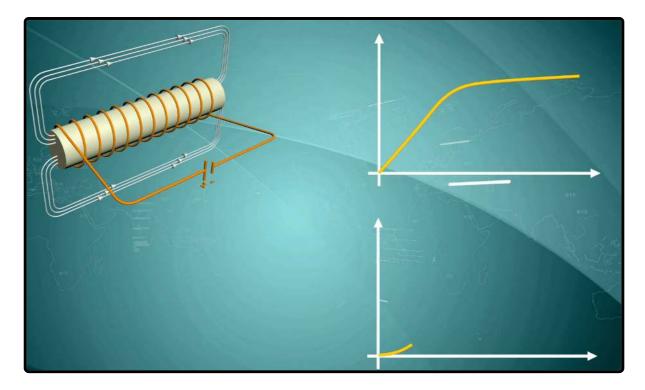
If you wish to set the wiring in a way other than the suggested way, after clicking on "Init Test", check "Don't Change Hardware Setting", then make your desired changes and initiate the test. Note that if before finding the saturation and knee points, an "Overcurrent" error is displayed, the wiring needs to be changed from "Low Current" to "High Current" and then initiate the test after pressing "Init Test". If again before finding the knee point the device is displaying an overcurrent error, this means that the knee point current is higher than the Range of the device and it is not possible to find the knee point using this device.

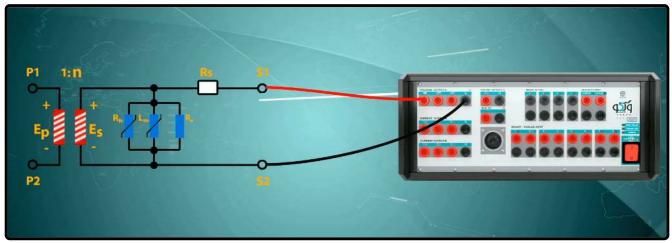
EALF		169.1 V
State Setti	ngs	
🗹 Demagne	tize	
Time:	10.0	00 s
% of Vend	50.0	10 %
Calc. Fro	m TestObject	
Frequency		50.00 Hz
V end		186.0 V
Excitation Ti	me Test:	30.00 s
Don't cha	ange hardware se	ttinos
the second secon	ange hardware se of Iprimary —	ttings
the second secon	-	
Calculation	of Iprimary -	t <u>2.313Ω</u>
Calculation V exc.	of Iprimary — na V R c	t 2.313Ω
Calculation V exc.	of Iprimary — na V R c na A RL 500.0000 I pr	ct 2.313 Ω 500.0 mΩ im 30.04 kA

121 : CT "EXCITATION TEST", PART III

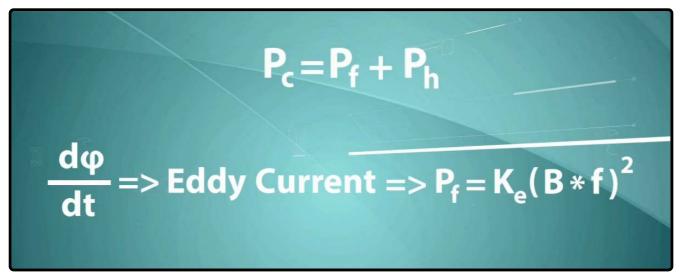
Saturation phenomenon and non-linear behavior in transformer

As you know, inductor is a linear element but if its voltage exceeds a specific limit, the inductor is saturated and enters the non-linear area. What we mean by saturation of the inductor is the saturation of its core. In fact, when the voltage exceeds the threshold, the core loses its ability to pass more flux and so it is saturated and the inductor turns non-linear. But by drawing the saturation curve of a "CT", you can see that there is also a non-linear area in the lower voltages. Up to now we have said that in higher voltages the inductor becomes excited and turns non-linear. To explain non-linear area in a lower voltage, the parallel circuit of a "CT" is drawn. In this parallel circuit, the turns ratio of the "CT" which is a transformer is "1:N". "Rs" indicate the resistance of the "CT". In the parallel branch, "R_{eddy}" and "R_h" stand for Foucault and hysteresis losses of the coil and L stands for the magnetizing inductance of the "CT" secondary. To perform the excitation test, secondary of the "CT" is fed by voltage and check to see what non-linear element is causing the "CT" to show a non-linear behavior even in lower voltages.





As mentioned before, the losses of core include Foucault and hysteresis. Therefore, to analyze the non-linear behavior of the transformer, we need to examine the Foucault and hysteresis losses. Foucault losses are caused by Eddy Current which occurs in the core segment because of time-varying flux in the core and voltage induction. Since the flux is directly dependent on the voltage, we can say that the Foucault losses are the result of a pure resistance. The relation of the Foucault losses is achieved through an empirical method and is as you can see:



In this relation, "B" is the flux density which equals "V/f". By substituting this relation, Foucault losses can be rewritten as $P_f = V^2/R_e$.

$$P_{c} = P_{f} + P_{h}$$

$$\frac{d\phi}{dt} \Rightarrow Eddy Current \Rightarrow P_{f} = K_{e}(B * f)^{2}$$

$$B = \frac{V}{f} \Rightarrow P_{f} = K_{e}(\frac{V}{f} * f)^{2} \Rightarrow P_{f} = K_{e}(V)^{2} \Rightarrow P_{f} = \frac{V^{2}}{R_{e}}$$

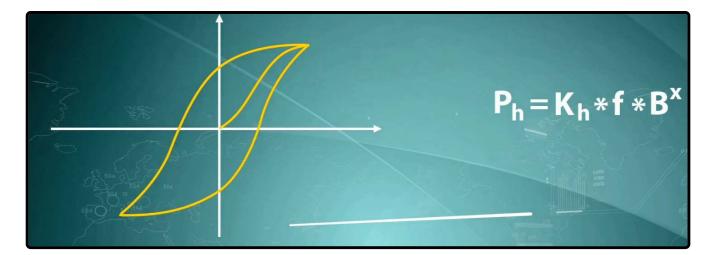
From this relation it can be deduced that the Foucault losses are caused by a fixed resistance that are not dependent on voltage and cannot be the reason for the non-linear behavior of the transformer in lower voltages. So, it is only possible that the hysteresis losses are the reason for the non-linear behavior in the "CT". Hysteresis losses occur in the core due to the residual magnetism. This means that passing of the magnetic flux through the metal core in a direction causes the core to be magnetized and turn into a weak magnet; so in the next half-cycle, a small amount of energy is lost to remove the magnetic effect of the previous half-cycle and this is being constantly repeated. The empirical relation of hysteresis is as you can see:

$$P_{c} = P_{f} + P_{h}$$

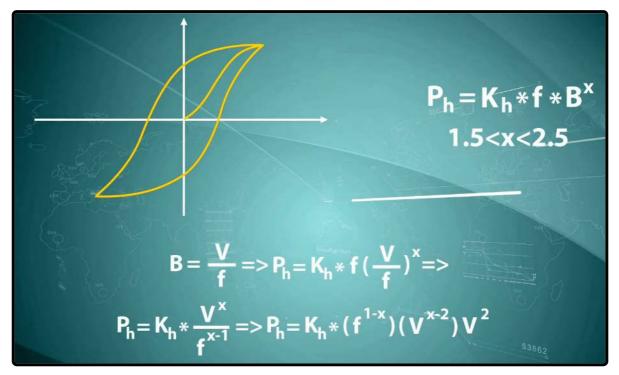
$$\frac{d\phi}{dt} \Rightarrow Eddy Current \Rightarrow P_{f} = K_{e}(B*f)^{2}$$

$$B = \frac{V}{f} \Rightarrow P_{f} = K_{e}(\frac{V}{f}*f)^{2} \Rightarrow P_{f} = K_{e}(V)^{2} \Rightarrow P_{f} = \frac{V^{2}}{R_{e}}$$

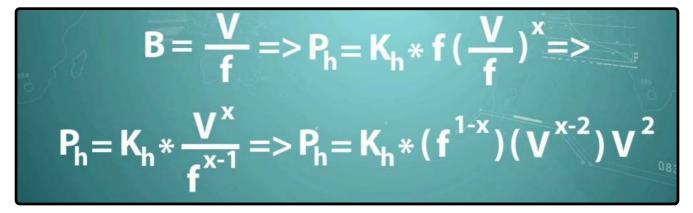
$$P_{f}: \text{Linear} \qquad P_{h}: \text{None Linear}$$



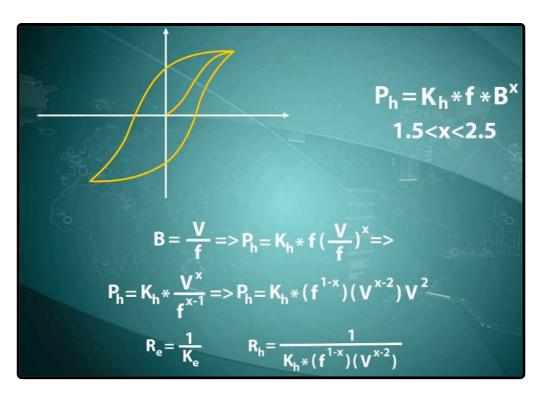
The value of "x" depends on the material of the core and can vary from 1.5 to 2.5. Also, in this relation, "B" is the flux density which equals "V/f" and by substituting it, the Hysteresis losses can be rewritten as you can see:



From the resulted relation, it is obvious that the hysteresis resistance is non-linear and dependent on the its voltage



The effect of this resistance in the total equivalent resistance of the "CT" in the lower voltages is significant. But from a specific voltage upwards, the effect of this resistance decreases and causes the "CT" current and voltage relation to approach linearity. This causes the relation between voltage and current to be non-linear in a specific range in the lower voltages.



122 : CT EXCITATION TEST, PART IV

Saturation Point and Frequency Variation

As mentioned earlier, the core losses include eddy current and hysteresis and its model is as you can see here:

$$Ph=Kh_{*} Vx / fx-1 => Ph= Kh * (f1-x) * (Vx-2) * V2$$

Pc= Pe + Ph = Ke (V2) + Kh * (f1-x) * (Vx-2) * V2

By using this relation, we can obtain the Foucault and hysteresis resistance models which Foucault resistance model is linear and independent from the voltage while hysteresis resistance model is non-linear and dependent on the voltage.

$$Re=1/Ke$$

Rh= 1/ (Kh * (f1-x) * (Vx-2))

If voltage is fed from the secondary side, since R_{ct} and the current drawn from the source is clear, the voltage of the parallel branch is calculated using:

E= Vterminal -RCT * I

After calculating E, the core losses are calculated using:

By having the core losses value and its extended formula Pc= Ke (V2) + Kh * (f1-x) * (Vx-2) * V2

It is possible to calculate K_e , K_h and X by solving the three equations in the three variables system. To solve these equations, it is possible to apply three different voltages. But if the frequency is the same, its determinant turns zero and no answer can be obtained for the variables. Therefore, it is better to apply one of the voltages with a different frequency.

In the first step of solving these equations with V_1 and f_1 as voltage and frequency, K_e and $(K_h^*(f^{1-x}))$ parameters can be obtained using a two equations in the two variables system.

Pc1= Ke (V12) + Kh *
$$(f11-x)$$
 * $(V1x-2)$ * V12
Pc2= Ke (V22) + Kh * $(f11-x)$ * $(V2x-2)$ * V22

Now, if one of the voltages is applied along with f_2 as the frequency, "x" is obtained and by substituting it in $K_h^*(f^{1-x})$, K_h obtained achieved as well. By specifying these parameters, the resistance of Foucault and Hysteresis obtained.

$$P_{c2} = K_e (V_2^2) + K_h * (f_1^{1-x})^* (V_2^{x-2}) * V_2^2$$

$$P_{c3} = K_e (V_2^{2}) + K_h * (f_2^{1-x})^* (V_2^{x-2}) * V_2^2$$

Due to voltage application limit for CTs with a very high saturation point, it is possible to find the saturation point in the nominal frequency by decreasing the voltage and frequency with the same proportion. Because the relation of the according flux is V/f.

But does not changing the frequency change the CT system? To explain this subject, we need to examine those components of the CT that are affected if the frequency and voltage are changed. According to previous analyses, Rct is dependent on the material of the wire and Reddy to the material of the coil. In Xm branch, due to the proportional change of V and f and the stability of the flux, this branch remains unchanged as well. Therefore, the only parameter affected by the voltage and frequency is hysteresis resistance which was obtained.

$$\underline{R}_{\underline{h}} = 1 / (K_{\underline{h}} * (f^{1-x}) * (V^{x-2}))$$

Now suppose that to obtain the saturation point, the fed voltage and frequency are split in two. Is it possible to obtain the saturation point in the nominal frequency by multiplying the voltage and current by two? This will be clarified later.

Suppose that the CT knee point is obtained by decreasing the frequency to 25 Hz with 500 volts of voltage and 15 milliamps of current. The voltage of the parallel branch is obtained using:

$$\underline{E}_{\underline{Exc}} = V_{terminal} - R_{ct} I_{Exc}$$

Since now we have $K_e \cdot K_h$ and x, by dividing E_{Exc} by R_{eddy} and R_h , I_a and I_h currents are calculated. By subtracting these two from I_{Exc} , the self-inductor current is obtained. According to this relation,

when the flux is fixed, the self-inductor current is fixed as well. Therefore, by doubling the voltage of the parallel branch, this current remains fixed. After doubling the voltage and frequency, as it is shoawn in this formula.

$$Ieddy=2 Exct /Reddy$$

$$I_{h}= 2 E_{Exc} /1/ (K_{h} * (f^{1-x}) * (Vh^{x-2}))= 2 E_{Exc} * (Kh * (50^{1-x}) * (2E_{Exc} x^{-2}))$$

$$Ie= 2 E_{Exc} * K_{e}$$

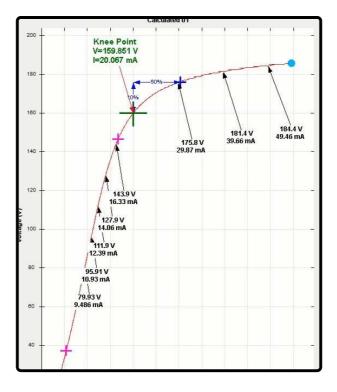
The Foucault and hysteresis currents are calculated and added by self-inductor current to achieve I_{Exc} using this relation. Then, the voltage of the parallel branch which is 25_{Exc} is added to $R_{ct}^* I_{Exc}$ and the terminal voltage is obtained.

Decreasing the Frequency and Performing the Test:

As you know, the maximum output voltage of a device in one-phase mode is "450" volts. Usually, to avoid damaging the measuring equipment, measuring CTs go to saturation in low voltages. But the saturation voltage of some protection CTs such as "TPX", "TPY" and "TPZ" is too high and usually this saturation point voltage is beyond the ability of the device. To test these CTs, it is possible to increase the voltage until the CT goes to saturation but some scientific references suggest that high voltages must not be fed into CTs because high voltages can damage the insulation resistance of the equipment. Another method for excitation test in CTs with too high saturation voltage is to decrease the frequency. This method is also mentioned in the standard CT excitation test, which can be performed with an "AMT105" device.

As you saw, the knee point of a 5P10 protection CT in 50 Hz frequency was measured to be about 159 volts. If you wish to specify the value of the final voltage and injected frequency manually, you need to uncheck "Calc. from Test Object" option and fill "Frequency" and "V end" fields. For example, "25 Hz" and "186 volts" are entered as frequency and final voltage respectively which means "372 volts" in "50 Hz" frequency. Note that by changing the voltage, it is so much probable that the wirings change as well. In this method, "Demagnetize" option is checked by default so that the magnetic residue is removed and the aforementioned calculations are done.

456/668



🗹 Demagnetize		
Time: [10.00 s	
% of Vend [50.00 %	
Calc. From Te	estObject	
Frequency		25.00 Hz
Vend	300.0 V	150.0 V
Excitation Time 1	Fest:	30.00 s
Choose Curr	ent Measureme	nt Mode: –
Low Current	t lexc<5	00mA
O High Curren	t 500mA < lex	c < 800mA

After adjusting this settings and specifying the test time, click on "Init Test" to initiate the test. As you can see in the "Signal View", by decreasing the frequency and equating, the knee point is almost equal with what was measured in 50 Hz frequency. Therefore, in cases where the CT saturation point voltage is beyond the limit of the device, by decreasing the frequency, you can measure the knee point and its saturation.

200 -		 	_
Knee Point V=158.867 V	 		1
l=19.693 mA			1
180 + 2			
180 - 65 50%			
• 0%s=1			
10%			
160			
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
1837V V			
180.7 V 1A IA			
40.7 V V 180.7 V A A A 174.8 V A 174.8 V A 174.8 V A			
1			
-			
120 – 143.0 V			
16.03 mA			
127.1 V			
¹⁰⁰ 13.77 mA			
111.2 V			
12.00 mA			
80 <u> </u>			
95.32 V			
10.44 mA			
79.43 V			
608.988 mA			
40			
+			

123 : OTHER TESTS PERFORMABLE IN "EXCITATION TEST" TAB

By checking "Extra Data", the additional information obtained from the excitation test is displayed. In the table of this section, the drawn current is displayed in E_{FS} with 110 percent. Moreover, in "Custom" row it is possible to enter the voltage and view the current drawn in that voltage. For example, the current drawn in a 50 volt is ... amps.

"Ratio Table"

In fact, this table is the standard turns ratio table which is completed by the software during the excitation test. Note that this table is completed using voltage turns ratio and in different burdens. Let us use a numerical example to explain how this section works. To begin the calculations, suppose that "Burden= 15 VA", Current equals 0.5ln, power factor equals 0.8 and CT resistance equals 2 ohms. To create the nominal burden in CT nominal current, we can suppose that a 12 ohm resistance is connected to the two ends of the terminal.

According to the equivalent circuit, in 0.5ln or 0.5 amp current, voltage of the parallel branch is achieved from

$$E_{Fxc} = (R_{ct} + R_I) * I = (2+12)*0.5 = 7 V$$

According to the equivalent circuit, using the relation, voltage of the primary side is achieved as 7*1/500 = 14mV. This number is the voltage which is (in half of the nominal current) to be measured in the primary. Therefore, to fill the 1.5In and 15VA cells, the software needs to create the 7volt in the the parallel (secondary) branch and measure its equivalent in the primary and finally, compare the measured value with the applied value. To create a 7 volt in the parallel branch, the

device and the software need to apply $V_{terminal}$ voltage to the CT in accordance with the displayed relation.

$$V_{terminal} = E_{EXC} + R_{ct}^* I = > V_{terminal} = 7 + 2^*I$$

Since the current loaded from the device can be viewed at any moment, the voltage of the device to create the 7 volt parallel branch is obtained. The mentioned process is repeated for all cells of this table and the turns ratio error, phase displacement, composite error and "ALF" are calculated for different burdens. To perform this test, after doing the wiring for excitation test, it is necessary to connect the CT primary to inputs 1 and 10 and run the test after pressing "Init Test". You will see that after the test is finished, the turns ratio obtained from "Ratio Table" is displayed in "N Turn". Other than this "Pol.Check", the tables related to this section are completed and the those cells that have error values beyond the allowed range are highlighted in red and displayed in "Error List" section. In the last table, "ALF" is calculated and displayed in different burdens.

Resistance Measurement

By checking " R_{dc} ", the winding resistance is measured using the voltage application and current measurement method. For this test, the capacitors are "Bypassed" using the binary output 1 and DC voltage is applied to the CT. Afterwards, input 5 is connected to the "CT" using binary output 3 and the actual voltage of the CT are measured. As you saw, during the process of resistance measurement, Binary outputs are closed. In the end, the resistance is measured.

124 : CT RATIO AND POLARITY TEST WITH CURRENT METHOD

To perform a ratio and polarity test you should use "Ratio and Polarity Test (With Current)" tab. In this tab, turns ratio, polarity and phase deviation between "CT" primary and secondary is performed where "AC" current is injected and the secondary current is measured through "Input9". To perform this test, you need to enter the current and time of the test in "State Setting", in "I test" and "State Time" fields respectively. Before initiating the test some points must be considered.

Test Object S	econdary Burden	Resistance Test	Excitation Test	Ratio and	Polarity T	est (Wit	th Current)	Rat
State Setting — ITest: State Time: at Calibration Stat Choose Current Me Manual Don't change har	asurement Mode:	Qms - When	or severe injury n injecting curr secondary wir	ent into the	CT's prima			Ire
Turns Ratio Resul	t	Phase -			Polarity	-		-
l calc.	200	.0 mA Phase Nor	n: []	0.00	Pol. Chec	k Not	Tested 🗸	
l actual	0.	000 A Phase Act	. 1	0.00			17	_
l meas.	0.	000 A Phase Dev	r. [0.0000 mi	in			
Turns ratio nom		500 Assessmer	-+ 1	lot Tested	~			
Turns ratio act	0.	0000	n [1	iot reated	<u> </u>			
Dev act	0	.00 %						
Assessment	Not Tested	~						

The first point is that the current limit is "128" amps while the "Binary/Analog Input9" limit is "500" milliamps. But since in sometimes the "CT" secondary current exceeds "500" milliamps which damages the "Input9", "Icalc" is limited to "450" milliamps. This means that you can increase the primary as much as that "Icalc" does not exceed "450" milliamps. The second point is that if the route resistance is too high and the device is not able to provide the needed "Burden", to perform the test you should decrease the resistance. To do so, you can parallel "4" pieces of wire. The third point is that if even by using "4" pieces of wire the problem is not solved, you need to decrease the current. Note that the test current must be based on the standard because the software uses that to assess the test.

The table made in this section is the basic standard for test assessment where the allowed turns ratio error and phase deviation are specified in percent and "minute" for classes of protection and measurements "CTs". In turns ratio section, the allowed error for different percentages of nominal current and in the "phase" section allowed error is specified in minute. For example, for a "Measuring CT" with the class of "0.5", in "5" percent of the nominal current, "1.5" percent turns ratio and "90" minutes of phase deviation error are allowed. But in "Protection" mode, the maximum error is determined independently from the primary current. For example, for a "Protection CT" with the accuracy class of "10P10", the maximum allowed turns ratio error is "3" percent and there is no limitation mentioned for phase deviation.

	Enor	limits	for me		ng cun	rent tr	ansto			_		
	-	Ratio erro						Pha			ement	
Accuracy class		± %				± Minutes						
, local acy slass	at current (% of rated) at			t current (% of rated)								
	1	5	20	50	100	120	1	5	20	50	100	120
0.1		0.4	0.2		0.1	0.1	-	15	8	-	5	5
0.2		0.75	0.35	120	0.2	0.2	14	30	15		10	10
0.2S	0.75	0.35	0.2	222	0.2	0.2	30	15	10	-	10	10
0.5		1.5	0.75		0.5	0.5	1000	90	45		30	30
0.55	1.5	0.75	0.5		0.5	0.5	90	45	30		30	30
1		3	1.5	-	1	1		180	90		60	60
3				3		3	Not specified		1. C			
5			-	5		5		1	Not s	pecifie	ed	
	Erro	r limits	for pro	tectiv	/e curr	ent tra	ansto	rmers				
Accuracy class	Rati		at rated	P	hase d rated p	lisplace	ement	at	unde	r Spe	error lin cified c onditior	luty
	+ %			± Minutes			%					
5P and 5PR		1			60				5			
10P and 10PR		3			1	No limit	2			1	0	
PX		0.25				-		_	_		•	
PXR		1		_		-						
TPX		0.5				30				ε^ =	=10	
TPY		1				60					=10	
TPZ		1			1	80±1	8	1	1		=10	

After entering the information in "State Setting", you should set the wiring according to the picture. In this wiring ,short circuit "Ia1", "Ib1", "Ia2" and "Ib2" together and "Ia3", "Ib3", "Ia4" and "Ib4" together and then according to the picture, connect a wire to "Ia1" and "Ib4" phases after passing it through the "CT". To measure the secondary current, connect "Input9" to "S1" and "S2". After wiring, for "CT Protection 500/1", "10" percent of the nominal current which equals "50" amps and "1" seconds as time are entered and the test runs after "Init Test" is pressed. You can view the "States" created by the software in "Table View". If "At Calibration State" is checked, in the first state (with zero current), the secondary is measured and is deducted from the final result. The second state is the same as the specified test current. Note that if "At Calibration State" is not checked, the noise is not removed from the response. In "Signal View" section, the waveform of the specified current along with its "Actual" values and the current measured by "Input9" can be viewed. After the test is finished, the results can be viewed in "Turns Ratio Results". "Icalc" is the secondary current calculated by the software in accordance with the turns ratio entered in "Test Object" and the "Itest". "Iactual" is the actual value of the injected current, "Imeas" is the measured current and "Turns Ratio Nom" is the "CT" nominal turns ratio. "Turns Ratio Act" is measured by comparing "Imeas" and "Iactual" and finally, the assessment is recorded in "Assessment" field in accordance with the difference between "Turns Ratio Act" and "Turns Ratio Nom"; if "Deviation act." is less than the value specified in the standard, the test "Passes" otherwise it fails. Here, since the fault percentage is less than the value specified in the standard, the test sis "Passed".

📲 Instrument Test 🗙		.	Table View		
Test Object Secondary Burden Resist	ance Test Excitation Test Ratio and Polarity Test (With Current) Rat	tio and Pol 🖣 🦹	÷	S1 S1 General:	irrect S2 Normal General: Direct
State Setting	Danger	_	Name	Ratio and Polarity Test(With Current)	Ratio and Polarity Test(With Current)
ITest: 50.00 A	Death or severe injury caused by high voltage or current	0 0	1L1:1L1	0.000 A 0.00 ° 50.	0 Hz 50.00 A 0.00 * 50.00 Hz
State Time: 1.000 s	- When injecting current into the CT's primary winding, make sure	ΥΥ	Bin. Out		
At Calibration State	that no secondary windings are open.		Trigger	<u> </u>	000 s 🕢 🖕 –©– 1.000 s
Choose Current Measurement Mode:	7 3 1		Туре	Normal	Vormal
Manual Automatic		8000	Comment		
Don't change hardware settings		Services #			
Turns Ratio Result	r Phase r Polarity	Ulius P	Condition	n	
I calc. 100.0 mA	Phase Nom: 0.00* Pol. Check Ok ~				
l actual 50.05 A	Phase Act: 0.19*	Annual tax	Bin, Input		
I meas. 99.58 mA	Phase Dev: -11.0017 min		bin. input		
Tums ratio nom 500	Assessment Passed ~				
Turns ratio act 502.5747	a babbar in the second se	Annual Tase			
Dev act 0.51 %		9 ad 94 19 ad 94			
Assessment Passed V		255 251 251 255 255 255 255 255 255 255			N
		CT Ratio Test (2
		or natio test			

In "Phase" section, In "Phase Nom" and "Phase Act" the nominal phase deviation and the measured phase deviation are specified respectively. In "Phase Dev", by comparing "Phase act" and "Phase nom", the error in terms of minutes is calculated and the assessment is specified in "Assessment" field. In "Polarity" section, "Pol.Check" field assesses the validity of the polarity. And in the end, after the test is performed, it is necessary to add the results of the assessment to the report which is done by selecting "Add to Report".

Phase		F Polarity -	
Phase Nom:	0.00 *	Pol. Check	Ok 🕚
Phase Act:	0.19*		
Phase Dev:	-11.0017 min		
Assessment	Passed 🗸		

If to perform the test in higher currents or to have more valid results, you wish to perform the test "Manually", you should set "Choose Measurement Mode" at "Manual" mode and according to the picture, use an ammeter. After checking "Manual", "Imeas" is editable and you can manually change its number. By entering this value, the software calculates the error and displays it. Note that in "Manual" mode it is only possible to perform the turns ratio test. After selecting "Manual" mode, connect the connectors of the "CT" to the ammeter and set the test time at "5" seconds. Then press "Init Test" to perform the test. After the test is finished, enter the number read by the ammeter in "Imeas" field so that the device can assess the test based on this value. In the end, after the test is finished, if you need to add the test results to the report, you can do that by selecting "Add to Report".

State Setting -	
ITest:	100.0 A
State Time:	5.000 s
☑ at Calibration S	tate
Choose Current	Measurement Mode: —
Manual	 Automatic
Don't change h	ardware settings
Turns Ratio Res	ult
I calc.	200.0 mA
l actual	0.000 A
I meas.	0.000 A
Turns ratio nom	500
Turns ratio act	0.0000
Dev act	0.00 %
Assessment	Not Tested 🗸 🗸

Two notable points are that first, "Error Other" means that there is a problem in the connections or the route resistance is too high that the device is not able to provide the "Burden" need for current. Therefore, if you faced this error you should check the "Actual" value from "Signal View". If the current is injected ("Actual Current") but its difference with the specified current is too much, this means that the resistance is too high and if the "Actual Current" is zero, it means that the current injection route is open. If the route resistance is too high, the test current should be decreased or using several parallel routes and if the "Actual Current" is zero, the connections should be examined. The next point is that the current read by the device needs to have similar cycles. If the read values have too high tolerances or the tolerance is zero, it means that the connectors are not connected correctly.

125 : CT RATIO AND POLARITY TEST (WITH VOLTAGE)

To perform ratio test you can use the "Ratio and Polarity Test (With Voltage)" tab too. In this tab, tests including turns ratio, polarity and phase movement between "CT" primary and secondary with voltage are performed. In performing these tests, "AC" voltage is applied to "CT" secondary and the primary voltage is measured through "Analog Input". To perform this test, you need to enter test voltage and time in "V_{test}" and "State Time" fields in "State Setting" respectively. Note that this test must be performed after excitation test because the applied voltage must be in the "CT" linear areas. Before starting the test, some points must be taken into account. First: in this test, the voltage is applied form the secondary and measured from the primary. Two: if you wish to remove the noise from the result, check "At Calibration State" option. By checking this option in a "State" before the test, the "Input" voltage is measured and deducted from the result.

Test Object Secondary Burden Resist	ance Test Excitation Test	Ratio and Polar	ity Test (With Curren	Ratio and Polarity	Test (With Voltage)	Megger
State Setting VTest: 5.000 V Frequency: 50.00 Hz State Time: 1.000 s Image: The state 1.000 s Image: Don't change hardware settings	Voltage Measurement Mo Voltage Measurement Bin 01 Bin 01 Bin 01 Bin 01 Bin 10	Max Voltage Up to 188 V Up to 30 V Up to 30 V Up to 4 V Up to 200 mV				
Turns Ratio Result V Actual 0.000 V V meas. 0.000 V Turns Ratio nom 500.0000 Turns Ratio act 0.0000 Dev act 0.000 % Assessment Not Tested ×	Phase Nom: [Phase Act: [Phase dev: [Assessment]	90.00 * 0.00 * 0.0000 min Not Tested ~	Polarity Pol. Check Not	Tested V		

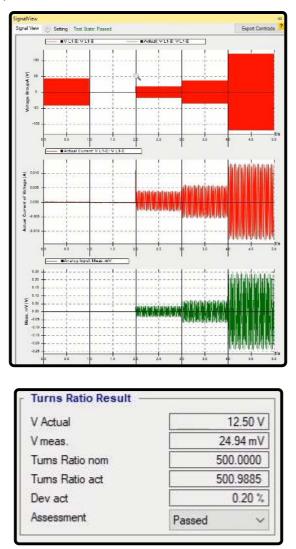
Generally, in "Table View" you can view the "States" that are created by the software. As you can see 5 "States" are created. In the first "State" 30 volts is applied, the "Actual" is measured and calibration factor is obtained from the difference between these two so that the test voltage is more accurate during the test. Note that while applying this voltage, the switches are open and no voltage is applied to the "CT". The second "State" is related to "At Calibration State". The fourth "State" is the specified test voltage and the third and fifth "States" are half and double the test voltage respectively which are created to measure the best state of the primary voltage. Note that this is why the maximum voltage limit is 220 volts. In "Voltage Measurement Mode", the "Input" specified to measure the voltage. Note that this item changes automatically according to the test voltage and the turns ratio specified in "Test Object".

V L1-E: V L1-E 3 Bin. Out Trigger 1	Ratio 30.00 V .000 s	Ratio 0.000 V 1.000 s	Ratio 2.500 V	Ratio 5.000 V	Ratio
Bin. Out Trigger 1	 .000 s	(44)	(44) (44)		
Trigger 1	.000 s				
	Contraction of the	1.000 s	1 000		
Type N	100220		1.000 s	1.000 s	1.000 s
	lomal	Normal	Normal	Normal	Normal
Comment					
Condition					
Bin. Input					

Voltage Measument	Max Voltage
O Bin 01	Up to 188 V
O Bin 01	Up to 30 V
O Bin 01	Up to 4 V
Bin 10	Up to 200 mV

After entering the "State Setting" information, you need to do the wiring according to the picture. Note that by doubleclicking on it you can maximize it. In this wiring, "Va1" must be connected to "S1" while "N" must be connected to "S2" and then a wire must be connected to "Input10" for measurement after passing through the "CT". After doing the wiring, 50 volts and 1 second are entered as test voltage and test time for "CT Protection 500/1" and after pressing "Init Test", the test starts. In "Signal View", the waveform of the voltage along with its "Actual" value and the measured voltage can be viewed. After the test is finished, the results can be viewed in "Turns Ratio Result". "V_{actual}", "Vmeas" and "Turns Ratio Nom" are the actual value of the fed voltage, the measured voltage and the "CT" nominal turns ratio respectively. Also, "Turns Ratio Act" is measured by comparing "Vmeas" and "V_{acutal}" and finally, the assessment is recorded in assessment

field in accordance with the difference between "Turns Ratio Act" and "Turns Ratio Nom". If the difference is less than the allowed value in the standard, the test passes otherwise it fails. Here, since the error percentage is less than the specified value in the standard, the test is passed. This test is assessed in the way that when you specify a test voltage, the current is measured according to the "Burden" entered in "Test Object" and after performing the test and measuring the turns ratio error percentage, the result is compared with the current standards table and assessed.



In "Phase Nom" field in "Phase" section, the phase and in "Phase Act", the measured phase are specified. In "Phase Dev" by comparing "Phase act" and "Phase nom", the error is calculated <u>in</u> minute and the assessment is specified in "Assessment" field. "Pol.Check" field in "Polarity" section checks the correctness of the polarity. Finally, after the test is performed, it is necessary to add the assessment to the report which is done by pressing "Add to Report". Also, if you wish to add some specified parts to the report or delete the report you can use "Add to Report" cog. Note that if the test has been performed using inputs and outputs other than the default settings, first you need to click on "Init Test" and then check "Don't Change Hardware Setting" and by going to "Hardware Configuration", in "Analog Output", activate phases of the intended voltage group and deactivate the rest and perform the test using the intended voltage group. Here voltage group A is deactivated and voltage group B is activated and instead of "Input 10", "Input 8" is selected and the necessary settings is adjusted.

Phase		F Polarity	
Phase Nom:	90.00 *	Pol. Check	Not Tested \sim
Phase Act:	0.00 *		
Phase dev:	0.0000 min		
Assessment	Not Tested 🗸 🗸		

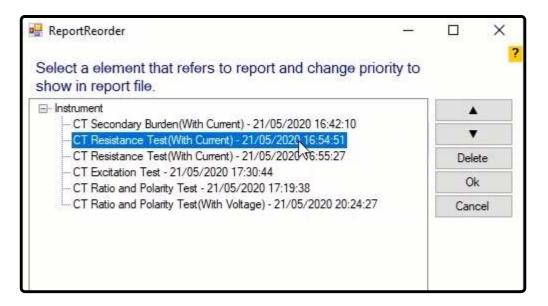
Analo	g Output Binar	y / Analog Inp	ut Binary Output	Extra Sett	ing				
	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description
C1	Not Used	Not Used	Drv		False	None	False		
C2	Not Used	Not Used	Drv		False	None	True		
C3	Not Used	Not Used	Drv		False	None	True		
C4	Not Used	Not Used	Drv		False	None	True		
C5	Not Used	Not Used	Drv		False	None	True		
C6	Not Used	Not Used	Drv		False	None	True		
C7	Not Used	Not Used	Drv		False	None	True		
►C8	Bin. in 8	Bin. in 8	Wet Max 4.5 (V)	1.00 V	False	AC 👻	True	0.000 V	(Vin > 1)=>(input=1
9	Not Used	Not Used	Shunt 1 Ohm	a constant	1000000	None			
10	Not Used	Not Used				None			
									_

Megger tab

No test is performed in "Megger" tab. This section is designed so that you can enter "Megger" test result and gather all results in one report. You can enter the number of rows and columns that you need in "Rows" and "Column" fields respectively and by clicking on "Insert", make your intended table and the results are added to the inserted fields. Also, in "Title" field you can enter a title for your test.

Test	Object	Secondary Bur	den Re	sistance Test	Excitation Test	Ratio and Polarity Test	(With Current)	Ratio and Polarity Test (With \	√oltage∕ N	<i>N</i> egger
Row(s) Column(s)		1 Inser	ert							
Title	[est]						<u> </u>			
b1										

Finally, after all the tests are performed and the results are added to the report, in "Report View" it is possible to view the report as a whole. By right-clicking and selecting "Reorder Reports", it is possible to change the arrangement of different test results. To do this, you need to select your intended report and by using "Up" and "Down" keys move the report or by using "Delete", delete it. Furthermore, if you wish to delete the added report, or edit the entered information, you can use the blue option named "Edit & Delete Report".



Report				
Export Report	● HTML () PDF			
AMPro C Transfor 1) Abstract 1-1) Date an	Na Marketova II 	ner: AMPro Cu	urrent	
	Туре	Date	Time	
Report Date and	Time(Persian):	1399/03/01	08:27:54.37 PM	
1-2) Test Mo	odule			
Name:	AMT Sequencer		Version:	99023101
User Name:	pq		Computer Name:	DESKTOP-3S1DTQ3
Equipment	AMT105		Serial Number:	26
Edit & Delet	e Report			

126 : INTRODUCING "CIRCUIT BREAKER(CB)" ROOM

One of the Instrument which can be tested by an "AMT105" is "Circuit Breaker (CB)" with a maximum excitation current of "2.5" amps which is used to connect and disconnect lines and other high-voltage equipment. When a fault occurs in the equipment and lines, the CB automatically stops the faulty system. When there is a fault, the CB must be able to react with certainty and command automatically. The "AMT105" is capable of testing "Medium Voltage" CB with a maximum supply voltage of "210V" and "2.5amps" of "Coil Current". By clicking on "Circuit Breaker(CB)" on the "Start" page, the "CB" test room opens. In this room, by adjusting the required settings, it is possible to perform "CB Time Test", contact resistance and minimum voltage to operate test. "Test Object" and "Megger" tabs are used to enter the nominal information of "CB" and the results of "Megger" test respectively.

📲 Instrument Test 🛛 🗙			
Test Object Timing Test	Contact Resistance Minimum	voltage to operate circuit break	er Megger Test Report
General Information Serial Number: Type: Station: Feeder/Bay: Phase: Manufacturer:	Operating Time t min Opening time: 20.00 ms Opening sync. 0.000 s Closing time: 40.00 ms Closing sync. 0.000 s Open-Close time 50.00 ms Close-Open time 60.00 ms	t max Open Clos 40.00 ms Supply Volta 4.000 ms AC 60.00 ms DC 5.000 ms Resistance 100.0 ms Contact res	e <u>R_max</u> _
Extra Data Date 25/05/2020 Tested By	Accessories Easy Mode	Averaging	

"Test Object" tab:

Every room, to perform the test, needs some information about the equipment to be entered in "Test Object" tab. In "General Information" tab, information about the "CB" which should be added to the report is entered. In "Serial Number", "Type", "Station", "Feeder/Bay", "Phase" and "Manufacturer" fields, the serial number, type, name and address of the substation, feeder's name, phase number and the name of the manufacturer are entered.

Serial Number:	
Type:	
Station:	
Feeder/Bay:	
Phase:	
Manufacturer:	

In "Operating Time" section, the minimum and maximum allowed times in different modes are entered. Since open command is sent to the "Breaker" bobbin, up to the moment the CB poles are detached is called "Opening Time" while since the "Close" command is sent, up to the moment the CB poles are closed is called "Closing Time" whose minimum and maximum allowed time should be entered in the related field. " T_{min} " and " T_{max} " fields in front of "Opening Sync" and "Closing Sync" determine the maximum allowed time difference between the opening of 3 poles and closing of 3 poles of the CB respectively.

Operating Time	t min	t max
Opening time:	20.00 ms	40.00 ms
Opening <mark>s</mark> ync.	0.000 s	4.000 ms
Closing time:	40.00 ms	60.00 ms
losing sync.	0.000 s	5.000 ms
pen-Close time	50.00 ms	100.0 ms
Close-Open time	60.00 ms	120.0 ms

Since the "open" command is sent to the breaker, up to the moment the CB poles are closed again after opening once, is known as "Open-Close Time" and its minimum and maximum allowed times are entered in the related field. In "Open Close Voltage Setting" section, the amount of the open and close voltage of CB bobbins is selected from among "AC & DC". Also, in "Supply Voltage" and "Threshold" the amount of supply voltage and the threshold voltage to begin the measurement of the CB operation time are entered respectively. About "Threshold", note that, when the voltage of the binary 7 or 8 goes below the value specified in this field, the device starts measuring the time. In "Resistance Contact" field, the ideal resistance of the CB poles are specified and the minimum and maximum allowed are entered in front of it. All the information of "Test Object" tab is entered from "Test Sheet" or the results of the previous tests.

Operating Time	t min	t max
Opening time:	20.00 ms	40.00 ms
Opening <mark>s</mark> ync.	0.000 s	4.000 ms
Closing time:	40.00 ms	60.00 ms
losing sync.	0.000 s	5.000 ms
pen-Close time	50.00 ms	100.0 ms
Close-Open time	60.00 ms	120.0 ms

Supply Voltage:	110.0 V	Threshold:	30.00 V
⊙ AC ● DC			
Resistance			
Resistance	<u>R min</u>	R max	
Contact resistance	10.00 μΩ	70.00µ Q	

In "Extra Data" section, in "Date", "Tested By" and "Approved By" fields, date of the test, information of the test man, and information of the supervisor are entered respectively. By checking "Easy Mode" option in "Accessories" section, the wiring format of the tests changes. This wiring is in accordance with the board designed for "CB" test by VEBKO company; this board is connect on the front panel and there are relays placed on it that can manage the wiring automatically which makes the test easier. The number entered in "Averaging" field indicates the number of cycles which are used for doing the calculations. This number is set at 1 by default. The more the number of cycles, the more cycles and time are considered for calculations by the software in "AC" and "DC" modes respectively. Doing this increases the calculations which leads to a more accurate test result.

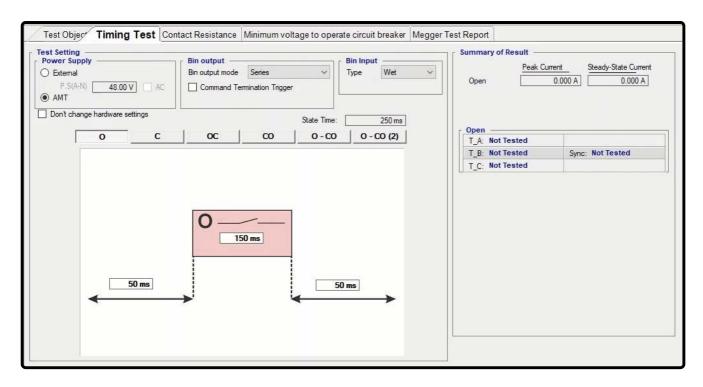
🛛 Extra Data ——		Accessories	Niose Suppression
Date Tested By Approved by	25/05/2020	Easy Mode	Averaging:

By checking "Add to Report" option at the bottom of the page, this information is added to the report and the message "The report was added to the list" is displayed. It is possible to view the report by selecting "Report" from the strip at the right. By clicking on "Delete Report" in "Delete from Report" window, the report added is deleted. If "Set as default" is checked, the entered information is saved as default and by opening the "Circuit Breaker(CB)" room at any time, this information is displayed.



127 : CB "TIMING TEST"

One of the most important tests performed in CB is "Timing Test". To perform a "Timing Test" it is necessary to specify three main important sections including 1- Supplement method of bobbins, 2- Wiring type of "Binary Outputs" and 3- type of "Binary inputs".



The supplement method of bobbins is specified in "Power Supply" section which is set at "AMT105" by default and its value is taken from "Test Object". To control the voltage applied to "Open" and "Close" bobbins, "Binary Outputs" of the device are used. In "Binary Output" section it is specified that which "Binary Outputs" are to be used to control "Close" and "Open" commands which is set at "Series" by default. In this mode, huge voltages which occur during opening and closing are divided between the two relays which prevents damage to the device. But if one of the "Binary Outputs" is not available, by selecting other options, it is possible to use only two "Binaries". For example, by selecting "Bin1" and "Bin4" you can only use the "Binaries" 1 and 4. In this instruction, "Series" mode is used.

Test Setting Power Supply	Bin output		
◯ External	Bin output mode	Series	~
P.S(A-N) 48.00 V AC	Command Tem	(C) bin 1 (O) bin 2	
AMT		(C) bin 1 .(O) bin 😡	
Don't change hardware settings		(C) bin 2 ,(O) bin 3 (C) bin 2 ,(O) bin 4 (C) bin 3 ,(O) bin 4	10
0 C	OC	Series	

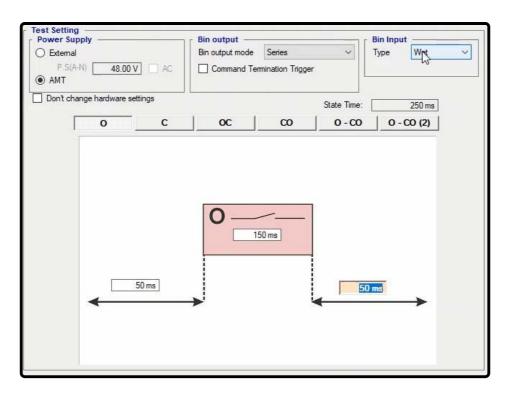
"Binary Input" is used to sense when the CB is closed or open. Since there is noise in substations, "Binary Inputs" are set at "Wet" by default so noise is removed from the "Binary Inputs". But if there is no noise in the test environment you can set the type of "Binary Inputs" at "Dry" and by changing the "Binary" type, the wiring changes as well.

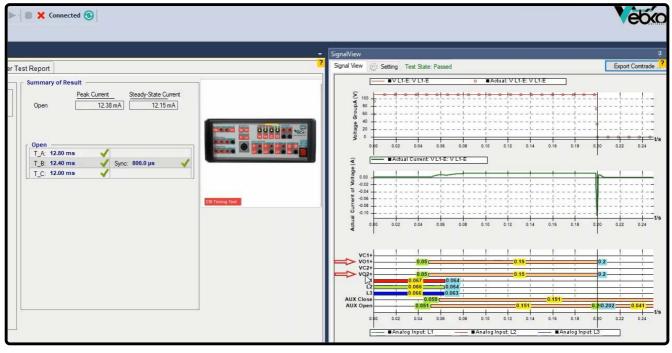
Bin Inp Type	Wet	~
-----------------	-----	---

Next you need to select the test type from among "Open—Close—Open Close--..." By selecting any of them, you need to enter the time in the specified box. For example, in "Open" test, you need to enter "three" times in the designed fields; the

first "time" is related to before command, the second "time" is related to the Duration which the command is kept on the

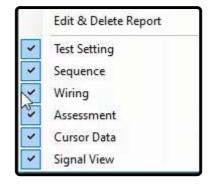
bobbin and the third time is related to after command. In this example, the bobbin is supplied by the device and "Binary Output" and "Binary Input" are set at "Series" and "Wet" respectively. For "Open" test, the default time values are considered as the time values. Then, you need to set the wiring according to the specified picture. Note that by double-clicking on the picture, it is possible to magnify it. In this wiring, the specified connections must be set, those points that have the same name must be connected to each other, Close and Open bobbins must be connected to the lower end of "Binary Outputs" number 3 and 4 and finally, the connections of "Binary Input" must be set to receive the key contacts. After setting the wiring, open "Signal View" and initiate the test by selecting "Init Test". In "Signal View" window, it is possible to view the voltage and current loaded from the device as well as the CB opening time. "Vc1+" and "Vc2+" indicate the status of the "Close" command control "Binary Outputs" while "Vo1+" and "Vo2+" are indicators of the status of the "Open" command control "Binary Outputs". "L1", "L2" and "L3" indicate the status of the CB contacts:





Three colored lines mean that the CB contacts are closed while no lines suggest the opposite. "AUX Open" and "AUX Close" signals are used to determine the origin time for measuring the performance time. As mentioned before, the CB performance is measured since when the voltage of the "Binaries" 7 and 8 exceeds the "Threshold" specified in "Test Object". Moreover, the test results are available in "Summary of Result" section. In this section, the peak current and "Steady State" current and in the "Open" table the opening time of each contact is provided separately. Note that the evaluation of these times is done in accordance with the "Opening Time" and "Opening Sync" specified in "Test Object". If the operating time is somewhere within the range specified in "Test Object" the test "Passes", otherwise it "Fails". For adding the results to the report, you can do so by pressing "Add to Report". Also, if you wish to add some specific parts to the report, or delete and edit the report. If you do not need each of them, you can unselect by unchecking them. Note that after performing a test the results are not automatically added to the report and it is necessary to add the results to the report "Clearing" the test.

State Time: 250 ms 2C CO 0 - CO 0 - CO (2) 150 ms	Open T.A: 1430 ms ↓ T.B: 1240 ms ↓ Sync: 800.0 µs ↓ T.C: 1200 ms ↓ C: 1200 ms ↓	Actual Coment VLFE VLFE Actual Coment VLFE VLFE VLFE Actual Coment VLFE VLFE VLFE Actual Coment VLFE VLFE VLFE VLFE Actual Coment VLFE VLFE	0
50 ms		VC1+ VC1+ VC1+ VC2+	
Operating Time tmin tmax Opening time: 10.00 ms 40.00 ms Opening sync. 0.000 s 4.000 ms Closing time: 40.00 ms 60.00 ms Closing sync. 0.000 s 5.000 ms Open-Close time 50.00 ms 100.0 ms	Open Close Voltage Setting Supply Voltage: 110.0 V AC 0 DC Resistance R min Contact resistance 10.00 μΩ 70.00 μΩ 70.00 μΩ	Analog Input: L1 Analog Input: L2 Analog Input: L3 Anal	
Close-Open time 60.00 ms 120.0 ms		£ 00	



In the following, some points about the test are provided:

The first point is that if you wish to use only one voltage group, first you need to press "Init Test" and then check "Don't Change Hardware Setting" and by going to the "Hardware Configuration", activate your intended voltage phases and deactivate the others in the "Analog Output" tab and perform the test using only the voltages of the intended group. For example, here voltage group "A" is activated and voltage group "B" is deactivated.

Analog Output Binary / Analog In	10000	0 1722 12		
Itage Output	Voltage O	utput Signal —		
150V, 60VA @ 400mAms 150V, 120VA @ 800mAms 300V, 120VA @ 400mAms 450V, 200VA @ 400mAms t Used	X1	Output Target V L1-E	Output Label	Show Actual Value
Irrnet Output	Current O	utput Signal — Output Target	Output Label	Show Actual Value
54A, 200VA @ 64A, 3Vms, 10A, 12Vms 32A, 200VA @ 32A, 6Vms, 5A, 24Vms 32A, 400VA @ 32A, 12Vms, 5A, 48Vms 128A, 400VA @ 128A, 3Vms, 30A, 12Vms t Used		Output Target	ouput Laber	Show Actual Value

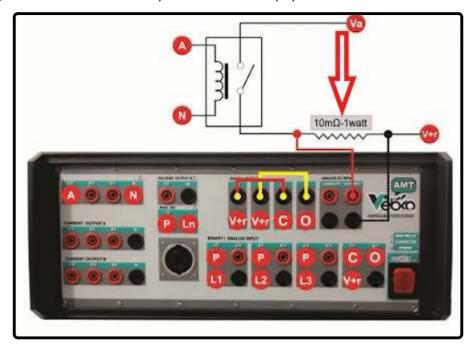
The second point is that when you enter "150" milliseconds as the command time, this means that the command voltage is kept on the bobbin for "150" milliseconds. If you check "Command Termination Trigger" option and enter "10" milliamps as the "Minimum Time", the command is removed from the CB, "10" milliseconds after its operation. To view this item, "Close" test is selected. To initiate the test, "Init" is pressed and test starts. After that, you can see that because of checking this option, unlike the previous case, "10" milliseconds after the CB operation the command is removed.

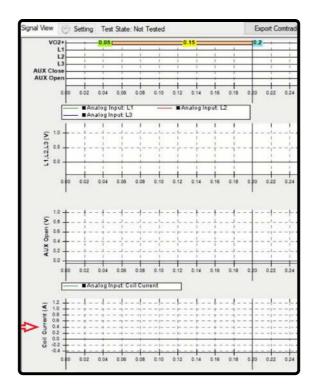
Bin output	A	
Bin output mode	Series	~
Command Ter	mination Trigge	er
MinimumTime	e [10 ms

The third point is that if the current needed to exciting the bobbin is more than "2.5" amps, it is necessary to use an external source. In this case, check the "External" option and set the new wiring and start the test after pressing "Init Test". If you are using an external source to provide the voltage of the bobbins, to better protect the bobbins, put a glass relay with the "Binary Outputs" in series so that if something unexpected happened to the "Binary Outputs" which made them no longer able to disconnect the voltage applied to the bobbins, the CB is not damaged and in this way you can have more control on connecting and disconnecting the supply applied to them. In using a glass relay, since the voltage of the binaries number 7 and 8 is used as the time origin, delay of the glass relay has no effect on the test result and this delay is deleted by the software.

Power Supply External	
P.S(A-N)	48.00 V 🗌 AC

Also, when testing the CB time test, it is necessary to know the current loaded by the CB. A "100" milliohm resistance is considered for this and when the current flow, a voltage is measured by the "Binary Input" 10 and by dividing the voltage by the resistance, "Coil Current" is calculated by the software and displayed in "Coil Current" section in "Signal View".





The third point is that "Error Other" while performing a test means that there is an issue with the connections or the high current loaded by the bobbins in a way that the device is unable to provide needed current. Therefore, in case of encountering this error, check the "Actual Current" value in "Signal View". If the "Actual Current" reaches "2.5" amps and then the test is stopped, it means that the device is not capable of injecting that current and an external source should be used. If the time recorded in the table is "-1ks", this means that the CB has been "Open" before performing the test or it has been closed for the "Close" test of the CB. In this case, other than the wiring, you need to check whether the CB is closed or open.

128 : "CONTACT RESISTANCE" TAB

In this tab, ohm resistance test of CB contacts is performed. The test settings include "I Test" and "State Time" is specified in "Test Setting". As you know, the method used by "AMT105" to measure the resistance is dividing the measured voltage by the injected current. In "Voltage Measurement Mode" section, you can select from among inputs "1" and "10" for the measurement in accordance with the voltage level and the maximum CB contact resistance. As you can see, "Bin 01" has two voltage levels for the measurement. The first level is "4.5" volts on "Wet4.5" while the second level is on "Wet30" but since the device current resources can only produce up to "8" volts, this item is limited to "8" volts.

Test	Object Timin	ig Test Con	tact Resis	stance	Minimum	voltage to op	erate circuit breake	er Megger 1	est Report
Don	ime:	100.0 A 1.000 s	Voltage Measu Voltage Measu Bin R1 Bin K9 Bin 10		t Mode: Max Vol up to 8 up to 4 up to 2	V 5V	Max Resistance R <80.00 mΩ R <40.00 mΩ R <2.000 mΩ		
Result	-			50012 R I G				100	
	Name	Phase	V DC	I DC	R meas	Assessmen	t i	VDC	0.000 V
▶1	L1	L1	0.000 V	0.000 A	0.000 Ω	Not Tested	•	IDC	0.000 A
								Rmea	0.000 Ω

In "Result" section, the ohm resistance measurement result of each contact is displayed. To perform this test, first, you need to add as many rows as the contacts by right-clicking and clicking "Add". Then, set the wirings in accordance with the specified picture. Note that by double-clicking on this picture you can magnify it. In this wiring, you need to "Jumper "la1", "lb1", "la2" and "lb2" together and "la3", "lb3", "la4" and "lb4" together and connect "la1" and "la4" phases to the CB contact in accordance with the picture. To measure the voltage, the selected "Binary Input" should be connected to the CB contact and further from the current connectors. Note that to perform the test using a clamp and injecting high currents, multiple parallel wires should be used and they should be connected to the side where there are three pins while the

voltage measuring wire should be connected to the side where there is only one pin. To perform the test, right-click on the phase related to that row and select "Apply Test". In "Signal View" section, the waveform of the current along with its "Actual" values and the measured voltage can be viewed. Also, in "Table View", you can see that two "States" are created in accordance with the settings specified in "Test Setting" and the test is performed. Note that, to test each contact, you need to add the related row in "Result" section and test each contact separately by setting the specified wiring.

	Name	Phase	V DC	I DC	R meas	Assessmen	rt	VDC 0.000
1	Apply Test	-	0.000 V	0.000 A	0.000 Ω	Not Tested	•	IDC 0.000
	Clear Result							Rmea 0.000
	Add							
	Remove							
	RemoveAll							

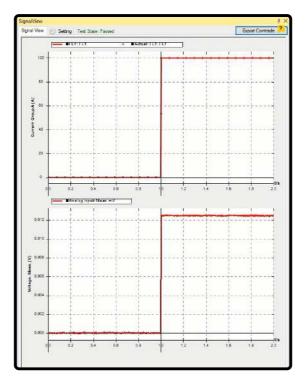


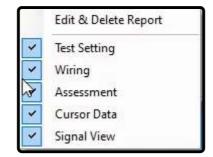
Table View	The second s				Manual
203	□ S1	Nom General: Dire	a 🗆 S2		Normal General: Direct
Name	state1: Contact Resi	stance	state1: Contac	t Resistance	
I L1: I L1	0.000 A	0.000 1/s 0.000 l	lz 100.0	A 0.000 1/s	0.000 Hz
Bin. Out			1	1 The second second	
Trigger		<u>0</u> - 1.000	s Q	-©-	1.000 s
Туре	Normal		 Normal 		
Comment Trigger Condition	l				

In this table, custom name, name of the phase, the measured voltage, the actual injected current, the measured resistance and the result of the assessment are entered in "Name", "Phase", "V DC", 'I DC", "Rmeas" and "Assessment" fields

respectively. Note that the test assessment is done by comparing the resistance entered in "Test Object" and the measured resistance.

Result	t						
	Name	Phase	V DC	I DC	R meas	Assessment	
1	L1	L1	12.45 mV	100.1 A	124.4 μΩ	Passed	•
2	L2	L2	12.46 mV	100.1 A	124.5 μΩ	Passed	-
▶3	L3	L3	12.45 mV	100.1 A	124.4 μΩ	Passed	•

In the end, after the test is performed, the results should be added to the report which is done by clicking on "Add to Report". Also, if you wish to add specific parts of the test to the report delete or edit it, you can use the "Add to Report" cog. By clicking on this cog, you can see that the items that can be added to the "Report" are checked and if you do not wish any of these items to be added to the report, you can simply uncheck your intended item. Also note that the test results are not automatically added to the report after performing a test and it is necessary to add the results to the report by selecting "Add to Report" before "Clearing the test".



In performing this test, it is imperative to note the following:

First: "Error Other" in performing the test means that there is a problem in connections or the current route resistance is too high that the device is not able to provide the "Burden" needed to inject the current. Therefore, in this case, check the "Actual current" from "Signal View". If the current is injected ("Actual Current") but the difference with the specified current is too large, this indicates the high route resistance and if the "Actual Current" equals zero, this means that the current injection route is open. In the cases where the route resistance is high, the test current must be decreased and if the "Actual Current" equals zero, the connections must be examined. make sure the CB is closed.



Second: the measured voltage must have similar cycles. A high tolerance or a zero voltage means that the connectors are not connected correctly.

Third: in cases of facing "Error: Over Voltage", you need to select the "Input" with the bigger "Max Voltage" from "Voltage Measurement Mode" section.

Voltage Measument	Max Voltage	Max Resistance	
O Bin 01	up to 8V	R <62.50 mΩ	
O Bin 01	up to 4.5V	R <31.25 mΩ	
Bin 10 Bin	up to 200mV	R <1.562 mΩ	

Fourth: if you wish to modify wiring or use binaries other than "1" and "10", first you need to check "Don't Change Hardware Setting" and then apply the desired hardware modifications.

128.0 A
1.000 s
state hardware settings

Fifth: "at Calibration State" option is used to remove the ambient noise effect from the voltage of the binaries. If this option is checked, in the first "State" the voltage is measured and deducted from the final result.

Test Setting	
ITest:	128.0 A
State Time:	1.000 s
✓ at Calibration ✓ Don't chang	n state e hardware settings
	hr

129 : CIRCUIT BREAKER OPERATION MINIMUM VOLTAGE TEST:

One of the most important tests that can be performed on circuit breakers is the "Circuit breaker operation minimum voltage test" or "Minimum Voltage" which is performed in "Minimum Voltage to Operate Circuit Breaker" tab. In this test, it is possible to find the minimum voltage which can cause the circuit breaker to operate by gradually increasing the voltage applied to the two ends of "Open" or "Close" bobbin.

atting ose your test set	Control(s)	Beauti Min Voltage Act. 0.000 V			
AMT105 New Device	Check DC Ground	Col Current: 0.000 A			
	Check Corresponding Vallage				
a Type Wise Ramping	Chack Short Circuit		To. 1100	IV]	
anual 50.00 V					
-					
Cose1 ~			Steps.	6	1.000
Termination		Δ Value: 1.00			
ontact Pole(s) 3 pole V		From: 5.000 V	Max. dures 240.1		
7ype Wet ~					
al Current					
An Coli Current 100.0 mA					
2					
t charge hardware settings		à Tirre R	net Value: Reset Time:		
I change hardware settings		300.0 ms	0.000 V 2.000 e		

In the first step of this test, the equipment to be used in the test is selected from among "New Device" and "AMT105" which is set at "AMT105" by default and here we proceed without changing it. Then you need to specify that whether you are going to perform a "Close" test or an "Open" test. Note that since some circuit breakers have two "Open" and two "Close" bobbins, there are "Open1" and "Open2" as well as "Close1" and "Close2". In this video we are going to perform the minimum voltage test once for "Close" mode and once more for "Open" mode.

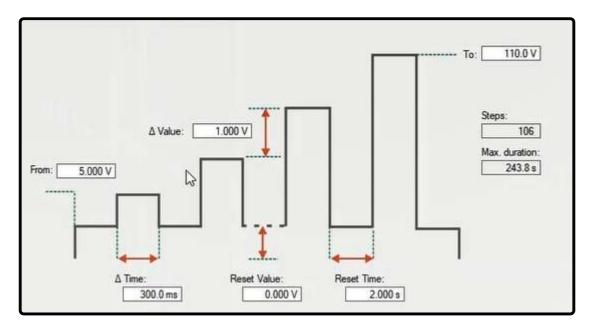
Test Setting — Choose your to AMT105	est set
O New Device	
State Type	
Pulse Ramping	ng
O Manual	50.00 V
Coil	
Coil:	Close1 ~
State Terminat	ion N

As the next step, you need to specify that whether the device is to detect the circuit breaker operation based on the contact reception or current drop; in this video we are using the former which is a more accurate and reliable method. In this method you can also specify that whether the test is to be performed in three-phase or single phase mode; here three-phase is selected. "Wet" is selected as the contact type so that noises cannot cause any dysfunction in the process. Note that by selecting any of the options in this section, the wiring changes. For example, if single phase or "Dry" are selected, you can see the change in the wiring.

 Contact 		
Pole(s)	3 pole	~
Туре	Wet	~
Coil Current		

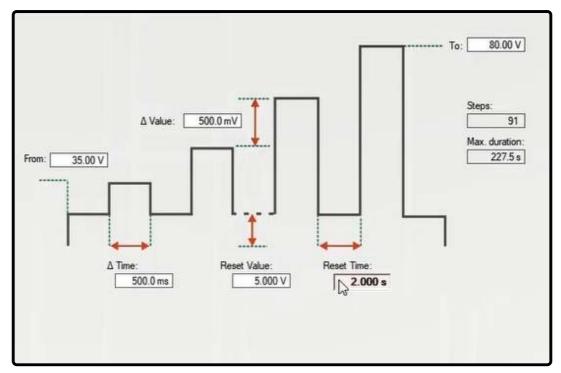
In this test two methods are available to apply voltage to stimulate the bobbin. Using the "Manual" method, you specify a particular voltage and after pressing "Init Test", apply that to the circuit breaker. But in "Pulse Ramping" method you can increase the voltage gradually and find the minimum voltage which can cause the circuit breaker to operate. By selecting "Pulse Ramping", a graphic figure is displayed whose different parameters must be specified. Let us explain this with an example.

State Type	
O Manual	50.00 V
Coil	
Coil:	Close1 ~

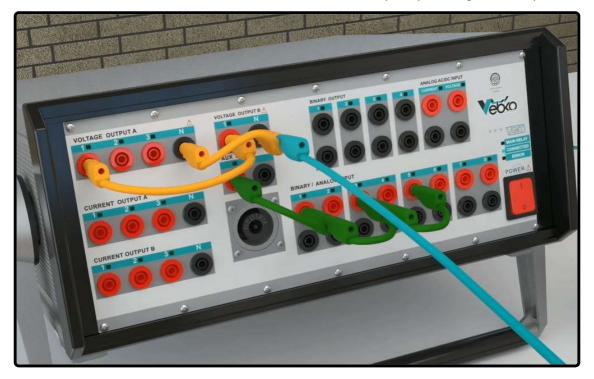


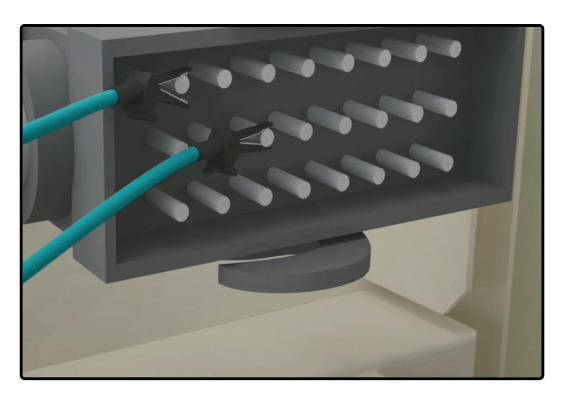
In this example the voltage is increased from 35 to 80 volts with 0.5 volt steps and each step takes 0.5 second. The value for "Reset" voltage is 5 volts and its application time is considered to be 0.5 second. After specifying these factors, the

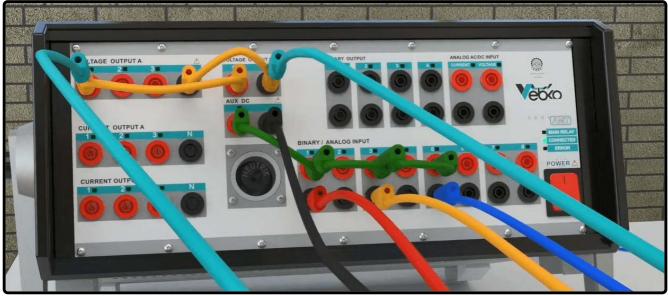
wiring is done according to the guide available in the picture. In this wiring, first, the two voltage sources are paralleled in order to use the maximum current of the device, and then they are connected to the control coil to apply the fed voltage. Afterward, in accordance with the number of contacts selected, (3 is selected in this test) L1, L2 and L3 contacts are connected to Binary Inputs to record the operation of the circuit breaker. After selecting "Coil Close1" and adjusting the wiring, "Init Test" is selected and the test runs. By opening the "Signal View" window you can view the applied voltage as well as the injected current. After the circuit breaker operates, the minimum operation voltage along with the amount of current drawn during the operation is displayed in "Result" section. By selecting "Add to Report" the test result is added to the output report. To test the "Open" bobbin of the circuit breaker, "Coil Open1" is selected and after pressing 'Init Test" the test is reruned and the results are added to the output report.

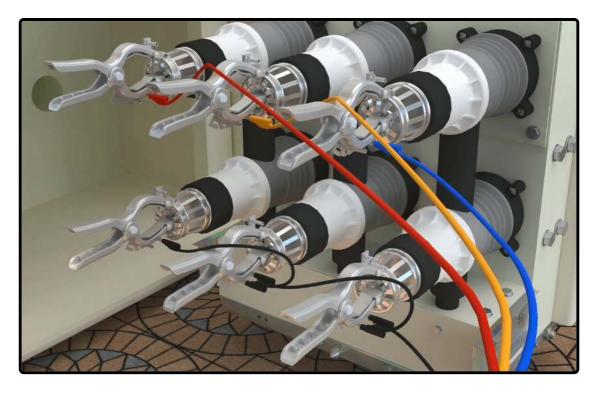


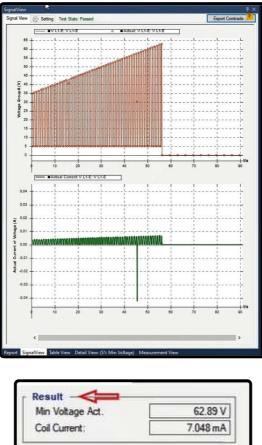
In using the "Coil current" method the wiring is changed and the circuit breaker operation is detected based on the current drawn from the resource. You need to specify the minimum current which is drawn from the device when the circuit breaker operates in "Min Coil Current" field. Here 1.5 amp is selected. For "Pulse Ramping" the same settings used in the previous example are used. After adjusting the wiring and pressing "Init Test" the test runs. In "Signal View" you can see that for every "Pulse", current is drawn from the device and in current And voltage the test result is achieved and the results are recorded in "Result". The results of this test are added to the report by selecting "Add to Report".





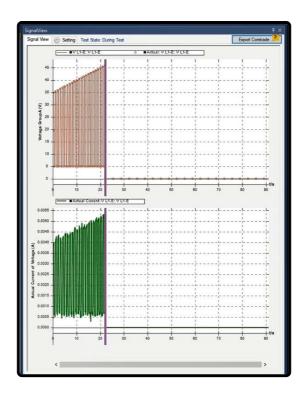






Coil:	Open1	~
-------	-------	---

about:blank



Post "DC" resource test: it is possible to perform the post "DC" resource test in "Check DC Ground" section. In posts whose potential difference is provided by two resources, it is possible to examine the parallelism of the two. For example, if the post uses a positive 100 volts and a negative 100 volts resource to provide 200 volts of "DC" potential difference, by performing this test, it is possible to examine that how much is each of these two potentials deflected from the intended 100 volts. To do this test, you need to specify the nominal voltage and maximum allowed tolerance after checking "Check DC Ground". Here "100 volts" and "%10" are entered as the required values and then the wiring is adjusted in accordance with the figure. After pressing "Init Test" and running the test, in "Plus Voltage" and "Plus Voltage dev", the positive potential difference and its difference with "Nominal Voltage" are displayed.

Test Object Tir	ming Test	Contact Resistance Minimum voltage to operate
Test Setting		Control(s)
Choose Your Test	Set —	Check DC Ground
O New Device		Check Corresponding Voltage
State Type O Pulse Ramping Manual	50	0 V

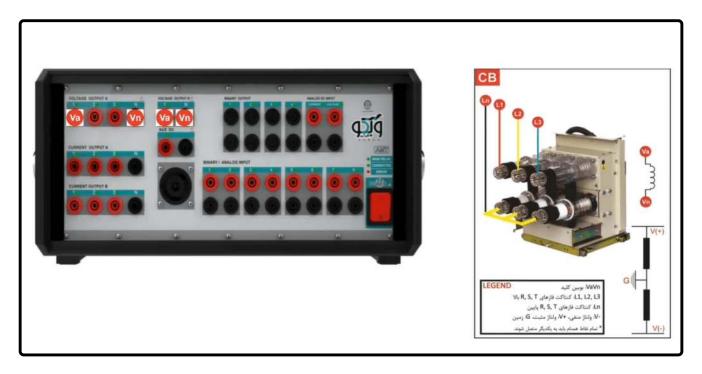
Nominal Voltage	100.01
	100.0 V
Tolerance	10.00 %
Plus Voltage	100.1 V
Pluse Voltage Dev.	0.13 %
Negetive Voltage	99.30 V
Negetive Voltage Dev.	-0.69 %

"Check Corresponding": since in some electrical installations multiple voltage resources are used to supply different equipment, it may be necessary to test the positive and negative potential of the existing cables so that no mistake occurs in terms of positive and negative potentials. For this test, the maximum voltage allowed between the two poles of the two resources is entered in "Voltage Drop" field. To be precise, suppose that two resources of "A" and "B" are being used to supply the equipment. Normally there should not be any potential difference between the positive "A" and negative "B" sides of the resources. If there is any potential difference between these two it means that they both belong to the same resource and can be used to supply the equipment.

Check DC Ground	257785
Check Correspondir	ng Voltage
Status	Passed
Voltage Drop	1.000 €
Dev	173.6 mV

"Check Short Circuit": by doing this test you can test the health of a bobbin. To do so you need to specify a voltage and a reference resistance in "Voltage" and "Rref" fields respectively. After doing the wiring and running the test, the drawn current is measured and then the applied voltage is divided by the drawn current and the self-resistance is calculated. If this resistance is smaller than the reference resistance specified in "Rref" field, it means that the self is short circuited.

Control(s)		Res
Check DC Grou	nd	Min Coil
Check Correspo	nding Voltage	
Check Short Cir	cuit	
Status		
Voltage	5.000 V	
	10000	-
R ref.	<u>10.00</u>	



Check DC Grou	nd
Check Correspo	nding Voltage
Check Short Circ	suit
Status	Passed
Voltage	5.000 V
R ref.	10.00 Ω
R act.	9.727 Q

Since it may happen that some users have also performed "Megger" test for this equipment and they wish to have the results in a report, in this tab they can create their intended table by selecting their desired row and column and then "Insert"; after entering the test results and selecting "Add to Report", the information will be added to the output report. Other options include "Delete Report" which is used to delete the information of this page from the report as well as "Export" and "Import" options which are used to export the information of this page or import them if necessary. Also, if you wish to set the characteristics entered for the created row and column as the default for this section of the room you can use "Set as Default" option.

t Object Timing Test C	Contact Resistance Mini	mum voltage to operate circuit break	Megger Test Report
(s) 5	nt 😡		
Type your Title			

				ĥ	
Add to Report	Delete Report	Set as Default	Export	Import	
VA1					

130 : CAPACITIVE VOLTAGE TRANSFORMERS

Voltage transformers are composed of a core, two windings, and insulation. VTs convert the high voltage of the primary side to low voltage on their secondary winding with the turn ratio written on their plate.

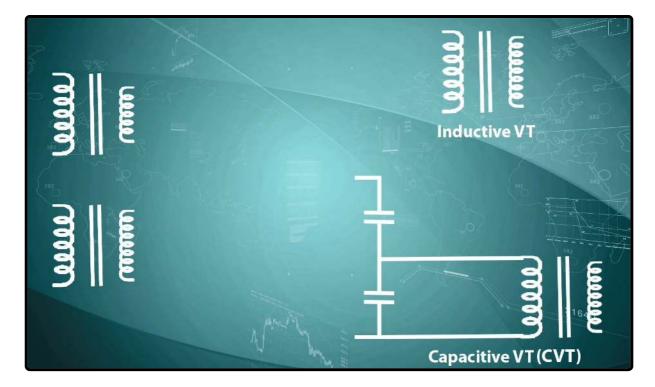
H.V Bushing	HV Side			IC	
Oil	nv side –	1			
	Technical data				
Winding	Туре		VMF12-1	VMF24-1	VMF36-1
Insulation	Highest voltage for equipment	kV	12	24	36
	Power frequency withstand test voltage, 1 minute	kV	28	50	70
/inding	Lightning impulse test voltage (1.2/50 µ s full wave)	kV	75	125	170
	Rated frequency	Hz	50/60	50/60	50/60
Single Phase Potential Transformer	Max. rated primary voltage	kV	12/√3	24/\3	36/\3
Circuit Globe	Secondary thermal limit current for measuring winding	A	7	7	7
	Rated voltage factor /8h		1.9	1.9	1.9
	Secondary thermal limit current for Earth - fault winding	Α	4	4	4
	Secondary Voltage	V	100/\	3; 110/\3; 22	20/\3
	Max number of cores		3	3	3
	Accuracy class measuring / protection Rated output			.5-1 /3P -6P -100 VA	

Because of the internal casualties such as copper and iron casualties, the vector of the secondary voltage is different from the primary voltage. Moreover, the connected burden is capable of affecting the turn ratio error and phase displacement. If the actual amplitude of the secondary voltage is <u>lower than nominal secondary voltage</u>, the amplitude error is negative. Also, if the secondary vector is lagging in relation to the primary vector, the phase error is negative.

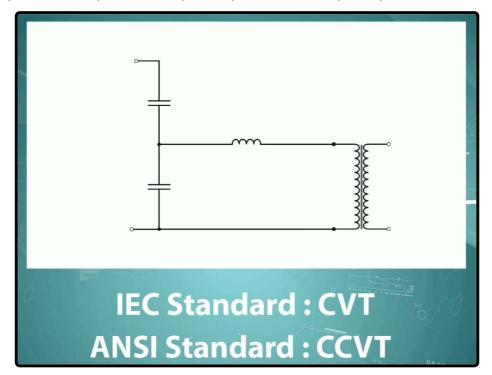


VLV(Nominal) VLV(Actual)	VLV(Actual)
V(W(Actual) < V _{LV(Nominal)}	φ _{LV(Actual)} < φ _{LV(Montinal)}
Turns Ratio Dev. < 0	Phase Dev. < 0

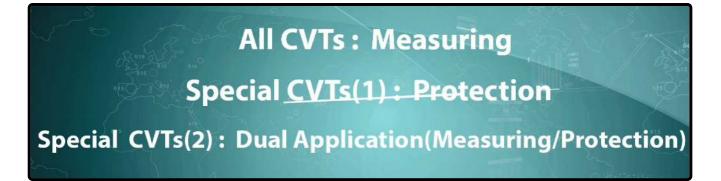
To compensate for the turn ratio error, sometimes manufacturers adjust the number of primary or secondary turns. Nowadays, most of the VTs that are used in the industry are either inductive VTs or capacitive VTs which are called "CVT".



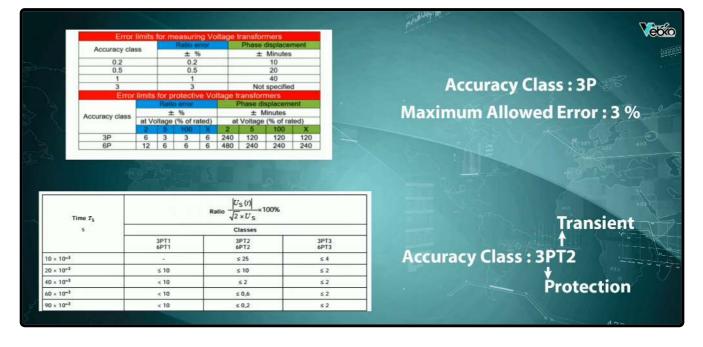
CVTs are composed of an inductive VT, a high-voltage capacitive divider and a compensator reactor. In the IEC standard, the title CVT is used for this equipment but in the ANSI standard, this equipment is called CCVT. The compensator rector is designed in a way that it can compensate for the phase displacement caused by the capacitive divider.



All CVTs can be used for measurement purposes but only certain types of this equipment are suitable for protection purposes. Dual-purpose CVTs (measurement and protection) must be in accordance with all of the considered descriptions and the current standards.



According to the maximum allowed error percentage, the accuracy class of the protection CVTs is considered to be from 5 percent of the nominal voltage to a coefficient of the nominal voltage (Rated Voltage Factor) and after its value, the letter P is used. 3P and 6P are the standard accuracy classes for protection CVTs. For example, 3P accuracy class means that the maximum allowed error is 3 percent. Moreover, in IEC standard, three classes of T1, T2 and T3 are considered for the function of CVT in transient state. For example, 3PT2 class indicates that the function of the 3P class is for protection purposes and T2 class is for transient states.



Classes related to the transient response are defined in the following table:

Time IS		Ratio $\frac{ U_{\rm S}(t) }{\sqrt{2} \times U_{\rm S}} \times 100\%$	
s		Classes	
	3PT1 6PT1	3PT2 6PT2	3PT3 6PT3
10 × 10-3		≤ 25	≤ 4
20 × 10 ⁻³	≤ 10	≤ 10	≤ 2
40 × 10 ⁻³	< 10	≤ 2	≤ 2
60 × 10 ⁻³	< 10	≤ 0,6	≤ 2
90 × 10 ⁻³	< 10	≤ 0,2	≤ 2

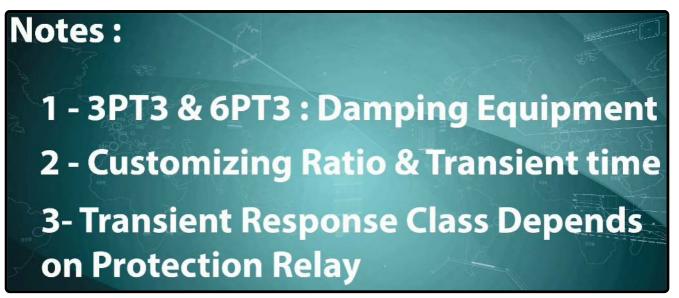
In the above relation, Us (t) is the response for the transient secondary voltage. For example, for the 3PT2 class, the relation of the transient voltage to the nominal voltage peak from 10 ms to 90 ms after the beginning of the transient state, It should decreas and be in the range of less than 25 times to 0.2.

In this regard, it is necessary to pay attention to several points:

CVTs need a damping piece of equipment for the 6PT3 and 3PT3 transient response classes.

By agreement between the manufacturer company and the customer, it is possible to consider different values for the turn ratio and Ts time.

Selecting the transient response class depends on the characteristics of the protection relays.



About Measuring CVTs, the accuracy class is defined based on the highest allowed error percentage in the nominal voltage with the nominal burden. The standard accuracy classes for single-phase Measuring CVTs are considered to be 0.2, 0.5, 1.0 and 3.0.

	Error	limits	for m	easurir	ng Vo	ltage t	ransfor	mers		
				Ratio e				displacer	nent	
	Accuracy clas	55		± %	0		±	Minutes		
	0.2			0.2			10			
	0.5		0.5				20 40			
	1									
3			3				Not specified			
	Error	limits	tor p	rotectiv	e vo	itage ti	ranstorr	ners		
		Ratio error			Phase displacement					
۵	ccuracy class	± %				± Minutes				
	couracy class	at Vo	t Voltage (% of rated)			at	at Voltage (% of rated)			
		2	5	100	X	2	5	100	X	
	3P	6	3	3	6	240	120	120	120	
	6P	12	6	6	6	480	240	240	240	

Test Object tab

To perform a test, every module needs a set of information about the equipment which is entered in "Test Object". In this tab, the general characteristics of the "CVT" and its information for performing the test and adding to the report are specified. In "Data" section, information such as serial number, model, the manufacturer company and the installation location of the "CVT" are entered to be added to the report.

Test Object	SecondaryBurden	5
Data <		_
Model:	VT	
Туре:	Oil Type	
Serial Number A:	37032089	
Serial Number B:	37032089	
Serial Number C:	37032089	
Station:	7	
Feeder/Bay:		
Manufacturer:		
Frequency:	50.00 H	z
Temperature Corre	ection	
Winding Material:	Copper	
Winding Temp.:	20.00	•
Reference Temp.:	75.00	=
Correction Factor:	1.2161	_
		_
Niose Suppression		-
Averaging:	1	
Extra Data ———		_
Date:	04/02/2021	
Tested by:		
Approved by:		

In "Winding Material" field in "Temperature Correction" section, the conductor type of the windings is selected from among "Copper" and "Aluminum". In "Winding Temp." field the current temperature of the windings and in "Reference Temp." field, the reference temperature for measuring the resistance of the windings are entered so that they can be used to correct the values measured in different temperatures. Usually, the reference temperature which is 75 degrees is written in front of the secondary winding resistance on the plate of the "CVT". In "Correction Factor" field which is uneditable, the temperature correction factor is calculated by the software in accordance with the current ambient temperature as well as the reference temperature and the winding material. It is possible to view the relation used for calculating this factor, by holding the cursor on its field.

Winding Material:	Copper
Winding Temp.:	20.00
Reference Temp.:	75.00
Correction Factor:	1.216
Extra Data ——	
Averaging:	
Date:	04/02/2021
fested by:	
Approved by:	

The "RMS" value of every parameter is calculated based on the average of several time periods. As the number of these time periods increases, it takes longer to make the calculations but also the accuracy increases and there will be fewer fluctuations. The number of these time periods is entered in "Averaging" field in "Noise Suppression" section. This field is the same as "No. of period" field in "Setting" in "Signal View" window.

Niose Suppress Averaging:	sion	1	
Extra Data			
Date:	04/02/2021		
Tested by:			
Approved by:			

In "Date" field in "Extra Data" section, the date of performing the test is entered in AD and the information about the performer of the test is entered in "Tested By" field. Also, the information about the supervisor is entered in "Approved By" field.

In "Data Table", the characteristics of every core and tap are entered in every row in accordance with the characteristics plate. The core number and the tap number are entered in "Core Number" and "Tap Number" fields, respectively. The primary parameters are entered in "Vprimary" and "Primary Factor" fields while the secondary characteristics are entered in "Vsecondary" and "Secondary Factor" fields. The burden is specified in "VA" field and in "CLP" and "CLM" fields, the Protection Core and Measuring of the transformer are entered, respectively. Likewise, the information related to the two other taps of the CVT that are being used is specified. Also, if the characteristics of the "VT resistance" are available, it is possible to check "Show Resistance Column" option to add the related column to the table. By checking this option, some changes are made in the "DC Resistance" test table which will be thoroughly explained in its related video.

	Core No.	Tap No.	Vprim.	Primary F	actor	Vsec.	Secondary	Factor	VA	CLI	2		CLM		R nom.
1	1	1	20.00 kV	1/\/3	×	110.0 V	1/\3	×	25.00 VA	3P	•	02		*	100.0 mΩ
2	2	1	20.00 kV	1/\/3	~	110.0 V	1/\3	~	25.00 VA	3P	-	02		•	100.0 mΩ
▶3	3	1	20.00 kV	1/\/3	~	110.0 V	1/\/3	~	0.000 VA	n/a	े म े	n/a		-	100.0 mΩ

Also, by pressing the "Add to Report" option in the box at the bottom, this information is added to the output report and a message stating "The Report was added to the list" is displayed. It is possible to view the report by selecting "Report" window from the bar at the right. By clicking on "Delete Report" option in "Delete From Repor" window, the added report is removed. If "Set as default" option is checked, the entered information is saved as default and every time, by opening the "Capacitor Voltage Transformer(CVT)" room this information is displayed.

Vi Irstrument Test X		Report	1 ×
Test Object SecondaryBurden Short Cr	rcurt impedance Resistance Excitation Ratio Megger Test Report	BOW ROOK @ HTML () PCP	- Faile
Test Object SocensaryUnder Short Or Bala Model VT Type: Savi Nurber 8. 3703268 Savi Nurber 8. 3703268	tuir impedance Resistance Locatarion Ratio Megger Test Report Media Kél (New) Stow Relationar Colom Care No. Top No. Spen. Primary Factor: Viec. Secondary Indo: Vie. CIP 1 1 1 2 28.01 Viech 1 v 25.01 Viech 1 v 25.01 Viec. 9	Boot Rook	Charlof
		Confia. Table VPmin Phintraction VSacc Scotfactors Peaker CLI DL LLI B 1 1 20 0100 VSacc Scotfactors Peaker DLDL DLD	1.0 m2

131 : SECONDARY BURDEN TEST

In this test, the "Burden" connected to the "CVT" secondary is measured. In this test, by injecting "AC" current and measuring the "AC" voltage by "Binary/Analog Input" and dividing voltage by current, "Z" and its angle and consequently "R" and "X" values are obtained. To do this test, after going to "State Setting" section, the current and time of the test must be entered in "I test" and "State Time" fields, respectively. The current limitation specified for this field is "32" amperes. After entering the "State Setting" information, the wiring must be done in accordance with the instructions picture. It should be noted that by double-clicking on the picture, it is possible to magnify it. To perform this test, in the first step, the

"CVT" must be separated from all elements that are used for transferring voltage to measurement devices. In this wiring "Jumper" "la1" and "lb1" current outputs and connect "la2" and "lb2" to the "CVT" voltage transmission path.

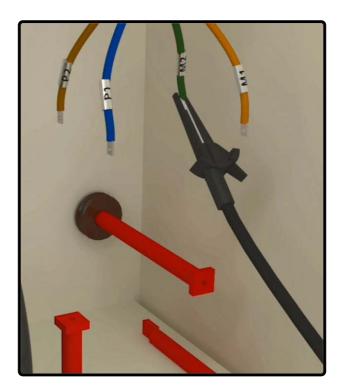
inj:	V meas:				
0.000 A	0.000 V				
2.	Angle:	R:	X:	L:	
0.000 Ω	0.00 *	Ω 000.0	Ω 000.0		0.000 H
(ZI^2):		(RI^2):	b		
0.000 VA	@ nominal current	0.000 W	@ nominal current		

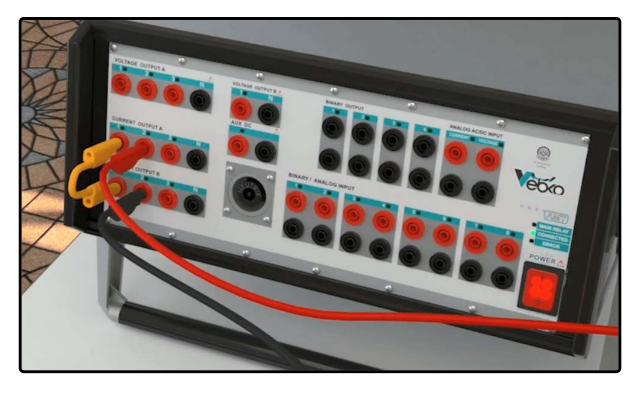
Test Objec	Secondary Bur
State Setting	R
ITest:	1.000 A
State Time:	5.000 s
Don't chang	e hardware settings



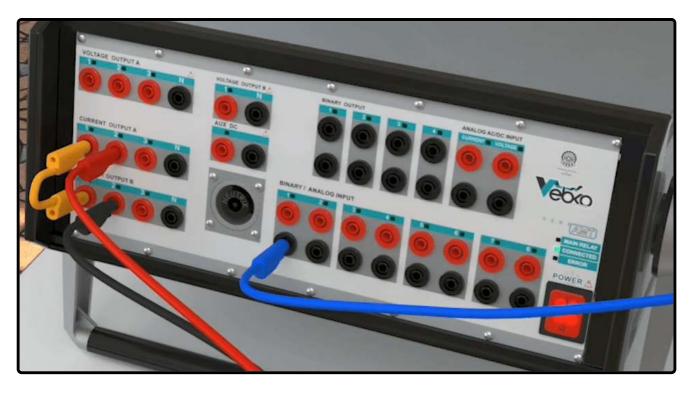


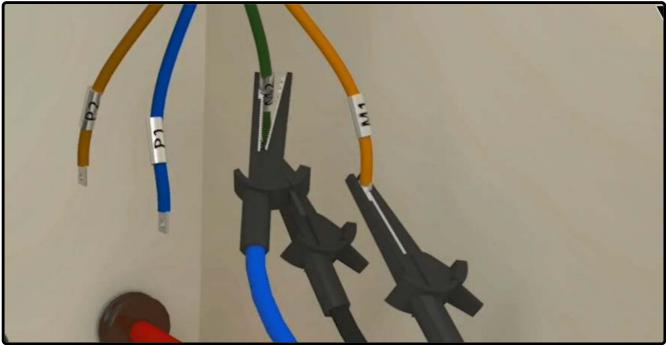
Also, to measure the "AC" voltage, "Binary/Analog Input1" must be connected to the test path a little further from the current injection connectors. This should be noted that before performing the test, it is necessary to press "Init Test" so that the device is automatically "Configured". By selecting this option, the settings including current and test time as well as hardware settings related to "Hardware Configuration" including the outputs of the device and "Binary/Analog Inputs" are adjusted by the device automatically. In "Analog Output" tab in "Hardware Configuration" section, we can see that the wiring of the device is set at "32A" with the maximum "Burden" of 400 Volts ampere and the "Binary/Analog Input1" is activated for voltage measurement. To better analyze the test, "Table View", "Detail View" and "Signal View" windows can be used. After opening "Table View" window, you can see that a "State" with the "50Hz" frequency and in accordance with the entered information in "State Setting" section is created. If you wish to view the information more thoroughly, use "Detail View" window instead.

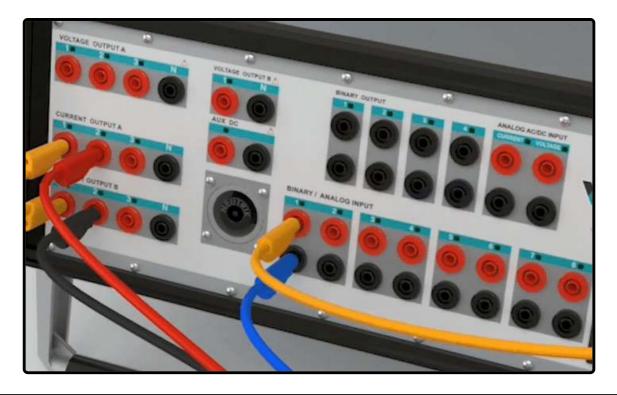






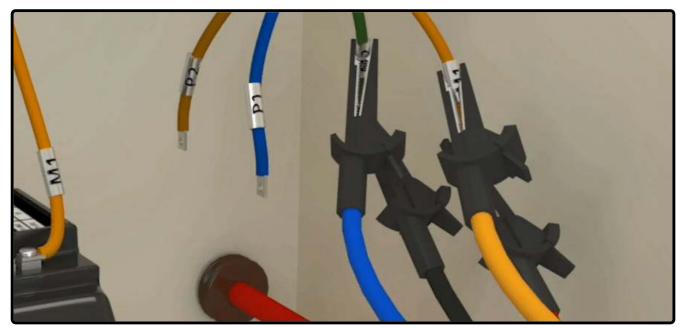






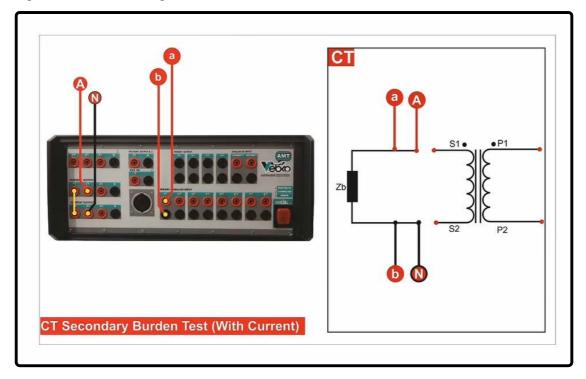
Performing the test and analyzing the results

After adjusting the wiring, here, 5 amps and 5 seconds are entered as test current and test time, respectively, and after pressing "Init Test", the test starts. In "Signal View" it is possible to view the waveform of "Actual" and the voltage measured by "Binary/Analog Input". Also, in "Signal View" by using the waveforms of "Actual" and the voltages recorded in "Signal View" it is possible to examine the connection of the connectors. In "Result" section, the user can view the results after the test is finished. The results include "linj", the amount of injected current, "Vmeas", the measured voltage, impedance, "impedance Angle" and finally the values of "R" and "X" are displayed using the "Z Cos(phi)" and "Z Sin(phi)" relations, respectively. In "Actual Burden" field, the amount of burden that the "CT" secondary can supply in the nominal current is calculated and the result is entered in this field by the software. In the end, after the test is finished, it is necessary to add the test results to the report which, in equipment test, is done by pressing "Add to Report".

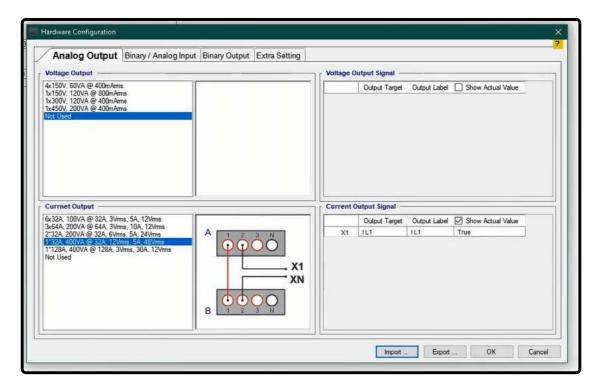


Also, <u>if you wish to</u> add certain parts of the evaluation to the report or to edit the report, use "Add to Report" cog. By clicking on this cog, the elements that can be added to the "Report" are displayed by checked checkboxes and <u>you</u> can uncheck any undesired elements. Note that after any test, the results are not automatically added to the report and it is necessary to add the results of the performed test to the output report by pressing "Add To Report" before "Clearing the test". It should also be noted that if the "Burden" of the path is low and the user wishes to have a more accurate measurement or "Binary/Analog Input1" is damaged, it is necessary to change the specified "Binary Input". To do this, after pressing "Init Test" and checking "Don't Change Hardware Setting" option, the user must enter "Hardware Configuration" window and specify a new input in "Binary/Analog Input" tab. Here, as an example, "Input10" is selected and after adjusting the necessary settings, the test is performed and the results are viewed. If you wish to select a binary between

binaries "1" to "8", you have to enter the "Binary Input Target" in accordance with the default binary number. For example, to use "Input7", "Bin1" must be selected as the "Binary Input Target". For this, it is suggested to right-click on "Input1" row and "Cut" the information and "Paste" it in the intended row. To change the current wiring, it should be noted that the "Output Target" of the selected wiring must be "IL1".



Add to Report Init Test	
IA1 C	



ge Binary-Input Target Binary-Input Type Threshold Reverse Show Actual Value Show Result Apply VDC Description C1 Bin.in.i Meass. Voltage 1 Wet Max 30 (V) 30.00 V False AC False 0.00 V (Vin > 30)=>(input C2 Not Used /ul>		Anai		nary Analog Input	Binary Output	Extra Setting						
C2 Not Used Not Used Dry False None False C3 Not Used Not Used Dry False None True C4 Not Used Not Used Dry False None True C5 Not Used Not Used Dry False None True C5 Not Used Not Used Dry False None True C6 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None Image: Shunt 2 State 10 Not Used Not Used Not Used None Image: Shunt 2 State Image: Shunt 2 State Current Output SizeA 100VA @ 32A, 30/ms, 5A, 12V/ms Shunt 2 State Image: Shunt 2 State Image: Shunt 2 State 272A, 200VA @ 42A, 40/WA @ 128A, 33/ms, 5A, 12V/ms Image: Shunt 2 State Image: Shunt 2 State Image: Shunt 2 Stat		ge	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show	Actual Value	Show Result	Apply VDC	Description
C3 Not Used Not Used Dry False None True C4 Not Used Not Used Dry False None True C5 Not Used Not Used Dry False None True C6 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None 10 Not Used Not Used Shunt 1 Ohm None None Current Output Carrent Output C1 Not Used Not Used Not Used Shunt 1 Ohm None None 10 Not Used Not Used Not Used Not Used None True 10 Not Used Not Used Not Used Not Used None None None 10 Not Used Not Used Not Used None None None 10 Not Used Not Used Not Used None None None None None None 10 Not Used Not Used Not Used None None None None None None None None	Þ	C1	Bin. in 1 🗾 💌	Meas. Voltage 1	Wet Max 30 (V)	30.00 V	False	AC		False	0.000 V	(Vin > 30)=>(input=1
C4 Not Used Not Used Dry False None True C5 Not Used Not Used Dry False None True C6 Not Used Not Used Dry False None True C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None 10 Not Used Not Used None None None Current Output Gasta 200VA @ 32A, Styms, 5A, 12Vms 3664A, 200VA @ 32A, Styms, 5A, 43Vms, 30A, 12Vms A I I I I I I Y Y Y Y Y Y Y I I I I I		C2	Not Used	Not Used	Dry		False	None		False		
CS Not Used Not True CS Not Used Not Used Dry False None True CS Not Used Not Used Dry False None True C3 Not Used Not Used Dry False None True C3 Not Used Not Used Dry False None True C3 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None 10 Not Used Not Used None None 10 Not Used Not Used None None Currnet Output SafAA, 200VA @ 32A, 3Vms, 5A, 12Vms A Output Target Output Label I Show Actual Value X1 IL1 IL1 True IL1 True		C3	Not Used	Not Used	Dry		False	None		True		
C6 Not Used Not Used Drv False None True C7 Not Used Not Used Drv False None True C8 Not Used Not Used Drv False None True C8 Not Used Not Used Drv False None True C8 Not Used Not Used Shunt 1 Ohm None True 10 Not Used Not Used None None Image: Comparison of the temperature of		C4	Not Used	Not Used	Dry		False	None	5	True		
C7 Not Used Not Used Dry False None True C8 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None True 10 Not Used Not Used Shunt 1 Ohm None Image: Contract Contend Contract Contr		C5	Not Used	100000000000000000000000000000000000000				None				
C3 Not Used Not Used Dry False None True 9 Not Used Not Used Shunt 1 Ohm None None True 10 Not Used Not Used Shunt 1 Ohm None None None None None None None None		C6	Not Used	Not Used			False	None				
9 Not Used Not Used Shunt 1 Ohm None 10 Not Used Not Used None 6x32A, 100VA @ 32A, 3Vms, 5A, 12Vms Current Output Signal 6x32A, 200VA @ 42A, 3Vms, 5A, 12Vms A 723A, 200VA @ 32A, 12Vms, 5A, 42Vms A 1128A, 400VA @ 128A, 3Vms, 5A, 12Vms A 128A, 400VA @ 128A, 3Vms, 5A, 12Vms A		C7		and the second se			information		â			
10 Not Used None 6x32A, 100VA @ 32A, 3Vms. 5A, 12Vms Gasta, 12Vms 3x64A, 200VA @ 64A, 3Vms, 10A, 12Vms Current Output Signal 2x32A, 200VA @ 52A, 6Vms, 5A, 24Vms Output Target 1*128A, 400VA @ 128A, 3Vms, 50A, 12Vms A 1*128A, 400VA @ 128A, 3Vms, 50A, 12Vms A 1*128A, 400VA @ 128A, 3Vms, 50A, 12Vms X1		C8		and the second			False			True		
Currnet Output 6x32A, 100VA @ 32A, 3Vms, 5A, 12Vms 3x64A, 200VA @ 32A, 3Vms, 10A, 12Vms 7:32A, 200VA @ 32A, 5Vms, 5A, 48Vms 1:32A, 400VA @ 32A, 12Vms, 5A, 48Vms 1:128A, 400VA @ 128A, 3Vms, 30A, 12Vms Not Used		9		and the second design of the s	Shunt 1 Ohm			None				
3x64A, 200VA @ 64A, 3Vms, 10A, 12Vms 2132A, 200VA @ 52A, 12Vms Subset registree output registree outpu	-			5A 12Vms			- Cur	rent Ou		Outruit Labo	C Show A	otual Value
1722A, 400VA @ 22A, 12Vms, 5A, 45Vms 17128A, 400VA @ 128A, 3Vms, 30A, 12Vms Not Used X1	3x	64A, 20	0VA @ 64A, 3Vms,	10A, 12Vms	100					and the second second second		ctual Value
	1*	128A, 4										

Table View			
ê	S1	G	Normal eneral: Direct
Name	Secondary Burden(With C	urrent)	
I L1: I L1	1.000 A	0.00 *	50.00 Hz
Bin. Out			
Trigger			5.000 s
Туре	Normal		D v
Comment			
Condition	C1		
Bin. Input			

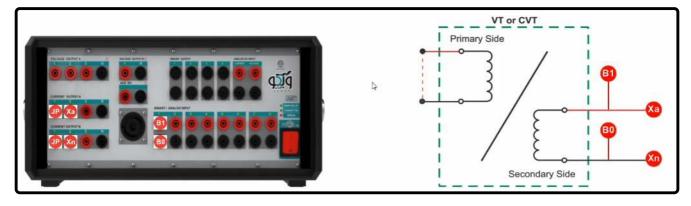
Two more notable points in performing the test are that first, "Error Other" in a test indicates that there is a problem in the connection of wirings of the current path or resistance is too high that the device is unable to provide the "Burden" needed for current injection. Therefore, in cases of facing this error, you can go to "Signal View" and examine the "Actual" value of the current. If the current is injected by the device ("Actual Current") but its difference with the specified current is high, this means that the path resistance is high and if the "Actual Current" is zero, it means that the current injection path is open. Where the path resistance is high, the test current must be decreased and in cases of a zero "Actual Current", the connection of connectors needs to be examined. The second point is that the voltage measured by the inputs of the device needs to have similar cycles. If the measured values have too big tolerances or they are zero it means that the connectors are not correctly connected.

State Type — State Type:		State Name:		Comment
Normal	~	Secondary B	lurden(With	State termination
Set Mode and	FaultType ———			Binary trigger condition as Binary trigger condition — Trigger Logic : ANE
Analog Output	Channels			C1:Meas X
Signal	Amplitude	Phase	Freque	
Binary Outputs Binary Inputs			ist Change	Delay after Binary Trigger
Meas. Vo				

Test Objec*	Secondary Burden	Resistance Test	Excitation Test	Ratio and Polarity Test (With Current)	Ratio an
State Setting - ITest: State Time:	(ZI^2)	V meas: 1.002 A 5 Angle: 503.7 mΩ	(RI^2):	X: L: 13.7 mΩ 406.8 μΩ -1.290 3.7 mW @ nominal current	μΗ

132 : SHORT-CIRCUIT IMPEDANCE TAB

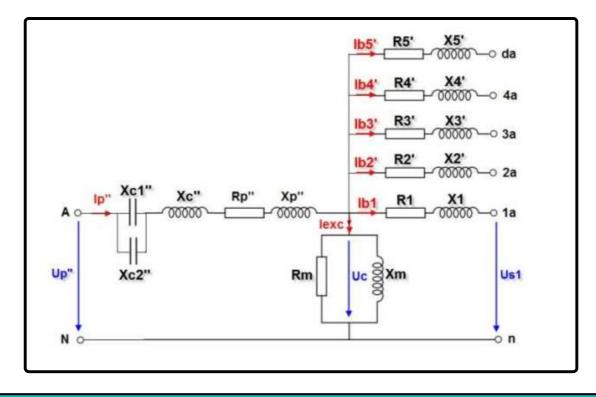
To perform a short-circuit impedance test, as can be seen in the picture, the primary winding is short-circuited. AC current injection is done through the secondary coil and the voltage difference that happens on the terminals, is measured through the inputs of the device. This measurement must be repeated for the other secondary coils. The obtained impedance called Zsc_x is a combination of primary and secondary stray losses.



$$\underline{Z}_{sc_x} = R_p^{\prime\prime} + iX_p^{\prime\prime} + R_x + iX_x$$

Where RP", Xp" and x stand for the resistance of the primary winding which is transferred to the secondary side, the leakage reactance of the primary winding which is referred to the secondary side, and the indicator which is considered for the secondary winding or in other words for where the current is injected from, respectively.

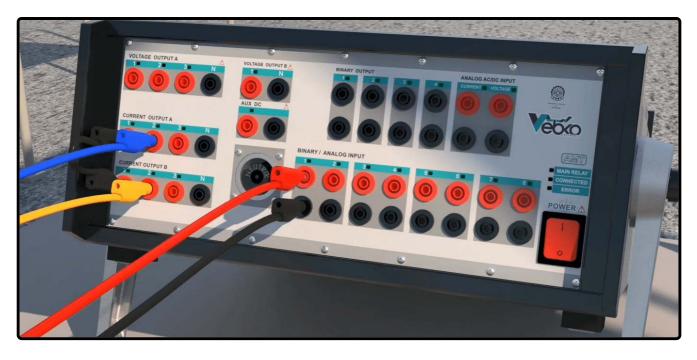
CVT Equivalent circuit



Performing the test and anlyizng the results

To perform this test, first, 1 is entered as the amount of the injected current in I test field and 1 is entered as the test time in State Time. By pressing Insert Rows button, it is possible to create other rows for testing other coils. After adjusting these settings, the wiring must be done according to this picture. In this picture, first phase of current groups A and B are made series so that the maximum Burden of the device is used. Then, the outputs of the device are connected to the CVT. To measure the caused voltage difference, input number 1 must be used. It should be noted that, in this wiring the voltage connectors are connected ahead of the connectors of current injection. Finally, to perform the test, by right-clicking on any of the rows in Table section and selecting Apply Test, the test runs and the resistance value of the intended coil is measured.

Test Object SecondaryBurd	er Short	-Cire	cuit impe	edance	Resistanc	e Excitatio	n Ratio	Megger T	est Report	
State Settings	Result	(Sele	cted) —				_			
I test: 1.000 A	l act:]	0	.000 A F	Rk:	0.000 Ω				
State Time: 1.000 s	Vmea	s: [0	000 V X	۹k:	0.000 Ω				
	V phas	e: [0.00 ° Z	3k:	0.000 Ω				
	Table	20 7								
Don't Change Hardware Setting		Тар	Terminal	Frequency	lact	V meas	V phase	Rk	Xk	Zk
	▶1	1	1a - 1n	0.000 Hz	A 000.0	0.000 V	0.00 °	0.000 Ω	0.000 Ω	0.000 Ω
			2a - 2n	50.00 Hz	A 000.0	0.000 V	0.00 °	0.000 Ω	0.000 Ω	0.000 Ω









	Tap	Terminal	Freque	ency	l act	V meas	V phase	Rk
▶1	.1	1a 1n	0.000) Hz	A 000.0	0.000 V	0.00 °	0.000
	F	pply Test Tear Result emove emove All) Hz	0.000 A	0.000 V	0.00 °	0.000

After the test is finished, to add the results to the report "Add to Report" button can be used. Also, by using the cog next to this button, you can remove the items they do not wish to be added to the report before selecting "Add to Report" option. <u>if, for any reason</u>, wish to modify the wiring of the device, first they need to apply the test once and then check "Don't Change Hardware Setting" option and select a different output from "Hardware Configuration" window and then set the Output Target at "IL1-E" and run the test after changing the wiring. To select other inputs, it should be noted that the selected Binary Input Target must be in accordance with the default "Binary Input Target". For this, it is suggested to right-click on "Input1" row and "Cut" the information and "Paste" it in the intended row.

		Edit & Delete Report	
R	~	Test Setting	-
5		Wiring	
4	~	Assessment	-
		Cursor Data	
A1	~	Signal View	

-	Ý Z			0000000
Test Object	SecondaryBurder	Short	-Circ	uit im
State Settings	i	Result	(Selec	ted) —
I test:	1.000 A	l act:	[
State Time:	1.000 s	V meas	s: [
		V phas	e: [
V		Table	-	
Don't Change	Hardware Setting		Тар	Termin
6		▶1	: 1	1a - 1n
Insert Rows		2	1	2a - 2n

Analog Output Binary / Analog Input Binary Output Extra Setting GOOSE Setting	
Koltage Uutput	Voltage Output Signal
x150V, E0VA @ 400mAms x150V, 120VA @ 900mAms (A1) x150V, 120VA @ 900mAms (A2) x150V, 120VA @ 900mAms (A3) x300V, 120VA @ 400mAms (A1 A2) x300V, 120VA @ 400mAms (A2 A3) x300V, 120VA @ 400mAms (A2 A3) x450V, 200VA @ 400mAms (A2 A3 B1) x450V, 200VA @ 400mAms (A2 A3 B1) x450V, 200VA @ 400mAms (A2 A3 B1) x450V, 200VA @ 400mAms (A2 A3 B1)	Output Target Output Label Actue
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x32A, 200VA @ 64A, 3Vms, 1A, 12Vms x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B2) x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B2) x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B3) x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B3) x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B3) x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B2B3) X1	Output Target Output Label Actua X1 IL1 IL1 True

	Dutpy Binary /	Analog Input	Binary Output E	xtra Setting	GOOSE	Setting				
	Binary-Input Target			Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description	Virtual Binary In
►C1	Rin in 1	Rin in 1	Wet Max 4.5 (V)		False	AC	False			VBin 1
C2	Set all Binary lik	ce this								VBin 2
C3	Paste			3					1	
C4	- WB								12	
C5	Paste		-						· · · · · · · · · · · · · · · · · · ·	
C6	Not Used									
C7	Not Used			-		-				
C8	Not Used			-						
9	Not Used			-						
10	Not Used									

nalog C	Dutput Binary /	Analog Input	Binary Output	Extra Setting	GOOSE	Setting				
	Binary-Input Target	Binary-Input Label	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description	Virtual Binary Ir
C1	Bin. in 1	Bin. in 1	Wet Max 4.5 (V)		False	AC	False			VBin 1
►C2	Not Used 🔹				-					VBin 2
	Cut Pasts		- - - - - - - - - - - - - - - -							
C8	Not Used			-	_					
10	Not Used									
9 10	Not Used Not Used									

133 : WINDING RESISTANCE TEST

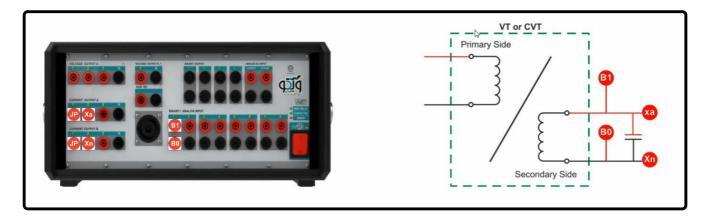
Winding resistance test is done in "Resistance Test" tab. In this test, by injecting "DC" current into "CVT" secondary and measuring voltage through the "Input" and dividing voltage by current, "DC" resistance or "Rmeas" is calculated. It should be noted that in the software, there is only one row in the test table by default. If the "CVT" has more than one taps or cores, by pressing "Insert Rows" it is possible to add as many rows as necessary and test any of them. To perform this test, the test current and time must be entered in "I test" and "State Time" fields in "State Setting" section, respectively. The current limitation specified for this field is "32" amps but "1" amp of current is usually enough for this test. About rows of the "Result" table, it should be noted that if "Show Resistance Column" option in "Test Object" is checked, three more columns including "Rnom", "Rdev" and "Assessment" are added to the table where "Rnom" and "Rdev" refer to the nominal resistance and the difference between "Rnom" and "Rcorr", respectively. If "Rcorr" is lower than "Rnom", the "Assessment" is "Passed", otherwise it is "Failed".

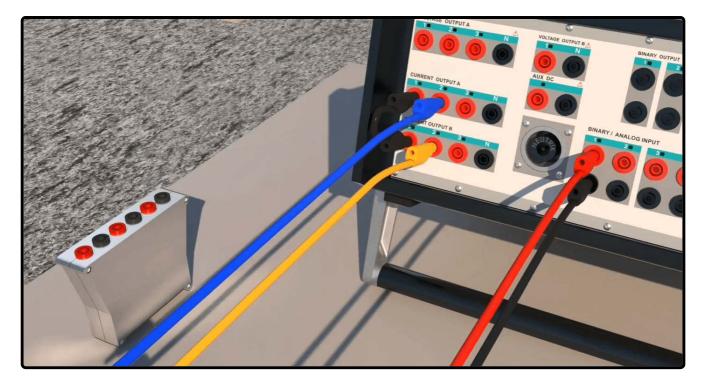
lest Object	SecondaryBurden	Short-Circ	uit impedanç	Resista	ince	Excitation	Ratio	Megger Te	est Report
e Setting -		Selected	Result		_				
	1.000 A	V DC:	0.000	V R meas	;	0.000 Ω]		
Time:	5.000 s	I DC:	0.000	A R corr:		0.000 Ω]		
on't Change	Hardware Setting	Result -							
Rows			Core	Terminal	V DC	I DC	Rme	as (20.00°)	R corr (75.00°)
		▶1	1 1	a - 1n	0.000 \	0.000 A		0.000 Ω	0.000 Ω

Test Object	SecondaryBurden	Short-Circ	uit impedance	Resistance	Excitation	Ratio	Megger
Data		Data T	able				
Model:	VT	- Ad	d Row	hew Resistance	Columo		
Туре:	Oil Type			63			
Serial Number A:	37032089		Core No.	Tap No.	Vprim,	Pn	imary Facto
Serial Number B:	37032089	►1	1	1	200.0 k\	1/\3	
Serial Number C:	37032089	7 2	2	1	20.00 k\		
Station:		3	3	1	20.00 k\	1/\3	
Feeder/Bay:		-11					
Manufacturer:							
		내					
Frequency:	50.00 H	z					

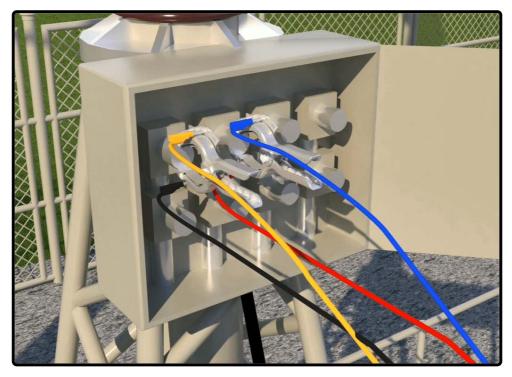
r Se	lected R	tesult —		_				i i			
VD	ю: [0.0	00 V R meas		Ω 000.0	R nom:	100.0 mΩ				
I DO	s: [0.0	00 A R corr:		0.000 Ω		0.00 %		П		
Re	sult —	Core	Terminal	V DC	I DC	R nom	R meas (20.00*)	R corr (75.00°)	R dev	Assessment	
	►1	1	1a - 1n	0.000 V	0.000 A	100.0 mΩ	0.000 Ω	0.000 Ω	0.00 %	Not Tested	+
	2	1	2a - 2n	0.000 V	0.000 A	100.0 mΩ	0.000 Ω	0.000 Ω	0.00 %	Not Tested	•
	3	1	3a - 3n	0.000 V	0.000 A	100.0 mΩ	0.000 Ω	0.000 Ω	0.00 %	Not Tested	-

After entering the information, the wiring needs to be done in accordance with the picture. It should be noted that it is possible to magnify the picture by double-clicking on it. In this wiring, first the "la1" and "b1" current output phases are Jumpered and "la2" and "lb2" phases are paralleled with the capacitor box. Here, "la2" is connected after connecting it to the positive end of the capacitor and to the "S1". CVT and "lb2" is connected after connecting it to the negative polarity of the capacitor and to the "S2". The reason for using a capacitor box is to compensate "CVT" inductance. In this capacitor box, there are three "1000" microfarad capacitors and the red and black ends of the capacitor box are the positive and negative polarity, respectively.





To measure the "DC" voltage, input1 should be connected to the "CVT" and a little further from the current connectors. Then, the source of the current which was paralleled with the capacitor is connected to the "CVT" terminals. It should be noted that to perform the test, it is necessary to right-click on one of the rows of the table and select "Apply Test". By doing this, the device settings related to the current and the test time as well as the hardware settings related to "Hardware Configuration" including the outputs and "Binary/Analog Inputs" of the device are automatically adjusted. To analyze the test it is possible to use "Table View", "Detail View" and "Signal View". After opening "Table View" window, two "States" with zero frequency and in accordance with the information entered in "State Setting" section can be seen. The function of the first "State" is to change the "CT" current from transient to steady state while the function of the second "State" is to measure the current and voltage and calculate the resistance. If the user wishes to have access to a more thorough source of information than the "Table View", they can use "Detail View" window.



condaryBurden	Short-Cir	cuit impedance	Resista	ince E	Excitation	Ratio M	Aegger Test Report				
	[Selecte	d Result						1			
1.000 A	V DC:	0.000 V	R meas	:	0.000 Ω	R nom	100.0 mΩ				
5.000 s	I DC:	0.000 A	R corr:		Q.000.Q	R dev:	0.00 %				
vare Setting	Result	-	W. 10255294]			
		Core 1	eminal	V DC	I DC	Rnom	R meas (20.00°)	R corr (75.00°)	R dev	Assessment	
	1	1 1a.	. 1n.	0.000 V	0.000 A	100.0 m	Ω 0000.0	Ω 000.0	0.00 %	Not Tested	
	2	Apply Test		0.000 V	0.000 A	100.0 m	Ω 000.0	0.000 Ω	0.00 %	Not Tested	
	3	Clear Result		0.000 V	0.000 A	100.0 m	Ω 0.000.0	0.000 Ω	0.00 %	Not Tested	٠
		Remove Remove All									

Bin. Out	
Bin. Out Trigger Out State	000 Hz
Trigger O -O 5.000 s O -O 1.0 Type Normal Normal Normal Image: Control of Contro of Contro of Control of Control of Control of Contro of Control	1.000 s
Type Normal Normal Comment	1.000 s
Comment	
Trigger C1 C1 C1	~
Bin. Input	

Analog Out	Binary Out	Trigger	Serial	Report Setting		N 4	2
State Type		State Name	1	Trigger Set Comment	ting		
Normal	~	Resistance	Test	State Term			5.00
Set Mode and Fault Set Mode	Туре ———				ary Trigger Conditio		elow
General: Direct	~			Binary Tri Trigger Log	gger Condition	AND OR	
Analog Output Char	nnels —			N N/G	Target Lai al Bin.in 1 Bin.		
Signal /	mplitude	Phase	Freq	ie	silan.in 1 (Bin.		
1 L1: I L1	1.000 A	0.000 1/s	0.0	00 Hz			
Binary Outputs -			Last Char	ge Delay afte	ogic Minimum Time er Binary Trigger : iger Overcurren		0.000
Trip				Overcur Overcur	rent Trigger ment Fror		
					rcent		0.00
				Th	reshold		0.000
				Synchron	izer Mode —		
				L.			
Other Setting Disable Error Other Disable Error Oven			able Get	Actual			

Performing the test and analyzing the results

After adjusting the wiring, 1 amp and 5 seconds are entered as the test current and test time, respectively, and by rightclicking on any of the rows and pressing "Apply Test", the test begins. It should be noted that in "Signal View" section, it is possible to view the actual waveform of the current and the voltage measured by the "Input". By using "Signal View" and the recorded voltage and current waveforms, it is possible to analyze the test using the "Actual" values and the recorded voltages, Check if the connectors are connected correctly.

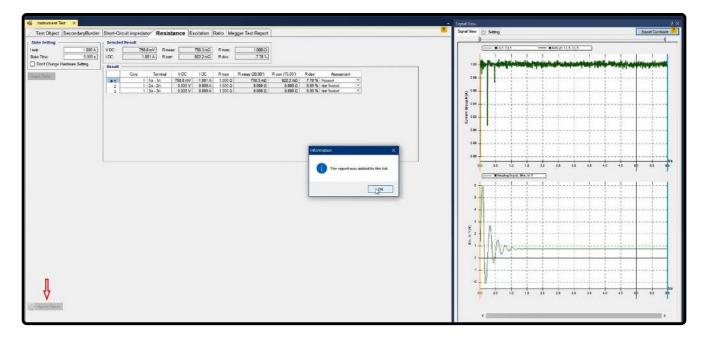
a Unbited - AMT Capacitor Voltage Kanoformer		- u x
File Verw Inst Facemeters Hadmann Window Help	(M. 37.00) (MS	
🖷 bstremet Test 🛪	ignal View	
M < 22 >>> M	2004 View South View South View	
		4. 50 13 03

After the test is finished, by selecting the row in "Result" section, the test results can easily be viewed. The results include "VDC", "IDC", "Rnom", "Rcorr" and "Rdev" which refer to the measured voltage, the injected current, the resistance measured in the current temperature, the resistance measured in the reference temperature and the difference between "Rcorr" and "Rnom" in terms of percent, respectively. In "Correction Factor" field, the temperature correction factor is calculated in accordance with the current ambient temperature, the reference temperature and the material of the winding. The information of this temperature is entered in "Temperature Correction" field in "Test Object" and the "Rcorr" is obtained by multiplying "Rmeas" by the "Correction Factor".

DC:	758.	8mV Rme	eas:	758.3 mΩ	R nom:	1.000 Ω				
DC:	1.0	001 A R co	ar:	922.2 mΩ	R dev:	-7.78 %	â			
Result 4	Core	Terminal	V DC	I DC	R nom	R meas (20.00")	R corr (75.00")	R dev	Assessment	
13	1	1a - 1n	758.8 mV	1.001 A	1.000 Ω	758.3 mΩ	922.2 mΩ	-7.78 %	Passed	
15	1	2a - 2n	0.000 V	0.000 A	1.000 Ω	0.000 Ω	0.000 Ω	0.00 %	Not Tested	٠
3	1	3a - 3n	0.000 V	0.000 A	1.000 Ω	0.000 Ω	0.000 Ω	0.00 %	Not Tested	+

Copper		~
	20.00	
	75.00	
	1.2161	and a second
on		TK For Copper = 234

In the end, after performing the test, if "Rcorr" is lower than "Rnom", the result of the assessment is "Passed" in "Assessment", otherwise it is "Failed". After the assessment, it is necessary to add the results to the report which in equipment test is done by pressing "Add to Report".

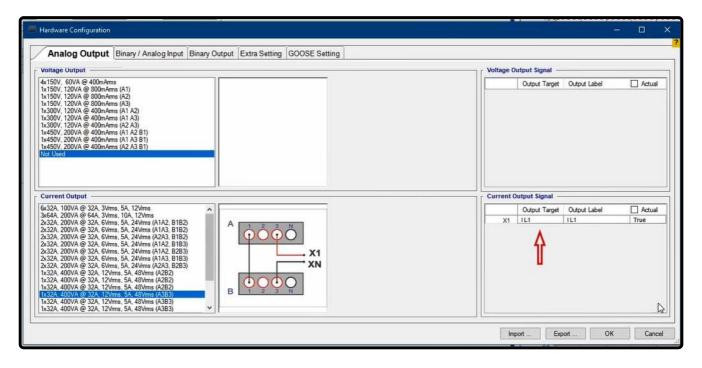


Also, if you wish to add specific parts of the test to the report or edit or delete the report, "Add to Report" cog. By clicking on this cog, the elements that can be added to the report are indicated by checked checkboxes and before pressing "Add to Report" the user can uncheck any of them that they do not wish to be added to the report. It should be noted that after every test the test results are not added to the report automatically and after every test, it is necessary to add the results of the performed test to the report by pressing "Add to Report" before clearing the test.

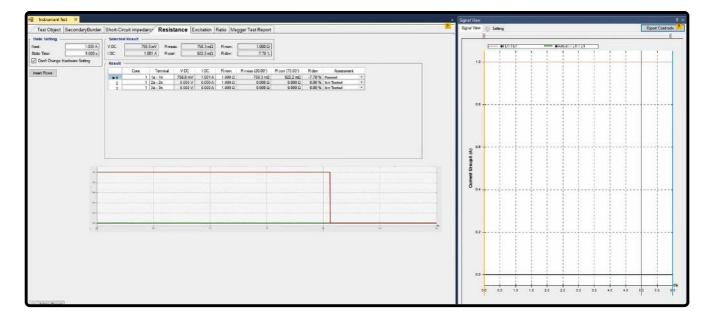
If you wish to use a different wiring for current injection, you need to have pressed "Apply Test" at least once. Then, check "Don't change Hardware Setting" and select their intended wiring in "Hardware Configuration" and press "Apply Test" one more time. To select a different "Input", it should be noted that the selected "Binary Input Target" must be similar to the default "Binary Input Target". For this, it is suggested to right-click on "Input1" row and cut the information and "Paste" it in the intended row. To change the current wiring, it is important to set the "Output Target" of the selected wiring at "IL1".

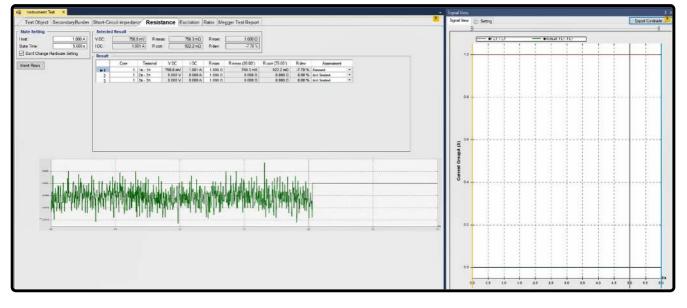
12	Test Object	SecondaryBurden	Short-
г s	State Setting -	1	Selec
11	est:	1.000 A	V DC:
S	tate Time:	5.000 s	I DC:
	Don't Change I	Hardware Setting 🧲	Resul

	Binary /	Analog Input	Binary Output E	xtra Setting	GOUSE	Setting				
	Binary-Input Target			Threshold	Reverse	Show Actual Value		Apply VDC	Description	Virtual Binary In
C1 C2	Bin. in 1 Not Used	Bin, in 1	Wet Max 4.5 (V)	-	False	DC	False			VBin 1 VBin 2 VBin 3
C: C: C: C: C: C: C: C: C: C: C: C: C: C	Set all Binary like Cut Sete Not Used Not Used Not Used	: this								U V8in 3
										>
								_		>
										,
										3
										,



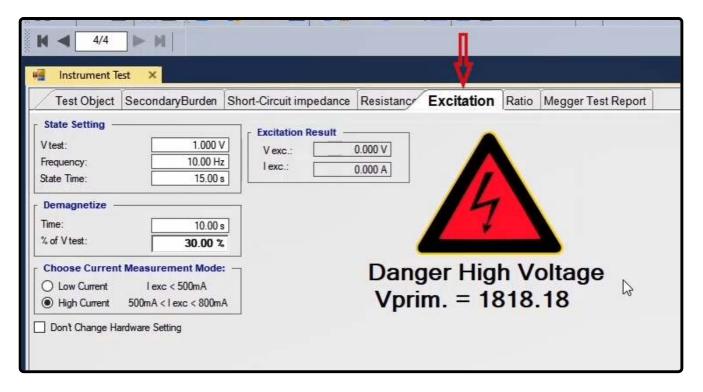
There are two more notable points; the first one is that "Error Other" indicates that either there is a problem with the wirings or the resistance is too high that the device is not able to provide the "Burden" needed for current injection. Therefore, in cases of facing this error, the user needs to examine the "Actual" value of the current from "Signal View". If the current is injected from the device ("Actual Current") but its difference with the specified current is high, the wiring resistance is too high and if the "Actual Current" is zero, it means that the current injection path is open. In cases where the resistance is too high, it is necessary to decrease the current and when the "Actual Current" equals zero, the connection of the connectors needs to be checked. The second point is that if the measured voltage has a too high tolerance or equals zero, this means that the connectors are not connected correctly.





134 : EXCITATION TAB

In fact, "Excitation" or saturation test, analyzes the characteristic of the core. In this test, by decreasing the frequency, a method is used to keep the voltage at a safe level. The core flux is in accordance with the relation between the voltage and the frequency and by using this relation and to prevent high voltages in CVT primary, it is possible to use a lower voltage for the test by decreasing the frequency. It should be noted that the software calculates and displays the saturation point in the nominal frequency. Moreover, decreasing the frequency helps to remove the effects caused by the stray capacity of the primary side.



Since the CVT damping circuit is used to stop the Ferro resonance effects, before performing the saturation test, it is necessary to isolate its circuit from CVT. Moreover, to perform coil resistance, secondary short-circuit impedance and saturation tests, it is necessary to detach the PLC/NHF terminal from the ground so that the high voltage does not cause any problem.

Doing the wiring in accordance with the picture and applying AC voltage to the secondary coil, the saturation curve is obtained. In this process, the voltage of the secondary terminal, excitation current and the phase angle between the excitation voltage and current are measured. In this room, first, it is necessary for the amount of voltage intended for the test, frequency and test duration to be entered in "State Setting" section. In this section, in fact, "Vtest" is "Vend" and, in this field, the test voltage increases from zero to the specified voltage.

📲 Instrument Te	est 🗙	
Test Object	SecondaryBurden	Short
State Setting -		-
V test:	N 1.000 \	7
Frequency: <	10.00 H	z
State Time:	15.00 s	

In "Demagnetize" section, before performing the saturation test, the software demagnetizes the "CVT" by AC voltage so that the residue flux caused by the "DC" resistance test is eliminated. In this section it is necessary to enter the "Demagnetization" time and the voltage in terms of a percentage of the "Vend".

Demagnetize	
Time:	10.00 s
% of V test:	30.00 %

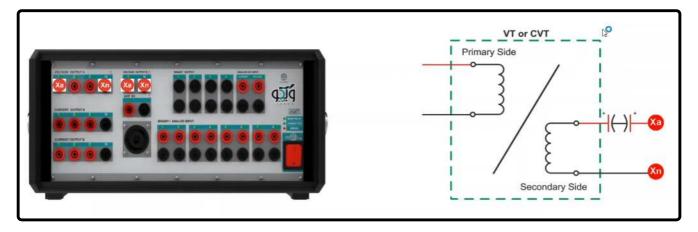
In "Choose Current Measurement Mode" section, it is possible to specify the current measurement mode so that the proper algorithm is applied in accordance with the current range. In this case, it should be noted that if the load current is low, it is better to use "Low current" mode because in this mode, the accuracy of load current measurement is higher.

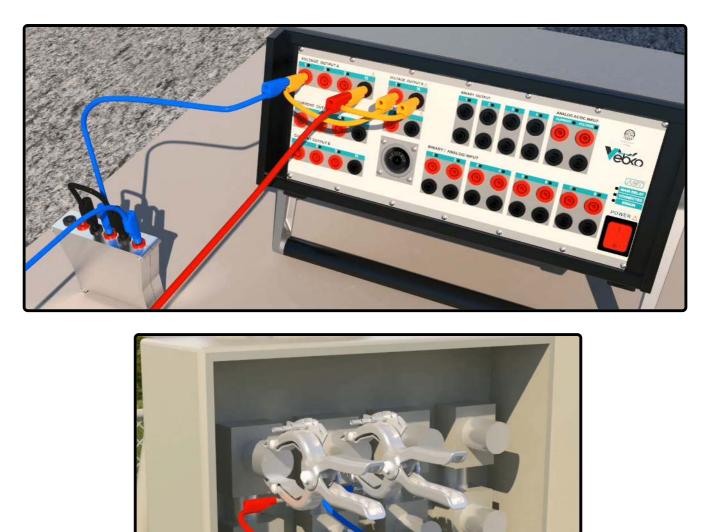
 Low Current High Current 	l exc < 500mA
---	---------------

Performing the test and analyzing the results

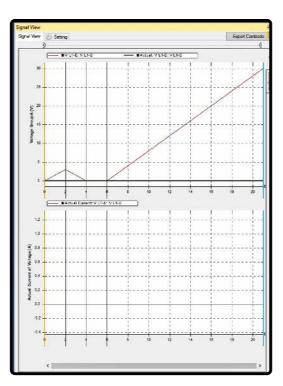
To perform this test, as an example, 20 volts, 10 Hz, 15s, and "High Current" are entered as "Vtest", frequency, and test time and test mode. On this page a warning can be seen which says that in this test the primary side voltage will reach 36000 volts. Therefore, while performing this test, observing safety points is required. After specifying the settings, the wiring should be done in accordance with the picture. In this wiring, the voltage of the first phase of the device is connected to the positive polarity of the capacitor and after <u>connecting two negative polarity of the capacitors</u>, the positive polarity of the second capacitor is connected to the positive polarity of the "CVT" and the other polarity of the "CVT" is connected to the null of the device. The reason for using the connections of capacitors in the path of applying voltage to the "CVT" is to filter the "DC" offset which is caused by the linear amplifier of the device.

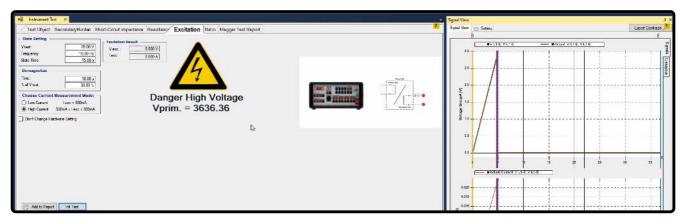


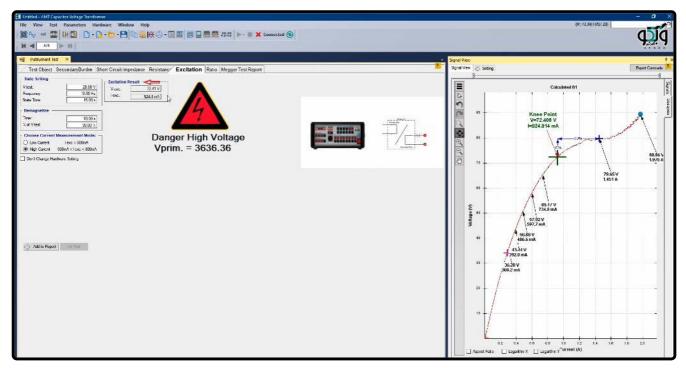




After doing the wiring, "Signal View" window is opened so that the signals of the load voltage and current and also the saturation curve can be viewed during the test. After completing these steps it is necessary to click on "Init Test" every time before performing the test so that the settings needed for the test are adjusted automatically. By running the test, it can be seen that first, the "CVT" is "Demagnetized" and then the saturation test is performed. After the test is finished, the test voltage and current are displayed on the diagram in "Excitation Result" box. After the test is finished, to add the test results to the report, click on "Add to Report". Also, by using the cog next to this option, before selecting "Add to Report", uncheck any item that you do not wish to be added to the report.







If for <u>any reason, you wish to use a voltage</u> other than the voltage of the first phase, <u>first, press "Init</u> Test" and then check "Don't Change Hardware Setting" option and then select a different output from "Hardware Configuration" window and set its "Output Target" at "VL1-E" and after changing the wiring, run the test.

Test Object	SecondaryBurden	Short-Circuit impedance	Resistance	Excitation	Ratio	Megger Test Report
State Setting – V test: Frequency: State Time:	20.00 V 10.00 Hz 15.00 s	lexc.:	0.000 V 0.000 A			
Demagnetize – Time: % of V test:	10.00 1	H		14		
Choose Curren Choose Current Low Current High Current	t Measurement Mode I exc < 500mA 500mA < I exc < 800m		and the second	er High n. = 36		
Don't Change Ha	ardware Setting	3				

Analog Output Binary / Analog Input Binary Output Extra Setting GOOSE Setting	
Voltage Output	Voltage Output Signal
4x150V. 60VA @ 400mArms (A1) 1x150V. 120VA @ 800mArms (A2) 1x150V. 120VA @ 800mArms (A2) 1x150V. 120VA @ 400mArms (A1 A2) 1x200V. 120VA @ 400mArms (A1 A2) 1x200V. 120VA @ 400mArms (A1 A2 B1) 1x450V. 200VA @ 400mArms (A1 A2 B1) 1x450V. 200VA @ 400mArms (A2 A3) 1x450V. 200VA @ 400mArms (A1 A2 B1) 1x450V. 200VA @ 400mArms (A2 A3 B1) 1x450V. 200VA @ 400mArms (A2 A3 B1) Not Used	Output Target Output Label Actual X1 VL1-E VL1-E
St2A, 200VA @ 32A, 6Vrms, 5A, 24Vrms (A1A2, B183) St2A, 200VA @ 32A, 6Vrms, 5A, 24Vrms (A1A2, B283) St2A, 200VA @ 32A, 6Vrms, 5A, 24Vrms (A1A3, B183) St2A, 200VA @ 32A, 6Vrms, 5A, 24Vrms (A1A3, B183) St2A, 200VA @ 32A, 6Vrms, 5A, 24Vrms (A2A3, B283) St2A, 200VA @ 32A, 12Vrms, 5A, 48Vrms (A2A2, B2E3) St2A, 400VA @ 32A, 12Vrms, 5A, 48Vrms (A2B2) St2A, 400VA @ 32A, 12Vrms, 5A, 48Vrms (A2B2) St2A, 400VA @ 32A, 12Vrms, 5A, 48Vrms (A2B2) St2A, 400VA @ 32A, 12Vrms, 5A, 48Vrms (A3B3) St2A, 400VA @ 32A, 12Vrms, 5A, 48Vrms (A3B3)	Current Output Signal Output Label Actua
J2A, 400VA @ 32A, 12Vms, 5A, 48Vms (A383) 32A, 400VA @ 32A, 12Vms, 5A, 48Vms (A383) 32A, 400VA @ 32A, 12Vms, 5A, 48Vms (A383) 32A, 400VA @ 32A, 12Vms, 5A, 48Vms (A1B1) 32A, 400VA @ 128A, 3Vms, 30A, 12Vms 41 Used	Import Export OK Can

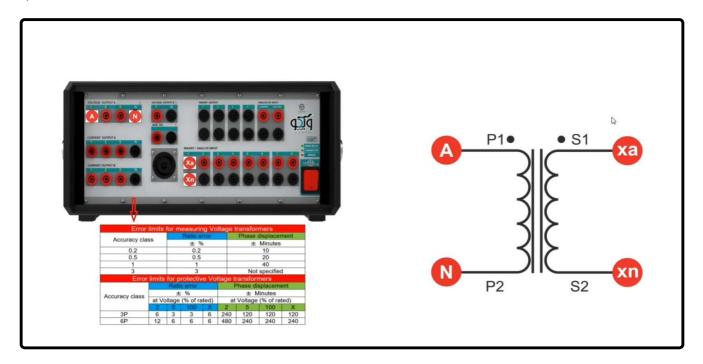
Note that if the device displays an "Overcurrent" error before finding the knee and saturation points, the wiring needs to be changed to "High Current" and the test can run after pressing "Init Test". If again, the device displays an "Overcurrent" error before finding the saturation point, this means that the saturation point current is <u>higher than the "limits" of</u> the device and it is not possible to find the knee point using this device.

135 : RATIO TAB

In this tab, CVT turn ratio test is performed where the voltage is given to the CVT primary and measured from the secondary. By dividing the primary and secondary values, turn ratio is obtained and the obtained value can be compared with the nominal value on the plate. For medium and high-voltage CVTs it is possible to perform this test by applying a low voltage or approximately 400 volts to the primary. If there are multiple measuring and protection secondary, it is necessary to measure voltages of all secondaries and obtain all their turn ratios.

est Object SecondaryBurden	Short-Circuit impedance	Resistance Ex	citation Ratio Megg	er Test Report	
te Settings: st: 50.00 V ctual: 0.000 V re Time: 300.0 ms log Input: 1 ~	Turns Ratio Result — V calc.: V meas.: Ratio nom: Ratio act: Ratio dev:	0.000 V 0.000 V 0.0000 0.0000 0.000 %	Phase Phase Phase nom:	0.00 * 0.00 * 0.0000 min	Assessment Protection Measuring Pro. / Meas.
At Calibration State Don't Change Hardware Settings	Insert Mode All Core Sort Direct	tion Up v	Insert Position Below Selected Row Above Selected Row End of Rows	Insert Rows	
Core No. Phase V test act	V calc. V meas.	Ratio nom Rati	o act Ratio dev Phase	e nom Phase act	Phase dev Pol. Check Assessment

According to the IEC 60044-2 standard, the allowed error percentage is set in accordance with the accuracy class of the CVT. The first column of this accuracy class table and the turn ratio error percentage accuracy column are also available. In the following table, the mentioned error percentages are for cases where the voltage is higher than 2 percent of the nominal voltage. In accordance with the table related to protection CVTs, for example, if the accuracy class is 3P, its allowed error percentage in 2 percent of the nominal voltage is 6 percent and in 100 percent of the nominal voltage is 3 percent.



To perform this test, first, fields of "State Settings" section are introduced. In "V test", "V actual", "State Time" and "Analog Input" fields, the amount of test voltage, the actual applied voltage, the duration of the test and the input intended for transformer secondary voltage measurement are specified, respectively. It should be mentioned that inputs number 1 to 8 and input10 are used for voltage measurement.

Test	t Object	Seconda	ryBurden
┌ State	Settings:		-
V test:		3	50.00 V
V actu	al:		0.000 V
State	Time:		300.0 ms
Analog	Input:	1	Ý
	Calibration S n't Change t ————		lettings

Don't Change Hardy 6 7 8	V test:	50.00
Analog Input: 1 2 3 4 5 Don't Change Hardu 8	V actual:	0.000
At Calibration State At Calibration State Don't Change Hardy	State Time:	300.0 m
Don't Change Hardy 6 7 8	Analog Input:	1 ,
	At Calibration State Don't Change Hardv Result	6 7

In noisy environments, there is some voltage on the inputs of the device and to increase accuracy, by selecting "At calibration state" option, at the beginning of the test, another state with zero as its value is created and in the end, this measured voltage will be reduced from the final result.

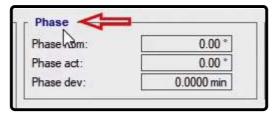
In "Turns Ratio Result", the results of turn ratio test of every core are displayed after performing the test. In "V calc" field, the secondary voltage is calculated by the software in accordance with the values entered in "Test Object" and in "V test" field. In "V meas", "Ratio Nom." and "Ratio Act.", the voltage measured by the input, the nominal turn ratio and the actual turn ratio are calculated by the software, respectively.

V calc.	0.000.11
	0.000 V
V meas.:	0.000 V
Ratio nom:	0.0000
Ratio act:	0.0000
Ratio dev:	0.00 %

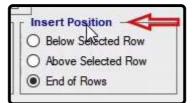
The insertion position of the cores is specified in "Insert Mode" in a way that by selecting "All Core", all cores are added to the "Result" table based on the selection between "Up" or "Down". Also, by selecting "Specific core", a specific core is added to the table in accordance with the choice of the user.

All Core Sort Direction	Up 🗸
O Specific Core CoreNo.	1

In "Phase" section, in "Phase Nom" field, the amount of applied voltage to the CVT and in "Phase Act" the phase difference between the two sides of the transformer are displayed. In "Phase Dev" the deviation of the measured phase in relation to the applied phase is recorded in terms of minutes (one degree equals 60 minutes). Finally, the results of the evaluation are determined in accordance with the type of the core which can be protection, measurement or protection/measurement and also in accordance with what the user selects in "Assessment".



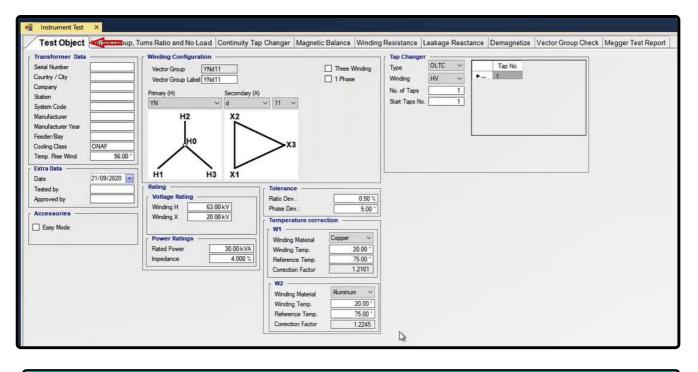
The insertion position of the cores in the table is specified by selecting the options available in "Insert Position". Tables can be added by pressing "Insert Rows" button.



Test	Object	Seconda	aryBurden S	hort-Circuit	impedance	Resistance	Excitation	Ratio	Megger Test	Report					
V test: V actu State T Analog	lime:	1	50.00 V 0.000 V 300.0 ms ✓	Turns Rati V calc.: V meas.: Ratio nom: Ratio act: Ratio dev: Insert Mo () All Core		0.00 0.00 0.00 0.00	0 V 0 V 0 V 00 0 V 0 V Pha Pha Pha Pha Pha Pha Pha Pha	ase ise nom: ise act: ise dev: Position wy Selected Ro		0.00 * 0.00 * 000 min	Assessm Protection Measurin Pro. / M	on ng			
Sec.	nt Change H		Gettings	O Specific		No. 1	_ O Abo	ve Selected R	ow	sert Rows	~				
Sec.	nt Change H		Settings				_ O Abo		ow	sert Rows	\				
Dor	nt Change H	lardware S	V test act				_ O Abo	ve Selected R	ow	Phase act	Phase dev	Pol. Chec	k	Assessmer	nt
Dor	n't Change H	lardware S		O Specific	Core Core	No. 1	O bec O bec O Abo O End	ve Selected R of Rows	ow	3			k •	Assessmer	nt
Dor	n't Change H	lardware S Phase	V test act	O Specific	Core Core V meas.	No. 1	Abo	ve Selected R of Rows Ratio dev	ow In	Phase act	0.0000 min		k •		nt
Dor Result	n't Change H	lardware S Phase	Vtest act 0.000 V	O Specific V calc. 275.0 mV	Core Core V meas. 0.000 V	Ratio nom 181.8182	Ratio act	ve Selected R of Rows Ratio dev 0.00 %	Phase nom	Phase act	0.0000 min 0.0000 min	Not Tested Not Tested	k •	Not Tested	nt
Dor Result	n't Change H	Hardware S Phase A B	V test act 0.000 V 0.000 V	O Specific V calc. 275.0 mV 275.0 mV	Core Core V meas. 0.000 V 0.000 V	Ratio nom 181.8182 181.8182	Abo Abo End	ve Selected Re of Rows Ratio dev 0.00 % 0.00 %	ow In: Phase nom 0.00 ° 0.00 °	Phase act 0.00 ° 0.00 °	0.0000 min 0.0000 min 0.0000 min	Not Tested Not Tested	k • •	Not Tested Not Tested	nt
Dor Result	t Change F	Phase A B C	V test act 0.000 V 0.000 V 0.000 V	V calc. 275.0 mV 275.0 mV 275.0 mV	Core Core V meas. 0.000 V 0.000 V 0.000 V	Ratio nom 181.8182 181.8182 181.8182	Ratio act 0.0000 0.0000 0.0000	ve Selected Re of Rows Ratio dev 0.00 % 0.00 %	ow In: Phase nom 0.00 ° 0.00 °	Phase act 0.00 ° 0.00 ° 0.00 °	0.0000 min 0.0000 min 0.0000 min 0.0000 min	Not Tested Not Tested Not Tested	k + + + + + + + + + + + + + + + + + + +	Not Tested Not Tested Not Tested	nt
Dor Result ▶1 2 3 4 5	t Change F	Phase A B C A	V test act 0.000 V 0.000 V 0.000 V 0.000 V	V calc. 275.0 mV 275.0 mV 275.0 mV 275.0 mV	Core Core V meas. 0.000 V 0.000 V 0.000 V 0.000 V	Ratio nom 181.8182 181.8182 181.8182 181.8182 181.8182	Ratio act 0.0000 0.0000 0.0000 0.0000	ve Selected R of Rows Ratio dev 0.00 % 0.00 % 0.00 %	Phase nom 0.00 ° 0.00 ° 0.00 °	Phase act 0.00 ° 0.00 ° 0.00 °	0.0000 min 0.0000 min 0.0000 min 0.0000 min 0.0000 min	Not Tested Not Tested Not Tested Not Tested	k • • • • •	Not Tested Not Tested Not Tested Not Tested	nt
Dor Result ►1 2 3 4	t Change H Core No. 1 1 1 2 2	Phase A B C A B B B	V test act 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V	O Specific V calc. 275.0 mV 275.0 mV 275.0 mV 275.0 mV 275.0 mV	Core Core V meas. 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V	Ratio nom 181.8182 181.8182 181.8182 181.8182 181.8182 181.8182	Ratio act 0.0000 0.0000 0.0000 0.0000 0.0000	ve Selected R of Rows Ratio dev 0.00 % 0.00 % 0.00 % 0.00 %	Phase nom 0.00 * 0.00 * 0.00 * 0.00 *	Phase act 0.00 ° 0.00 ° 0.00 ° 0.00 ° 0.00 °	0.0000 min 0.0000 min 0.0000 min 0.0000 min 0.0000 min 0.0000 min	Not Tested Not Tested Not Tested Not Tested Not Tested	k • • •	Not Tested Not Tested Not Tested Not Tested Not Tested	nt
Dor Result ►1 2 3 4 5 6	t Change H Core No. 1 1 1 2 2 2	Phase A B C A B C A B C	V test act 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V	V calc. 275.0 mV 275.0 mV 275.0 mV 275.0 mV 275.0 mV 275.0 mV	Core Core V meas. 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V	Ratio nom 181.8182 181.8182 181.8182 181.8182 181.8182 181.8182 181.8182	Ratio act 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	ve Selected R of Rows Ratio dev 0.00 % 0.00 % 0.00 % 0.00 %	Phase nom 0.00 ° 0.00 ° 0.00 ° 0.00 ° 0.00 °	Phase act 0.00 ° 0.00 ° 0.00 ° 0.00 ° 0.00 ° 0.00 °	0.0000 min 0.0000 min 0.0000 min 0.0000 min 0.0000 min 0.0000 min 0.0000 min	Not Tested Not Tested Not Tested Not Tested Not Tested Not Tested	k • • • • • • • •	Not Tested Not Tested Not Tested Not Tested Not Tested Not Tested	nt

136 : INTRODUCING "TRANSFORMER" ROOM

Power transformer tests are performed in "Transformer" room. This room comprises of nine tabs. In "Test Object" tab, information and the nominal characteristics of the transformer are entered from the "Name Plate". In any of the "Vector Group, Turns Ratio and No Load", "Magnetic Balance", "Winding Resistance", "Continuity Tap Changer", "Leakage Reactance" and "Demagnetize" tabs, one of the tests of the transformer are performed. Also, in "Megger Test Report" tab it is possible to enter the insulation resistance test or "Megger". Also, In "Vector Group Check" it is possible to test the transformers vector group independently.



"Test Object" Tab

"Test Object" tab: as mentioned earlier, the nominal characteristics of the transformer being tested are entered in this tab. In "Transformer Data" section, a group of information including serial number, name of the manufacturer and name of the manufacturing country of the transformer as well as the location on which the transformer is used and the type of the cooling system of the transformer are entered. In "Extra Data" section, the date of performing the test in AD, the information regarding the person who is performing the test and the information regarding the supervisor are entered in "Date", "Tested by" and "Approved by" fields respectively.

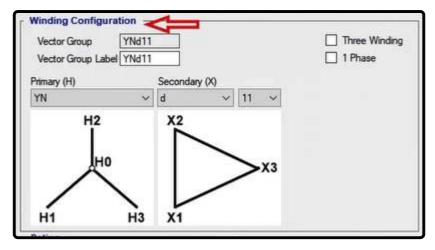
Instrument Test	×
Test Object	Vector Group, T
Transformer Data	
Serial Number	
Country / City	
Company	
Station	
System Code	
Manufacturer	
Manufacturer Year	
Feeder/Bay	
Cooling Class	ONAF
Temp. Rise Wind	56.00 *
Extra Data	21/09/2020 💽

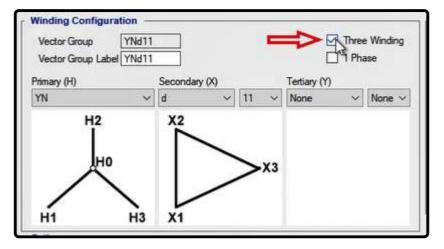
By checking "Easy Mode" option in "Accessories" section, the wiring type of tests changes. This wiring is in accordance with the board which is designed by Vebko Company to test the transformer. This board is located on the front panel of the device and on it there are relays to do the wirings of the front panel of the device automatically which makes performing the test easier.

Approved by



In "Winding Configuration" section, the vector group of the transformer as well as the type of wiring of its two ends are selected. The wiring type of the primary and secondary windings are entered in "Primary (H)" and "Secondary(X)" fields and if there is a third winding, its wiring type is entered in "Tertiary(Y)" field. If the transformer has three windings, by checking "Three Winding" option, the third winding is added while if the transformer is single-phase, "1phase" option should be checked. In "Rating" section, the nominal value of voltages and the apparent power of the transformer are specified. Also, in "Voltage Rating" field, the primary and secondary nominal voltages as well as the third one, in case of its existence, are entered. In "Power Rating" field, the nominal power of the transformer as well as its impedance are entered in the corresponding fields in terms of KVA and percent, respectively.





Winding Configu Vector Group Vector Group Lab	10	_	Three Winding
Primary (H)	Secondary	(X)	13
1	~ I	~ 0 ~	
H10	—∘н0 X1∘—	o X0	

oltage Rating	,
Winding H	63.00 kV
Winding X	20.00 kV

1.40	Rated Power	30.00 kVA
	Impedance	4.000 %

The information regarding the tap changer of the transformer needs to be entered in "Tap Changer" section. The tap changer type is selected from among "OLTC (On-Load Tap Changer)" and "DETC (De-Energized Tap Changer)" in "Type" field. In "Winding" field, it is required to specify that at which side of the transformer winding is the tap changer located. In "No. of Taps" field, the number of taps of the tap changer are entered while in "Start Tap No." it is specified that from what number the transformer taps to begin are. In the next step it is necessary to enter the voltage of every tap which can be done in multiple ways.

nding	Туре	OLTC ~		Tap No.	
, and	Winding	HV v	Þ	1	
		1. W. 201			
	No. of Taps	1			
	Start Taps No.	1			
	L				
	Tap Changer	6			
1910.	Hard Construction	OLTC V		Tap No.	Voltage Value
nding	Туре	ULIC .	1	and the second second second	
iding	Type Winding	HV v	•	1	72.45 kV
nding	Winding	HV ~	2	1 2	72.45 kV 69.30 kV
nding	Winding No. of Taps	HV ~ 7	2	1 2 3	72.45 kV 69.30 kV 66.15 kV
nding	Winding	HV ~ 7	2 3 4	1 2 3 4	72.45 kV 69.30 kV 66.15 kV 63.00 kV
nding	Winding No. of Taps Cart Taps No.	HV ~ 7	2	1 2 3 4 5	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV
nding	Winding No. of Taps Vart Taps No.	HV ~ 7	2 3 4 5	1 2 3 4	72.45 kV 69.30 kV 66.15 kV 63.00 kV
nding	Winding No. of Taps Mart Taps No. Image: First / middl Middle	HV ~ 7 1 le / last	2 3 4 5 6	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
nding	Winding No. of Taps Art Taps No. First / middl Middle First / Seco	HV ~ 7 1 le / last	2 3 4 5 6	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
inding	Winding No. of Taps Mart Taps No. Image: First / middl Middle	HV ~ 7 1 le / last	2 3 4 5 6 7	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
nding	Winding No. of Taps Art Taps No. First / middl Middle First / Seco	HV ~ 7 1 le / last	2 3 4 5 6 7	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
	Winding No. of Taps art Taps No. First / middl Middle First / Seco Custom First Voltage	HV ~ 7 1 le / last and 72.45 k	2 3 4 5 6 7	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
	Winding No. of Taps art Taps No. First / middl Middle First / Seco Custom First Voltage Middle Voltage	HV ~ 7 1 le / last ond 72.45 k 63.00 k	2 3 4 5 6 7	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
	Winding No. of Taps Art Taps No. First / middl Middle First / Seco Custom First Voltage Middle Voltage Last Voltage	HV ~ 7 1 le / last 0nd 72.45 k 63.00 k 53.55 k	2 3 4 5 6 7	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
Ĥ	Winding No. of Taps art Taps No. First / middl Middle First / Seco Custom First Voltage Middle Voltage	HV ~ 7 1 le / last 0nd 72.45 k 63.00 k 53.55 k	2 3 4 5 6 7	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV
inding	Winding No. of Taps Art Taps No. First / middl Middle First / Seco Custom First Voltage Middle Voltage Last Voltage	HV ~ 7 1 le / last 0nd 72.45 k 63.00 k 53.55 k	2 3 4 5 6 7	1 2 3 4 5 6	72.45 kV 69.30 kV 66.15 kV 63.00 kV 59.85 kV 56.70 kV

In the first method if the distance between the taps of the transformer is equal, the first, middle and last voltages are entered in "First Voltage", "Middle Voltage" and "Last Voltage" fields, respectively, so that the software can calculate the voltage in other taps. In some "Name Plates" of transformer, it may happen that only the middle tap voltage and the difference between the tap voltages are mentioned in percentage. In this case, the "Middle" option is selected and the middle tap deviation percentage as well as its voltage are entered in "Deviation" and "Middle Voltage" fields, respectively, and the software calculates the voltage of other taps automatically. If the difference between the taps is equal and voltages of the first and second taps are mentioned on the transformer plate, this option is selected and the voltage of "First Voltage" and "Second Voltage" fields are entered. In all of the mentioned cases the voltage of the taps are calculated and displayed in "Voltage Value" table. If the distance between the taps is not equal or the user wishes to enter the tap voltages manually, "Custom" option can be used. By selecting this option, "Voltage Value" table appears and you can manually enter the voltage for each tap.

e Winding	Туре	OLTC 🗸	-	Tap No.	Voltage Value
ase	Winding	HV V	Þ	1	72.45 KV
ase		1000	2	2	69.30 kV
	No. of Taps	7	3	3	66.15 kV
	Start Taps No.	1	4	4	63.00 kV
		·	5	5	59.85 kV
	First / middle	e / last	6	6	56.70 kV
	O Middle First / Seco Custom		7	7	53.55 KV
	First Voltage	72.45 kV			
	I man ronage				
	Middle Voltage	63.00 kV			
	States and	63.00 kV 53.55 kV			
	Middle Voltage	53.55 kV			
0.50 %	Middle Voltage	53.55 kV			

ree Winding	Tap Changer Type	OLTC	~	<u> </u>	Tap No.	Voltage Value
				Þ	1	70.56 kV
hase	Winding	HV	~		2	68.04 kV
	No. of Taps	8	7	2	3	65.52 kV
	Start Taps No.		1	4	4	63.00 kV
	ciar reporto.	-		4 5 6	5	60.48 kV
	O First / middl	e / last			6	57.96 kV
	Middle			7	7	55.44 kV
0.50 %	First / Seco Custom Deviation Middle Vd sige Tap Control Manual Automatic	6; settings				

Vinding	Туре	OLTC	~	1	Tap No.	Voltage Value
))	Winding	HV	~	Þ	1	72.45 kV
ŧ.				2	2	63.00 kV
	No. of Taps		7	3	3	53.55 kV
	Start Taps No.		1	4	4	44.10 kV
	Contraction (Contraction)			5	5	34.65 kV
	O First / middl	e / last		6	6	25.20 kV
	O Middle			7	7	15.75 kV
	First / Seco Custom First Voltage	7	2.45 kV			
	 Second Voltage 	• 6	3.00 kV			
0.50 %	Tap Control					

ţ	~	Þ	1000		-
				72.45 kV	
		2	2	63.00 kV	
	7	3	3	53.55 kV	
	1	4	4	44.10 kV	
			5	34.65 kV	
ast		6	n n n n n n n n n n n n n n n n n n n		
		1		15.75 KV	Shown Valu
tings					
	last		1 4 5 6 7	1 4 4 5 5 6 6 7 7	1 4 4 44.10 kV 5 5 34.65 kV 6 6 25.2 VV 7 7 15.75 kV

The tap changer type is specified in "Tap Control Setting" section. If you wish to control the taps manually you should select "Manual" option; otherwise, select "Automatic Tap Control" so that the taps are controlled automatically. If "Automatic Tap Control" is selected, "Tap Changing Setting" and "State Termination" sections are displayed. In "Tap Changing Setting" section, the settings related to tap changing is specified. In "Impulse" field the time during which the pulse is sent by the device binary to change the tap is specified. In fact, "Raise" or "Low" command is issued by the device to change the tap for 1 second. In "Time" field the stop time for each tap is specified which is a 10-second delay after the tap change command is issued during which the tap changes. In "State Termination" section, the ending style of every state to inject the voltage to the next tap is specified. If "By Time" is selected, the voltage injected in every tap is specified in accordance with the time selected in "Tap Changing Setting" section and after the time is passed, a pulse is sent to change the tap. By selecting "By Inprogress Contact" and using a contact and connecting it to the binary inputs of the device, by changing the binary input mode, "AMT105" device recognizes the tap change and regardless of the time entered for tap change, a pulse is sent to change the tap. In "No. of Analog Input" field, number of the binary used to detect the tap change is specified while in "Reverse" field, the primary state of the binary input is specified. By selecting "Dry" option, the contact is determined to be of the wet type and its voltage level is entered in front of it. By selecting "Dry" option, the contact is determined to be of the dry type.

IJ	Tap Control settings	
0.50 % 5.00 *	Manual Automatic Tap Control	

Automatic Tap Control Tap Changing setting Time 10.00 s Impulse 1.000 s	State Termination By Time By Inprogress Contact	

Manual			
Automatic	Tap Control		
ap Chang	ing setting	IF State Termination	
lime	10.00 s	O By Time	
Impulse	1.000 s	By Inprogress Conta	
		No. of Analog Input	8 ~
		Reverse	Normal State: 0 🗸
		O Wet	100.0 V
		Dry	

The amount of allowed measurement tolerance to detect "Pass" and "Fail" of the test is entered in "Tolerance" section. In "Ratio dev." Field, the allowed tolerance value for the measured phases is specified in terms of degree. In "Winding Material" field in "Temperature Correction" section, the material used in the windings is selected from among "Copper" and "Aluminum". The current temperature of the winding of the transformer and the reference temperature for measuring the winding resistance are entered in "Winding Temp", "Reference Temp." fields, respectively, so that the resistance values measured are corrected in different temperatures. "Correction Factor" field is related to transformer correction factor (K Factor) and by changing "Winding Material", "Winding Temp." and "Reference Temp." sections, this section changes automatically.

Tolerance —	
Ratio Dev.:	0.50 %
Phase Dev .:	5.00 *

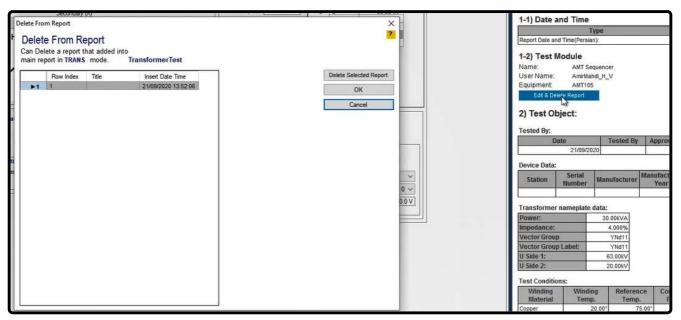
	Temperature corre	
	Winding Material	Copper V
0.00 kVA	Winding Temp.	20.00 *
4.000 %	Reference Temp.	75.00 *
	Correction Factor	1.2161

Also, by pressing "Add to Report" option in the box at the bottom of the screen, this information is added to the output report and a message stating "The Report was added to the list" is displayed. It is possible to view the output report by selecting "Report" window from the box at the right side. By clicking on "Delete Report" option in "Delete from Report" window, it is possible to delete the added report from the "Report" window. If "Set as default" option is selected, the entered values will be saved as default and every time, by opening the "Transformer" room this information is displayed.

ł	ļ	E .			
Add to	Report	Delete Rep	1.00	Set as defa	uit
_	VA3 1/	41 IA2 IA3		2	×
I vel vel	•	e report wa	s adde	d to the li	st.
				OK	

about:blank



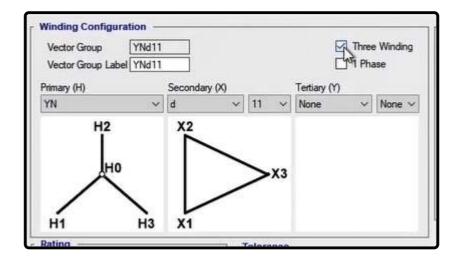


137 : "VECTOR GROUP, TURNS RATIO AND NO LOAD" TAB

In the device and the software provided by Vebko Company, turns ratio, vector group and no load current tests are performed simultaneously. To perform this test, the voltage is applied from high voltage side and the voltage of low voltage side is measured using binary inputs. In measuring the LV side, the voltage and its angle are measured at the same time. Also, to measure no load current, actual current of voltage outputs are used. To perform this test, first, the test method must be selected from among "LL" and "LN" from "Test Setting" section in field "Test Method". In fact these methods determine the type of voltage applied to the primary; in "LL" the voltage applied is three phase while in "LN" the voltage is applied in form of phase to null or coil to coil. Note that in both of these methods, the secondary voltage measurement is done in coil to coil form. In "Direction" section, the direction of the conversion ratio test is specified; the conversion ratio test between primary and secondary while it is "Primary to Tertiary" for a conversion ratio test between primary and tertiary. The test voltage is specified in "VLL" field while its corresponding phase voltage is specified in "VLE" field. In "Stage Time" section, the time of voltage application is specified; this time for "LL" method is the time of test while for "LN" method, this time equals the time of voltage application to each of the coils.

Test Object	ector Group/
Test Setting —	
Test Method:	LN N
Direction	
VLL Test:	20.00 V
VLE Test:	11.55 V
Phase Test:	0.00 °
State Time:	1.000 s
Add to Report:	Just Result 🛛 🗸
Read Input Voltage:	Actual Voltage 🗸

Test Method:	LN ~
rea monor.	
Direction	Prim-Sec ~
VLL Test:	20.00 V
VLE Test:	11.55 V
Phase Test:	0.00 *
State Time:	1.000 s
Add to Report:	Just Result 🛛 🗸
Read Input Voltage:	Actual Voltage 🗸
7.0.00	
] Don't Change Har	rdware Setting



Test Object V	ector Group
Test Setting	
Test Method:	LN ~
Direction	Prim-Sec X
VLL Test:	Prim-Sec
VLE Test:	Prim-Tert
Phase Test:	0.00 *
State Time:	1.000 s
Add to Report:	Just Result 🛛 🗸
Read Input Voltage:	Actual Voltage ~

Test Objec* V	ector Group
Test Setting	
Test Method:	LN ~
Direction	Prim-Sec ~
VLL Test:	20.00 V
VLE Test:	11.55 V
Phase Test:	0.00*
State Time:	1.000 s
Add to Report:	Just Result \sim
Read Input Voltage:	Actual Voltage 🗸

You can see two options of "Just Result" and "All Table" in "Add to Report" drop-down field. By selecting "Just Result", only those parts of the table whose test has been performed are added to the report. But if "All Table" is selected, the whole test table is added to the report.

Test Object	Vector Gr	oup, '	Tur
Test Setting -	12		IT IT
Test Method:	LN	~	
Direction	Prim-Sec	~~	
VLL Test:	20	0.00 V	
VLE Test:	11	1.55 V	T
Phase Test:		0.00 *	V
State Time:	1	000 s	Т
Add to Report:	Just Result	Y	
Read Input Voltag	e: All Table Just Result	45	Т
Don't Change H	Hardware Setting		T

In "Read Input Voltage" field, the measurement method for the actual voltage applied from the device is specified which can be selected from among "Actual Voltage" and "Binary Input" of the device. In "Insert Mode" section, the settings related to inserting the number of "Taps" are adjusted. If you wish to insert all of the taps, you need to select "All Tap" and in "Sort Direction" field, specify that whether the taps are to be inserted from top to down to top by selecting "Up" or "Down". If you wish to test a specific tap, you need to select "Specific Tap" and then enter the number of your intended tap. Also, if you wish to insert a specific number of taps, you need to select "In Range" and then specify your intended range. After specifying the mentioned information, by selecting "Insert Rows", rows are inserted in the test table in accordance with the number of taps of the transformer. If you wish to insert a number of taps in a specific position in the

table, you can use "Insert Position" section. For example, here taps number one and two are inserted above tap number one.

Test Object	Vector Grou	ip, Turns F
Test Setting -		Insert
Test Method:	LN	~ O AI T
Direction	Prim-Sec	v O Spec
VLL Test:	20.0	OV OIn R
VLE Test:	11.5	5V Turns
Phase Test:	0.0	0* Vsec
State Time:	1.00	0s TTR no
Add to Report:	Just Result	✓ V sec
Read Input Voltag	e: Actual Voltage	X TTR
Don't Change H	Actual Voltage lat Binary Input	TTR de

Group, Turns Ratio and No Load Continuity Tap Chan

	r Insert Mode			_	
	All Tap	Sort Direction	Up	~	
~	O Specific Tap	TapNo.	1		
20.00 V	O In Range	[Sen	1		Ta 1
11 55 1/	Turne Datie De	autt (Calasta	-	1/2	stor Crown Boo

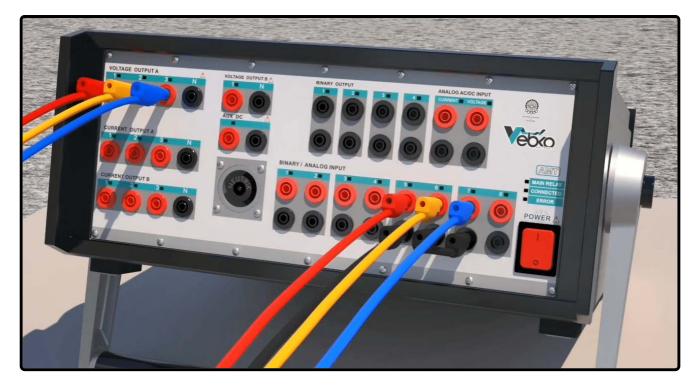
	Direction	Up	~		
O Specific Tap	TapNo.	1			
O In Range	Nom	1		To	1

Performing a test for a transformer with off-load tap changer: to make a test file for a "Dyn11" transformer with three taps and "Offload" tap changer, "LL" should be selected as the "Test Method" and 50 volts line to line should be selected as the test voltage and "Up" should be selected as the "Sort Direction" for the taps. Then, by selecting "Insert Rows", the test table is created. To perform the test, first, you need to adjust the wiring in accordance with the picture. In this wiring, the voltage resources are connected to the primary side of the transformer and to measure the voltage, the secondary of the transformer is connected to the inputs of the device according to the picture. Next, "Apply Test" must be selected after selecting the intended row in the software. Here, all three rows of a "Tap" are selected and then by pressing "Apply Test" the test is performed and the results are recorded. The results of this test are recorded in "I Prim. Meas.", "V Sec. Meas.", "TTR Act.", "TTR Dev.", "Phase Meas." and "Phase Dev." columns respectively. The mentioned parameters stand for no load current, the measured secondary voltage, the measured actual conversion ratio, the diversion of the conversion ratio from the specified value, the measured phase and its diversion from the actual value respectively. After performing the test, the results of the test are assessed in "Assessment" column based on the factors entered in "Tolerance" section. Considering these factors, the maximum allowed conversion ratio fault is 0.5 percent and the maximum allowed phase diversion is 5 degrees; since the conversion ratio fault of phase number two is above the specified amount, the assessment of this row fails and the two other phases pass. It is possible to view the result for any of the phases categorized as "Turn Ratio Result", "Vector Group Result" and "Current" by selecting its corresponding row.

Test Setting -	/ector Group, Tur	ns Ratio and	NO LOAD	Continuity Tap Cr	nan
Test Method:			Direction Up	~	
Direction	The second se	Specific Tap	TapNo: 3		-11
VLL Test:	00.00 +) In Range	From 1	To 2	
VLE Test:	the second	urns Ratio Result	Contract of the local division of the local	Vector Group Re	sult
Phase Test: State Time:	1 000	/sec	0.000 V	V phase nom.	L
		TR nom.	0.0000	V phase act. Phase dev.	-
Add to Report:		sec [0.000 V		
Read Input Voltage		TR [0.0000	Current (Selecte	(b
Don't Change Ha	rdware Setting	TR dev.	0.00 %	I prim.	
Add To Report					XO
				X2	×0 ×1 ×2









	Tap No. Tap	Voltage	Phase	Label	Direction	Test Method	TTR Nom.	Phase Nom.	Vin	V Sec. Calc.	I Prim. Meas.	V Sec. Meas.	TTR Act.	TTR Dev.	Phase Meas.	Phase Dev.	Assessme	nt
	4 + 400		A	A	Prim-Sec *	LL	4.3478	330.00 °	49.60 V	11.50 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 °	0.00 *	Not Tested	
5	Apply Test	-	8	В	Prim-Sec *	LL	4.3478	330.00 °	49.55 V	11.50 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 °	0.00 °	Not Tested	-
	Clear Result	-	C	C	Prim-Sec -	LL	4.3478	330.00 *	49.60 V	11.50 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 *	0.00 *	Not Tested	-
	Cicul Result	-	A	A	Prim-Sec *	LL	3.2609	330.00 °	0.000 V	15.33 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 °	0.00 *	Not Tested	-
	Remove	-	В	В	Prim-Sec *	LL	3.2609	330.00 °	0.000 V	15.33 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 °	0.00 °	Not Tested	•
		-	C	C	Prim-Sec *	LL	3.2609	330.00 °	0.000 V	15.33 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 *	0.00 *	Not Tested	
	Remove All	-	A	A	Prim-Sec *	LL	2.1739	330.00 °	0.000 V	23.00 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 °	0.00 *	Not Tested	*
8	3 * 50	+	В	В	Prim-Sec *	LL	2.1739	330.00 °	0.000 V	23.00 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 °	0.00 °	Not Tested	-
9	3 50	+	C	C	Prim-Sec *	LL	2.1739	330.00 °	0.000 V	23.00 V	0.000 A	0.000 V	0.0000	0.00 %	0.00 *	0.00 °	Not Tested	

Dev.	Assessment					
.50 *	Passed	-				
.53 °	Passed	-				
.53 °	Passed	-				
° 00.	Not Tested	+				
• 00.1	Not Tested					
• 00.	Not Tested	•				
° 00.	Not Tested					
° 00.	Not Tested	٠				
° 00.	Not Tested					

V sec	11.50 V	V phase nom.	330.00
TTR nom.	4.3478	V phase act.	329.47
V sec	11.27 V	Phase dev.	-0.53
TTR	4.3995	Current (Selecte	d) —
TTR dev.	1.19 %	l prim.	101.0 mA

Also in "Plot" section, the results of the test as well as the changes of the parameters measured in different taps are displayed in form of diagrams. In this section, "TTR", "Ratio dev", "V phase", "Phase dev" and "No load Current" diagrams are displayed for every phase and it is possible to remove the diagram by unchecking it.

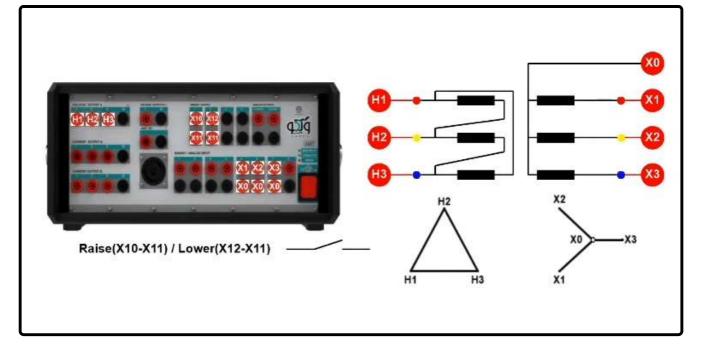
Plate 🔶 Ratio dev 🗹 V phase 🖉 Phase dev 🗹 No load Ourrent		
1	TTR	12.00
016	•	I Phone A I Phone U I Phone C
44	q	
94	ę	
<u>4</u>	Tap changer position	
	Ratio dev	50 C
124	0	V Press 2 V Press 2 V Press 2
12-	o	

Performing the test for a transformer with "On Load" tap changer: There are three methods to perform a test for a transformer with "On Load" tap changer. "Manual" method: in this method, it is possible to select all rows of the table and then "Apply the Test". After the test is finished for every tap, a message stating that "To Continue the Test, Press the Space Button" appears. In this case, you need to change the transformer tap manually and then continue the test by pressing the space button. This procedure continues until the last tap is tested.

vpe	OLTC	~	1	Tap No.	Voltage Value
/inding	HV	~	Þ	1	100.0 V
ning	ΠV	31.6	2	2	75.00 V
o. of Taps		3	3	3	50.00 V
art Taps No.	[1			
First / middl	e / last				
) Middle	o / laoc				
) First / Seco	nd				
) Custom					
st Voltage		100.0 V]		
iddle Voltage		75.00 V			
st Voltage		50.00 V]		
	antting	e	<u>k</u>		
Tap Control	setting				
Tap Control Manual					

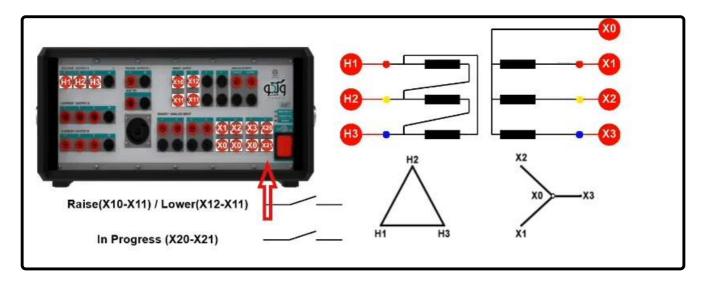
"Automatic Tap Control, By time" method: in this method which has its own wiring, from the "Tap Changer" command panel, you should take two contacts of "Raise" and "Lower" to the binary out of the device in accordance with what can be seen in the wiring so that after testing every "Tap", the command is applied to "Tap Changer" as long as the value specified in "Impulse" field and the "Tap" change operation begins. By applying the "Tap" change command, after the time specified in "Time" field, the next "Tap" test begins. This time is allocated for waiting for the "Tap Changer" to settle on the next "Tap" of the transformer. This procedure continues until the last "Tap" test is performed. In performing this test, just like the "Manual" method, "Apply Test" is selected after selecting all of the rows. After applying, the test begins automatically.

Automatic Tap Exiangi Time Impulse	State Termination State Termination By Time By Inprogress Contact	



"Automatic Tap Control, By Inprogress" method: this method has one more step of wiring than the previous method and in addition to time, it has the condition of contact reception. This means that, from the command panel, two contacts that indicate the state of "Tap Changer" should be brought to the input number 8 of the device so that if the "Tap" change occurs before the specified time, the next "Tap" test begins. In performing this test, like other methods, "Apply Test" is selected after selecting all of the rows. After applying the test, it begins automatically.

) Manual	T C	-	
) Automatic	Tap Control		
Tap Chang	ing setting	State Termination	
Time	10.00 s	O By Time	
Impulse	1.000 s	🛛 🍳 By Inprogress Conta	ict
		No. of Analog Input	8 ~
		Reverse	Normal State: 0 🗸
		◯ Wet	100.0 V
		Dry	



ි Ad	d to Re	port]					
Table	Plot	1						
	Tap	No.	Tap Voltage	Phase	Label	Direction	1	Test Metho
X	1.		100	A	A	Prim-Sec	•	LL
	API	oly T	est .	В	В	Prim-Sec	-	LL
	Cle	ar Re	esult	C	C	Prim-Sec	-	LL
				A	A	Prim-Sec	-	LL
	Ren	nov	e f	В	В	Prim-Sec	÷	LL
				С	C	Prim-Sec	-	LL
10	Ken	nov	e All	A	A	Prim-Sec	٠	LL
8	3	•	50 -	В	В	Prim-Sec		LL
9	3		50 *	С	С	Prim-Sec	•	LL

138 : "MAGNETIC BALANCE" TAB

The transformer magnetic flux test is performed in this tab. In this test, the voltage is applied to a voltage transformer coil and the voltage of other coils is measured and the flux division ratio between the two other coils is analyzed. Two important points for this test are that firstly magnetic balance test is not performed for single-phase transformers and secondly, this test can be performed on three-phase transformers only in the side where there is a grounded neutral.

Test Setting 15:00 V Vik Test, 15:00 V Star Tree 1600 r Defra Viker, Alexan Energy Image: Set	Magnetic Education Result Ville Spectram H1 Ville Spectram 60000 Ville Ville Spectram 00000 Ville Ville Spectram 00000 Ville	None Image: HS Deve. 1+22 1+55 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V 0.000 V	. w2		
Add To Reput Inset Rows	MRZ SI-WAS SI-WAA SI-WAS SI-WAG SI-WAR	ST-WAR ST-WAS ST-VD1 ST-VD2 ST-VD3	S1-VD4 S1-VD5 S1-VD6 S1-VD7 S1-VD0	STARD STACT STACE STACE STACE STACE	SHACE SHACT SHACE SHACE New Two

Flux division test has three steps for every phase. In the first step, voltage is applied to coil #1 and voltages of the two other coils are measured. In the second step the second coil is short circuited and voltage is applied to the coil of phase #1 and voltages of the two ends of the third coil are measured. In the third step, the third coil is short circuited and by applying voltage to phase #1, voltages of the two ends of coil #2 are measured. These steps are repeated for the two other phases. Note that the voltage of the short circuited coil is zero and during all three steps, sum of the measured voltages of the two coils must equal the voltage applied to the first coil.

If "Dev." option is checked, the total difference between the two measured phases and the phase to which the voltage is applied is calculated and is displayed in "Dev%" field in terms of a percentage of the applied voltage. Also, if you wish to measure the voltage that occurs to the secondary side of the transformer during the test, you can use "W2" option. Note that if this option is checked, you need to do another step of wiring.

Voltage Injection	Measuring Volt	tage			
	H1	W1 H2	НЗ	Dev.	□ w2
1. I. I. I.		1.0.00		dev%	
V1= Injection	0.000 V	0.000 V	0.000 V	0.00 %	
V1= Injection , V2 = 0	0.000 V	0.000 V	0.000 V	0.00 %	
V1= Injection , V3 = 0	0.000 V	0.000 V	0.000 V	0.00 %	
V2= Injection	0.000 V	0.000 V	0.000 V	0.00 %	
V2= Injection , V1 = 0	0.000 V	0.000 V	0.000 V	0.00 %	
V2= Injection , V3 = 0	0.000 V	0.000 V	0.000 V	0.00 %	
V3= Injection	0.000 V	0.000 V	0.000 V	0.00 %	
V3= Injection , V2 = 0	0.000 V	0.000 V	0.000 V	0.00 %	
V3= Injection, V1 = 0	0.000 V	0.000 V	0.000 V	0.00 %	

X1 43	X2	X3
0.000 V	0.000 V	0.000 \
0.000 V	V 000.0	0.000 \
0.000 V	0.000 V	0.000 \
0.000 V	0.000 V	0.000 \
0.000 V	0.000 V	0.000 \
0.000 V	0.000 V	0.000 \
0.000 V	0.000 V	0.000
0.000 V	0.000 V	0.000
0.000 V	0.000 V	0.000

|--|

In "Test Setting" section, the settings related to the test is entered. Also, in "VLE Test" and "State Time", the amount of voltage of the test and the test performance time of the test are entered, respectively. In "Display Values" it is specified that the test results are to be displayed as numerical values (in terms of volt) or as a percentage of the voltage of the test. If "Absolute" is selected, the applied voltage and the measured voltages of different taps are displayed in terms of volt while if "Relative" is selected, these voltages are displayed in terms of a percentage of the test voltage.

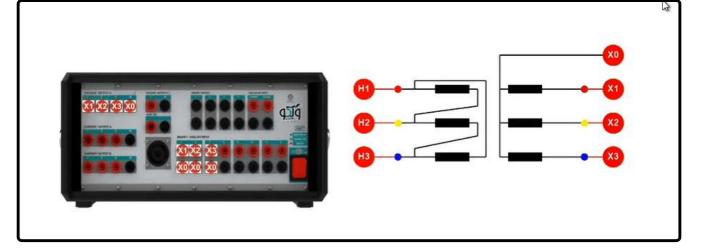
VLE Test:	15	00 V
State Time:	1.0)00 s
Display Values:	Absolute	~
Add To Report:	Just Result	~
Don't change	hardware settings	i.

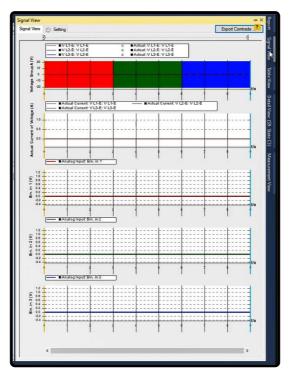
VLE Test:	15.00 V	
State Time:	1.000 s	
Display Values:	Absolute N	
Add To Report:	Relative Absolute	

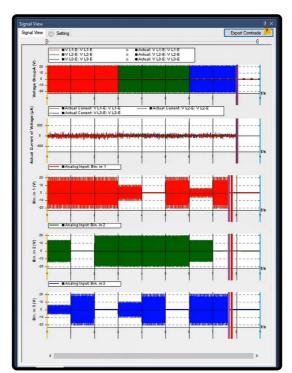
The use of "Insert Mode" and "Insert Position" sections are exactly the same as those explained in conversion ratio test video. In "Magnetic Balance Result", the results of the flux division test are displayed. This section is designed to help better analyze the test results. In this section, the voltage is injected from a phase and the voltage induced to the two ends of the coil is read by the inputs and displayed in this section. By checking "Insert Rows", a row is added to the test table in accordance with the settings adjusted in "Total Result" and all the results of the test are displayed in a row.

	۲	Specific T	ар	TapNo	. 1		
	00	Below Sel Above Sel End of Ro	ected ected ws	I Row d Row			
Ad			LAN.				
	Result -	Tap Volt		Vcal	S1-VA1	S1-VA2	S1-VA3

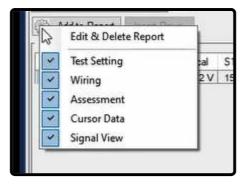
Performing the test and analyzing the results: "15" volts is specified to perform the test and after selecting "Insert Rows" and inserting the transformer "Taps", the wiring needs to be done in accordance with the picture. In this wiring, you only need to connect the voltage outputs of the device to the transformer and the inputs of the device. To measure the voltage, open signal view before beginning the test so that you can view the voltage signal, "Actual Current" and the voltage measured by the binary inputs of the device during the test. By selecting the related row and pressing "Apply Test", the necessary hardware and software changes are applied automatically and the test starts. Note that if "Start Test" option is selected instead of "Apply Test", the test will not begin.







In the end after the test is finished, it is necessary to add the results of the evaluation to the report, which is done by selecting "Add to Report". In addition, if you wish to add specific parts of the evaluation to the report, edit, or delete the report, you can use "Add to Report" cog. By clicking on this cog, you can see that the elements, which can be added to the report, are displayed with a checkmark and it is possible to uncheck any of them that you do not need in your report. Note that after finishing every test, the results are not added to the report automatically and it is a necessity to add the test results to the output report by pressing "Add to Report" before "Clearing the Test" and after performing a test.



In perfuming this test, it is vital to consider some points: the first point is that "Error Other" in performing the test means that there is a problem in connection of the wirings and the null point of the device is connected to its phase. The second point is that if "Error Power" appears during performing a test, it means that too much current is drawn from the voltage phases and you need to decrease the test voltage to resolve this issue.

/LE Test:	15	00 V	<
Rate Time:	1.	000 s	
isplay Values:	Absolute	~	
dd to Report:	Just Result	~	
	Just Hesult Hardware Settino	×	

VLE Test:	15.00 V
State Time:	1.000 s
Display Values:	Absolute ~
Add to Report:	Just Result ~

Voltage Output		r Other	[)	Voltage O	utput Signal —		
\$1507. 60VA @ 400mAms \$1507. 120VA @ 800mAms (A1) \$1507. 120VA @ 800mAms (A2) \$1507. 120VA @ 800mAms (A3) \$120V. 120VA @ 800mAms (A1 A2) \$120V. 120VA @ 400mAms (A1 A2 B1) \$120V. 120VA @ 400mAms (A1 A2 B1) \$120V. 120VA @ 400mAms (A1 A2 B1) \$120V. 120VA @ 400mAms (A2 A3 B1) \$120V. 120VA @ 400mAms (A2 A3 B1)	X1 X2 X3 XN	1:X1 2:X2 3:X3 1.2.3 "4.2.3 1 "1.4.3 2 "1.2.4 3 "1.2.4 4 1.2.3.4	4:Y1	X1 X2 X3 ▶¥1	Output Target Not Used V L2-E V L3-E V L1-E V L1-E	Output Label Not Used V L2-E V L2-E V L3-E V L1-E	Actual Faise True True Faise
Current Output 2x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B3) 2x32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B3) 2x32A, 200VA @ 32A, 5Vms, 5A, 24Vms (A1A3, B1B3) 2x32A, 200VA @ 32A, 5Vms, 5A, 24Vms (A2A3, B2B3) 1x32A, 400VA @ 32A, 12Vms, 5A, 48Vms (A2B2) 1x32A, 400VA @ 32A, 12Vms, 5A, 48Vms (A2B2)				Current O	utput Signal — Output Target	Output Label	Actual
kx224, 400VA @ 32A, 12Vms, 5A, 43Vms (A2B2) kx32A, 400VA @ 32A, 12Vms, 5A, 43Vms (A3B3) kx2A, 400VA @ 32A, 12Vms, 5A, 43Vms (A1B1) kx2A, 400VA @ 32A, 12Vms, 5A, 43Vms (A1B1) kx2A, 400VA @ 32A, 12Vms, 5A, 43Vms (A1B1) kx2A, 400VA @ 32A, 3Vms, 30A, 12Vms							

	Binary-Input Target	Binary-Input Labe	Binary-Input Type	Threshold	Reverse	Show Actual Value	Show Result	Apply VDC	Description		Virtual Binary In
	Set all Binary like this		Wet Max 188 (V)		False	AC	False				VBin 1
-63			Wet Max 188 (V) Wet Max 188 (V)	-	False False	AC AC	False False				- VBin 3
	Cut		Wet Max 100 (V)		raise	AC	raise				-
	Paste			-							
C6	Not Used			-							-
C7	Not Used										
C8	Not Used	1						1			
9	Not Used										
10	Not Used			1							
		_		_				-		, ,	

139 : "WINDING RESISTANCE" TAB

*One of the most common and important tests of transformers is the winding resistance test. In this test the amount of "DC" resistance or "Rmeas" is calculated by dividing the voltage measured through the binary inputs by the injected current. To perform this test, first, you need to specify the primary or secondary side among "HV" and "LV" in "Side" field. Note that, if the transformer has three windings, "TV" is added to the two mentioned options. Then, you need to specify the test time and current in "I Test" and "State Time" fields in "State Setting" section, respectively. Since transformers have a big self-inductance and core, in the beginning of DC injection, there is a huge difference between the actual current and the specified current and after some time, the actual current is equal to the specified time. This time is entered in the "Initiated Time" field. Due to the fluctuation in voltage and DC current during this time, the measured resistance has a lot of fluctuations. Since resistance measurement must happen in a situation with the least voltage and DC current fluctuations, the maximum allowed fluctuations of the impedance and the shortest time during which the measured impedance needs to fluctuate below the "Nominal Stability" value are specified in "Nominal Stability" and "Stabe Time" fields, respectively. The current measurement mode is specified in "Current Measurement Mode" section and if the current is below 0.6 amps, "Analog Input" should be selected while if it is higher than 0.6 amps, "Actual Current" should be selected.

Test Object Test Setting	HV ~ 27.49 mA 10.00 s 50.00 s 7.000 s 1.00 %	Actual Current Measureme Actual Current (Up to Analog Input (Bin09 Voltage Measureme Voltage Measureme Otage Measureme Bin 01	ent Mode: — o 32A) - up to 600 mA)	Insert Mode	Sort Direction TapNo. From ed Row	Up ~	Leakage Rea
Add to Report: Don't Change H Result(Selected	Just Result ~ Hardware Settings () 000 s V DC:	 Bin 01 Bin 10 	Up to 30V Up to 4.5V Up to 200mV 0.000 Ω R co 0.00 % R do	 End of Rows			nsert Rows

Test Object	Vector Group, Tu
Test Setting -	
Side:	HV V
ITest:	27.49 mA
Initiated Time:	10.00 s
State Time:	50.00 s
Stable Time:	7.000 s
Nominal Stability	1.00 %
Add to Report:	Just Result 🗸 🗸

Side:	HV V
ITest:	27.49 mA
Initiated Time:	10.00 s
State Time:	50.00 s
Stable Time:	7.000 s
Nominal Stability	1.00 %
Add to Report:	Just Result V

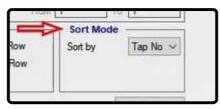
.49 mA 10.00 s	Actual Current (Up Analog Input (Bin0	to 32A) 19 - up to 600 mA	5
50.00 s 7.000 s	Voltage Measuren Voltage Measument	nent Mode: —	Max Resistance
1.00 %	O Bin 01	Up to 48V	R <1.746 kΩ
	O Bin 01	Up to 30V	R <1.091 kΩ
~	Bin 01	Up to 4.5V	R <145.5Ω
as	O Bin 10	Up to 200mV	R<7.275Ω

*The voltage measurement mode is specified in "Voltage Measurement Mode". Since the resistance measurement method divides voltage by the current, voltage Range of the binary inputs affects the measurement accuracy. Therefore, it is necessary to select one of the inputs of this section for measurement based on the winding resistance and the maximum resistance specified to each binary input. If the resistance is bigger than the specified range, the device shows an "Overvoltage" error, in which case, you need to either decrease the current or increase the resistance measurement range. Also, if you are facing an "Error Other" of the current outputs, you need to decrease the current.

Voltage Measurment	Max Voltage	Max Resistance
O Bin 01	Up to 48V	R <1.746 kΩ
O Bin 01	Up to 30V	R <1.091 kΩ
Bin 01	Up to 4.5V	R <145.5Ω
O Bin 10	Up to 200mV	R <7.275Ω

Side:	HV ~	Current
ITest:	27.49 mA	Actua
Initiated Time:	10.00 s	Analo
State Time:	50.00 s	Voltage
Stable Time:	7.000 s	Voltage M
Nominal Stability	1.00 %	
Add to Report:	Just Result 🗸 🗸	 Bin 0 Bin 0
Don't Change H	Hardware Settings	O Bin 1

*The order and the position of the "Taps" of the transformers are specified in "Insert Mode" and "Insert Position" section. The mentioned section has already been explained in the video related to the test. Another one of the most important options of the software, which helps a lot in accelerating the test, is "Sort Mode". Generally, for tap changer transformers it is suggested that this option is set at "Phase"; by doing so, it is possible to test all taps of a phase and then go to the next phase. But if "Tap No." is selected, first you need to measure the resistance of all three phases and then change the tap. For example, suppose that your transformer has 21 taps. By setting "Sort Mode" at Phase and selecting "Insert Rows" you can see that the rows are arranged according to the selected phase which helps a lot to increase the speed of the test. After creating the table, you need to select the intended row and then adjust the wiring according to the guide picture and then run the test by pressing "Apply Test".



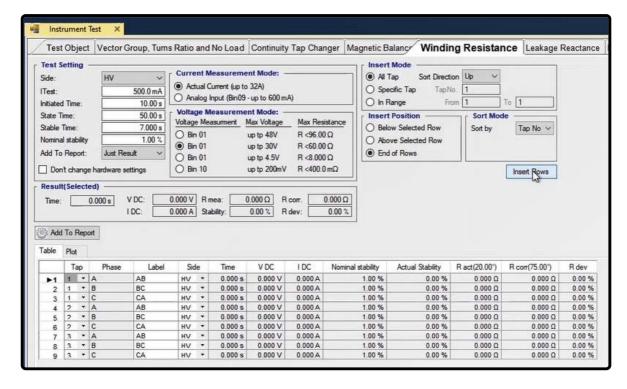
ble	Plot												
	Ta	p	Phase	Label	Side	Time	V DC	I DC	Nominal Stability	Actual Stability	R act(20.00")	R corr(75.00°)	R dev
▶1	1.	*	A	A	HV *	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
2	2	*	A	A	HV *	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	Ω 000.0	Ω 000.0	0.00 %
3	3	٠	A	A	HV 🕶	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
4	4	•	A	A	HV -	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	Ω 000.0	Ω 000.0	0.00 %
5	5	*	A	A	HV 🔻	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
6	6	•	A	A	HV 🔻	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
7	7	•	A		HV *	0.000 s	V 000.0	A 000.0	1.00 %	0.00 %	0.000 Ω	Ω 000.0	0.00 %
8	8	*	A	A	HV •	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
9	9	*	А	A	HV .	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
10	10	•	А	A	HV T	0.000 s	0.000 V	A.000.0	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
11	11	*	A	A	HV ·	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
12	12	*	A	A	HV ·	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
13	13	*	A	A	HV	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	Ω 000.0	0.00 %
14	14	*	A	A	- 2	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
15	15	*	A	A	HV +	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
16	16	٠	A	A	HV *	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
17	17	٠	A	A	HV *	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
18	18	-	A	A	HV *	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
19	19	*	A	A	HV ·	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
20	20	*	A	A	HV ·	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
21	21		A	A	HV ·	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
22	21	+	8	В	HV T	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
23	20	•	В	B	HV -	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	Ω 000.0	0.00 %
24	19	*	В	В	HV ·	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
25	18		8	B	HV ×	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
26	17	•	в	B	HV ·	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	Ω 000.0	Ω 000.0	0.00 %
27	16		в	B	HV *	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
28	15	•	В	B	HV ·	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
29	14	*	В	B	HV ·	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	Ω 000.0	0.00 %
30	13	*	В	B	HV *	0.000 s	V 000.0	A 000.0	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
31	12	٠	в	В	HV .	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00 %
32	11	*	В	В	HV *	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00 %
32	10	*	B	B	HV Y	0.000 s	0 000 V	A 000 0	1 00 %	0.00.%	0 000 0	0 000 0	0 00 %

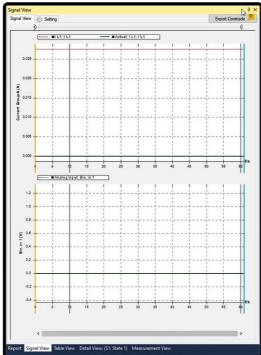
Running the Test and Analyzing the Results

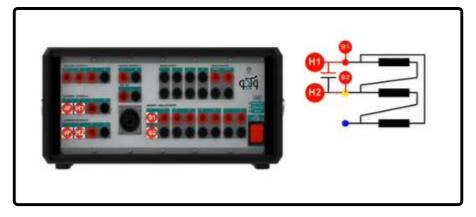
*To perform this test, for example, the "HV" side with three "Offload" taps and 0.5 amps of current is tested for all three taps. The settings related to time is left at its default and "Sort by" is set at "Phase" and then by pressing "Insert Rows", the test table is created. The "Signal View" window is opened so that it is possible to view the current changes of the read voltage. To perform the test, the first row is selected, the wiring is adjusted in accordance with the guide picture. Then the first row is selected and test runs by pressing "Apply Test". By running the test, the changes of the measured voltage as well as the injected current can be viewed. You can see that by changing the voltage and the current, the value of "Stability" changes as well and the test goes on until these changes reach below 1 percent. After the time test is finished, the actual voltage and current, "Stability" and the measured and corrected resistance (according to the reference temperature) are inserted in "Test Object". To continue the test, two other rows are selected and the test is applied. Then, the wiring is adjusted for the next phase according to the guide picture and three rows are selected and the test is applied.

After the test is finished, in "Plot" tab, the curve resistance change in different "Taps" and phases can be viewed. In the end, by pressing "Add to Report", the results are added to the report.

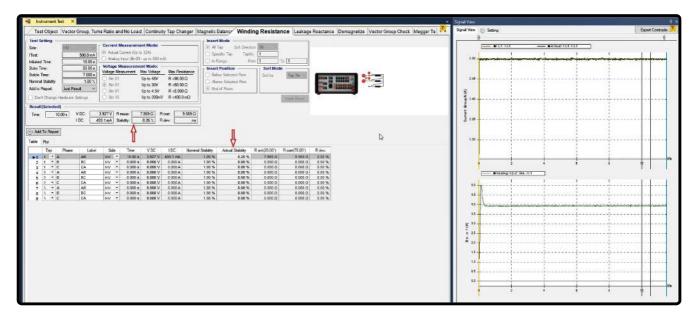
Side:	HV ~
Test:	500.0 m.A
nitiated Time:	10.00 s
State Time:	50.00 s
Stable Time:	7.000 s
Nominal stability	1.00 %
Add To Report:	Just Result ~



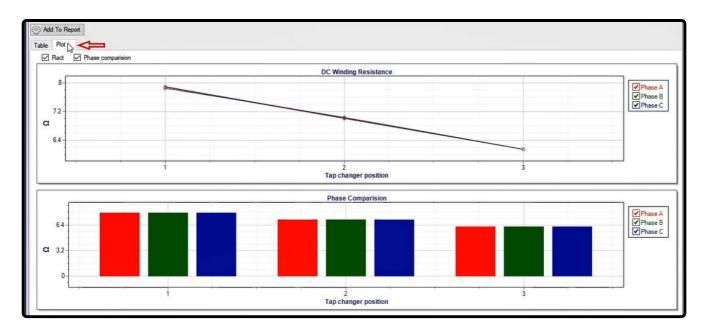


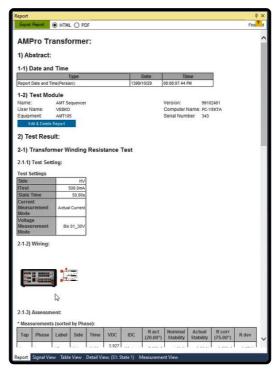


able	Plot											
	Tap Phase	Label	Sid	e	Time	V DC	I DC	Nominal Stability	Actual Stability	R act(20.00*)	R corr(75.00°)	R dev
-1	1 7 A	AB	HV	-	0.000 s	V 000.0	A 000.0	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00
	Apply Test	IC	HV	-	0.000 s	V 000.0	0.000 A	1.00 %	0.00 %	Ω 000.0	Ω 000.0	0.00
		A	HV	-	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00
	Clear Result	B	HV		0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	Ω 000.0	0.000 Ω	0.00
	Demonstra	IC IC	HV	-	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00
	Remove	A	HV	-	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	Ω 000.0	0.00
	Remove All	B	HV	-	0.000 s	V 000.0	A 000.0	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00
8	3 * 18	BC.	HV	*	0.000 s	0.000 V	A 000.0	1.00 %	0.00 %	0.000 Q	0.000 Ω	0.00
9	3 * C	CA	HV	-	0.000 s	0.000 V	0.000 A	1.00 %	0.00 %	0.000 Ω	0.000 Ω	0.00









**Some Points about Winding Resistance Test

*Since these transformers have a huge self-inductance, injecting "DC" current causes huge voltage "Spikes" and the more the injected current, the bigger the created voltage. This voltage causes two problems: the first problem is "Error Overvoltage" of the inputs of the device; as you know, if the voltage of the input is more than 0.1 second bigger than the value specified for it, the device displays an error. Therefore, if the caused voltage "Spikes" have too long durations, the device may display an error. Another problem is the voltage that occurs to the "Mosfets" of the device. In case of injecting too big currents, this voltage damages the device. Therefore, we suggest to consider these points while injecting the current.

140 : "LEAKAGE REACTANCE" TAB

This tab is used to calculate the transformer leakage reactance value. In fact, the short circuit voltage is the voltage applied to the primary coil while the secondary coil is short-circuited. In the short circuit voltage, the nominal current is established on both sides of the transformer. The active power absorbed in the short circuit voltage is the same as the transformer losses. The purpose of obtaining the value of the short circuit voltage is to calculate the transformer losses. As the load current increases, the short circuit voltage increases linearly. The short circuit voltage is obtained using the following equation.

$$U_{cc} = U_{ccm} * \frac{I_r}{I_m}$$

In this formula, U_{cc} , U_{ccm} , I_r , and I_m are the values of the short circuit voltage in the I_r nominal current, the value of the short circuit voltage in the Im measuring current, the nominal current and the measured current, respectively. Now, to calculate UK%, the short circuit voltage calculated in the above formula is used in the following equations.

$$U_{cc} = \sqrt{U_X^2 + U_R^2} \quad \rightarrow \quad \varepsilon_{ccm} = \frac{U_{cc}}{U_r} * 100$$

In the above equation, U_r is the transformer nominal voltage while ε_{ccm} =UK%.

It is necessary to observe some points in this test. To short circuit the secondary side, the cable size is calculated. Cable size or short circuit busbar on the secondary side are obtained using an example. Suppose There is a transformer with 7.5 MVA of nominal power, 33 to 11 KV conversion ratio with Dyn11 vector group and a %10 short-circuit voltage. The primary and secondary nominal current equal 131 Amp and 393 Amp, respectively. The CT turns ratio equals 800 to 5 amp on the secondary side and 150 to 50 amp on the primary side. Considering the conversion ratio on the primary side, the UK% value of the transformer equals 10 percent. Therefore, the short-circuit voltage is obtained to be 3300 volts which means that if 3300 volts are applied to the primary of the transformer. Assuming a 400 volts of voltage being applied to the primary of the passing currents, the primary and secondary are obtained using the following equation.

$$I_{1cc} = 131 * \frac{400}{3300} = 15.87^{A}$$
$$I_{2cc} = 393 * \frac{400}{3300} = 47.63^{A}$$

Taking into account the current value obtained in the secondary side, the cable cross section is selected in accordance with the passing of this current.

If CT is present in the transformer, to avoid CT excitation, the secondary terminals are short-circuited. Also, this test is performed in the nominal tap and then the highest and lowest taps. It should be noted that to avoid sudden increase of the current during the test, the voltage is increased gradually. To do so, first, a "Continuous Ramp" state is created to avoid inrush current in the transformer. The measurement current must not be smaller than the nominal current but if this is not feasible, according to the IEEE Std C57.152[™]-2013 (Revision of IEEE Std 62TM-1995), as much as 50 percent of the nominal current can be used instead.

It should only be noted that if the secondary winding of a transformer is yn, the secondary neutral should not be connected to the other phases.

In "State Settings", the test voltage value and the test time are specified.

If the transformer has several taps, "Insert Mode' you can specify in which taps and in what order to add them to the test table.

In "All Tap", you can specify how the taps are arranged, from top to bottom or from bottom to top. In "Specific Tap", you can select a specific tap; And in "In Range", you can specify from one tap to a specific tap.

"Insert Position" also specifies where the newly added test row should be above the selected row, below it, or after the last row.

After performing the wiring shown in the figure, by clicking on "Insert Rows" for each phase, a new row is added, in front of each of which, the name of the phase and Uk and the nominal power of the transformer are written. These values come from the "Test Object" tab in "Power Ratings" section by default, but they can also be changed from inside the table.

After performing the test, by clicking on the row of each phase, either in "Result (Selected)" section or inside the same row, the test results are displayed.

In the fields "Iact", "V meas" and "V phase" the amount of current drawn from the specified voltage phases, the actual value of the injected voltage and the injection voltage phase is specified, respectively.

The short-circuit voltage and its deviation from the specified value which are displayed on the transformer plate are also specified in "Uk calc" and "Uk dev" fields.

To execute this test, a transformer with Dyn11 vector group and a UK%=3.3% is used. First, the values are entered in Test Object and after configuring the wiring, by right-clicking on the table and clicking on Apply Test the test is executed and the test results for each phase can be viewed. Also, the waveform of the voltage injection and the current drawn from the transformer is displayed in Signal View.

141 : "DEMAGNITIZE" TAB

To eliminate the residual flux of a transformer, the demagnetize tab is used. For example, after executing a DC resistance test, it is generated in the transformer. Demagnetizing is done in such a way that a DC current is injected in steps and decrements in direct and reverse directions to each phase of the transformer.

M 🚽 1/16	► H					-		
🖷 Instrument Te	est X							
Test Object	Vector Group, Turns Ratio and No Load	Continuity Tap Changer	Magnetic Balance	Winding Resistance	Leakage Reactance	Demagnetize	Vector Group Check	Megger Test I
State Settings: I Test Test Method: Side: Phase: State Time: Don't Change I	5000 A ThreePhase ~ HV ~ A 20.00 s							

The amount of injection current is entered in "I Test" field.

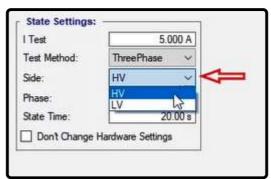
I Test	5.0	00 A
Test Method:	ThreePhase	~
Side:	HV	~
Phase:	A	
State Time:	20	.00 s
Don't Change	Hardware Settings	i.

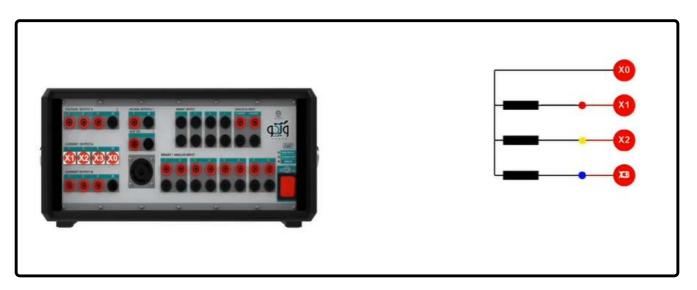
In "Test Method", the test method is determined as single-phase or three-phase. By changing this section, the wiring changes as shown on the right of the page.

l Test	5.000 A
Test Method:	ThreePhase 🗸
Side:	SinglePhase ThreePhase
Phase:	A
State Time:	20.00 s



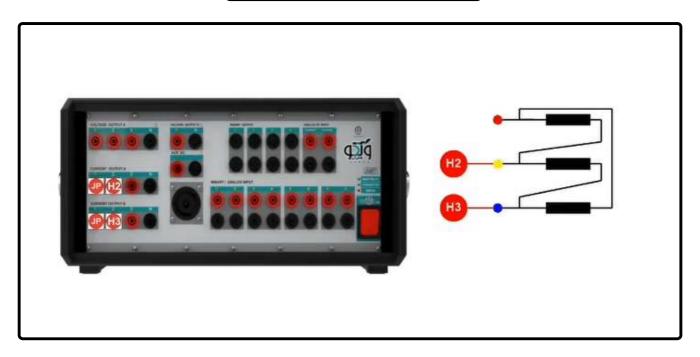
It's specified in "Side" field to perform the test on the transformer. By changing this section, the wiring changes as shown on the right.





In "Phase", each of the phases A, B and C can be specified for testing. By changing this section, the wiring changes as shown on the right of the page.

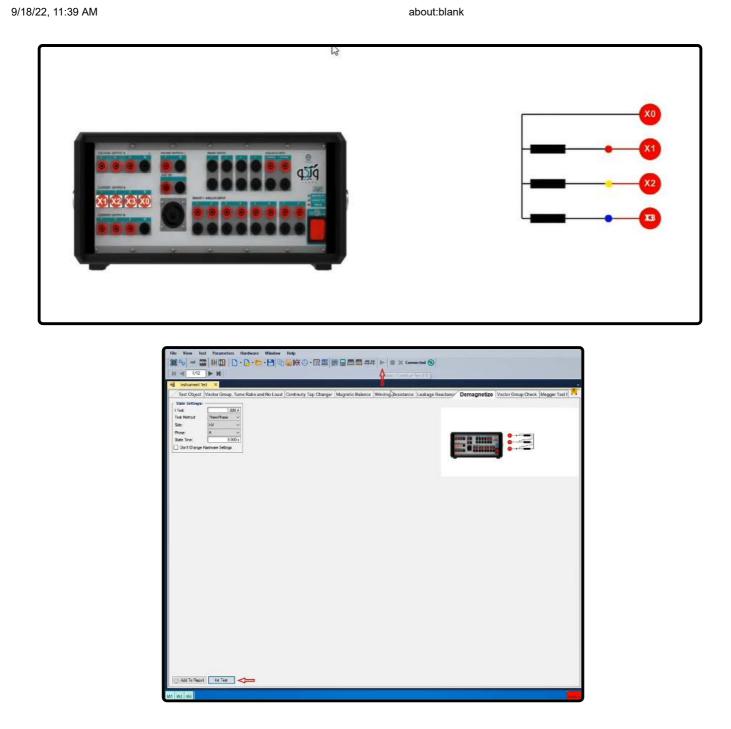
l Test	5.0	00 A	
lest Method:	SinglePhase	~	
Side:	HV	~	
Phase:	A	~	
State Time: Don't Change	A B HaC	à	



In "State Time", the time of each state to change the current is specified.

l Test	5.0	A 00
Test Method:	ThreePhase	~
Side:	HV	~
Phase:	A	N.
State Time:	20	.00 s 🧲
Don't Change	Hardware Settings	

After configuring the wiring in accordance with the picture, to execute the test, first press "Init Test" button, then run the test. In "Signal View", the injected current and the actual current value are displayed; this current value turns zero as soon as the demagnetization is completed.



142 : OVERCURRENT QUICK TEST ROOM

On the Start page of the software, by clicking on "Overcurrent Quick Test" from "Special Test" subcategory, enter an environment that is used for overcurrent quick test.

Generally, in this room it is possible to test the overcurrent elements in the shortest time possible by entering the essential settings yet this section is exclusively used to test relays that need a high burden such as electromechanical and disc relays whose pickup and drop-off is measured in accordance with the disc movement. wiring for this test can be viewed on the right side of the page.

By default, it is possible to access "Report", Signal View", "Detail View" and "Measurement View" windows from the bar on the right side of the room; also, if necessary, it is possible to access the other windows by using the main menu of the software.

After specifying the phase in "Inputs" section, the amount of the current setting and the time are entered and the performance curve type is specified. Here CDG11 relay of GEC brand with 0.1 amp as the setting, 0.2 as the performance time and normal inverse as the time characteristic is being tested. If the "Instantaneous" unit of the relay is active, it is necessary to enter its amount of the current setting and performance time in Ins section. In ΔI it is possible to enter the start value of the injected current as well as the increase or decrease step of the current for Pickup and Drop-off tests. In this test, 95 milliamperes is specified as the start value for the injected current and 1 milliampere is entered as the increase step of the injection current.

The reason behind designing this room is enabling the users to use shortcuts to manage and enhance test speed.

By opening the Table View window, it is possible to view the created states. It should be noted that it is possible to adjust the change step of the current using – or + keys during the test. If the Up arrow key is pressed, the amount of the injected current increases in accordance with the specified step. By pressing $ctrl+\uparrow$ combination key, it is possible to reset the amount of the injected current. In the end, by pressing Enter key, the obtained values are saved.

Now view the actual value of the injected current in "Actual Current" section. Also, in the result section, pickup and drop-off current values, tripping time in 2 and 4 times the pickup current and the instantaneous performance time along with the error value are recorded.

Finally, after doing the test, it is necessary to add the results of the evaluation to the report which is done by selecting "Add to Report". Also, if you wish to add specific parts of the evaluation to the report or delete or edit the report, you need to use "Add to Report" cog. By clicking on this cog, the items that can be added to the "Report" are displayed as checked checkboxes and if you wish any of them not to be added to the report, simply uncheck the intended checkbox. It should be noted that after doing the tests, the results are not automatically added to the report and after doing every test, it is necessary to manually add the results of the performed test to the report by pressing "Add to Report" before Clearing the test.

143 : UNDER OVER VOLTAGE TEST ROOM

On the start page of the software, by clicking on "Under Over Voltage Test" from "Special Test" subcategory, enter the environment related to testing numbers 27 and 59 voltage functions. This room is designed to simplify testing the mentioned functions and create various states automatically.

"Under Over Voltage Test" room is composed of six main windows of "Instrument Test", "Detail View", "Signal View", "Table View", Report" and "Measurement View" and for a better analysis and examination, it is possible to add other windows such as "Vector View" from the menu at the top.

To begin, different information such as relay type, serial number, station name, feeder/be number and the name of the device manufacturer must be entered in "Test Object" section. The date of performing the test in AD, the information of the performer of the test and the information of the supervisor of the test are entered in "Date", "Tested by" and "Approved by" fields, respectively. This information will be used in the final report.

In ,Test Settings" section, the intended function is selected from among "OV" and "UV" in "Function Type" field. Also, the secondary nominal voltage and the operation mode are selected from among OR and AND in "Vnom sec" and "Operation mode" fields, respectively. If the mentioned functions need a current value to operate, such as "Minimum Current" element, it is possible to check "Enable Current" option and select the necessary current value. If the intended connection of the user is open delta connection, they can check "Open Delta" option.

Every time "Insert Row" is pressed a row in "Data Table" is created in accordance with the number of voltage stages entered in the relay to enter the information of every Stage. In the created row, the stage number is entered in "Stage No" and in "V setting" section, the amount of the voltage setting for the mentioned functions is entered. In "Voltage Type" section, the voltage calculation algorithm is specified which can be in form of phase to earth or phase to phase. Also, the time settings are entered in "Time Setting" section. "Reset Ratio" is the reference considered for measuring the amount of reset voltage, "Tol.Time" is the amount of the accepted time error in form of percentage and "Tol.Voltage" determines the amount of the accepted voltage error in the result of the test.

The settings related to "States", "Binaries", Pickup" and "Dropoff" are entered in "Testing" tab. Also, it is possible to specify the voltage change condition from among "Continuous Ramp" and "Step Ramp" in "State Type" section.

In "State Pickup/Drop Out Termination" section, the condition for ending the pickup and dropoff is selected in form of a separate contact such as C2 or pressing Space key (at the same time as the LED turns on) or the Trip contact. The

conditions for recording the Trip is specified in "State Trip Termination" section. Also, it is possible to consider a different binary input for recording pickup-dropoff or trip in "Hardware Configuration" section.

By pressing "Add Row" key in "Test Plan" section, new rows are added for the test in accordance with the stages created in "Test Object". If "Continous Ramp" option is checked in "State Type" section, the settings are as follows:

In "Stage No" section, it is possible to specify the stage number of the function operation. In "Fault Type" section, the fault type for every phase or a combination of phases is selected. In "Time Test" section, it is specified that whether the user wishes the voltage function operation time to be estimated or not. In "Vtest" section, the voltage in which the relay operation time is going to be examined is entered. In "PU Test" and " DOU Test" sections it is specified that whether the user wishes to perform these two tests or not.

In "PU Val. Assess" section, the evaluated value from the pickup voltage is entered and in "PU Start" section, the start point of the voltage test is specified. "PU End" and "DOU End" stand for the final voltage value in the pickup and dropoff, respectively. In "Total" section, the time duration considered for every pickup or out dropoff state is entered. The longer this time, the more continuos paces.

If "Step Ramp" option is selected in "State Type" section, instead of "Total" column, "dt (PU)" which is the time duration considered for every voltage change pace in pickup states, "du(DOU)" which is the time duration considered for every voltage change pace in dropoff states and "dv" which is the amount of the voltage change paces are specified.

After entering the mentioned values, by clicking on "Init Test", the user can view the states that are created in "Table View", and in "Measurement View", in "Time Assessmet" and "Ramp Assessment" windows, see that the values are entered as the test result evaluation. It should be noted that by selecting any State and pressing the middle button of the mouse, the user can view the details related to that state.

Running the test and analyzing the results

As an example, here an overvoltage function with 76 volts as the setting, and 4 seconds as the time setting in Micom P141 relay is tested. After applying the necessary settings in the relay, the configuration is specified as it can be seen. For this purpose, LEDs 1 and 4 of the relay are configured to show the pickup and the trip of this function, respectively. In the output contacts section, R4 is specified as the contact for recording the pickup. Moreover, R6 output contact in the relay is configured as a trip contact.

To run the test, by opening a new window in "Over/Unver Voltage" room and after entering the primary information such as the relay type, serial number, station name, feeder/be name and the manufacturer company, as an example, function OV is selected and the secondary voltage is set at 110 volts and OR is selected as the operation mode so that the results are recorded with pickup or trip of any of the phases. Since here there is no need for current injection, Enable Current option is not enabled. Also, since here open delta connection is not the case, Open Delta option is not selected either. In Data Table, stage 1 is selected and the voltage setting is set at 76 volts (the value specified in the relay) and LN is selected in Voltage Type section. The time setting of the relay is 4 seconds which is entered in Time Setting section.

Now by going to the State Setting in Testing section, Continuous Ramp option is selected. Here binary C2 and C1 are selected to record the pickup and drop and record the trip, respectively. Since the purpose of the overvoltage element test is to test all three phases, Fault Type option is set at L1E L2E L3E. 80 volts is entered In Vtest section which is bigger than the voltage specified in the relay settings and the relay must give a trip in this voltage. Also, by selecting Yes in "PU Test" and "DOU Test" section, pickup test and drop out will be done. In PU Val.Assess section, the approximate estimation of the value expected for the pickup which is 75.5 is entered. The test voltage start value and the final voltage value for the pickup test are specified in PU Start and PU End sections, respectively. DOU End is the final voltage value for ending the dropout test. The total time is entered in Total section.

Now Init test button is pressed so that the states are created in "Table View" in accordance with the entered information. After running the test, the results of the evaluation can be viewed in "Measurement View" window, "Time Assessment" and "Ramp Assessment" tabs.

In the end, after runing the test it is necessary to add the results to the report which is done by pressing "Add to Report". Also, if you wish to add specific parts of the test to the report or delete or edit the report, you need to use "Add to Report" cog. By clicking on this cog, the items that can be added to the "Report" are displayed as checked checkboxes and if you wish any of them not to be added to the report, uncheck the intended checkbox. It should be noted that after doing the tests, the results are not automatically added to the report and after doing every test, it is necessary to manually add the results of the performed test to the output report by pressing "Add to Report" before Clearing the test.

144 : AMT AR ROOM

Various studies have shown that around 70 to 90 percent of the faults in overhead power lines are transient. At lower-level voltages such as distribution, there are fewer and about 80 percent transient faults while in higher-level voltages such as transmission, this value is about 90 percent.

Thunder is one of the most common reasons for a fault to occur. The swinging of the wires or short-circuit of the grid with sundry objects is another cause for the occurrence of transient faults. Most faults can be solved by correctly using the trip process or reconnection so that the grid disconnection time reaches a minimum. To test any type of reclosers, its exclusive room which is AMT AR can be used.

The main window of this room is Instrument AR. Also, it is possible to access other windows from the View menu or the bar on the right side of this page. To begin the test, first, the user needs to insert the functions that need the reconnection process to be examined for them into the Data Table. Therefore, it is possible to examine and assess the action or inaction of the AR for different functions. By clicking on "Add Cycle", the next rows are added so that the reconnection is examined after the selected functions. After selecting the title of the function, the user only needs to enter the performance characteristic and its settings for the delay and instantaneous units. After that, the amount of the injected current and the fault angle are entered so that the time duration for different states is determined in accordance with the selected Curve. Dead Time and Reclaim Time are two other options that are used to speed up making the states. Finally, in the Expected section, the user needs to specify their expectation from the success or failure of the recloser after the action of the specified function.

In the next step, the user needs to specify the necessary Binary Inputs and Binary Outputs in accordance with the elements required for the recloser test. It should be noted that for the convenience of the users, the important signals are available in the drop-down list by default. In this section, by selecting Add Row and Delete Row options, it is possible to add a row to add the binaries and delete the selected row, respectively. Considering the two types of the reclose test including laboratory

testing (simulation of the binary of the outputs by the test device and receiving the binaries by the device) and testing in

power stations (receiving binary of the inputs by the device and presence of the binary outputs through the wiring post), some of the titles are common between the two lists of inputs and outputs.

After selecting the number of the binary input and signal, it is possible to specify its influence on the current states including PreFault, Fault, Deadtime and Reclaim time. In other words, the condition for ending every state is determined by the binary inputs.

In the next step, after selecting the number of the binary output and its signal, the user only needs to specify its condition for every state. This is most useful in cases where, for example, signals such as CB Ready or Close and Open are needed and testing the relay in the laboratory is intended. After adjusting the settings, by clicking on Init Test option, the states are created. These states can be viewed from Table View section. Also, it is possible to compare the different settings and elements of every state with more details in Detail View section.

In this video, the AR function test for the MiCOM P139 relay is going to be performed. In this test, the recloser function is activated after the occurrence of the earth fault. To begin, the user needs to go to the settings section of the relay and set the parameters related to the functions. Here, in the subcategory number one of parameters, function DTOC is assigned to SEF protection. In IDMT1 section, the protections of OC and EF are of the delay type while in IDMT2 section, the protections of OC and EF are set at the instantaneous type. Now, by going to the ARC section, the settings related to the auto-recloser are adjusted. Here, the TDR option refers to recloser with time delay; Dead Time and Reclaim Time are set at 4 and 20 seconds, respectively, but it is also possible to activate the HSR which is the high-speed recloser.

Next, the outputs are configured. Moreover, in INP section, the inputs needed for the assessment and the test are configured. By referring to the relay manual, it is possible to view an outline of the behavior of the P131 recloser function.

In certain situations such as cases where there is a manual close, external signal, ARC function deactivation, and manual trip and protection deactivation, the recloser will be blocked. It is possible for the user to examine these signals in the AR room of the AMPro software. The user can begin the test after ensuring that the necessary conditions for the recloser to perform are met; these conditions include activating the protection, not blocking the ARC function, and being able to open and close the breaker and have the close state of the key. To adjust the relay wiring, the user can use the connection diagram from the manual.

The user needs to go to the AMT AR room one more time and add the two functions of earth fault and overcurrent. It should be noted that in the first step, reconnection is tested for the earth fault function. This step must be passed successfully and receiving the close signal or the connection needs to happen as well. After specifying the settings related to this function in the first row, single-phase fault to earth is selected and Dead Time and Reclaim Time values are entered. Also, in the Expected section, the expectation from the act of reconnection is set at successful. In the next row, OC function is added. Similarly, the settings related to the delay and instantaneous stages as well as the fault current value, fault type, Deadtime value and Reclaim Time value are entered. In this section, we expect the act of reconnection to be unsuccessful.

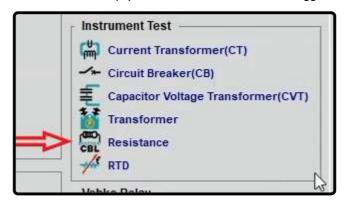
Now it is time to configure the input binaries. In this section, connection trip and pulse are selected from the list in this exact order. Here, trip is selected as the finisher element for the Fault state. It is also possible to select Close Pulse or Reclosure Successful as the finisher element for the Deadtime state. This should be noted that the "PreFault" state time is automatically longer than the "Reset Time" or "Reclaim Time".

In the binary outputs section, three signals of CB Close, CB Open and CB Healthy or AR Ready are added. Here it is possible to specify the status of every signal for different states ranging from "PreFault" to "Fault", Dead Time", and "Reclaim Time".

Finally, the "States" are created by clicking on "Init Test" option. The user can view the created states by opening the Table View window. After creating the states, it is possible to adjust the necessary settings for the assessment in the "Assessment" section. Also, after performing the test, it is possible to assess the performance of the recloser for these two functions. In the end, by clicking on "Add to Report" option, the test result is added to the created report.

145 : RESISTANCE TEST

By clicking on "Resistance" on the "Start" page of the software, ohm resistance test room opens. In this room it is possible to measure ohm resistance of various equipment in the "Resistance Test" tab. "Test Object" and "Megger Test Report" tabs are used to enter the nominal information of the equipment and the results of the "Megger" test, respectively.



Test Object Resis	tance Test	Megger Test Report	
Resistance data —			
lame of Device:		Company:	
Serial Number:		Country:	
Nanufacturer:		Station:	
ype:			
Resistance		Extra Data	
Resistance	20.0	00 * Date:	01/02/2021
		00 * Date:	01/02/2021
Ambient Temperature		00* Date: 000 Tested by:	01/02/2021
Ambient Temperature Temperature Correction Facto	or 1.00	00* Date: 000 Tested by: mΩ Approved by:	

Test Obje	ct Resista	ance Test	Negger Test	Report		
Row(s)	1	Insert				
Column(s)	5	1				
litle Typ	e your Title					٦
						- 64
						- 50

"Test Object" tab:

To perform a test, every module needs information about the equipment. This information is entered in "Test Object". In "Resistance Data" section, the general information about the piece of equipment which is to be recorded in the output report is entered. The name of the equipment, serial number, name of manufacturer, type, name of company, name of country and the address to the location and the power station where the equipment is installed are entered in "Name of Device", "Serial Number", "Manufacturer", "Type", "Company", "Country" and "Station" fields, respectively, to be added to the report.

Test Object	Resistance Test	Megger Test Rep	port
Resistance data -			
Name of Device:		Company:	E
Serial Number:		Country:	
Manufacturer:		Station:	
2011			

In "Resistance" section, the temperature and ohm range of the equipment are entered. The ambient temperature is entered in "Ambient Temperature" field while the temperature correction factor in accordance with the current ambient

temperature and the reference temperature, and also the coil material, the amount of ohm resistance, and Dev+ and Devof the resistance tolerance are entered in "Temperature Correction Factor" field.

Ambient Temperature	20.00 °
Temperature Correction Factor	1.0000
Resistance	70.00 mΩ
Dev.+:	5.000 mΩ
Dev:	5.000 mΩ

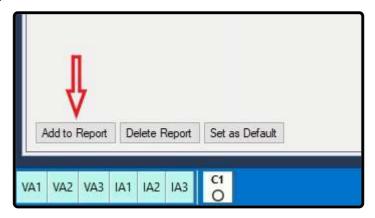
In "Extra Data" section, the date of testing in Gregorian calendar, the information of the performer of the test, and the information of the supervisor are entered in "Date", "Tested By" and "Approved By" fields, respectively.

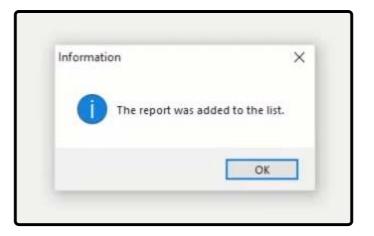
Date:	01/02/2021	-
Tested by:		
Approved by:		
Noise Suppression	r	
Averaging:		ୀ ,

The RMS value of each parameter is calculated based on the average of several time periods. The bigger number of time periods, the longer the calculation takes which consequently leads to higher accuracy and less fluctuations. The number of time periods is eneterd in Averaging field in Noise Suppression section. This field is the same as No. of Period field in Setting in Signal View window.

Date:	01/02/2021	
Tested by:		
Approved by:	J	
Noise Suppressi Averaging:	ion	1

By clicking "Add to Report" option at the box at the bottom of the screen, this information is added to the report and a message saying "Report was added to the list" is displayed. It is possible to view the report by selecting "Report" window from the right toolbar. By clicking on "Delete Report" in the "Delete from Report" window, the added report is removed from the "Report" window. If "Set as Default" is selected, the entered information is set as default and displayed every time the "Resistance" room is opened.





eport	С) PDF						F	Tinis d
AMPro R		e:							~
1) Abstract 1-1) Date ar									
1-1) Date al	Туре	ŕ	D	ate		Time			
Report Date and			1399/1	1/13	06:31:57.	63 PM			
Name:	AMT Sequer VEBKO				Version: Compute	991112 er Name: PC-YER			
Equipment Edit & Dele 2) Test Obj Tested By: Dat	AMT105 le Report ect:	Tested By	Approved By		Serial Nu				
2) Test Obj Tested By:	AMT105 le Report ect:	Tested By Company	Approved By Country	S			Туј	pe	
Equipment: Edit & Dele 2) Test Obj Tested By: Dat Device data:	AMT105 te Report ect: 01/02/2021 Serial			S	Serial Nu	umber: 524		pe	
Equipment: Edit & Delet 2) Test Obj Tested By: Dat Device data: Device	AMT105 te Report ect: 01/02/2021 Serial Number	Company	Country	S lev+	Serial Nu	Manufacturer		pe	

Manufacturer:	Station:	
Type:	Delete From Report	×
Temperature Correction Factor	Delete From Report Da Can Delete a report that added into Te main report in RESISTANCE E mode ResistanceTest Te main report in RESISTANCE E mode ResistanceTest	× 7
Resistance 70.00 Dev.+: 5000 Dev: 5.000		Delete Service Report OK Cancel
Add to Report Delete Report Set as De	efeut	

Add to Report Delete Report	Î
Add to Report Delete Report	Set as Default
VA1 VA2 VA3 IA1 IA2 IA3	а 0

"Resistance Test" tab

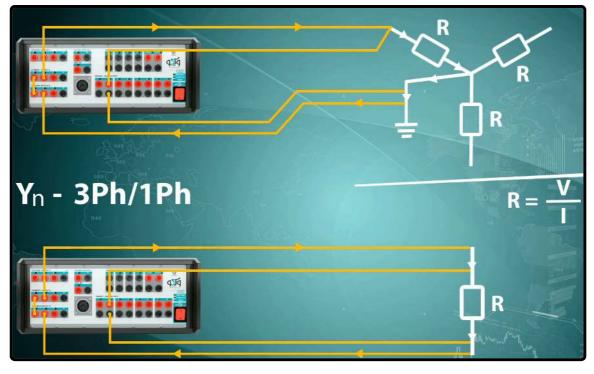
To perform this test, it is necessary to enter the test current, time and the intended input for measuring the voltage in "State Setting" section in "I test", "State Time" and "Analog Input Target" fields, respectively. Also, if the resistance of the equipment is low and you wish to have a more accurate measurement, it is recommended to select "Input 10". In the next step, the connection type is to be selected from among "D-3ph, Y-3ph and Yn-3ph/1ph" in "Object Type" section.

State Setting	R	esult Test State: Not Tested		
I test: State Time: Analog Input Target Analog Inp	5.000 A 5.000 s V	inj.: 0.000 A	R meas * C.F.: [Rdev. : [Ω 000.0 Ω 000.0
Don't Change Hard Analog Inp Analog Inp Analog Inp Analog Inp Analog Inp Analog Inp	out 3 out 4	oltage Measurement Mode lax Voltage of Current Source	Max Voltage	Max Resistance
Yn - 3ph / 1ph Analog Inp Analog Inp Analog Inp Analog Inp Analog Inp Analog Inp Analog Inp	out 6 (Up to 8V Up to 8.5V	 Up to 188V Up to 30V 	 R < 1.6 Ω
Analog Inp	out 10) Up to 16V) Up to 32V) Up to 8.75V	O Up to 4.5V	R < 0.9 Ω

R=V/I

If the single-phase or three-phase equipment which is to be tested is star point grounded, the first radio button should be selected and the wiring should be adjusted in accordance with the range of the injected current as well as the voltage level as can be seen in the figure. The equivalent circuit for this type of wiring is displayed as follows and the ohm resistance is calculated using the following relation:

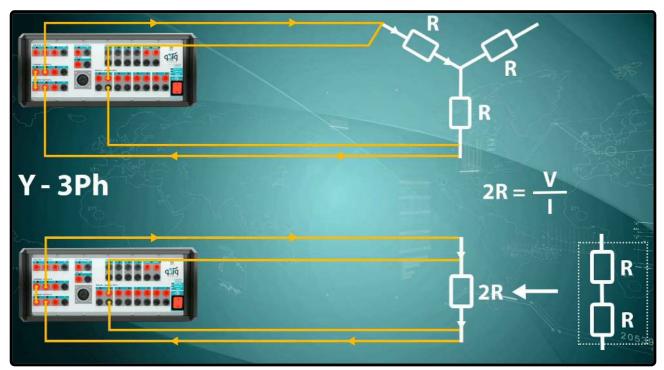
R=V/I



2R=V/I

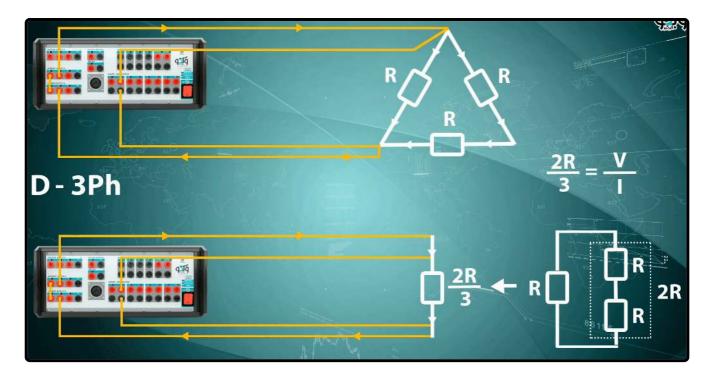
For a three-phase equipment without a null point the second radio button should be selected and the wiring should be adjusted in accordance with the range of the injected current as well as the voltage level seen in the figure. The equivalent circuit for this type of wiring is displayed as follows and the ohm resistance is calculated using the following relation:

2R=V/I



In D-3ph method, the wiring is adjusted in accordance with the range of the injected current and the voltage level as can be seen in the figure. The equivalent circuit for this type of wiring is displayed as follows and the ohm resistance is calculated using the following relation:

(2/3)R=V/I



The voltage measurement mode is specified in "Voltage Measurement Mode". Since the method used to measure the resistance is dividing the voltage difference by the current, "Range" of the "Inputs" voltage is effective in measuring the

accuracy of resistance. Therefore, for measuring the resistance, one of the inputs of this section should be selected in accordance with the coil resistance and the maximum resistance specified for every "Input". If the resistance is greater than the selected "Range", the device shows an "Overvoltage" error. In this case, either the current must be decreased or the resistance measurement "Range" must be increased. In case of facing an "Error Other" of the current outputs, the current needs to be decreased.

Test Object Re	esistance Test 🛛	legger Test Report		
State Setting I test: State Time: Analog Input Target	5.000 A 5.000 s Analog Input 1 ~	Result Test State: Not Tested I inj.: 0.000 A V meas: 0.000 V	R meas * C.F.: [0.000 Ω 0.000 Ω
Don't Change Har	dware Setting	Voltage Measurement Mode Max Voltage of Current Source	e	Max Resistance
 ○ Yn - 3ph / 1ph ○ Y - 3ph ● D - 3ph 		 Up to 8V Up to 8.5V Up to 16V Up to 32V Up to 8.75V 	 Up to 188V Up to 30V Up to 4.5V Up to 200mV 	 R < 1.6 Ω R < 0.9 Ω

Running the test and analyzing the results

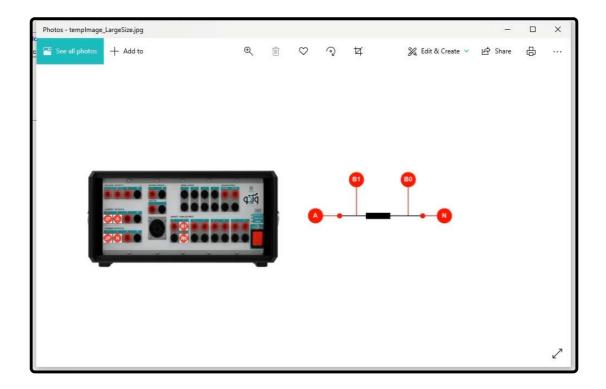
To begin the test, first in Test Object 200 milli ohm, 50 milli ohm, 10 amps, 1 second are specified as ohm resistance, upper and lower tolerance, current and test duration, respectively; also Input2 is selected "Analog Input Target". Then, Object Type is set at "Yn-3ph/1ph" and "VoltageMeasurement Mode" is set at Up to 28V and since the approximate resistance is smaller than 200 milli ohm, Max Voltage is set at Up to 4.5V and then wiring is adjusted according to the figure. It should be noted that it is possible to magnify the figure by double-clicking on it. In this wiring, "IA1" and "IB1" current output phases are "Jumpered" and "IA2" and "IB2" phases are directly connected to the equipment.

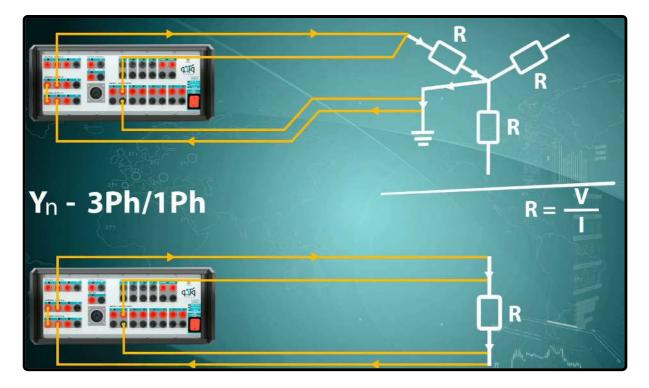
Test Object Resistant	ce Test Megg	jer Test Report		
Resistance data				
Name of Device: Serial Number: Manufacturer: Type:		Company: Country: Station:		
Resistance Ambient Temperature Temperature Correction Factor	20.00 ° 1.0000 200.0 mΩ	Extra Data Date: Tested by: Approved by:	01/02/2021	
Resistance Dev.+:	50.00 mΩ		-	

Test Object R	esistance Test	Megger Test Report		
tate Setting	10.00 A	Result Test State: Not Tested		
tate Time:	1.000 s	(Inj.: 0.000 A	R meas * C.F.: [0.000 Ω 0.000 Ω
nalog Input Target] Don't Change Har	Analog Input 1 V Analog Input 1		L	0.000 \$2
bject Type ——	Analog Input 2 Analog Input 3 Analog Input 4	Voltage Measurement Mode Max Voltage of Current Source	e	Max Resistance
) Yn -3ph ∕1ph) Y-3ph	Analog Input 5 Analog Input 6 Analog Input 7	Up to 7V	O Up to 188V	
D - 3ph	Analog Input 8	O Up to 8V	Up to 30V	R < 0.7 Ω
5 0 001	Analog Input 10	Up to 14V	O Up to 4.5V	R < 0.45 Ω
		O Up to 28V O Up to 8.5V	O Up to 200mV	

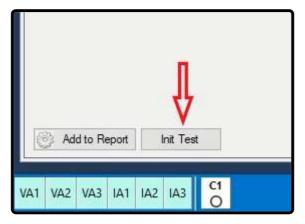
Test Object Resistance Test M	egger Test Report		
State Setting I test: 10.00 A State Time: 1.000 s Analog Input Target Analog Input 2	Result Test State: Not Tested I inj.: 0.000 A V meas: 0.000 V	R meas * C.F.: [Rdev. : [0.000 Ω 0.000 Ω
Don't Change Hardware Setting	Voltage Measurement Mode	i	
Object Type	Max Voltage of Current Source	Max Voltage	Max Resistance
Yn - 3ph / 1ph X - 3 - 1	O Up to 7V	O Up to 188V	
O Y - 3ph	O Up to 8V	Op to 30V	R < 2.8 Ω
OD-3ph	O Up to 14V	O Up to 4.5V	R < 0.45 Ω
	Up to 28V O 0p to 8.5V	O Up to 200mV	

Max Voltage of Current Source	Max Voltage	Max Resistance
O Up to 7V	🔘 Up to 188V	
O Up to 8V	O Up to 30V	R < 2.8 Ω
O Up to 14V	Q Up to 4.5V	R < 0.45 Ω
Up to 28V	Up to 200mV	
O Up to 8.5V	10 op to county	

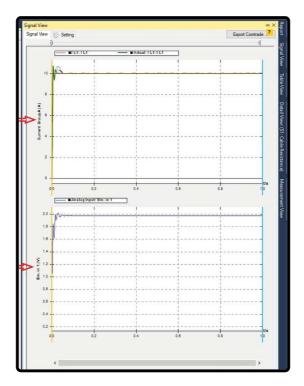




To measure the voltage difference, it is necessary to connect "Input2" to the test and further ahead of current injection connectors. It should be noted that before running the test it is necessary to click on "Init Test" so that the device "config" is adjusted automatically. By selecting this option, the settings related to current and test time as well as the hardware configurations related to "Hardware Configuration" including outputs of the device and "Binary/Analog Inputs" are adjusted automatically by the software. In "Analog Output" tab in "Hardware Configuration" section, you can see that the wiring of the device is set at "32A" with the maximum "Burden" of 400 milli amps and "Binary/Analog Input" #2 are activated to measure the voltage. After performing the test, in "Signal View" it is possible to view the current waveform along with its "Actual" values and the measured voltage and also examine the connections of the connectors.



age Measu	Analog Output	Binary / Analog Input	Binary O
Voltage of O	Voltage Output		
Up to 7V Up to 8V Up to 14V Up to 28V Up to 8.5V	4x150V, 60VA @ 400mAm 1x150V, 120VA @ 800mAm 1x150V, 120VA @ 800mAm 1x150V, 120VA @ 800mAm 1x300V, 120VA @ 400mAm 1x300V, 120VA @ 400mAm 1x300V, 120VA @ 400mAm 1x450V, 200VA @ 400mAm 1x450V, 200VA @ 400mAm 1x450V, 200VA @ 400mAm	ns (A1) ns (A2) ns (A3) ns (A1 A2) ns (A1 A3) ns (A1 A3) ns (A1 A2 B1) ns (A1 A2 B1)	
	Current Output		
	6x32A, 100VA @ 32A, 3Vm 3x64A, 200VA @ 64A, 3Vm 2x32A, 200VA @ 32A, 6Vm 2x32A, 200VA @ 32A, 6Vm	ns, 10Å, 12Vmrs ns, 5A, 24Vmrs (A1A2, B1B2 ns, 5A, 24Vmrs (A1A3, B1B2 ns, 5A, 24Vmrs (A2A3, B1B2 ns, 5A, 24Vmrs (A1A2, B2B3 ns, 5A, 24Vmrs (A1A2, B2B3 ns, 5A, 24Vmrs (A1A3, B1B3 ns, 5A, 24Vmrs (A2A3, B2B3	ý)))



After the test is finished, the test results can be viewed in "Result" section. The results include "linj", "Vmeas", "Rmeas*C.F" and "Rdev" which refer to the amount of injected current, the measured voltage, the measured impedance and the difference between the nominal resistance and the resistance specified in "Rmeas*C.F" field, respectively. It should be noted that by holding the cursor on either of these two fields, the relations related to them are displayed. In the end, after the test is finished, it is necessary to add the evaluation results to the report which is done by selecting "Add To Report" in equipment test.

itest colley it	esistance Test			
State Setting ——		Result Test State: Failed		
test:	10.00 A	l inj.: 10.01 A	R meas * C.F.: [197.4 mΩ
State Time:	1.000 s	V meas: 1.976 V	Rdev.: [-2.613 mΩ
Analog Input Target	Analog Input 2 \sim	V mods. 1,5/0 V		-2.013 mL2
Don't Change Ha	dware Setting	Voltage Measurement Mode		
bject Type		Max Voltage of Current Source	Max Voltage	Max Resistance
Yn - 3ph / 1ph		Max voltage of culterit Source	max voltage	Max nesistance
OY-3ph		O Up to 7V	Up to 188V	
OD-3ph		O Up to 8V	O Up to 30V	R < 2.8 Ω
O D Spri		O Up to 14V	Up to 4.5V	R < 0.45 Ω
		Up to 28V	O Up to 200mV	
		O Up to 8.5V	2.5	

Also, if the user wishes to add specific parts of the evaluation to the report or edit the report, they need to use "Add to Report" cog. By clicking on this cog, the items that can be added to the "Report" are checked and the user can simply uncheck any of them which they do not need. It should be noted that the results are not automatically added to the report after each test when a test is performed it is necessary to add the test results to the output report by selecting "Add to Report" before "Clearing the Test". Also, if one of the "Analog Outs" is faulty, the specified "Binary Out" should be changed; to do this, you must first click on "Init Test", then tick "Don't Change Hardware Setting" option and by going to the "Hardware Configuration" window, in the "Analog Out" tab, "Output Target" change the selected wiring according to the wiring.

1		Edit & Delete Report	1
		Test Setting	
		wiring	
	~	Assessment	
	~	Cursor Data	
IA1	~	Signal View	

📲 Instrument Test	×
Test Object R	esistance Test Me
State Setting	
I test:	10.00 A
State Time:	1.000 s
Analog Input Target	Analog Input 2 🗸 🗸
Don't Change Ha	rdware Setting
Object Trees	

Analog Output Binary / Analog Input Binary Output Extra Setting GOOSE Setting	
oitage Output	Voltage Output Signal
x150V, 50VA @ 400nAms x150V, 120VA @ 800nAms (A1) x150V, 120VA @ 800nAms (A2) x150V, 120VA @ 800nAms (A3) x300V, 120VA @ 400nAms (A1 A2) x300V, 120VA @ 400nAms (A2 A3) x450V, 200VA @ 400nAms (A1 A2 B1) x450V, 200VA @ 400nAms (A1 A3 B1) x450V, 200VA @ 400nAms (A2 A3 B1) bt Used	Output Target Output Label Actua
urrent Output	Current Output Signal
x32A, 100VA @ 32A, 3Vms, 5A, 12Vms x64A, 200VA @ 64A, 3Vms, 10A, 12Vms 32A, 200VA @ 32A, 6Vms, 5A, 24Vms (A1A2, B1B2)	Output Target Output Label
A32A, 200VA @ 32A, 5Vms, 5A, 24Vms (A1A2, B1B2) 332A, 200VA @ 32A, 5Vms, 5A, 24Vms (A1A3, B1B2) 332A, 200VA @ 32A, 5Vms, 5A, 24Vms (A2A3, B1B2) 332A, 200VA @ 32A, 5Vms, 5A, 24Vms (A1A2, B2B3) 332A, 200VA @ 32A, 5Vms, 5A, 24Vms (A1A2, B2B3) 332A, 200VA @ 32A, 12Vms, 5A, 24Vms (A2A3, B2B3) 332A, 400VA @ 32A, 12Vms, 5A, 48Vms (A2B2) 332A, 400VA @ 32A, 12Vms, 5A, 48Vms (A2B3) 332A, 400VA @ 32A, 12Vms, 5A, 48Vms (A2B3) 332A, 400VA @ 32A, 12Vms, 5A, 48Vms (A3B3) 332A, 400VA @ 32A, 12Vms, 5A, 48Vms (A3B3) 332A, 400VA @ 32A, 12Vms, 5A, 48Vms (A3B3)	Î

Two notable points about performing this test are that "Error Other" during a test indicates that there is a problem in connection of the wirings or the resistance is too high that the device unable to provide the required "Burden" for current injection. Therefore, in cases of facing this error, examine the "Actual" current value in "Signal View". If the current is injected from the device ("Actual Current") but its difference with the specified current is too big it means that the resistance is too high while if the "Actual Current" is zero, this means that the route current injection is open. In cases where the resistance is too high, the test current needs to be decreased while if the "Actual Current" is zero, the connection of the connectors needs to be examined. The second important point is that the voltage read by the binaries of the device

must have similar cycles. If the read values have a too big or zero tolerance, this means that the connectors are not properly connected.

Instrument Test × Test Object Resistance Test	egger Test Report					2
State Setting Itest: State Time: Analog Input Target Analog Input 2 Ont Change Hardware Setting	Result Test State: Failed linj.: 0.000 A R meas * C.F.: 0.000 Q V meas: 0.000 V Rdev.: -2.613 mQ					
Object Type 	 Up to 8V Up to 14V Up to 28V 		Max Resistance R < 2.8 Ω R < 0.45 Ω			•
	Up to8.5V					

📲 Instrument Test 🛛 🗙						
Test Object Resistance Test Me	gger Test Report					?
State Setting Itest: 10.00 A State Time: 1.000 s Analog Input 7 arget Analog Input 2 Dont Change Hardware Setting Object Type	Result Test State: Failed Inj.: 0.000 A R meas * C.F.: 0.000 Ω V meas: 0.000 V R dev.: -2.613 mΩ Voltage Measurement Mode					• •
Yn - 3ph / 1ph	Max Voltage of Current Source	Max Voltage	Max Resistance			0 0
O Y-3ph	O Up to 7V	O Up to 188V				
O D - 3ph	O Up to 8V	O Up to 30V	R < 2.8 Ω			
	 Up to 14V Up to 28V Up to 25V 	Up to 4.5V Up to 200mV	R < 0.45 Ω			
	O Up to 8.5V					
12	-					
0						
10						
12						
44	14	1		10	28	
1				1		

Since some users perform a "Megger" test for this equipment and they may need the results in a report, it is possible for them to enter their intended line and column in "Megger Test Report" tab and by selecting "Insert", create their needed table and after inserting the test results and selecting "Add to Report", add the information to the output report. Other options such as "Delete Report", "Export" and "Import" are used to remove the information of this page from the report, exporting the output file only from the information of this page and importing it if necessary, respectively. Also, if the user wishes to set the characteristics of the created line and column as default for this section of the room, they can use "Set as Default" option.

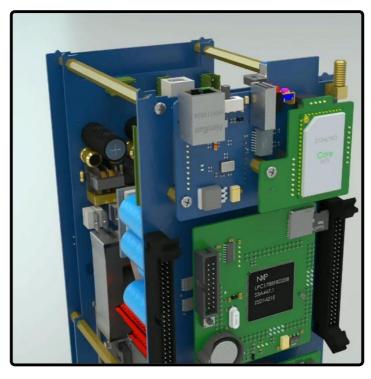
and the second second	ument Test 🔉						
	Object Resis	tance Tes N	legger Te	st Report			
Row(s) Column(s)	1	Insen					
Title	Type your Title						
		T		T		I	
					Π		
					₩		
Add to B	leport Delete F	Report Set on I	Seta di F	mot	Respon		

146 : THE COMPLETE MAIN SWITCHING

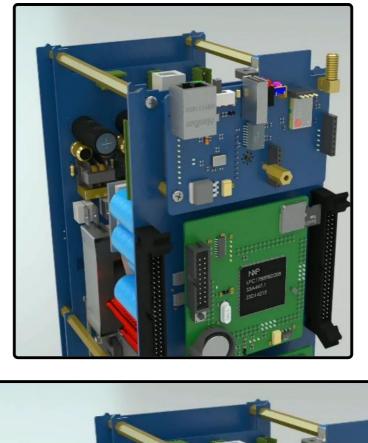
The complete Main Switching, which is installed on switching number two, is the main part of the switching device. On this board, we have several modules including LAN-GPS, Wifi Module, Micro Module, Command Module, Fan Controller Module and Power Supply (PS) Module. In some cases, we face some problems where we have to replace one of these modules. Here we are going to explain how to replace a module.

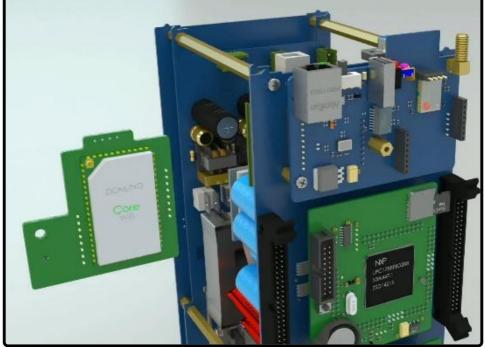


If Wi-Fi connection has issue or more specifically we cannot connect to the device using the Wi-Fi and we have already performed all the tests and did not get any result, we need to replace the Wi-Fi module. When we substitute the Main Switching of two devices, we leave the Wi-Fi module as it is so that we do not have to reset the Wi-Fi settings. This part is what is meant by Wi-Fi module. This means that if we have a problem with the Wi-Fi and we want to swap the Wi-Fi of the two devices, we open this screw and swap only this module. This module is called Wi-Fi.



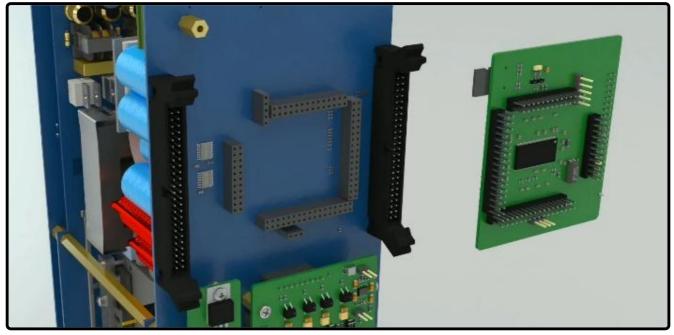
If there is a problem with the GPS module, in other words if we have a problem connect to the GPS or the LAN connection we can conclude the LAN-GPS module is not functioning properly, and we need to swap this module. To swap this module, first we need to open this spacer, then open this screw and then the LAN-GPS module is released. So, this is the Wi-Fi module and this is the LAN-GPS module.



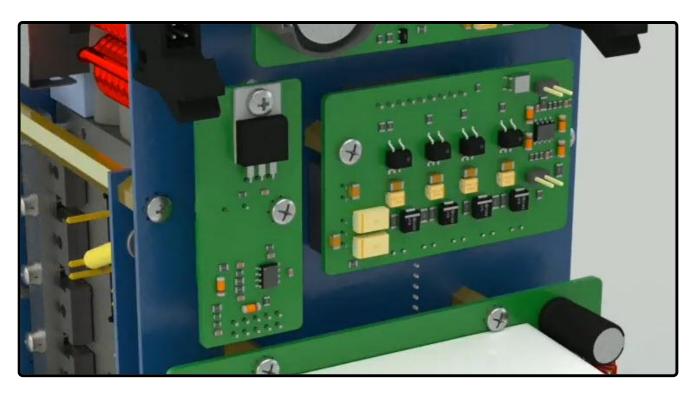


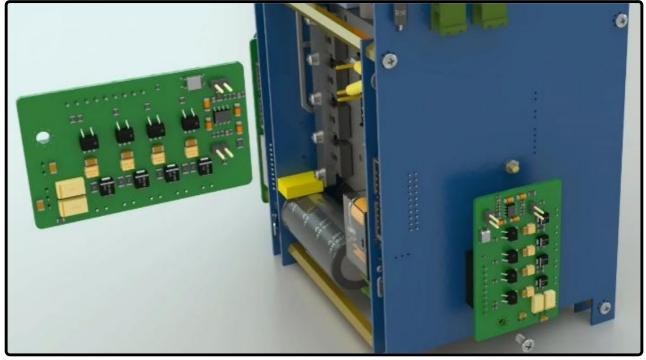
The micro module is the heart of the device. When we are performing different tests, there are some issues where we may conclude that the microprocessor of the device is not functioning properly and we need to swap it. There is no screw on the micro and it is connected to the board only by some pins. To detach the module, we release it from one side and then completely release it from the other side. This is how the micro module is detached. Reinstalling this module is as easy as it was to detach it. There are three pins at the bottom and five pins at the top, first we need to adjust them and then the pins with a higher number are installed. This is how this module is installed.





Next is the "command" module in which we have the Overcurrent error of board number two. Whenever we face the Overcurrent error of the board number two, first we replace the "command" of the complete Main Switching side with the other side. The screw is opened like this and the module is detached and replaced with the command of the other side. After the replacement, we turn the device on using a series lamps. Then connect the relays of the device and connect to the device. If the Overcurrent error of board number two is eliminated, this means that the problem was with this "command" and it must be corrected. If the Overcurrent error of board two still remains, we need to examine the other parts (which will be explained later).





Fan controller module, in fact there are four fans in the device, two fans in the back panel, one fan on the heat sink and another one on the amplifier module which will be explained later. If any of these fans be it the heat sink fan or the fan on the back panel which is on the same side as the switching is not working, and there is no problem with the fan, then our conclusion is that the fan controller module is causing the problem and it needs to be replaced. The module is opened like this and then swapped with the other fan controller module and the problem is solved.



PS module, in fact the 12 volt power of the modules is provided from here. When the device is turned on and electricity enter the switching, there is no problem but the fans not working means that power is not reaching the micro and it has no reaction and only the power button is turned. In such cases, the problem may be with the PS module and it needs to be replaced. This module has four screws, two on the top side and two on the bottom side that are opened like this.

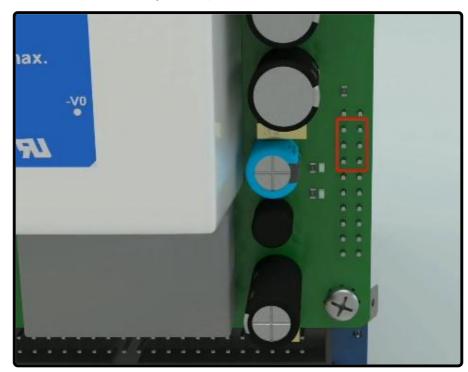


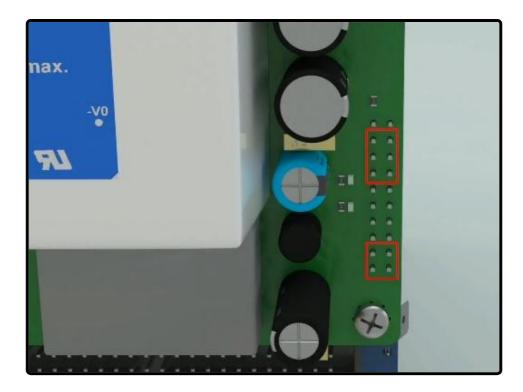
If the problem is caused by this module or in other words you do not have the 12-volt power, a test must be performed to see if the problem is with the upper Minmax or the lower one. Then, the faulty one is replaced with the spare module. This is one of the modules that are located on the Main switching and its function, how to move it and how to replace it have been already explained.

Another point about PS module is that this module provides our switching set with two 12 volts DC and 5 volts DC Minmaxes. If we want to test to see whether this module is providing us with the 12 volt Minmax or the 5 volt Minmax, there is a set of Pin Headers using which we can check these values.



These six upper Pin Header are 12 volts positive and these four lower pins are 5 volts positive and these eight pins in the middle with GND phrase written on them. This means that between measuring the voltage between GND and 12 volt we can make sure that the 12 volts is healthy and between GND and 5 volts we can check to see if the circuit is provided with the 5 volt voltage or not. If we do not have any of these, one of the 12 volt or 5 volt Minmaxes is definitely damaged.

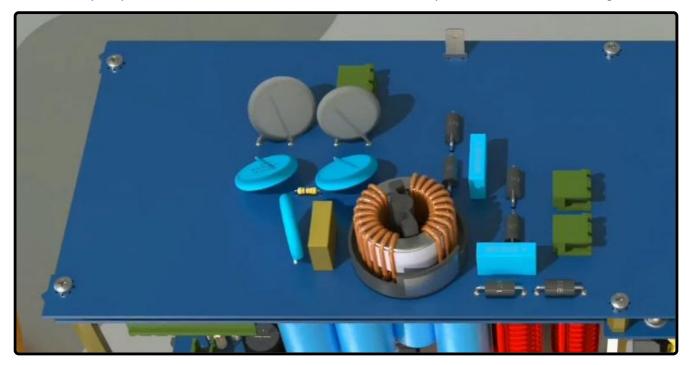




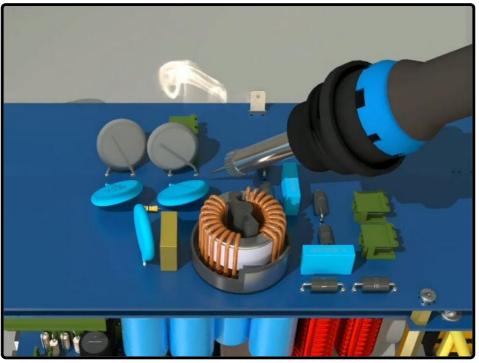
147 : MAIN SWITCHING ERROR OVERCURRENT BOARD

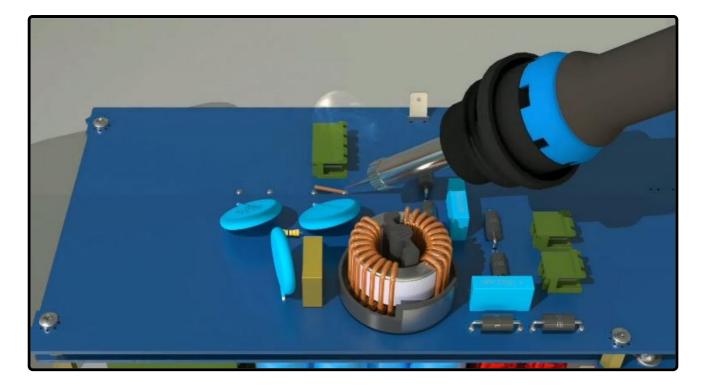
In the incomplete Main Switching, there are two problems that can avoid the device from turning on and functioning. Sometimes the NTCs of these two parts and also their diodes burn out. However, these NTCs have been totally removed from the latest boards. In the old boards that have this part, if there is any problem with it, it can be easily replaced with a

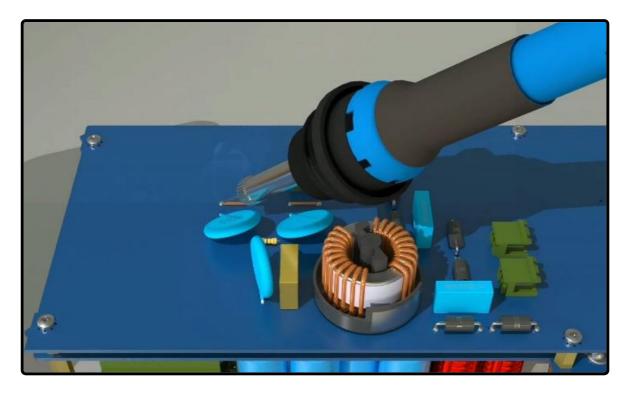
piece of wire (it should be short-circuited). When this part burns out, the device will not turn on because it has no power and it either becomes open-circuited or explodes. Normally, this part has 11 ohm resistance which is a small amount. When this part burns out, its signs are totally obvious. This part must be detached as you can see and replaced with a piece of wire. This way the problem with the device is solved and we will not have the problem of the device not turning on.



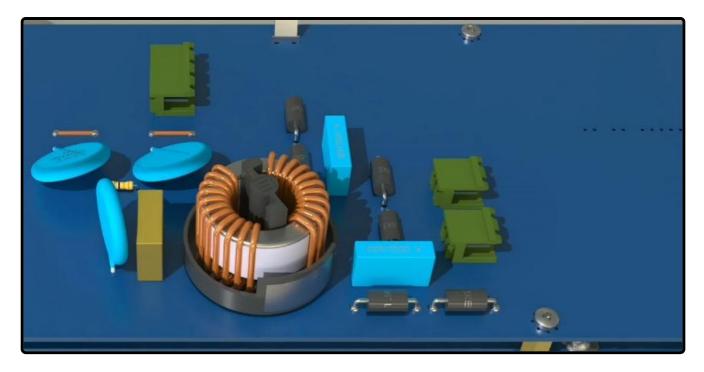


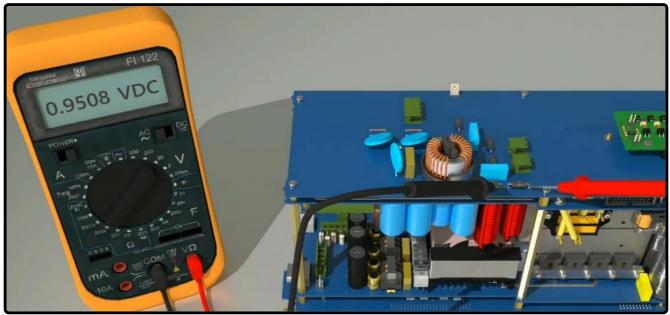




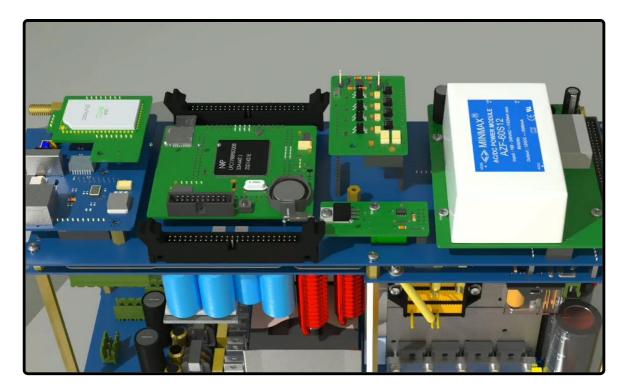


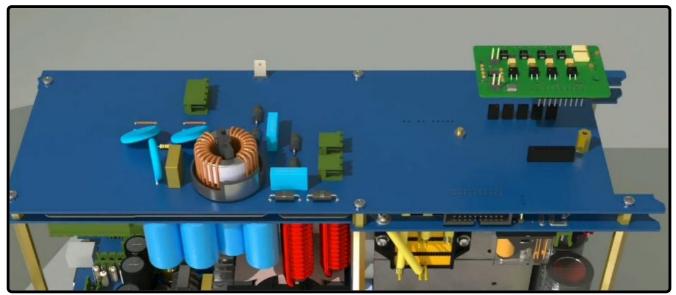
Another topic is three pairs of diodes. In fact, these diodes are located between the earth and phase, earth and null and phase and null. Whenever the earth of the system we are using is electrified or its null and phase become one, one of these three pairs of diodes burns out. In this case if the earth of the device is connected and the device is turned on, the fuse of the device will definitely burn out or the fuse of the place from which the electricity is taken will trip. In such case, you can only use the device if the earth is not connected to the device and it works without earth. To solve this problem, the diodes must be replaced. It is so simple to test these diodes. First, remove the diode from the circuit and test it like this. The diode is open from one side and Overload from the other and all of the diodes are tested like this. Any of the diodes which is burned out, needs to be replaced with a similar diode with the similar voltage. And this topic which was about the earthing problem of the device ends here. In cases where the earth has a problem, these diodes are damaged and need to be repaired.

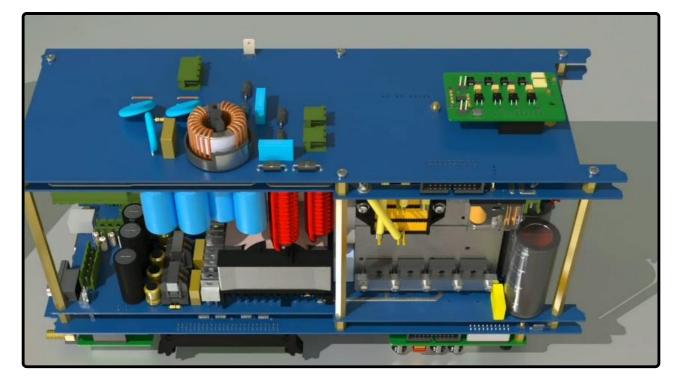




There is one more notable point about overcurrent error of the board where if the problem is with the command, the command is opened like this and replaced with the command of the other side. Now, using a series lamp which will be explained later, we turn the device on. If the device is turned on and the switching of side one is activated and its relays are connected, if the problem is with the command and we have replaced it, then the overcurrent error of the board must be eliminated.



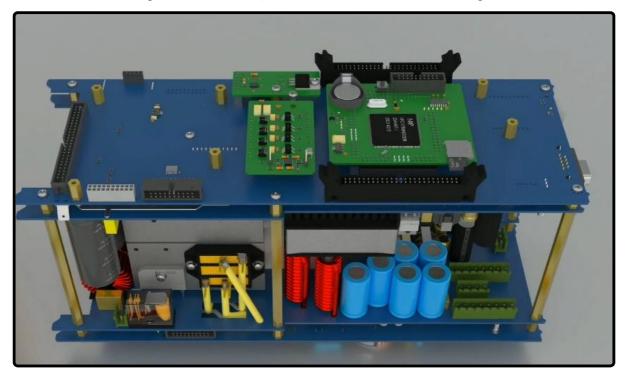




If the overcurrent error of the board number one still remains, the problem is not with the command and we have to move to the next stage.

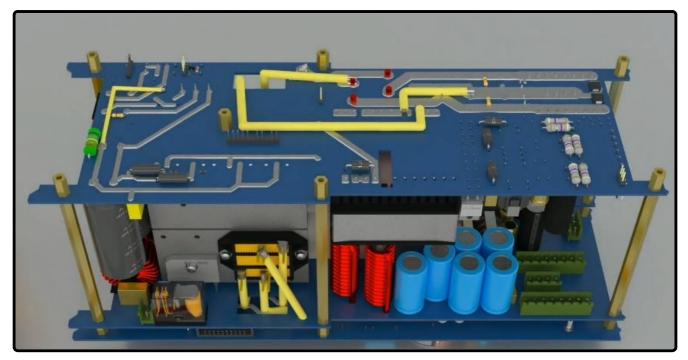
148 : OVERCURRENT ERROR OF BOARD 2 PART 1

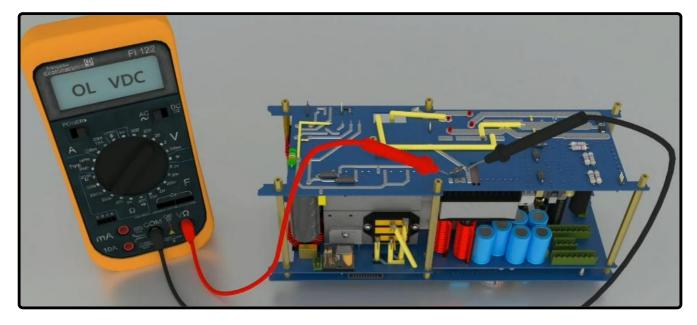
Now we are going to examine this error. The first point is to examine the "command" problem. By replacing the "command", it is possible to find out if the "command" is healthy or not. We replace the "command" of this side with the "command" of the other side which we have detached before, take a test and turn the device on. If the overcurrent error of board 2 still remains, it means that the "command" is healthy and we need to check other possibilities; if the error is eliminated, the overcurrent error of board 2 is eliminated, it means that its command is damaged. Lets suppose that the overcurrent error of board 2 still remains as the command has be replaced. To do this need to open the Main Switching. Open the Main switching, open the two screws at the top, three in the middle and two screws on the end of the board. Then detach the Main switching. To test these items, test the diodes that are on the switching module.

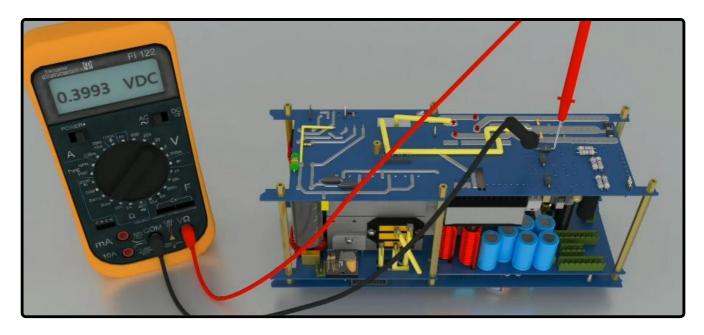


The first diode is the one that is located on the transformer and to test this diode, It needs to be released it from one side because it is connected to the both sides of the transformer and if a diode test is performed it will show short-circuit and it

won't be able to find out whether the diode is healthy or not. Here there are three diodes to test. There are ten diodes here and two other diodes that are located at the voltage and current output. First, following the instructions that were given earlier, we detach one of the sides of the diode that is located on the two sides of the transformer. The diode test of this diode must show overload in the both sides (this is a two-way diode and the result must be overload in the both sides). If the route of the voltage is displayed in one side, this diode is probably damaged. If the diode is overload in the both sides, it is healthy. If the diode is damaged, remove the diode from the circuit like this. Take the diode completely out of the circuit and if it is possible, replace it but if there isn't a diode, we can just remove this damaged diode from the circuit and the device will be fine.

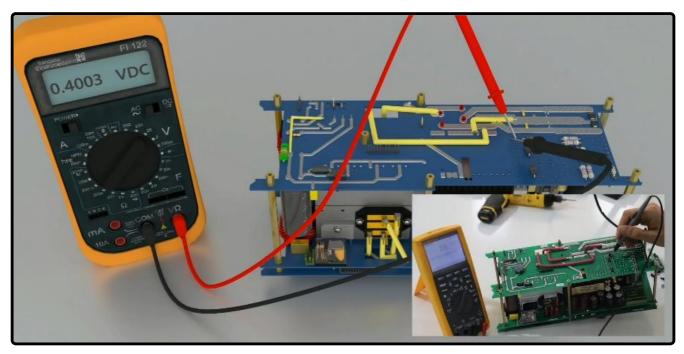


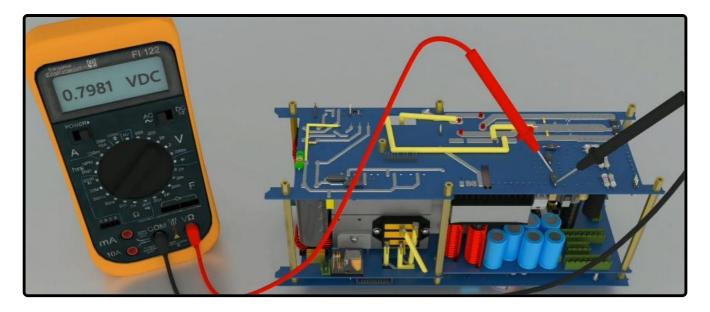


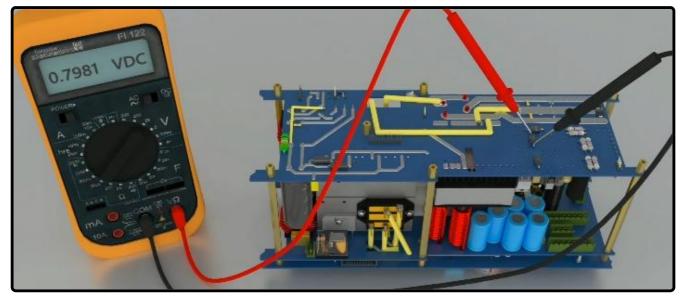


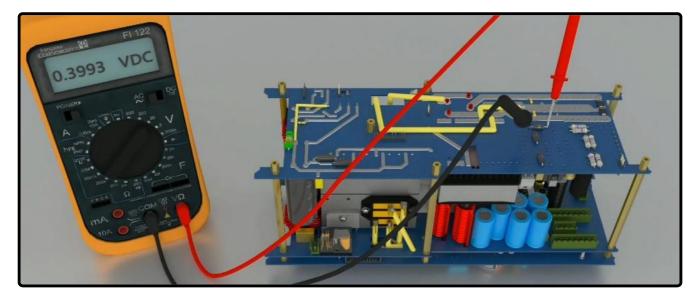
The next diodes that need to be tested are these three diodes. The first diode must show overload from one side and a value as big as 0/8 from the other side. The second and third diodes are tested in the same way. If any of these diodes is damaged, we can just remove them from the circuit like we did with the diode that was on the both sides of the transformer and this will not cause any problem for the device. If we have a spare diode, we can replace it with the damaged part. The next diodes that need to be tested are these ten diodes that are located here. These diodes pass the current from one side and their other side is a closed route.

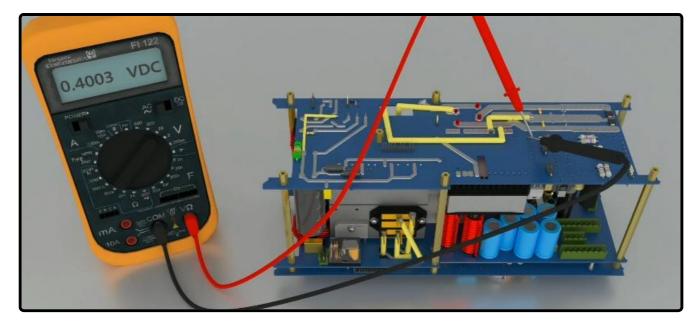
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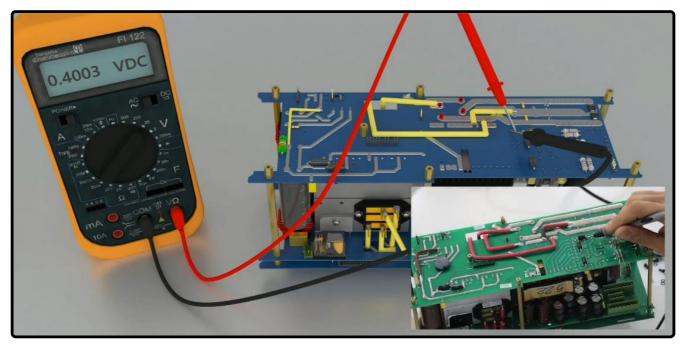




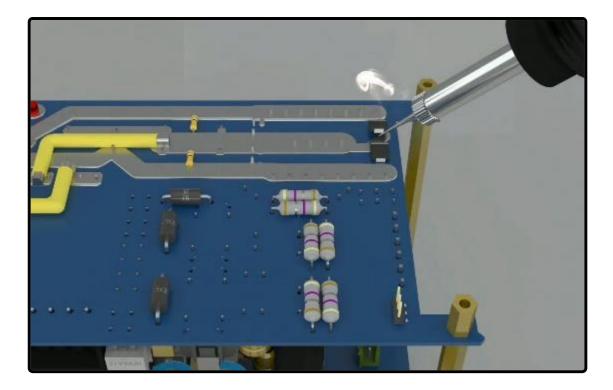




One notable point is that this diode belongs to the DC voltage output. If this diode is burned out, it shows us that this other two diodes are burned out. In the first stage, we need to remove this diode from the circuit and then test these two diodes. Usually these two are shown to be healthy. This means that this diode's burning out causes the other two diodes to be showed as burned out. But when this diode is removed from the circuit, there is no sign of damage in these two diodes and they are healthy and this problem is solved by removing from the circuit.

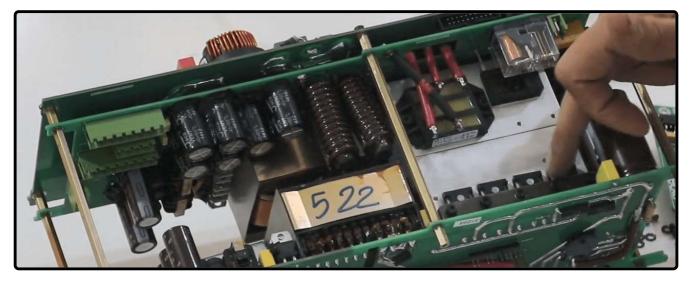


These two here are the next diodes. We need to release them from one side like this and then perform a diode test like this. They should be overload from both sides; if they let the current pass from one side or show short-circuit then that diode is burned out and must be removed or replaced with a spare part if possible.



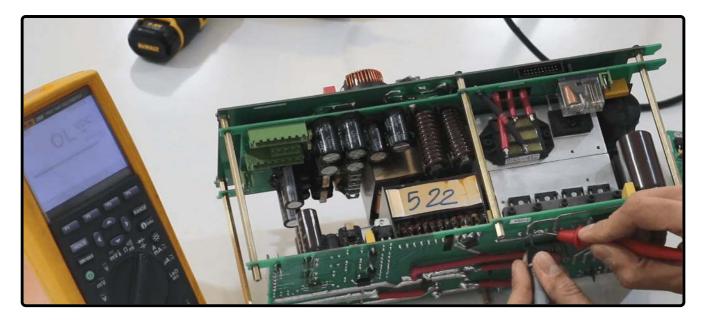
149 : OVERCURRENT ERROR BOARD 2 PART2

IGBTs' burning out can be another reason for an Overcurrent error of board number two.



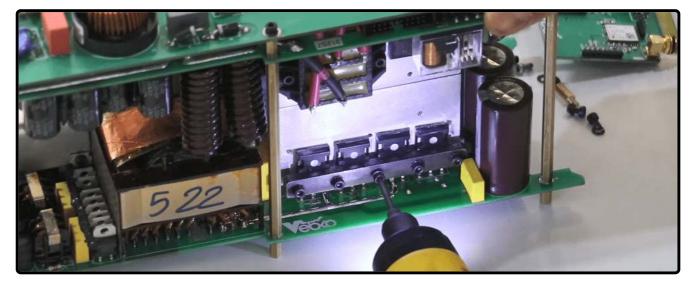
Here there are four IGBTs which are numbered as IGBT1, 2, 3, and 4 and they are connected to each other two by two. IGBT 1 is connected to IGBT 3 and IGBT 2 is connected to IGBT 4. In testing them if IGBT 1 is burned out, IGBT 3 will definitely be shown as burned out as well. In this case, it is possible that both of them are burned out or maybe only one of them is burned out. To detect the burned-out part, we need to remove one of the IGBTs from the circuit and test it outside the circuit. If it is healthy then the other one is burned out. But if the one outside the circuit is burned out, we test the other IGBT on the board and if it is healthy there is no problem but if it is not healthy then both IGBTs are burned out and need to be replaced.

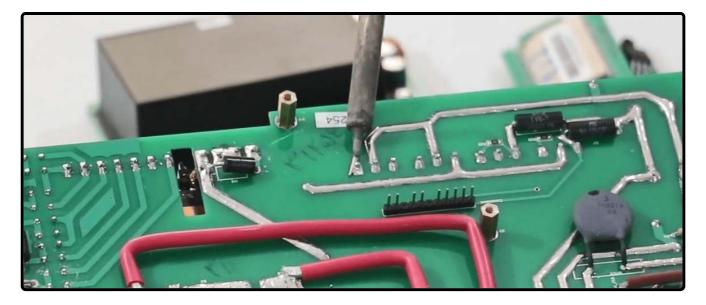
To test an IGBT, we need to test its three pins including gate, drain and source. Between drain and source, a diode test should be connected on one side and Overload from the other side. Diode test between gate and source pins and between gate and drain pins should be Overload on the both sides and if there is a short-circuit or a value, the IGBT has been damaged. Now we test the IGBT. First between drain (the middle pin) and source (the right-side pin) which is open from one side. The negative probe is connected to drain pin while the positive probe is connected to source pin. There is 0/48 value from one side and Overload from the other. Now we take gate with drain and source, they should be both Overload and the results does not change if the probes are swapped. There must no plan to any other pins from drain. This test is the same for all pins.



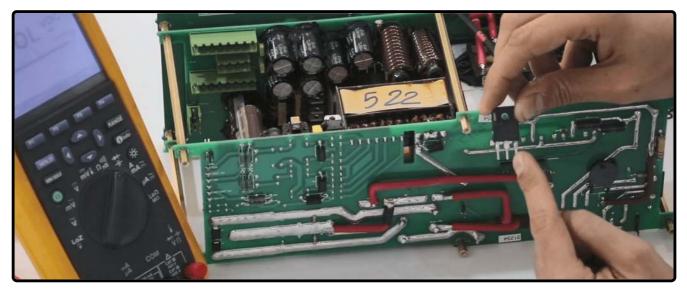
Now we suppose that one of these IGBTs is damaged which means that we have an Overcurrent problem of board number two. We tested the diodes and they are all healthy. So, our conclusion is that the problem must be with IGBTs. We tested the IGBTs and IGBT one and three have signs of being burned out. Now we need to find out which one is burned out and explain how to replace it.

There is a holder on IGBTs one which has five screws. This holder attaches all IGBTs to the heat sink applying the same amount of pressure. To open it we need to open these five screws, and then the holder is released. Now we want to remove IGBT number one from the circuit. To do this we need a tool named desoldering suction. This too, in fact, removes the tin from the circuit so that we can easily release the pins. Now we hold the soldering iron on the first pin of the IGBT until the tin is completely melted, then using the desoldering suction, we remove the tin. We repeat this for the rest of the pins. If the tin is not completely removed, we can add some more tin and try removing the tin again. We turn the module upside down; by moving the IGBT we can easily remove it from the circuit.

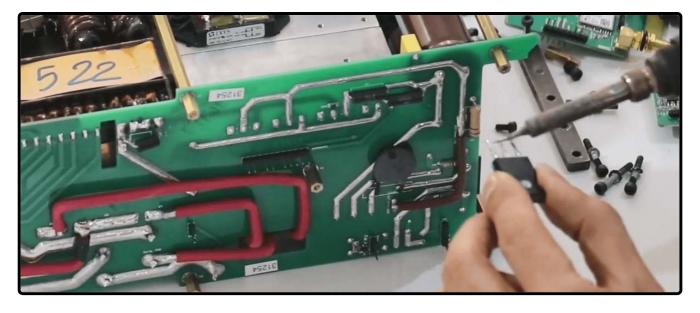


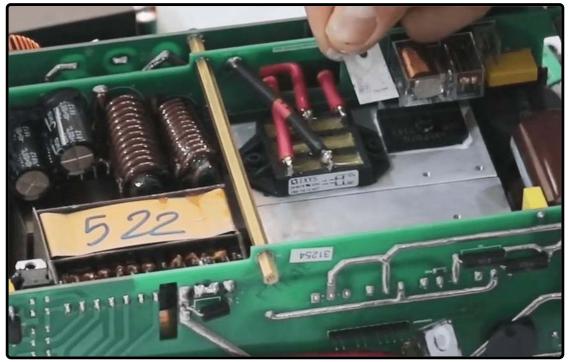


We test the IGBT one more time outside the circuit. The pins of the IGBT are gate, drain and source. There is a connection between drain and source from one side and the diode test shows a number but from the other side, when we swap the probes, it shows Overload. Between gate and drain and also gate and source there should be Overload. This means that there must not be any route between gate and drain, and gate and source. We test again, the drain middle pin and source show Overload from one side and a number from the other side. Also, gate and drain, and gate and source are also Overload.



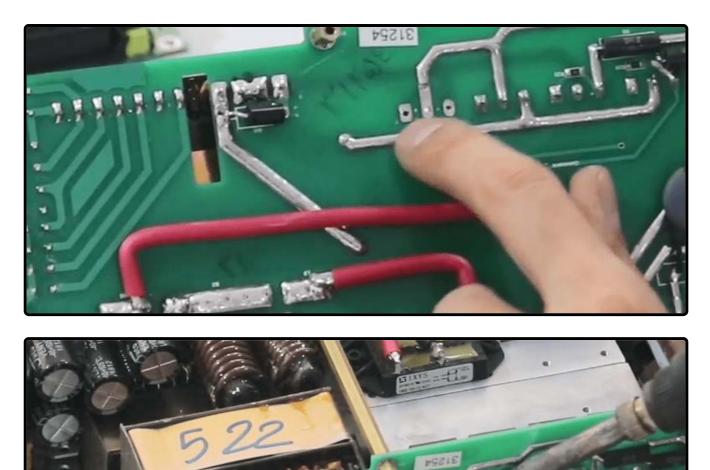
Now, this IGBT is healthy; supposing that there is a problem with the device, if this is healthy then definitely IGBT number three is damaged and if we take a diode test, it must prove this theory. Since now all IGBTs are healthy, it is not possible to show this., Suppose that IGBT 1 was damaged and we replaced it and now we want to put it back in its place. Now we need to remove the extra tin on its pins using a soldering iron because extra tin does not let the pins cross inside the pads. There is an insulation named mica on every heat sink and beneath every IGBT. In fact, this insulation is used to prevent any connection between the body of this MOSFET and this heat sink which is located on the switching.





Before putting the IGBT back in its place we need to check its pads and make sure that there is no tin left so that we can easily install the IGBT. If there is any tin left inside the pads, we need to remove it using the desoldering suction. The holes are opened like this and this is how we put the IGBT back in its place. , Then we put the insulation back in its place meticulously. It is necessary for the height of these IGBTs to be the same because to close the holder, they all must be at the same level and with the same amount of pressure. When the IGBT is adjusted, we put tin on one of the pins like this and make sure that it is flat. Now we put tin on the other pins to stabilize them. The tin must thoroughly cover the pins.

The crack you can see here needs to be evenly filled with tin.





When the IGBTs are removed, there is metallized in these pads. After we remove the part, this metallized is damaged and rendered useless. In fact, the metallized is the connection between the upper and lower layer of the board. To solve this problem, we should tin-plate these pins from above. We put the tin here so that the connection between the upper pins and the upper pads is completely established, like this. After we ensure their connection, it is time to close the holder. To close the holder, we begin by fastening the middle screw. Then we put the holder back in its place and fasten the screw as long as it is reached its end but not completely fastened. Then we put the holder in a straight angle and fasten the other screws. The screws must be fastened following this exact order so that the pressure applied to the IGBTs to attach them to the heat sink is evenly distributed.



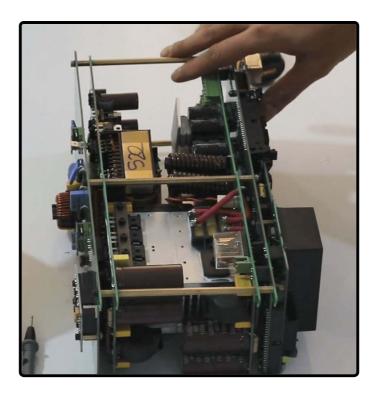


Now we want to make sure that there is no body connection between the IGBT and heat sink. We set the multimeter at ohm mode. We take an IGBT test from the middle pin of IGBT and the heat sink should be Overload. Then we test all IGBTs following the same procedure to ensure that there is no connection. So here the replacement of the IGBT ends and now we can close the Main Switching and take a test to see whether the problem has been solved or not.

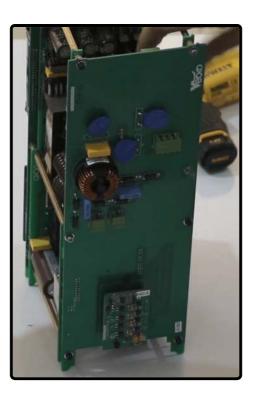


150 : SWITCHING TROUBLESHOOTING

Switching is composed of two parts switching one and switching two. This part on which the microprocessor is located on is in fact switching number two. Both sides have a Main Switching. The side which has a microprocessor is the Main Switching while the other side which has fewer modules is the incomplete Main Switching.



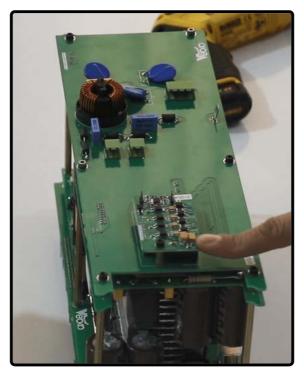


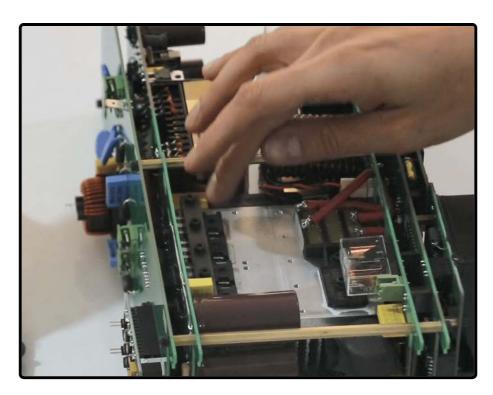


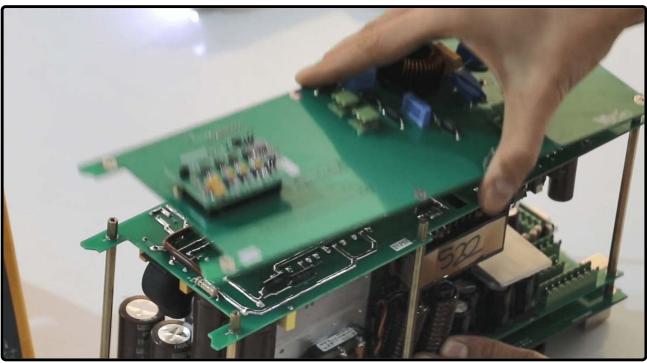
Now, let's look at the Overcurrent error of board number one. The first thing we face in the Overcurrent error of board number one is "command". After the Minmax burns out, the "command" is damaged which cause an Overcurrent error of the board number one. The easiest way to test it, is to replace the "command" of the complete wide with the one of the incomplete side and see if it is healthy or not. The next things that we can check are the IGBTs that are located on the switching. There are four IGBTs on which a diode test has to be performed to see if they are healthy (This will be more explained later). Next are the diodes on the switching module that are located under the Main; since these diodes can cause an Overcurrent error of board number one, they need to be tested as well. To access these diodes, the Main of the incomplete Switching needs to be opened which is done by unscrewing seven screws. After unscrewing the screws, the Main is easily detached. There are some diodes on the Main which should be tested to examine the reason for the

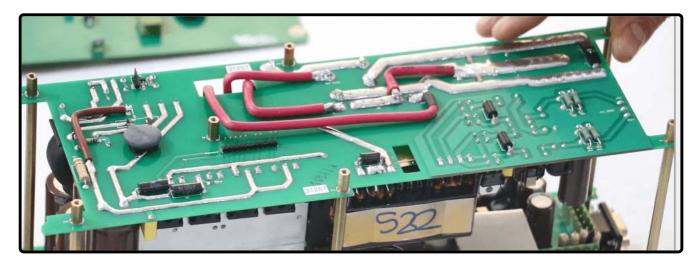
Overcurrent error of board number one. A diode has a transformer on each side. To test this diode, it is necessary that one

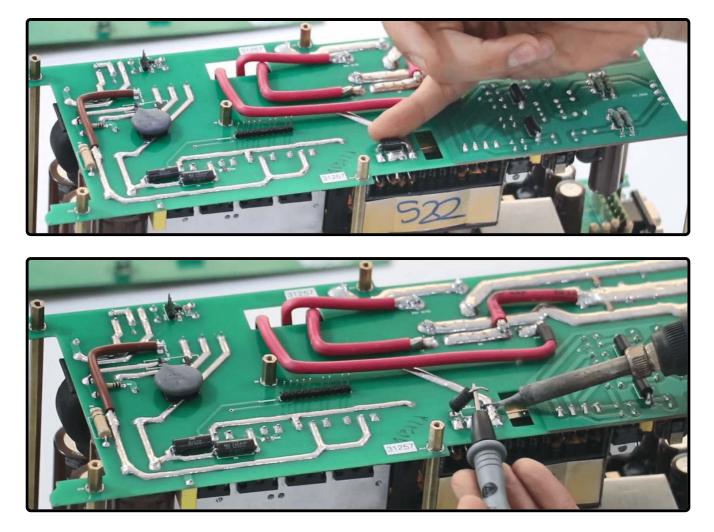
of its ends is detached from the circuit because this diode is located at the two ends of the Trans and if we perform the test in this state, a short-circuit is displayed. Therefore, one of its ends must be detached.



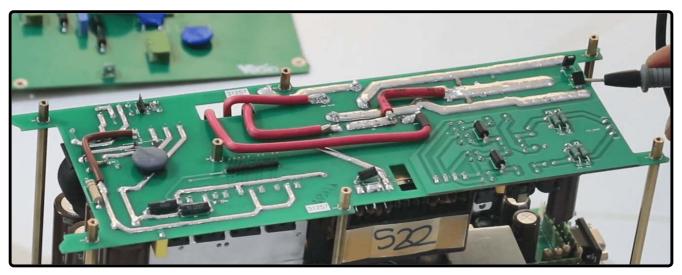








There are two diodes on this side and eight on the other side. Also, there are two diodes at the end of the voltage output of the currents. To perform the test one of the ends of these two diodes must be detached. The first two-end transformers is tested. First, one side of the diode is detached using a soldering iron and the multimeter is set at diode test mode. After testing the diode it can be see that the diode is on Overload diode from both sides.



Now it is time to test the next two diodes. Overload must be displayed from one of the sides and the value 0/7 must be displayed from the other side. In this case the diode is healthy and there is no need for replacing it. There are 8 other diodes showing 0/3 on one side and overload on the other. All diodes are tested in the same way.

In the end, these two diodes located on each ends of the currents voltage Used for Supplying the current Mosfet are detached like this. One side is detached These diodes need to be overloaded from both sides. What is meant by both sides is that by moving the end of the probes in any side, it must have the Overload value.

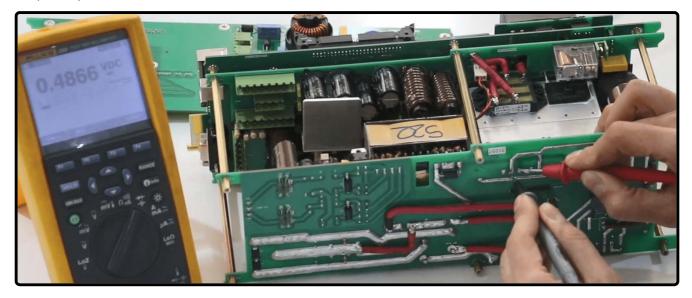
this way, the diode test ends. Now, if any of these diodes has a problem, the faulty part must be replaced with a one in accordance with its Part Number. But, the absence of some of these diodes do not cause any problem. This means that if this diode is not available, it is ok to detach it from the circuit. Such as the two-end transformer diode and these two

diodes. But it is necessary for these eight diodes to be present in the circuit. Also, it is ok for these two diodes not to be present.

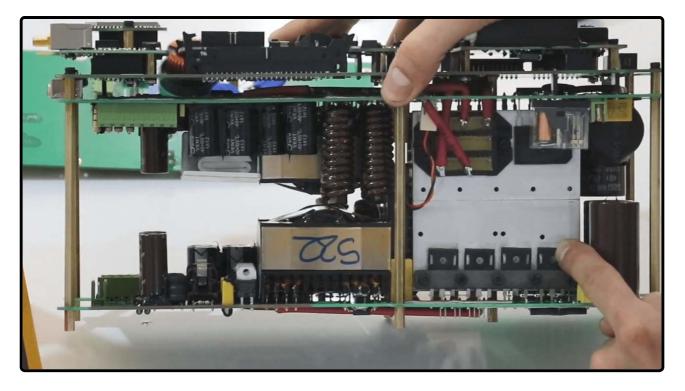
151 : OC BOARD IGBT TEST

The next element that we are going to examine is the IGBT.

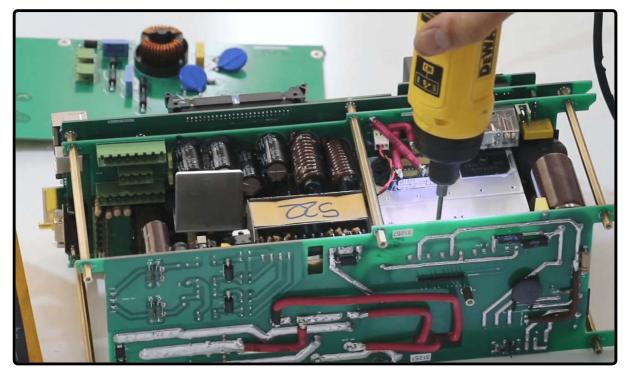
It was mentioned earlier that there are four IGBTs. A diode test must be performed for the pins of these IGBTs. Every IGBT has three pins of gate, drain and source. The diode test is first performed between drain and source. If you look at the IGBT from this angle, the middle pin is drain and the right pin is source. The diode test between these pins is performed from positive to negative or from negative to positive. When the negative probe of the multimeter is placed on the drain pin and the positive side is placed on the source pin, the multimeter shows 4/8. If the probes are swapped, Overload must be displayed. The rest of the IGBTs are tested following the same procedure. In the first place, this indicates the health of the IGBT. Next, the gate pins are to be tested with drain and source which refer to the left side pin and the side pins, respectively.

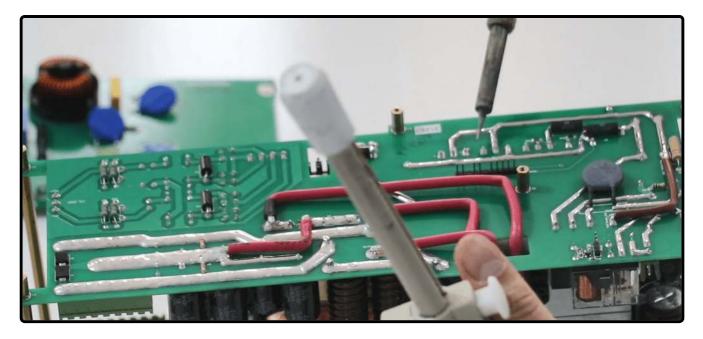


In this state, we should have the Overload value between every one of the pins. In fact, there should not be any connection between the gate and drain and source pins. If there is a short-circuit between these pins, the IGBT is definitely burned out. These IGBTs are shared two by two. If we number the IGBTs as 1, 2, 3 and 4, then IGBT 1 and 3 and IGBT 3 and 4 are connected. When these IGBTs are damaged, if it is assumed that the first IGBT is burned out, if the third IGBT is tested it is displayed as burned out as well. This means that their pins are short-circuited. There are two cases here where one of the IGBTs is burned out and the other is being displayed as burned out. In this case, one of them is tested by being detached from the circuit. Or maybe both of them are burned out. It is the same for the second and fourth IGBTs. If they both display signs of being burned out in the diode test, one of them is detached from the circuit (how to detach an IGBT is explained in the following) and the test is performed. If this IGBT is healthy, then the other one is burned out, otherwise the other IGBT is tested as well.

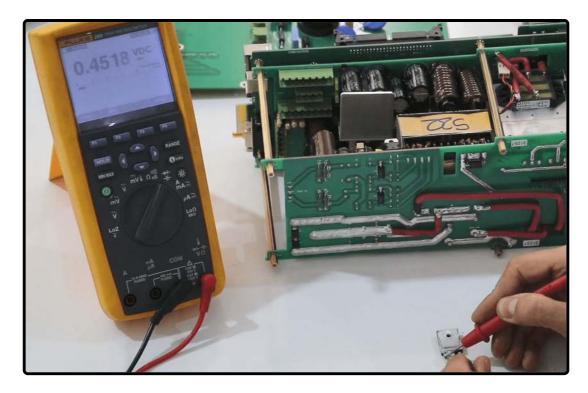


To open the IGBT, first we need to open this holder. The holder has five screws. The middle screw, the two side screws and then the other screws are unscrewed respectively and the holder is opened. Now, as an example, IGBT number one is removed from the board. To do this, we need a desoldering suction to remove the tin from the pins of the IGBT. Then we heat the pin and after the tin is completely melted, we remove it using the desoldering suction. We can do this as many times as needed for every pin until the tin is completely removed. If the tin is not completely removed, we can add some tin and then melt all of the tin on the pin and remove it again. The IGBT is removed from the board simply by giving it a shake. Now we test the IGBT outside the circuit. We repeat the pins, gain, drain and source. Between drain and source we should have 4/8 from one side, 4/8 inside the circuit and 4/5 outside the circuit. But between gate, drain and gate, the source must always have the Overload value. This IGBT here is healthy.

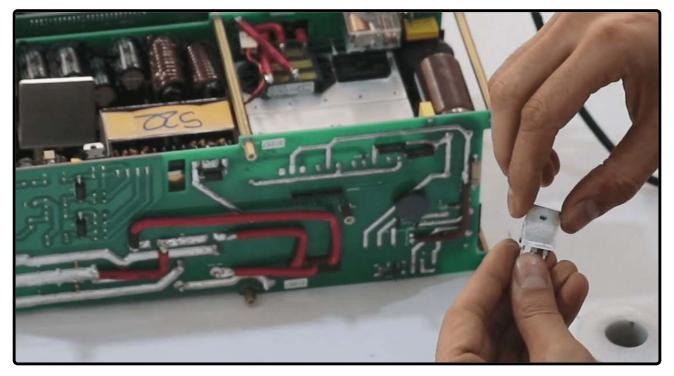




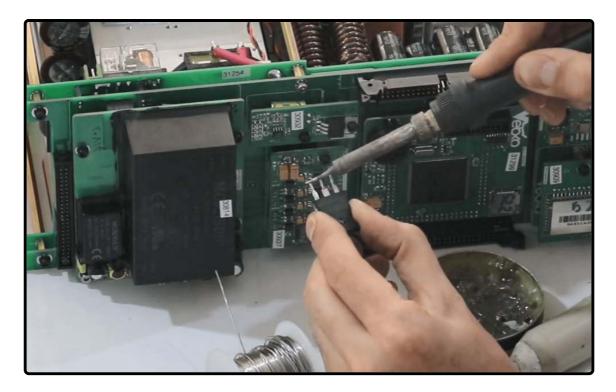


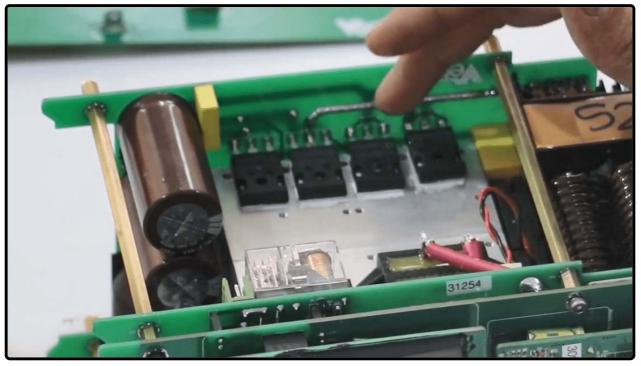


To reinstall the IGBT, there is insulation beneath every IGBT just like this. In fact, this insulation prevents the MOSFET body and heat sink from touching each other. This insulation must be exactly beneath the IGBT and silicon paste is used beneath the insulation. We put the insulation beneath the IGBT like this and then put the IGBT on the heat sink and then remove its pins from the pads. But before this, first the IGBT pads must be emptied from any tin. To do this, we put some tin on the pads to melt all of the tin inside. Then we remove the tin using a desoldering suction.

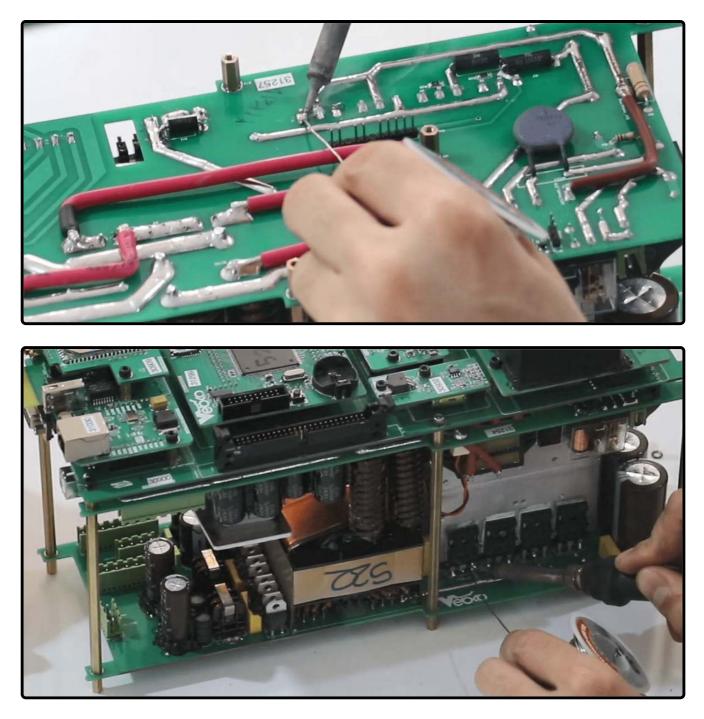


We repeat this for the next pads. Then, we remove the tin on the basses of the IGBTs. First we need to clean the tip of the soldering iron and put some flux on the pins and collect the additional tin. We repeat this for the other pins. We put the insulation talc and then install the IGBT on its extra. We put the pins of the IGBT in the pads as much as it is at the same level as the others.

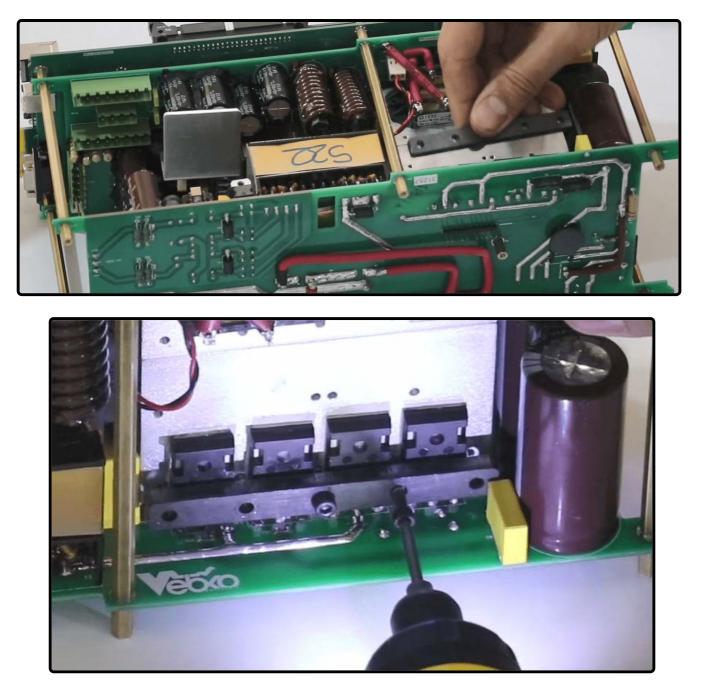




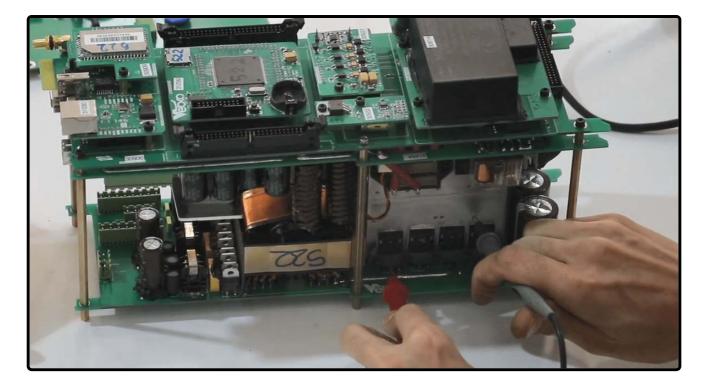
Adjust the IGBT and the talc beneath it, so there must not be any connection between the heat sync and MOSFET. After installing the IGBT, correctly fill the middle pin with tin so that the connection is established. Then we repeat this for the other pins. Another important point when replacing the IGBT is that when remove the IGBT from the board, the pads may be damaged. In fact, the metalized that is inside these pads is separated. For this, put the tin on the pin from the top so that the connection with the board is thoroughly established.



Then close the holder. To do so, first, fasten the middle screw because a piece of metal is putting pressure on the IGBTs and the screws must be fastened in a specific order so that this pressure is uniformly applied to all of the IGBTs. This is why you don't completely fasten the screws. Only fasten them at the end. If you are using a torque wrench for fastening the screws, set the pressure on 2.5 newtons on meter and then fasten the screw. If you are using a screwdriver, keep fastening until you feel that the screw is tight enough.



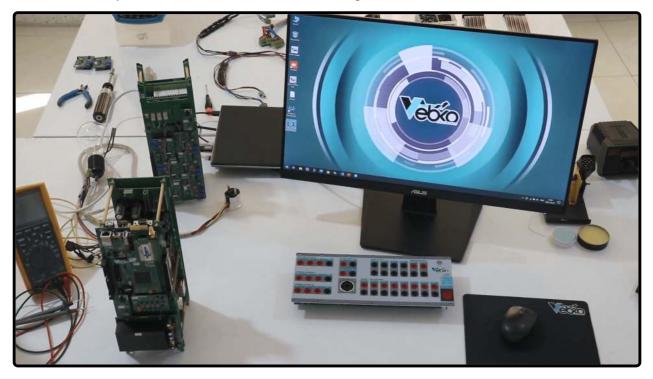
After closing the holder, to ensure that there is no connection, put the multimeter in the ohm mode and check the middle pin of every IGBT with the body of the heat sink. It must be Overload in all states. So replacing the IGBT ends here.

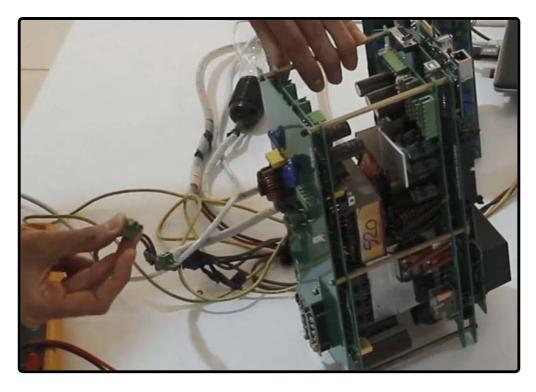


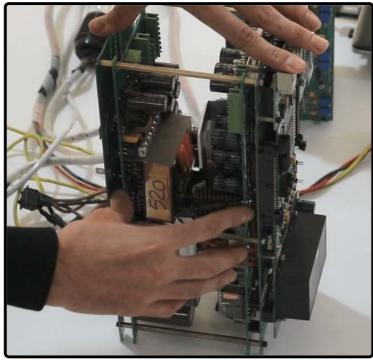
152 : INTRODUCING THE INTERNAL MODULES PART1

In this part, we are going to introduce internal modules of the Vebko relay tester device, the possible problems and how to solve them.

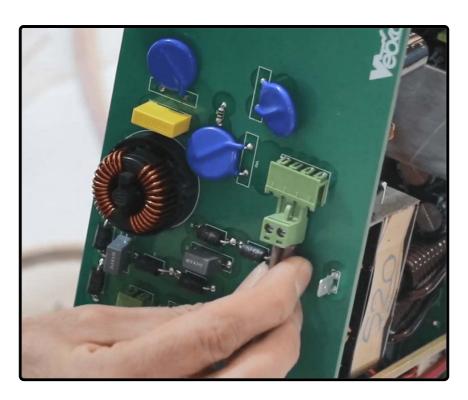
After watching the video tutorial on how to open the device, you must have noticed that the device has three main modules, including the switching module, the amplifier module and the front panel of the device. First we are going to get familiar with the switching module which provides the second module or amplifier with the main power supply. After opening the device, to prevent facing any problems during the test, you can use a lamp series that we have placed in the route of the input electricity. The phoenix that you are seeing is placed after the series lamp and is connected to the input section of the switching module. The switching module has a main module that is located in the middle and has two complete and incomplete sides. The complete side is the side where there are more modules on the Main while the incomplete side has, in fact, more protective elements. There are four pins in the incomplete side two of which are located on the left side of the phase and the other two are located at the right side of the null.

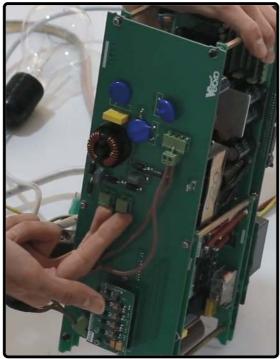


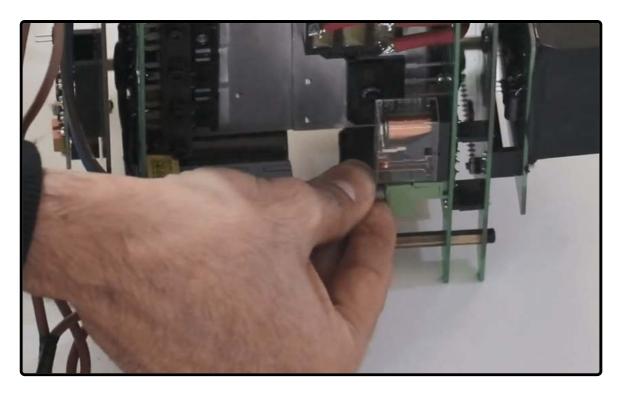




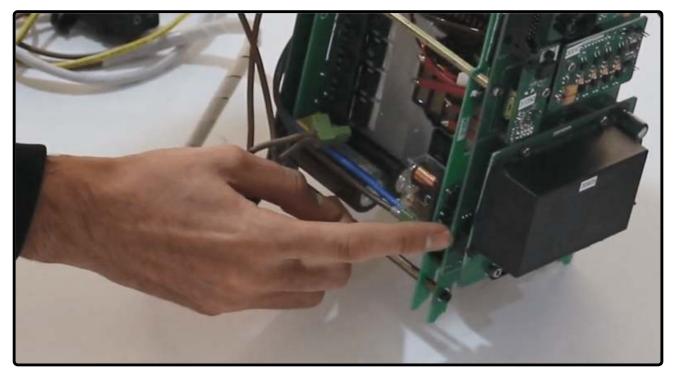
We connect this phoenix to the two pins at the middle of these four pins which includes phase and null. When the input electricity enters the incomplete side it crosses a set of protective elements including varistor, line filter and protective diodes two of which are located between phase and null, two between phase and earth and two more between null and earth. The incomplete side has two outputs. This means that the electricity enters the two phase and null outputs after crossing the protective elements which is connected to the two sides of the main input of the device by two cables. Therefore, the two complete and incomplete sides must be electrified. This part of the output electricity is connected to the incomplete side and this cable is connected to the complete side.

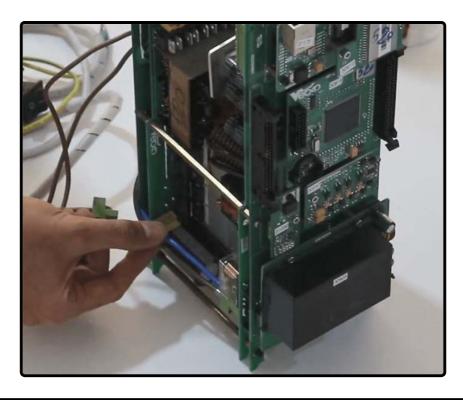


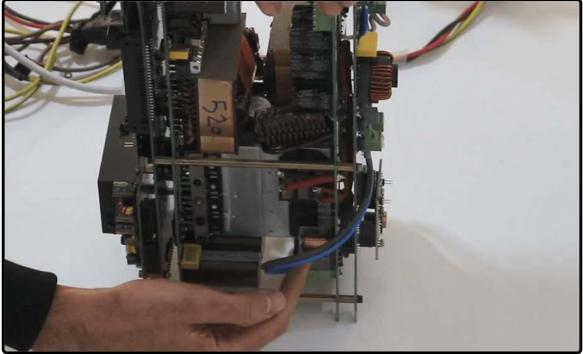


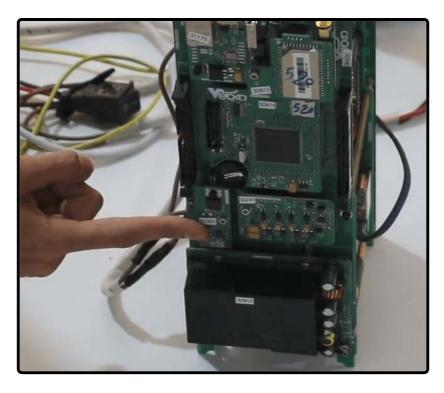


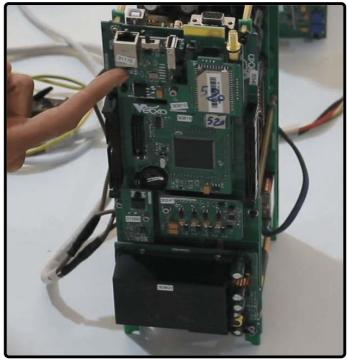
Note that as soon as the electricity of the complete side is connected, the black header enters the Main Switching through this pin. When 220 volt electricity enters this section, it enters the PS or the input power supply through this phoenix. As soon as we electrify the two sides of the switching the middle module does not get electrified at all. When the connection command of the switch number one and two appear in the software, the middle module gets electrified. This means that the middle module is never electrified at the first moment and the electricity only enters the PS from this section. This PS has 12 and 5 volts DC outputs. Through this PS, the electricity enters other modules including fan controller, micro module and LAN-GPS module. After the electricity enters the PS, its outputs that are 12 and 5 volts DC electrify the above modules. These 5 volts enters the micro and by this IC changes into 3/3 volts which provides the power supply of the micro.



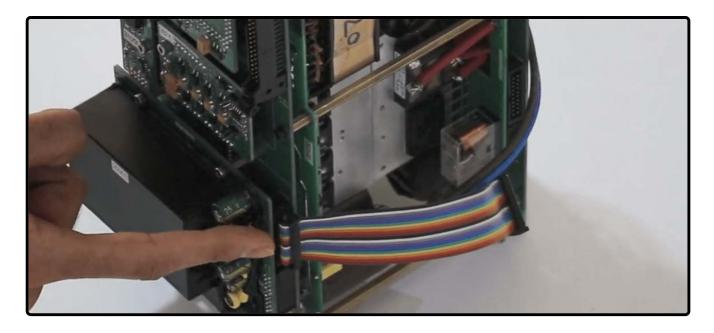








After that we can apply the commands of the main parts of the device by the micro. One of these commands is the command to connect switch one and two in the software. So let us emphasize that after the input electricity crosses the protective circuits that are embedded into the incomplete side of the switching, the two sides of the output are electrified by its outputs which enters the complete side from here and the incomplete side from here. The main commands are issued by the micro. The input electricity enters from this part and the PS is electrified. Then its output reaches the above modules. So, we provided the power supply of the incomplete side from this part but the connection of the commands of the incomplete side micro establishes the connection between the complete and the incomplete switching sides by a flat cable that is embedded in this part.



153 : INTRODUCEING INTERNAL MODULES PART2

When the device is electrified in this state, after the electricity passes the lamp series, it enters the incomplete Main Switching through this phoenix and crosses these protective elements. In the end, this Main has two 220-volt outputs and one of the outputs enters the complete switching side from this way and the other output enters the incomplete switching side through this phoenix. When the electricity reaches this part, it enters the PS through this black pin header. This PS receives the 220 volts AC and converts it to 5 volts and 12 volts DC and provides the upper modules with power supply. These 5 volts enters the micro and is converted to 3/3 volts by this IC; using this 3/3 volts electricity micro LPC1788 which is the main micro of the device starts working.

In this part where the phoenixes are electrified, the middle part of the device is not electrified yet and only the digital part of the device is electrified. Then it is ready to command the middle part of the switching by the micro. Above the phoenix there is a glass relay which belongs to the complete switching side and is known as switch number two in the software. On this side, this glass relay is the relay which activates by connecting switch number one in the software and electrifies this part of the switching. Here there is a series lamp in the circuit. When the switches activate, the lamp turns on for a moment and then it turns off. It is better that there is a series lamp series in the circuit because if current is drawn from a part of the circuit, this lamp is turned on.

As soon as the device is electrified the digital part enters the micro by 5-volt and 12-volt PS and prepares the micro module for issuing the command. In this part, we enter the settings of the software and connect to the device by entering the IP., In Hardware tab there are two sections of Enable Switch 1 and Enable Switch 2 and these are the relays that were explained.

154 : INTRODUCEING INTERNAL MODULES PART3

In the settings section of the software, after entering the IP and connecting to the device, there are two sections of Enable Switch 1 and Enable Switch 2 in Hardware tab. By activating Switch number one and selecting Apply, this section which is related to the switching of the device activates. This glass relay here is connected and the input electricity which is connected to the phoenix through a cable, electrifies this part of the switching.

By activating switching number two, this relay is connected and electrifies the middle part of the switching. Whenever there is a problem in the switching module, if you have a series lamp, it remains on the whole time and you can find the source of the problem by disconnecting the key. Note that if you do not have a series lamp, other parts of the device might get damaged in which case an Overcurrent error is displayed.

In the output phoenixes section of the switching module, we can have the desired voltage for powering the amplifier module by connecting this relay. The notable point is that the command module is the upper voltage section, specially these pins that are out of it. There is no problem before the switches are connected, in other words, it does not have any dangerous voltage. But when the switch is connected, be sure not to touch the command module with bare hands. The other modules are safe to touch.

Up to this point, after switches one and two are connected, we must have the desired voltages in the device. Generally, the two sides of the switching module are similar to each other. Here there are two 8-pin phoenixes and one 4-pin phoenix. 8-pin phoenixes are the outputs that power the current phases of the amplifier. Later more will be said about the amplifier

module. The phoenix that is located on the outside section on the board must have 12 to 13 volts in relation to the 4-pin phoenix while the phoenix on the inside of the board must have -12 to -13 volts in relation to the 4-pin phoenix.

When switches one and two are active, set the multi-meter at DC mode and in measurement, you can even measure these two 8-pin phoenixes in relation to each other and the multi-meter must show a value from 22 to 24 volts.

After activating switches number one and two in the software, you must measure the output voltages of the switching module. All pins of this 8-pin that is located on the outside section of the switching module are connected to each other and it must show 12 volts of value in relation to this middle phoenix which is the earth. This 8-pin which is located on the inside section of the switching module, must should -12 volts of value in relation to this phoenix in the middle.

If we measure two 8-pin phoenixes in relation to each other, 22 to 24 volts of value must be displayed. This phoenix is the output of voltage. In general, the switching module has two outputs one of which is the output of these phoenixes and has 12 and 12 volts of voltage. The output of this section of the module powers the amplifier. This phoenix is the second output whose output voltage is 300 and 300 volts. Next, we measure its value by using a cable. In this phoenix the earth middle pin and the side pins are 300 and 300 volts. These outputs that were just explained belong to the incomplete switching side.

Also, in the complete switching side, this phoenix that is located on the outside of the switching, just like the incomplete switching, must have 12 volts of voltage in relation to the middle phoenix. This phoenix which is inside the switching has a 12 volt output in relation to the middle phoenix.

In this part we measure two 8-pins in relation to each other and an approximate value of 23/3 volts is displayed. Therefore, the output of the switching module is correct and we only need to check some other items on the module. We turn the

device off and introduce modules of the complete switching side one more time. The PS module that is responsible for

powering other modules has 12 volt and 5 volt outputs. This is the fan controller module which is also on the board of the amplifier and when temperature of the device rises, it increases or decreases the speed of the fans. This is the command module and this is the micro module which is responsible for the commands of different parts of the device. LAN-GPS and Wi-Fi modules are located at the top which are used to establish the connection between the software and the device through LAN, Wifi and GPS.

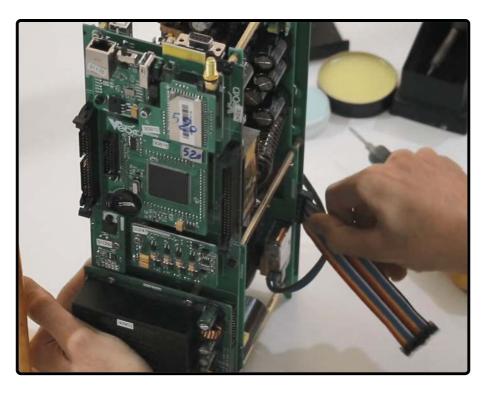
After the device is turned on, we first connect to the device. By connecting the switches, for the complete switching side, 220-volt electricity enters the switching and passes through Diode Bridge and eventually generates 310 volts DC. At the same time, using the command, the micro generates 4 high-frequency pulses whose outputs are located in this section and enters the switching module through a set of pins located at the back of the Main. These high-frequency pulses are connected to the gates of these IGBTs while 300 volts of DC voltage is connected to the drain of these IGBTs. Finally, a high-frequency pulse with a DC amplitude of 300 volts, which is the output of these IGBTs, is taken from the sources and connected to the input of the transformer.

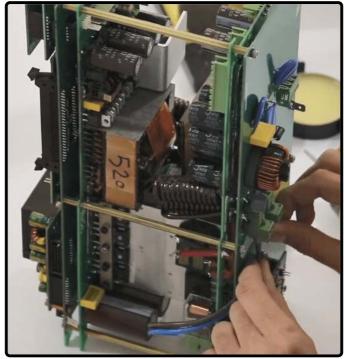
So, the input of the transformer is a high-frequency pulse with a 300-volt range which comes from the input electricity and is converted to DC by the diode bridge. Considering the coil of a transformer, it produces the expected output voltage of the switching module in several 12-volt and 12-volt, 75-amp, 300-volt, and 300-volt windings that do not have much current. The desired voltages are generated after passing through the rectifier diodes in DC. The intended voltages are converted to DC after passing through rectifier diodes.

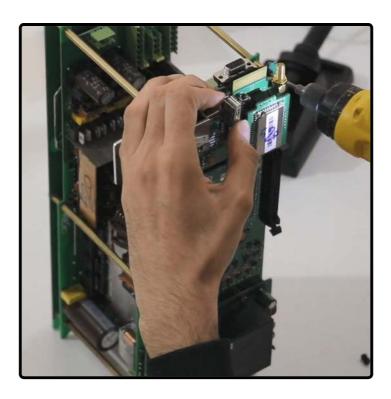
The input electricity of these two sides enters this section through this cable and the connection command of the relay of the incomplete switching side and its connections are adjusted from the complete side through this cable. If this cable is removed from its place or its connection with this part is not completely established, when the switching number one is connected, an Overcurrent error of board one is displayed which is not eliminated by Clearing it. Just the relay disconnects and reconnects so that this flat is correctly placed in its location. Another point is that the relays receive the command from here through the pin header of this section and then it enters the relay to stimulate its bobbin. It is the same in these parts. If this upper pin header is not correctly installed, the relay will not connect and to know when these relays connect, by activating the switches in the software you can hear a sound to ensure that the relays are connected and ultimately have the output voltage from the switching module.

155 : SWITCHING MODULE

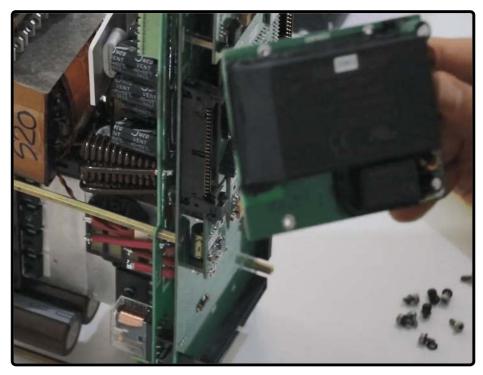
Next, we are going to see how to work with the switching module. If in the switching module we have an Overcurrent error of the board one or board two, we have to open the board of the switching to find its problem. First, we disconnect the connection between the two sides of the switch, which is this flat, and then the input power cables that enter the two sides of the switch from the protection circuit. Then, we open the screws that are attaching the two sides of the Main to the Spacer. Every one of these modules, except for the micro module, is attached to the Main by these screws. The micro module is attached to the Main by its own pins.

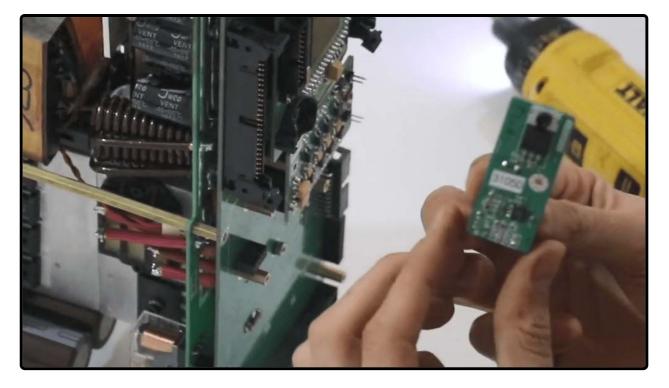


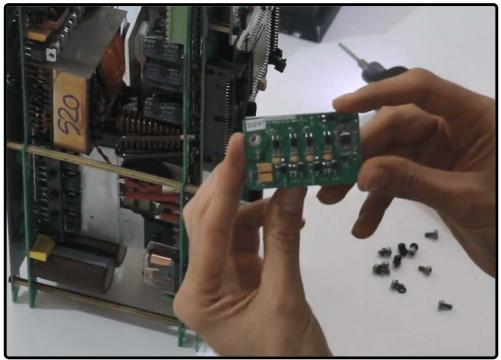


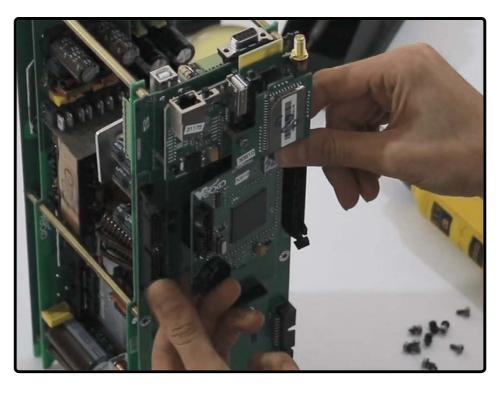


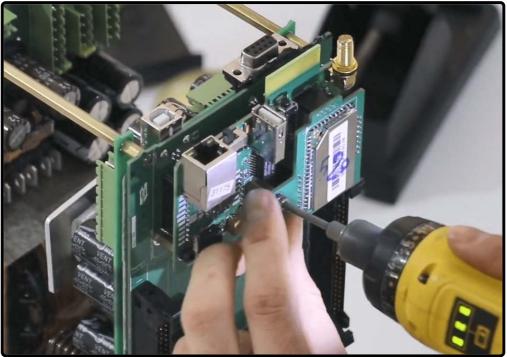
You can easily detach PS, Fan Controller, Command and Micro modules from the Main by applying little pressure to the outside. To detach LAN-GPS, first, the above screws are opened and the Wi-Fi module is detached. Then, by opening this spacer and a screw in this part the LAN-GPS module is detached. There is one screw in the end which is in the back of the PS module and two more screws at the bottom of the module. After all side screws are opened, the Main can be easily detached.

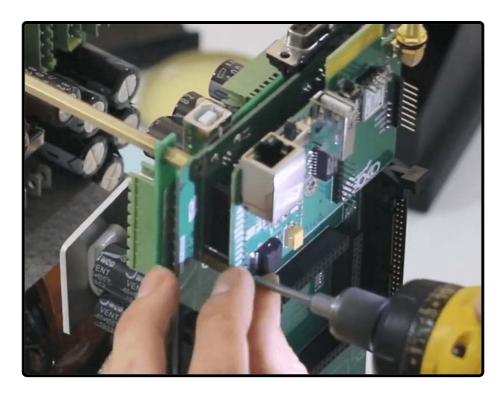




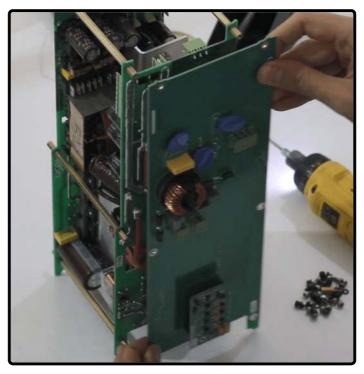


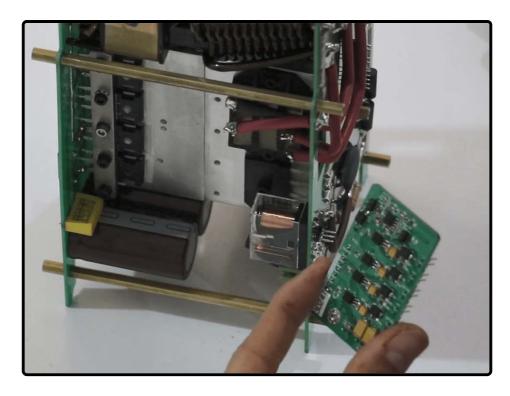




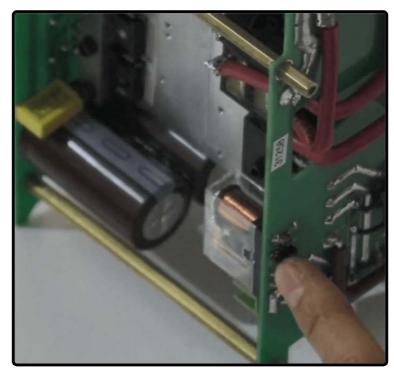


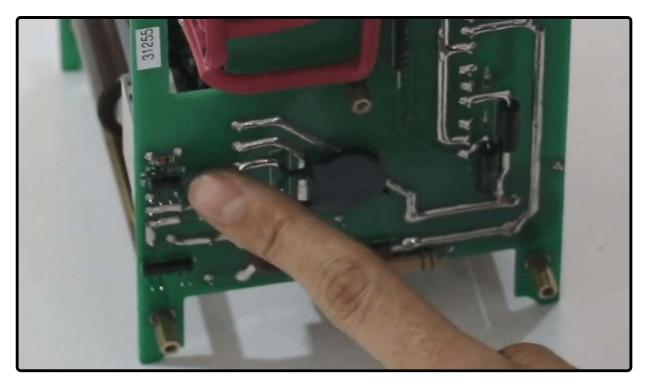
On the Incomplete Main Switching, other than these protective elements, there is a command which, just like the complete switching side, generates high-frequency pulses and the output of this module is 4 pulses. We can detach the Incomplete Main Switching by opening the screws around it. Also, it was already mentioned that in addition to the protective modules, there is a command module as well. The command used in the Complete Switching Side is no different from the one used in the Incomplete Switching Side. This was mentioned to note that when we have an Overcurrent error on a Switching side, before opening the Mains, we should swap the commands of the two sides to make sure that the problem is with the command module. If the error is eliminated the problem is with the command otherwise there is a problem in other parts.

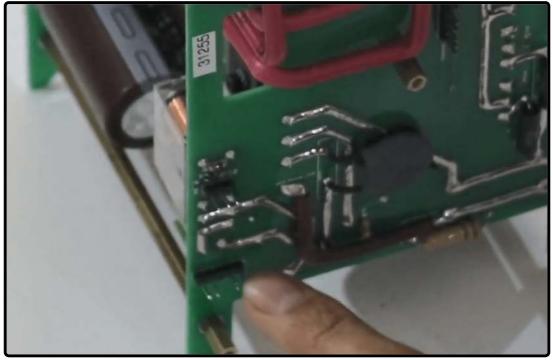




After opening the switching module, it is a little hard to differentiate between the complete and incomplete side. In the complete switching module side you can see a double pin header. The electricity is AC that reaches the PS module. Then the PS is electrified so that the other modules are electrified. There is no such pin header in the incomplete switching side. Only there is a 3-pin pin header which issues the connection command of the relay of the incomplete side or switch number one. In the complete side, we have the same triple pin-header which is used for the complete side switch or switch number two. Also, we have the phase and null that electrifies the PS. Therefore, the side where this double pin header is located is the AC electricity and because of this, we know that this is the complete side of the device. When there is an Overcurrent error of board two or board one, as mentioned before, first we swap the command modules of the two sides. If the problem is solved, the command module is causing the error, otherwise, we need to open the Main as already mentioned and then move the faulty side up to this level like this. Here you can check some items to see what part is causing the Overcurrent error.

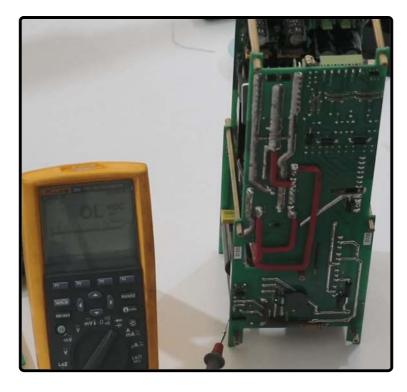




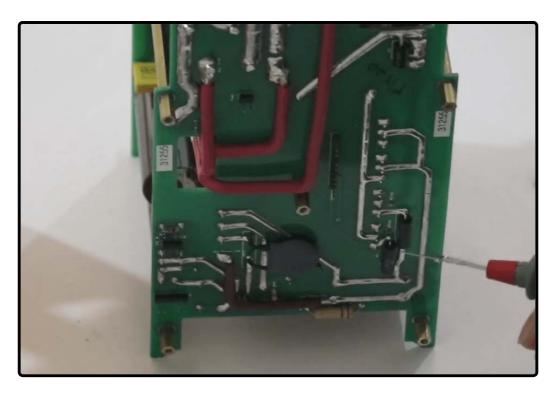


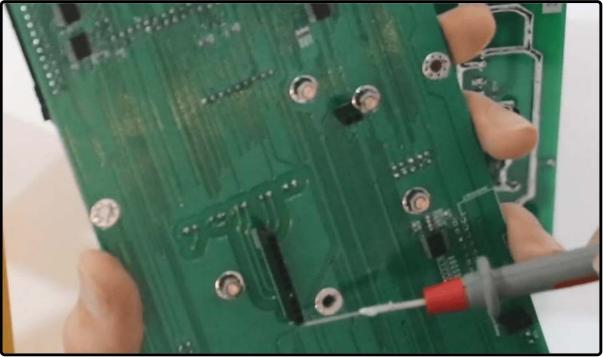
156 : POSSIBLE ERRORS IN THE SWITCHING MODULE

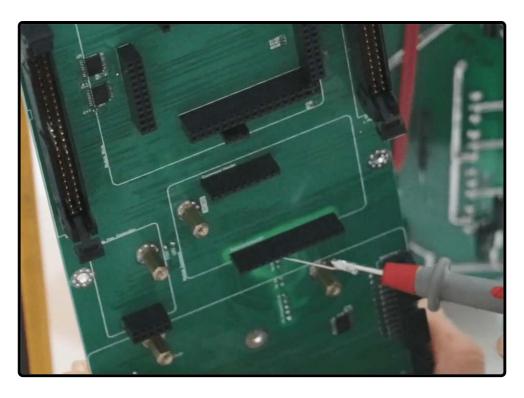
Overcurrent error of board one and two is one of the most common errors in the switching module. After making sure that the command module is healthy, in the switching module, we need to find the problem in accordance with the error that we are having on a side. As mentioned earlier, the input electricity enters from this section. When switch number two is connected, it is converted to DC by the diode bridge and 300 volts DC enters these two lines. It enters the IGBT from here. If you pay careful attention to the complete Main Switching, you can see that these female pin headers are connected to this part. These connections enter the command module from here.



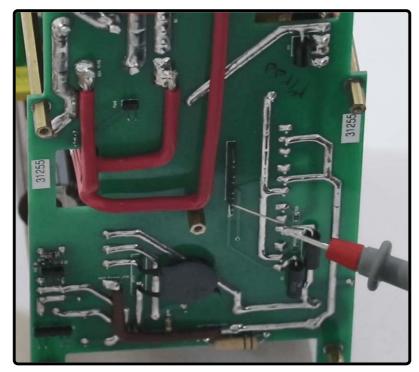








This means that the command pulses enter this part from here and then go to the IGBTs. Each of these pins is connected to one of these IGBT pins. Some of the problems that some users might face are that when the IGBTs are placed on the board, while installing them in this section, the pads may be detached, or if the tin of these bases is weak, the connection between this IGBT base and the pin header may not be established. So the first step is to examine the command and after making sure that the command is healthy, we enter the switching module. First we perform the IGBTs' test. We set the multimeter at diode test mode. The second and third bases from the top for every IGBT are drain and source bases. We connect the negative and positive probes of the multimeter to the second and third bases, respectively, and the approximate value of 0/4 must be displayed and in the opposite state is Overload. We perform the test for every one of these IGBTs.



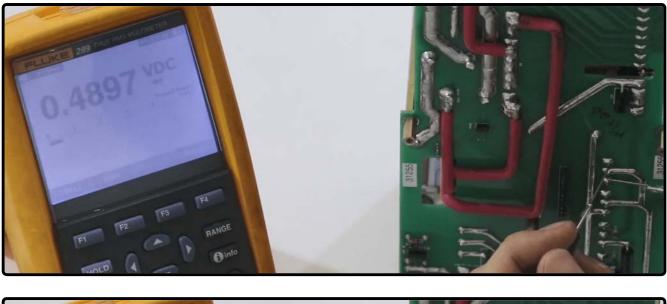






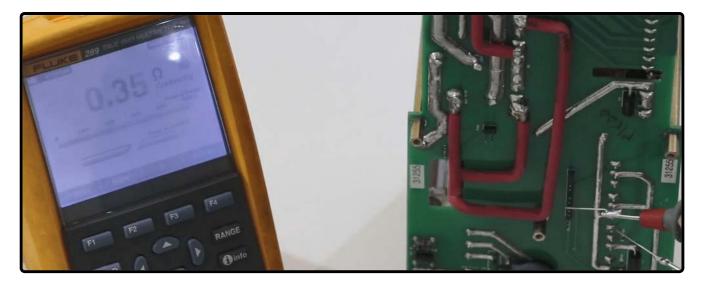
So examining the command is the first step and then we need to test the IGBTs to see if one of them is burned out. If drain and source has a 0/4 value and its opposite state is open or is not Overload and if gate and source bases are open, that IGBT is burned out. So far we know that the IGBTs are healthy. We set the multi-meter at Buzzer mode and check the connection between these IGBTs and these pin that connect the command and the switching module. From the top, the gate and source of the first IGBT must be connected to pins number one and two, respectively. The connection between

this pin and here is a track from inside the switching module. When the IGBT is changed, it is possible that this track is disconnected or it does not have any tin and the connection is not properly established.



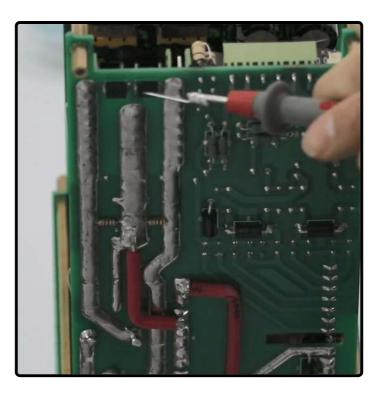


Then, the second IGBT and its source are connected to pin number 3 and pin number 4, respectively. The source of the third IGBT is connected to the last three pins and for the fourth IGBT, the second base which is its gate and its source is connected to the last three pins. If all of the connections are correct, the IGBTs and their connection to the command module are completely healthy. In the end, we precede one more step and if we still are not able to eradicate the Overcurrent error, there is one more thing that we can do which will be explained in the following. There is a set of protection diodes in the input and output of the transformer so that they can neutralize any sudden voltage and also there are two protection diodes in the current output. We can examine these diodes by a diode test. This diode that is located at the two ends of a coil and normally, these two ends are connected to each other, by testing it we can see that the two ends are connected so the only way to test this diode is to remove one diode base from the circuit and then test it.











157 : CHECKING THE PARTS, IN SWITCHING MODULE ERRORS PART1

To test this diode, first, we need to detach one of its bases from the board and perform a diode test on it. In this test, the diode must be Overload on both sides. Then we test the other three diodes. This diode which is in a vertical position, if positive and negative probes are connected to its top and bottom, 0/4 is displayed and by reversing the probes, it must be Overload. This does not mean that these diodes are usually like this. All diodes are similar and do not allow anything to pass from any direction. It is because of the elements with which they are made parallel or series that these values are displayed. In fact, the correct value is 0/7 that you can see and its opposite is Overload. It is the same for the next diode.

We can test these two diodes by detaching one of the bases. The top side of these two diodes must be Overload as well.

In the end to eradicate the Main Switching error, if the problem is not with the command, IGBTs and the connections with the pins, then it can be said that the problem is with the diodes. This error can have several reasons at the same time; for example, maybe the IGBT and diode are both burned out. In the first step, we replace the IGBT but the error still persists. It is better to test all elements and then turn the device on. Another solution is to check these rectifier diodes located at the transformer output. Ten rectifier diodes are located in the output of the transformer on the complete switching side. It is possible that these diodes are faulty and we are going to test them. So you can easily determine that which part of the switching is not functioning properly. Here there is a track and by removing the tin on this track, its connection is severed. By disconnecting this track, the connection between the input of the transformer which is these IGBTs in the bottom side and the top side of the switching is severed. Then we connect the switch to see whether the error is gone or not. If this track is severed, only the bottom side of the switching is not with the top side of the circuit and IGBTs, command and the connections of pins must be tested.

More on the Overcurrent error

First, we connect the electricity while the series lamp is in the track of the input electricity. It was mentioned that there are some protection diodes in the input and output of the transformer. We simulated the input of the transformer and our assumption is that the protection diode is burned out. Then we short-circuit it and by connecting switch number two, the lamp series which is located in the track of the input electricity stays on and disconnects the system completely. This is a sign of the Overcurrent error of board number two and we need to find the problem which is the diode that we short-circuited. You can see that when the switch is connected, the lamp series turns on and disconnects the electricity. By disconnecting the series lamp in the track of the electricity and by connecting the switch, you can see the Overcurrent error of board number two. When the device is assembled, there is no lamp series in the electricity track and we see Overcurrent error of boards one and two. If the device is open and if the lamp series is in the circuit, we can easily find the problem at any stage.

158 : CHECKING THE PARTS, IN SWITCHING MODULE ERRORS PART2

Now, to solve the Overcurrent error that we caused on purpose, using a short piece of wire, we short-circuit the diode which is located in the input of the transformer and suppose that the diode is burned out and we are not aware of this problem. In the first step, we replace the command of the incomplete switching side with the command of the complete switching side. But the error still persists. So, it is not the command that is causing the problem. Therefore, as previously mentioned, we open the screws of the Main Switching. We completely detach the main from the module, and then examine the IGBTs and their connections with the pins that are connected to the command. Finally, we get to the test of protection diodes. We cannot test this protection diode which is located in the input of the transformer, while it is still connected to the switching module because it is located on the two ends of a coil while that coil is short-circuited as well.

Therefore, we need to detach one of its bases from the circuit and test it. We replace this wire here which is the burned out diode and is causing the error with a healthy diode. Then we connect to the software and the error must be gone. We have explained how to test these diodes before. To test any of them, first, we detach one of the bases and then test the diode. It is the same for these rectifier diodes. Every one of them must show 0/3 or 0/4 as value for one side, and Overcurrent for the opposite side. Note that to test these diodes; it is necessary for one of the bases of the above diodes to be detached because if this diode is short-circuited, when connected, we may see them as burned out while they are in fact healthy.

We install the healthy protection diode in the input of the transformer again. Then, we connect the complete and incomplete Main Switching's, connection flat of the complete side to the incomplete side and the input electricity of the modules. Finally, we connect the input electricity of the incomplete switching side and the commands.

After replacing the diode of the input of the transformer and adding a lamp series to the circuit, we connect to the software and connect switch number two whose diode we just changed. Now we can see that the lamp series are turned on for a moment and turned off. All items are healthy and the output voltage is flowing.

Suppose that we have an Overcurrent error problem of board number one. In this case, first, we replace the command of the incomplete side with the command of the complete side. If the problem still persists, we need to detach the Main Switching of the incomplete side. First, we disconnect the electricity cables from the two sides and the connection flat; after opening the screws, we remove the Main from its place. Then we perform a test for IGBTs and their connection with these pins. Next, we test the protection diodes as well as these two diodes and the rectifier diodes, just like how we tested the other side.

159 : CHECKING THE PARTS, IN SWITCHING MODULE ERRORS PART3

In the switching module, when switch number two is connected, we get an Overcurrent error of board two. According to our previous explanations, we need to proceed step by step to find the problem. In the first step, we replace the command module with the command of the incomplete side to see whether the command is causing the problem or not. Before doing this, we need to turn the device off. Then we replace the modules. Since we have already connected switch number two, it does not really matter if we connect the command of the incomplete side because we cannot activate switch number one. Then we turn the device on and connect to it. You can see that even by replacing the commands, the error still persists. We

turn the device off again and open the Main Switching of the complete side.

As mentioned before, we open all screws of the modules and then Main and completely detach the Main from the module. Then we test the IGBTs. To do this, we set the multimeter at diode test mode and test the IGBTs one by one, as explained before. Bases two and three must show the value of 0/4 in one side in the diode test and it must be Overloaded in the other side. Most probably the IGBTs are damaged because all of the four IGBTs are damaged in the test and to make sure of this, we need to remove the IGBTs from the circuit and repeat the test. To remove these IGBTs, we detach the Incomplete Main Switching so that the switching module is easily put on the desk.

These IGBTs must be tested one by one. On these IGBTs, there is a holder that is tightened on the body of the heat sink by five screws. Before melting the tin of the bases of the IGBT, we need to open these screws and detach the heat sink a little and put these insulations that are located between the IGBT and the heat sink on the body of the heat sink. Then, by adding the extra tin on the bases of the IGBT and holding the soldering iron at this point, remove the IGBT from the module. Then we test it and we can see that this IGBT is short-circuited. Then we test the next IGBT on the board and this one is short-circuited as well. So we remove it and test it again which does not change the result and it is still short-circuited.

Usually, in over voltages that are applied, it is possible that all of the IGBTs get damaged, and here only the IGBT number four is healthy and the rest are damaged. Then we assembled the healthy IGBTs on the board. When we removed the IGBTs from the circuit, inside the pads got filled with tin. Using a desoldering suction, we remove the tin inside them so that we can easily install the parts. By holding the soldering iron on the pad, its tin melts down and then we can easily remove it using the desoldering suction. Then, after removing the tin, we install the healthy IGBT until the last part like this and then we fix it by adding some tin. Following the same procedure, we remove the tin from the pad of the next IGBT and install the part in its place.

After replacing the damaged IGBTs, as you can see, we emptied the pads, installed the IGBTs and then filled the bases with tin. In the end, we fix the holder that is placed over the IGBTs. After fixing the holder, we need to take a IGBTs connection test (drain base) with the body of the heat sink which is the same as the ohm test where none of them has body connection. Finally, we put the incomplete Main Switching and along with its command module and the complete Main Switching in their places. Then we connect the connection flats and electricity cable of every part. By turning the device on and activating switch number two and clearing the error, the series lamp turns on for a moment and then turns off which means that there is no problem. After that, we check the output voltage of the side that had an issue. Then we take a test between the eight-pin external phoenix and the eight-pin internal phoenix which should give 23 to 24 volts as the result. So the problem with this module was that three of the IGBTs on the switching module were burned out and by replacing them, the problem was solved and the output voltage is correct.

160 : THE CONNECTIONS BETWEEN THE SWITCHING MODULE AND THE AMPLIFIER

In the beginning, it was mentioned that the switching module is responsible for supplying power for the amplifier module. Two flats are used to establish the connection between the command of the micro and the amplifier module. In this section, the connection between the complete Main Switching and the front panel is established through this IDC. First, we explain the connections between the switching module and the amplifier. The switching module must supply the amplifier

module with power through the output voltages.

In this section of the switching module, the external eight-pin phoenix has 12 volts, the phoenix in the middle of the GND and the next phoenix have -12 volts that in these cables, blue is -12, black is earth and red is 12 volts. These cables are responsible for supplying current phases of the amplifier with power. Before connecting it, we need to explain the amplifier module. The amplifier module, just like the switching module, consists of a middle section and two sides called incomplete and complete sides. There are differences between the complete and incomplete sides of the amplifier module.

On the complete side, every one of these modules which is called controller, is related to a current or voltage phase and this controller at the top is related to the VL1 phase and the other is related to VL2 while the one at the bottom is related to VL3. By looking at the front panel, you can see that VL1, VL2 and VL3 are in accordance with the GND. The current phases are in this section. IA1, IA2 and IA3 that are connected to IA1, IA2 and IA3 front panel through phoenixes and cables in relation to earth. In the incomplete side of the amplifier, there are five phases. This is the DC output voltage which is located here in the front panel. This section is the output voltage of group B. here IB1, IB2 and IB3 in the front panel are connected to IB1, IB2 and IB3 in relation to earth.

There is a difference between the incomplete and complete sides. As you can see, there are six phases in this section including three voltage phases and three current phases which have been explained before. On the incomplete side, there are five phases including one voltage phase of group B and one DC phase and three current phases of group B. Another difference is that on the complete side there is a fan controller module amplifier while there is no such thing on the incomplete side of this module. On the whole amplifier module, in addition to the main module which is the middle amplifier module, there are two mains on the two sides just like the switching module where the incomplete and complete sides are separated. In the amplifier module, after opening these screws we can separate these two mains and solve the problems of the module. Also, there are three sensors on every side of the module that are located on the output of the current phases. If we connect to the software, we can see the temperature of IA1, IA2 and IA3 sensors as well as IB1, IB2

and IB3 sensors which is the same temperature as the room temperature.

By drawing current from current phases, the temperature of these sensors rises. As soon as the temperature of the first sensor reaches 60 degrees, we get a Thermal error of the amplifier in the software. Now we connect the electricity that is being taken from the switching module side to the amplifier. If you place the amplifier in front of yourself like this, there are two phoenixes on the right side that are responsible for supplying VL1, VL2 and VL3 voltages and there are five phoenixes on the left side that are responsible for supplying IA1, IA2 and IA3 current phases. This black wire which comes from the power of the phoenix in the middle is connected to the phoenix number one on the left side at the top. Two red wires that carry a 12 volts DC, are connected to this section. Also, the blue wire carrying -12 volts is connected to these phoenixes.

So, now we have connected the power of IA1, IA2 and IA3 current phases to the amplifier through the switching. In the next part, we connect the power of VL1, VL2 and VL3 voltage phases. As mentioned before, this phoenix here, the wire at the center of the GND and the left side of the red 300-volt wire and at the right side which is the blue -300-volt wire goes through resistances. We connect these two phoenixes to the power of the voltage phases. When we connect the switch, we must have 600 volts between the two ends of these phoenixes. So, in the first step, we took the power of current and voltage phases from the switching and connected it to the amplifier. As soon as switch number one is connected, the output of the voltages reaches here and enters the amplifier module through these cables. Also, from this part, a flat is connected to the amplifier module to connect the command of the micro and the SPI signals. Each of these two IDC

Latches that are located on the right and left sides of the Main Switching module is related to one side of the amplifier module. If we connect this cable to this part, the commands will not be executed correctly.

If by initializing the VL1, a Self Calibration error will appear. The electricity for the complete side of the amplifier must be taken from the right side of the Main Switching. By injecting voltage into this side of the module and testing it, we need to take the flat from the left side of the switching module. When the device is assembled, both sides of the device are electrified simultaneously and we connect the flat. Just note that the flat that is connected to the complete side of the amplifier must come from the right side of the Main Switching. So far, have connected power to current and voltage phases as well as the flat that establishes the connections.

We turn the device on. Each of these controllers has a series of boot loaders that are put on the STM32 IC and when they are functioning properly, their LED blinks like this. When we connect to the software, usually we can see this earth error which appears if the related wire is not connected. We connect the earth wire and by clearing the error it disappears. Now, this part is electrified and the electricity reaches the amplifier module through these cables.

By looking at the monitor, you can see four temperatures including Sensor Ia1=24°c, Sensor Ia2=25°c, Sensor Ia3=25°c and Heatsink1 =25°c. By detaching one of these sensors, for example, la1, an error is displayed in the software which can be cleared by selecting Clear Error. The sensor we just detached displays zero-degree temperature. By reconnecting the sensor, 24 degrees is displayed in the software again. To view the heat sink sensor, we first need to turn off the device. It was mentioned that there are three sensors on every side of the module which are related to the currents and two sensors are related to the heat sink. This part is the heat sink and the sensor is located in this part of the heat sink and is connected to the Main by this pin header. Ib1, Ib2 and Ib3 and the sensor related to the heat sink number two are located in this part and connected to the Main by this pin header and its value is read by this Max1202 and displayed in the software. So, there are three sensors in this part and one sensor at the bottom and four more sensors in this part that are

read by this Max.

If current is drawn from any of these phases, these temperatures increase and as soon as the first temperature reaches 60 degrees a Thermal error of the amplifier will be displayed. Sometimes, any of these LN35s may have a problem in reading or this connection cable is damaged. This temperature displays, for example, Ia1 300 degrees as soon as the device is connected. This means that when the device is connected to the software, it displays an error because it has a temperature above 60 degrees and this error does not go away no matter how many times you clear the error unless the Thermal error is disabled in the software. But, even by doing this, some other problems may be caused. So, as soon as you notice this

unusual temperature, you need to start looking for a solution to solve this problem.

We connect the flat cable that transfers the commands. As you can see, the temperatures are as follows: Temperature Sensor Ia1=25°c, Temperature Sensor Ia2=25°c, Temperature Sensor Ia1=25°c and Temperature Heatsink1 =25°c. Also, Temperature Sensor Ib1=0°c, Temperature Sensor Ib2=0°c, Temperature Sensor Ib3=0°c and Temperature Heatsink2 =0°c which are related to this side and since the flat is not connected to this section yet, zero is displayed as their temperature. Now we turn the device off and connect the flat of the side of the incomplete temperature to check them. When we want to check the incomplete side of the amplifier module, we need to connect the left side of the flat from the switching. Then, we turn the device on and this time temperatures of lb1, lb2, lb3 and Heatsink2 must be displayed. So, if any of these temperatures is unusual and there is a Thermal error of the amplifier, we need to solve the problem considering the faulty sensor.

Sometimes, temperatures of sensors one, two, three and four are all wrong. The tin of this IC which is related to reading temperatures may have a problem or the IC itself may be damaged. But if only one of the temperatures is being displayed wrongly, probably this IC is healthy and it is possible that the LV35 senor which can be seen easier by opening the modules, has a problem; also, it is possible that this cable which is connected from LN35 bases to this pin header has a problem.

We turn the device off and turn the module toward the complete side. If you enter the amplifier in any current or voltage phase, every phase of Va1, Va2 and Va3 voltages has two MOSFET, N and P. Also, current phases I1a, Ia2 and Ia3, just like current voltages, have two MOSFET, N and P.

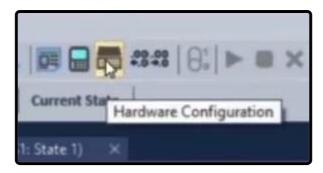
161 : END-TO-END TEST

One of the most essential tests to be performed on the lines that are protected by relays on both sides is an "End to End test". To perform this test, both devices on the sides of the line must be synchronized and inject the required signals into the relays simultaneously.

The first step is the stability test. There are two things to consider for this test: first, the transformation ratio of CTs and second, the polarity of CTs.

For example, suppose that the transformation ratio of CT in post A is 1000/1 and in substation B is 800/1 and the polarity of both substations is toward object. If the current in the line is assumed to be 1000 amps, then the current of the relays of the substation A and substation B will be 1 and 1.25 amperes respectively. Also because the polarity of both CTs is toward object, there will be a 180 degree phase difference in the corresponding phases.

The "AMT Sequencer" room is used for performing the stability test. In this room, 6 current phases must be activated. To do this, go to the "Hardware Configuration" page and deactivate the voltage phases. Then all the 6 current phases will be activated in the "Current Output Signal" section. Considering what was said in the preceding example, 3 balanced 1 amp phase current and three balanced 1/25 amp phase which have a 180 degree phase difference with their corresponding phase toward each other, will be entered in the "Table View" tab.



stage Output	Vollage Output Signal
a 1507, 12014 ⊕ 400a-Mene a 1507, 12014 ⊕ 400a-Mene a 2007, 12014 ⊕ 400a-Mene a 2007, 2007A ⊕ 400a-Mene	Output Target Output Laber 🗌 Show Actual Value
umat Output	Current Output Signal
Job advin grade Updra 30 Alterna UERA 400VA & T23A 31Ams. 30A. 12Mms id Usad	Output Target Output Label Phone Actual Value 81 11.1 15.1 Frakes 92 11.2 11.2 Frakes 93 11.3 11.3 Frakes 91 11.11 11.31 Frakes 91 11.2111 Frakes 11.11 92 11.2111 Frakes 11.11 93 11.3111 Frakes 11.2111 93 11.3111 Frakes 11.2111 93 11.3111 Frakes 11.2111

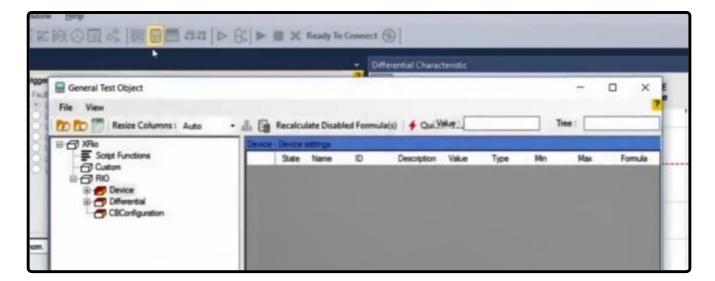
			2
Name	State 1		
1 L1: I L1	1.000 A	0.00 *	50.00 H
112:112	1.000 A	-120.00 °	50.00 H
1L3:1L3	1.000 A	120.00 °	50.00 H
I L1(1): I L1(1)	1.250 A	189.00*	50.00 H
I L2(1): I L2(1)	1.250 A	60.00 *	50.00 H
I L3(1): I L3(1)	1.250 A	300.00 *	50.00 H
Bin. Out	B1 B2	/- B3/-	B4/-
Trigger	Ó.		1.000
Туре	Normal		

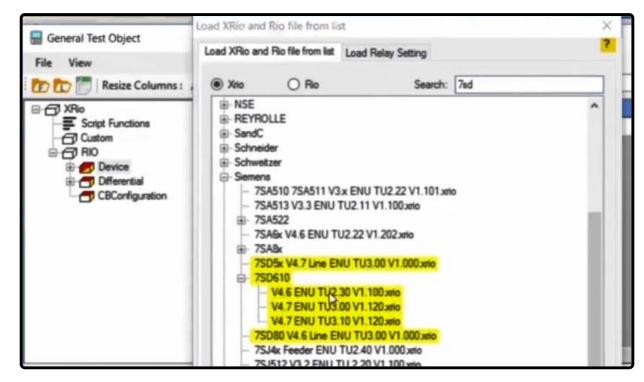
Injecting these currents into the relays will take 100 seconds. During this time, the "Idiff" of the relay, visible on the measurement panel in front of the relay, must be zero.

			2
Name	ate 1		
1 L1: I L1	1.000 A	0.00 *	50.00 Hz
112:112	1.000 A	-120.00 *	50.00 Hz
1L3:1L3	1.000 A	120.00 °	50.00 Hz
I L1(1): I L1(1)	1.250 A	180.00*	50.00 Hz
I L2(1): I L2(1)	1.250 A	60.00 *	50.00 Hz
I L3(1): I L3(1)	1.250 A	300.00 *	50.00 Hz
Bin. Out	11 B2	/- B3/-	84
Trigger	(Ö		100 s
Туре	omal		~

The second step is the characteristic curve test. In this room, first, the 'XRio" file of the differential relay which is being tested will be imported. To do this, go to the "Test Object" page and click on the "Import from list" option to open the "Template" list of the relays. For example, "7sd" is searched and its "Template" is selected. Then from the "File" menu, click on "Load Relay Setting" and the "XRio" of the relay of the post A which is exported from the "DIGSI" software is entered. A very important point to note in this section is that, also, the post B relay settings should be entered in the "XRio" of the post A relay. Because the curve of the differential of this relay is related to the settings of both relays, it is necessary that the settings of both relays are available in one file so that the curve is created correctly. To do this, open "XRio" from the subdirectory of "7sd" and then open "Additional Information". After that, select "Relay Parameter Section (Remote Relay)".

AMT Sequ	encer - AMT Se	equencer		
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1L1:1L1	1.000	A D	AMT Distance	
112:112	1.000	A	AMT Differential	L
1 L1(1): 1 L 1 L2(1): 1 L	1(1) 1.250	A	AMT Diff Harmonics	Н
1 L3(1): 1 L3	3(1) 1.250		AMT Meter	p
Bin. Out Trigger	11/_	82. J	AMT Transducer	
Туре	ormal	Ó	AMT Synchronizer	
Comment		3	VCC	





File	View
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8	Export Vebko XRio
	Load Relay Setting
	XRio Organizer

Relay Setting	2			×
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XRio Contains				
	Foreign ID (PCM600	0		
Equal ID				
XRio Contains				
Setting Contain	ns XRio ID			1
Advanced	New		ОК	Cancel

In this section, in order to enter the information of the other side, the information on the parameters that are green in the "State" column, must be entered in the "XRio" of the relay. This information can be entered in two ways: if the file of the relay is available in the "DIGSI" software, the information is imported from the software. Otherwise, the other person in the post B should read this information from the relay and announce it. After entering the information, the characteristics of the curve of the relay will be created in the post A.

The same steps are taken from the "Import from list" point to the end in the post B and in the "Additional information" section, the relay information of the Post A must be entered so that the curve is created in the Post B too.

By double-clicking on the "Line Differential" option, the "Differential Protection Parameters" page opens. The point to note on this page is to enter the post A relay information in both posts A and B of the "Primary" Column and enter relay information of the post B in the "Secondary" column. It should also be noted that the information of "Protection Device" tab, "Idiff" section and also "Characteristic Definition" tab must be exactly the same on both sides.

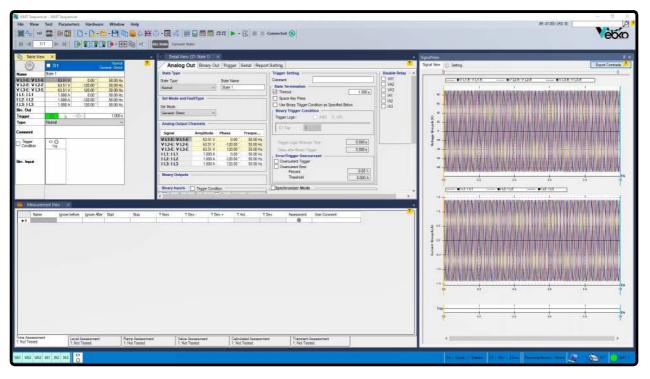
After the relay curve is made, the person on the side of the relay A must flow the 3 upper phases and short circuit the lower 3 phases. Meanwhile, the person on the side of the relay B must flow the 3 lower phases and short circuit the 3 upper phases of the current.

Once the curve is made and it has been made sure that everything is the same on both sides, such as the transformer's differential test and "Check" test, then the "Shot" and "Search" are performed. The point is that every test and "Fault Type" which is added to the test table on one side, must be exactly repeated, with the same values, on the other side in the "Fault Type".

To perform this test, it is necessary to perform the test simultaneously on both sides. For this purpose, it is essential to connect the "GPS" antenna to the back of both devices first. Then go to the "Start-Condition Repetition" page and select "On GPS" option in the "Start Condition" tab. On this page, by activating the "Start Time" option, both devices show a specific time in the time field on their front. By doing this, both devices will, at the specified time, simultaneously start injecting the flow to run the test and recording the results.

162 : OVERVOLTAGE PROTECTION FUNCTION TEST IN MICOM P141 RELAY

"AMT Sequencer" is a module where all kinds of tests can be performed. It's an ideal option for testing functions such as overvoltage and undervoltage by giving the user freedom to enter information related to various parameters, accurately and finally, creating the output in the way he wants.



With this introduction, in the following and in this module, the two foregoing functions are tested as an example in the MiCOM P141 relay by creating different states.

Before starting, it's helpful to mention a few points in order to advance the testing process properly:

In the first step, it's necessary to read the related settings of functions 59 and 27 from the relay. They're maybe set in two or more stages. Also, a logic of the relay operation should be determined to specify as an example whether the relay operation is single-phase or more phases are involved in the measurement and, finally, the performance of the functions!?

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E D CECURITY CONFIG			
E TRL I/P LABELS			
B GROUP 1 SYSTEM CONFIG			
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0 a GROUP 1 EARTH FAULT 1			
CROUP 1 VOLT PROTEC		Teores	
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V< Operate Node V<1 Function	Three Phace DT	42.03 42.04	
V<1 Function V<1 Voltage Set	51.00 V	42.05	
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V<1 Poledead Inh	Disabled	42.08	
V<2 Status	Disabled	42.09	
- OVERVOLTACE		42.0D	
V> Measur't Mode	Phase-Neutral	42.0E	
- V> Operate Mode	Any Phace	42.0F	
V>1 Function	DT	42.10	
V>1 Voltage Set	76.08 V	43.11	
V>1 Time Delay	4.000 ¢	42.12	
V>2 Statue	Disabled	42.14	
dy/dt Near Mode	Phase-Phase	42.38	
ev/dt Ress Rode	Disabled	42.18	
dv/dt2 Function	Disabled	42.1P	
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👜 🤖 GROUP 1 SUPERVISION			
B TO GROUP 1 FAULT LOCATOR			
GROUP 1 INPUT LABELC			
H GROUP 1 CUTPUT LABELS			

In the next step, it's not that bad to take a look at the relay configuration to determine what options are available to the user in order to display the Pickup-Dropoff and trips related to the mentioned functions. The record of the mentioned cases may be done through LED or contact.

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In addition, elements that may block functions 59 and 27 are examined. For example, a "VTS" (Voltage Transformer Supervision) signal, or even a breaker status, can block voltage functions. Finally, keep in mind that elements such as "Current Supervision" can also affect the performance of voltage functions to include current values in these functions.

All three can be displayed in the relay settings or its config file.

To get started, just click on the "AMT Sequencer" on the software home screen to enter the test module.



Explanations of this module have already been presented in separate videos.

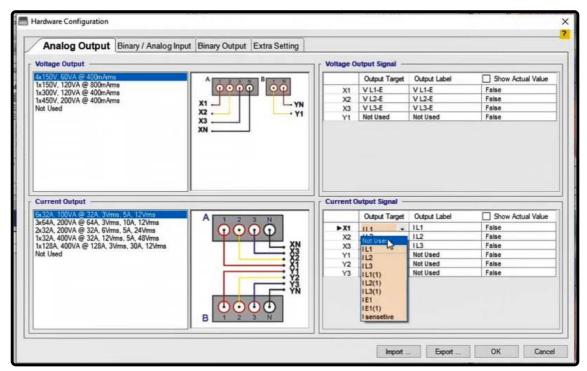
Testing Overvoltage in "AMT Sequencer"

The overvoltage protection function, as its title implies, checks the increase in voltage amplitude relative to the relay settings. Now imagine that in the relay, OR logic is used for this function so that if any of the phases become overvoltage, finally the opration signal appears and you can see the trip or hear alarm.

Assuming a single-phase setting of 76 volts with a time of 4 seconds for the MiCOM P141 relay, the test preparation process begins.

For these two parts, the settings and configuration of the relay can be displayed so that the user knows from which part these items are extracted.

Note that the current group settings can be disabled in the "Hardware Configuration" section due to the "Current Supervision" function not being active and therefore no need to inject current into this relay.



Now name state 1 "Prefault" to associate the natural state of the system. All you have to do is right-click on one of the cells containing the voltage value and select "Nominal Value" to retrieve the values from the "Test Object Parameters" already entered. In the next step, equalize the three voltage values. Use the "Normal" mode, since in this state, stable conditions are created and there is no change in the values of the injected voltage.

You can specify the completion condition of this state on a time or by selecting the "Space Key Press" option, you can manage the test run time.

Detail View: (S	il: Prefault)	×			
Analog Ou	It Binary Ou	ut Trigger S	erial Repo	rt Setting	2
State Type				Trigger Setting	Disable Relay - ^
State Type:		State Name:		Comment	VA1
Normal	~	Prefault		State Termination	□ VA2 □ VA3
(1.10	1	☐ Timeout : 1.000 s	
- Set Mode and Fa	ultType ——			Space Key Press	□ IA2
Set Mode :				Use Binary Trigger Condition as Specified Below	🗌 IA3
General: Direct	~			Binary Trigger Condition	
Louis and the second second second				Trigger Logic : O AND O OR	
Analog Output C	hannels —			C1:Trip : X	
Signal	Amplitude	Phase	Freque	Contraction and Contraction of Contr	
VL1-E: VL1-E	63.51 V	0.00 *	50.00 Hz	Tripper Logic Minimum Time : 0.000 s	
VL2-E: VL2-E	63.51 V	-120.00 *	50.00 Hz		
VL3-E: VL3-E	63.51 V	120.00 *	50.00 Hz	Delay after Binary Trigger : 0.000 s	
111:111	1.000 A	0.00 *	50.00 Hz	F Error/Trigger Overcurrent	
112:112	1.000 A	-120.00 *	50.00 Hz	Overcurrent Trigger	
113:113	1.000 A	120.00 *	50.00 Hz	Overcurrent Error	
Discon Outputs				Percent 0.00 %	
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Now make the next state to create the pickup conditions of phase A. Since phase A pickup is considered in this state, it is recommended to use one of the two state types "Continuous Ramp" or "Step Ramp" to increase the voltage value of this phase. The difference between them has already been explained in previous videos, but briefly it can be said that in "Continuous Ramp" the values are constantly increasing or decreasing, but in "Step Ramp" the values are increased or decreased with the steps specified by the user.

2	Detail View: (S2: F	100000000 000		7	7
Nom ? Seneral Direct	Analog Out	Binary Out	Trigger	Serial	Report
	State Type	Sta	rt Time Ref.	From This	s State 1
50.00 Hz	State Type:		State Name		
50.00 Hz	Mananah	~	Prefault		
50.00 Hz	Normal	~	Tielduk		
50.00 Hz	Nomel	-			
50.00 H	Quick				
50.00 HL	Step Ramp Continuous Ramp				
	Harmonic				
1.000 s	Transient				
1.000 5	Tracking				

"Step Ramp" is selected here. Double-clicking on "Detail View" tab brings you full-size windows in front.

In "Start value", a start voltage values of the state remains by default. Since the time characteristic is constant in this relay, it takes 4 seconds to show its performance, after each change of value, you need to wait even more. Therefore, "Step Time" is set to a time of more than 4 seconds, for example 4.5 seconds. Another solution is to change the time in the relay from 4 to 0 in order to test fast. This way, you can set "Step Time" to a less value, such as 200 milliseconds.

🖳 Detail View: (S2: Prefault) 🛛 🗙			
Analog Out Binary Out Trigg	ger Serial Report Setting	ма	
State Type State Time State Type: State N Step Ramp Preface	lame: Step Tim	Ne Reset O Rate Value per Second	Simple mode (L
Set Mode and FaultType	Number (Total Tim	Description(Errors) Of Step Ramps: 1 le: 500.0 ms In Step Ramp	
Parallel Martine	Step 1/2	hunn	Offent Malue

Step Time 4.5(s Enable Reset Reset Time 500.0 ms	Ramp Type Step Value Rate Value per Second
Ramp Description(Errors) - Number Of Step Ramps: 1 Total Time: 500.0 ms No Error In Step Ramp	

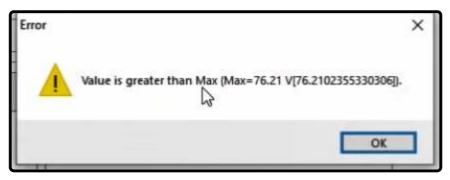
In "Step Values", an increasing step value of the voltage is specified. The smaller steps, the more accurate of pickup value, but the test takes long time. Since only the pickup of phase A is considered, an increasing step value is entered only for this phase.

Signal	Amplitude	Phase	Freque
VL1-E: VL1-E	0.2V	0.00 *	0.000 Hz
VL2-E: VL2-E	0.000 V	0.00 *	0.000 Hz
VL3-E: VL3-E	0.000 V	0.00 *	0.000 Hz
I L1: I L1	0.000 A	0.00 *	0.000 Hz
112:112	0.000 A	0.00 *	0.000 Hz
113:113	0.000 A	0.00 *	0.000 Hz

In "Final Values", the final value is specified. Since the relay settings are 76 volts, this value is set to a larger number, for example, 80 volts.

-	Final Values —			
	Signal	Amplitude	Phase	Freque
	VLI-E-VLI-E	63.51 V	0.00 *	50.00 Hz
Change	VL2-E: VL2-E	63.51 V	-120.00 *	50.00 Hz
-	VL3-E: VL3-E	63.51 V	120.00*	50.00 Hz
	1L1:1L1	1.000 A	0.00 *	50.00 Hz
	112:112	1.000 A	-120.00 °	50.00 Hz
	113:113	1.000 A	120.00 *	50.00 Hz

Keep in mind that by entering the number 80, you face a voltage limit error. So, just go to "Test Object" and increase the "Vmax" value in the "Device Settings" section.



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C XRio	🕎 Device Settings		– 🗆 X	
Script Functions	Device Settings			? Formula
B→ C RIO	r Device	Nominal Values -		
E Device	Name/Description :	f nom :	50.00 Hz	
Distance Differential	Manufacturer :	V nom(secondary) :	110.0 V(L-L)	
Overcurrent CBConfiguration	Device Type :		63.51 V(L-N)	
	Device Address :	V primary :	230.0 kV(L-L)	
	Serial/Model Number :		132.8 kV(L-N)	
		I nom(secondary) :	1.000 A	
	Additional Information 1 :	I primary :	1.000 kA	
	Additional Information2 :			
		Residual Voltage/Co	1.730	
	Substation Name :	IN/I nom	1.000	
	Address :		1.000	
		Limits		
	Bay	V max :	200.0 V	
	Name :	I max :	64.00 A	
	Address :	Debounce/Deglitch		
		Debounce Time :	3.000 ms	
		Deglitch Time :	400.0 µs	-
occess Log Error / Warning Formula F				w/Hide
				ancel

The "Triger" tab specifies under what conditions this state ends. If a definite LED is specified to record the relay pickup, you can select the "Space Key Press" option and press the space key while the LED is on.

Analog Out Binary Out Tr	igger Serial Report Setting
intergreat pointing by 11	Teport County
Comment	
State Termination	
Timeout :	378.0 s
Space Key Press	· · · · · · · · · · · · · · · · · · ·
Use Binary Trigger Condition as Sp	ecified Below
Binary Trigger Condition	
Trigger Logic : O AND	0.08
C1:Trip : 0->1 ~	
1	
Trigger Logic Minimum Time :	0.000 s
Delay after Binary Trigger :	0.000 s
Error/Trigger Overcurrent	
Overcurrent Trigger	
Overcurrent Error	
Percent	0.00 %
Threshold	0.000 A

By referring to PSL relay of the MiCOM P141, an LED is defined using a timer to turn on and off at the same time as pick up and drop off.

If a particular contact is defined for the relay pick up, select "Use Binary Trigger Condition as Specified Below" to, for example, record the pick-up time by connecting the output of the relay contact to the default binary input C1. Here you can select the binary 0 to 1 as the end element of the state.

Analog Out B	inary Out	Trigger	Serial	Report Setting
Comment				
State Termination				
Timeout :			37	78.0 s
Space Key Press			20	
Use Binary Trigge		is Specified Be	wole	
Binary Trigger Co	and the second second			
Trigger Logic :	O ANI	D OR		
C1:Trip :	~ 14			
L'				
Trigger Logic Mir	100	1	0.00	0.0
Delay after Binar	1->0	Í	0.00	0.0
Error/Trigger Ov				
Overcurrent Trigs				
Overcurrent Error	r.			
Percent				4 00 %
Threshold				

By referring to the PSL of a MiCOM P141 relay, a contact is assigned to the relay pickup.

In the next step, perform the "Drop Off" process in the same way, but with a decreasing voltage. "Step Ramp" is selected here. A higher value set than the setting value in relay, for example, 80 volts. Since this process is instantaneous, you can set "Step Time" to a low value such as 200 milliseconds. In "Step Value", enter the value of 200 mV, and in "Final Step, the nominal value remains the same.

Signal	Amplitude	Phase	Freque		
VL1-E: VL1-E	80.00 V	0.00*	50.00 Hz		
VL2-E: VL2-E	63.51 V	-120.00 *	50.00 Hz		
VL3-E: VL3-E	63.51 V	120.00*	50.00 Hz		
111:111	1.000 A	0.00 *	50.00 Hz		
112:112	1.000 A	-120.00 *	50.00 Hz		
113:113	1.000 A	120.00 *	50.00 Hz		

Step Ramp Setting —	Ramp Type
Step Time 0.2	Step Value O Rate Value per Second
Reset Time 500.0 m	s

In "Triger", you can press space key as a drop off and the end of a state when the binary changes from 1 to 0.

😰 Detail View: (S3: Dr	op off P	×		
Analog Out Bin	nary Out	Trigger	Serial	Report Setting
Comment State Termination Timeout : Space Key Press Use Binary Trigger Binary Trigger Cor		s Specified Be		.0 ms
Trigger Logic : C1:Trip : 11		O OR		
Trigger Logic Mir 0- Delay after Binan 0- C Error/Trigger OV X	>0			00 s
Overcurrent Trigge Overcurrent Error Percent Threshold	ar			.00 %

The same pick-up and drop-down process on phase A can be followed for other phases, or a combination of two phases and three phases, depending on the mode of relay operation.

The next step is recording the operation time. To do this, it is recommended first create the Prefault state to return the condition to normal again. The trigger of this state can be a specific time or pressing the space key as the user desires. Now in the final state, to measure the operating time, the "State Type" is used for phase A, with a voltage above the operating voltage.

The state trigger can also be the trip contact of the relay, which is assigned to one of the binary inputs by default, or it can be recorded by pressing space key when it sees the relay LED. However, it is advised to use binary status change due to high accuracy. It is desirable that you create a prefault state after this state to complete the test.

10	1		2 FIL	JÆ LJÆ L <mark>M</mark> - 125		surrent state			
Table View	×								🕳 🔲 Detail View: (S1: Prefault) 🛛 🗶
3	🗹 S1	🗌 S2	S3	🗆 S4	Normal General: Direct	🗆 S5	G	Normal ieneral: Direct	Analog Out Binary Out Trigger Serial Report Setting
1000	Prefault	Pick up	Drop off	Prefault		Time Test			Comment
E: V L1-E	63.51 V	63.51 V	80.00 V	63.51 V	0.00 * 50.00 Hz	80.00 V	0.00 *	50.00 Hz	r State Termination
E: V L2-E E: V L3-E	63.51	63.51 V 63.51 V	63.51 V 63.51 V	63.51 V 63.51 V	-120.00 * 50.00 Hz 120.00 * 50.00 Hz	63.51 V 63.51 V	-120.00 * 120.00 *	50.00 Hz 50.00 Hz	Tanati Internet
IL1	1.000 A	1.000 A	1.000 A	1.000 A	0.00 ° 50.00 Hz	1.000 A	0.00 *	50.00 Hz	💀 Copy & Paste of State - 🗆 🗙
I L1 I L2 I L3	1.000 A		1.000 A	1.000 A	-120.00 * 50.00 Hz	1.000 A	-120.00 °	50.00 Hz	
IL3	1.000 A	1.000 A	1.000 A	1.000 A	120.00 ° 50.00 Hz	1.000 A	120.00 *	50.00 Hz	
)ut er	1.000 s	-	200.0	6 -	©- 1.000 s	(A &	-@	1.000 s	S1: Prefault
	Nomal	StepRa	StepRa	Normal		Normal		1.000 s	S3: Drop off PHA
									S4: Prefault S5: Time Test
ent								_	S5: Time Telt
gger ndition	C1 O	C1 O	C1 O	C1 O		C1 O			
ndition				Trip		Trip		_	
nput									
								- 1	
		_						_	Options for Paste
Measurem	ent View	(×							After V State: S1: Prefault V Repetition: 1
Name		Ignore befor	e Ignor	e After Start	Stop T Nom.	T Dev	T Dev.+	T Act.	
			_						OK Cancel
								1	

At the end of the test, it is time to apply the settings to record values in the "Measurement View" window. First the name, ramp status, condition for ending the state, a checked signal, signal type, nominal value and tolerance are entered for the state in which the pick-up is recorded, i.e., state 2. If the values are entered correctly, you see the recorded voltage value for the Phase A pickup in the "Act" column. Also, in the "Dev" the amount of error is recorded and a green circle is seen to confirm the test result or a red cross to fail in the "Assessment". Follow this procedure for the state in which the drop off is set down.

	Name	Ramp State	Condition	Signal	Signal Type	Nom.	Dev	Dev+	Act.	Dev.	Assessment	T Act.	T Act. Final Step	User Comment
1	Pick up PHA	S2: Pick up PHA	End of State	VL1-E: VL1-E	Amplitude	76.00 V	2.000 V	2.000 V	76.20 V		+	27.67 s	671.6 ms	
▶2	Drop off PHA	S3: Drop off PHA	End of State	V L1-E: V L1-E	Amolitude	76.00 V	2.000 V	2.000 V	74.00 V	-2.63 %	+	6.158 s	158.4 ms	
			N											
			63											
ime A Pass	ssessment	Level Assessm 6: Passed	ent Ramp 2: Pas	Assessment	Value Assessn 1: Not Tested		Calculated Asse 1: Passed	ssment	Transient Ass 1: Passed	essment	1			

Now you can record opration time assessments in "Time Assessment" tab. Enter here the state(s) name, the conditions which are ignored in this test, the start and end conditions, the nominal value and the tolerance limit. In this tab, if all items are entered correctly, in the "T Act" column, you can see the execution time. Although, in the "T Dev", the error value is specified, and in the "Assessment", you make sure of the correct operation.

	Name	Ignore before	Ignore After	Start	Stop	T Nom.	T Dev	T Dev.+	T Act.	T Dev.	Assessment	User Comment
1	Time Test	S5: Time Test	S5: Time Test	S5: Time Test	C1: Trip 0>1	4.000 s	500.0 ms	500.0 ms	4.410 s	10.25 %	+	
ne As Passe	sessment	Level Asses	mant R	amp Assessment Passed	Value Asses	ement	Calculated /	Assessment	Transiant	Assessment		

After this step, by selecting the Parameters menu and then clicking on Reports, you can select the changes you want from the Report Settings section and have the output as a file.

File View Test	Parameters	Hardware	Window	Help
R A rel abs	Test Ob	ject	Ctr	l+T
M 4 3/6	Report	-	Ctr	I+R
	Delete	All Added Rep	oorts	
Table View 🗙		r Of Decimal		00

tel View (S3: Drop off P ×		 Report 			
nalog Out Binary Out Trigger S	erial Report Setting	Boon Report HTML O PDI	F.		1
Type State Tanie Half Fin Type: State Name Rama Drop of PHA	Step Time 3	AMPro Sequencer:			
Adde and FaultType rds rut Client		1-1) Test State Passed 1-2) Date and Time			
Report Setting	× Step Values	Type		Date Time	
Long v Ad	anced >> ? Signal	A Report Date and Time(Persian):	1	399/09/08 01:50:29.56 PM	
Report Setting MAPs 3/ste Sequencer MAPs 3/ste Sequencer MAPs 3/ste Sequencer Market Concert Setting Test Object Market Configuration Market Configuration Market Setting Market Setting	HTML VL2E VL2E VL3E VL3E VL3E Final Values Signal VL2E VL2E VL2E VL2E	1-3) Test Module Name AVT Sequencer User Name karm Equipment AVT105 A 2) Test Settings: 2-1) State Group;		Version: Computer Na Serial Numbe	99090601 ime: DESKTOP-OSFLEV6 bt: 436
Ri- III Test Results	VLAC VLAC	State	Prefault	Pick up PHA	Dtop off PHA
E- Estra Text Result		Stute type	Normal	StepRamp	StepRamp
	1	Analog Output Mode	Direct	Direct	Direct
		VL1-E VL1-E	63.51 V 0.00 * 50.00 Hz	75.00 V 0.00 * 50.00 Hz	80.00 V 0.00 * 50.00 Hz
		V L2-E: V L2-E	63.51 V -120.00 * 50.00 Hz	83.51 V -120.00 * 50.00 Hz	63.51 V -120.00 * 50.00 Hz
	*	VL3E:VL3E	63.51 V 120.00 * 50.00 Hz	63.51 V 120.00 * 50.00 Hz	63.51 V 120.90 * 50.00 Hz
OK	Cancel	Max, State Time		117.0 s	16.80 s
	Contraction and	Trigger Termination Type	SpaceKey Press	TimeGut and SpaceKey Press	TimeOut and SpeceKey Press
		Trigger Logic		and the second se	
		Binary Input Dolay After Tr.	0.000 s	0.000 s	0.000 a
		Trigger Logic Minimum Time	0.000 s	0.000 s	0.000 s
		State	Time Test	Prefault	
		State type	Normal	Normal	
		Analog Output Mode	Direct	Direct	
		WIN PAUL F	80.00 V	63.51 V 0.00 *	
		V L1-E: V L1-E	0.00 * 50.00 Hz	50.00 Hz	
		VL2-E:VL2-E	63.51 V -129.00 * 50.00 Hz	63.51 V -120.00 * 50.00 Hz	
			63.51 V	63.51 V	
		· · · · · · · · · · · · · · · · · · ·	144.64.8		

163 : UNDERVOLTAGE PROTECTION FUNCTION TEST IN MICOM P141 RELAY

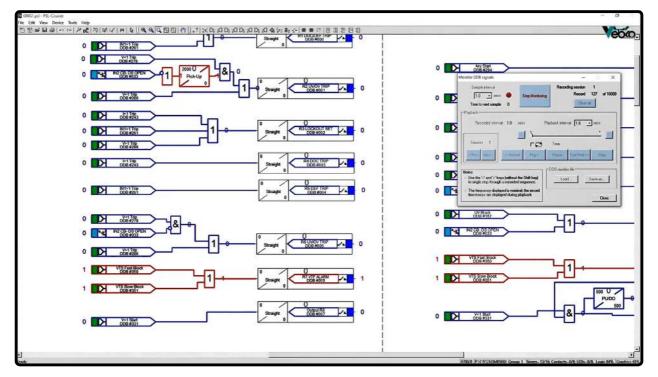
Voltage collapse occurs for various reasons such as increasing network load, decrease in phase voltage due to fault in the network, complete loss of bus voltage and similar cases. So, protection 27 is intended for different equipment. Suppose that in the MiCOM P141 relay, there is AND logic, through which the relay measures the phase-to-ground voltage and has a three-phase operation logic. The test preparation process will begin, provided that the setting at 51V phase to ground with a time of 4 seconds is provided for the relay.

MICGM 31 Agree V2.1.2						- 8 30
Quick Connect Rie Ven Print	Tools Options Help					1
Sirt Papel P141.P141.000				+ 2	C System Explorer	ebio
View - File commerces Save Save as C	apy			Search	/# # 3-	
Mark Telecomments and advects a Mark Telecomments and advects a Carl Control Barks Carl	Volice	Address (C.R)	Liver ridda	, Parkan	System (P141) Tempides Onice (P141) Societ (P141) Societ (P141) Societ (P141)	
GROUP 1 VOLT PROTEC		42.05				
Ve Xeeded a Modes	Phane-Deutrel	16.20				
 V: Operate Mode V: Numerian V:	Three Phase Phase Phase Disabled Phase-Deutsal Act Phase Phase-Deutsal Act Phase Phase-Deutsal Act Co Disabled Disabled Disabled	42.06 42.04 42.06 42.06 42.06 42.06 42.06 42.06 42.06 42.06 42.06 42.06 42.12			Properties COLINE August College Constant Constant College Constant College Col	област Малия соносоновстватуристра и кадар на месяда и со не ме Малия и ранен Малия и ранен Малия и ранен Малия и ранен Сонов и рассийски и вателениу госснорого закар на ва на br>на на на на на на на на н

First of all, take a look at the relay configuration during AMPro settings to be aware of the conditions that may have blocked an operation of the undervoltage function. For example, as you can see here, opening the breaker or disconnector blocks the undervoltage.

MICOM B14	Programmable Scheme Logic			contrast yes	MICOM P141 Pro	arammable Sebr
MICOW P 14	Opto Input Mappings		Þ	DOB #243	MICOM F141 FIO	Jianinable Sch
			D	1+2 Trip COB #247		Trip O
	Contraction and the second		A A	008 #251		Note: DDB Sic
HZ CB-DS OPEN DOB 4033	142222 C		D	008 #255		and Trip Con together in th
1005 #034			Þ	12×2 Trip DDB #514		togenerard
input L4 ODB #035			Þ	DOB A515		
Input LS DOB #036			R	12+4 Tris DDB #516	1	
				Broken Line Top DOB A210]	
DDB #037			Þ	Thermal Trip DOB #276		
			D	NIT-1 TAP DOB #261		
CEB abis				N122 Trp D08 #242 N123 Trp D08 #243		
			D A	1018 A295		
			D-	RI2>1 Trg DOB #294		
			Ď	142>2 Trp DOB #216		
				8823319		
			D H	142>4 Trp DOB #288		
			K	ISEF>1 Trip DOB #218		
			D	008 #270		
			Þ	DOB #271		
Fau	It Record Trigger Mapping		মা মিন্দ্র	REF> 11p DOB A272 REF> 11p DOB A273	95	 1⊢<
D 006 #243			38 4	008,4273		
DDB#243		INZ CEL DS OPEN DOB #033	ਾ ਯੋ	V-2 Trip DOB #282] [
			D	V=1 Trip D08 #216		
				V-2 Top D08 #210		

As another example, with online monitoring using "Monitor DDB Signals" feature, you also find that VTS blocks function 27 with AND logic when only one of the voltage phases is off.



Note that if no conditions has prevented its operation, by default, a tripping command is issued by it and therefore the tripping contact is active. For this reason, it is necessary to create state 1 by default with nominal values to get the relay out of it and ready to test.

Table View	1. ×		
Ś	🗆 S1 <	 G	Normal eneral Direct
Name	Prefault		
VL1-E: VL1-E	63.51 V	0.00 *	50.00 Hz
V L2-E: V L2-E	63.51 V	-120.00 *	50.00 Hz
V L3-E: V L3-E	63.51 V	120.00 *	50.00 Hz
Bin. Out			
Trigger	Q	-©	
Туре	Normal		~
Comment			
Condition	C1 O Trip		

Since the "Current Supervision" function is not active, there is no need to inject current in the relay, therefore deactivate the current outputs in "Hardware Configuration".

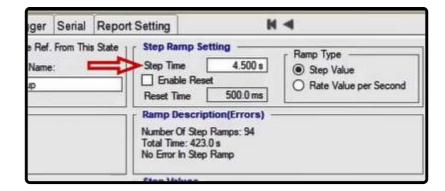
You can specify the end condition of this state on a time or pressing space key in order to manage time duration.

Create the next state to make pickup conditions in three phases. Here you can select "Continuous Ramp" or "Step Ramp" in "State Type" to reduce three-phase voltage simultaneously. The difference between these two state types has already been explained in the following videos, but briefly it can be said that the values are steadily decreasing in "Continuous Ramp" and they decrease with the specific steps by the user in "Step Ramp". The "Step Ramp" is selected here.

?	Analog Out	Binary Out	Trigger	Serial	Report
	State Type		rt Time Ref. State Name		s State
	Step Ramp Normal	×	Pickup		
-2	 Step Ramp Continuous Ramp Harmonic Transient Tracking 				

In "Start Value", start voltage values of the state remain by default, but in order to speed up the test, you can select a value close to the operation settings. Since the constant time characteristic requires 4 seconds to display its performance, it is needed to make it and even a little more after each voltage change. Therefore, "Step Time" is set to more than 4 seconds, for example 4.5 seconds. Another solution is to change the amount of time in the relay from 4 seconds to 0 and perform the test faster. So, you can set the "Step Time" to a little value, such as 200 milliseconds.

Set Mode and Fa Set Mode :	ultType		
General: Direct	~		
Start Value			
	Amplitude	and the second se	n. in Frea Ste
Signal	Amplitude	Phase	Freque
Signal V L1-E: V L1-E	63.51 V	Phase 0.00 *	Freque 50.00 Hz
Signal		Phase	Freque



In "Step Values", specify the value of the voltage reduction step. The smaller the steps, the more accurate the pickup value obtained, but it takes a long time.

Frea Steo	> Step Values —			
reque	Signal	Amplitude	Phase	Freque
50.00 Hz	VL1-E: VL1-E	-200.0 mV	0.00 *	0.000 Hz
50.00 Hz	VL2-E: VL2-E	-200.0 mV	0.00 *	0.000 Hz
50.00 Hz	VL3-E: VL3-E	-200.0 mV	0.00 *	0.000 Hz

Finally, the final value is specified in "Final Values". Because the voltage is set to 50 volts in the relay setting, this value is set to a less value, for example, 45 volts.

	Signal	Amplitude	Phase	Freque
	VLI-E: VLI-E	45.00 V	0.00*	50.00 Hz
hange	VL2-E: VL2-E	45.00 V	-120.00 *	50.00 Hz
	VL3-E: VL3-E	45.00 V	120.00 *	50.00 Hz

Afterwards in "Trigger", you should specify under what conditions this state ends. If a specific LED is determined to record the relay pickup, you can select "Space Key Press" option and press the space key while the LED is on.

Analog Out Binary Out Trig	ger Serial Report Setting
Comment State Termination Timeout Space Key Press Use Binary Trigger Condition as Spec Binary Trigger Condition	423.0 s
Trigger Logic : O AND ()	OR
Togger Logic Minimum Time : Delay after Bruary Trigger Error/Trigger Overcurrent Overcurrent Trigger Overcurrent Error Percent Threshold	0.000 s 0.000 s 0.000 %

By referring to the MiCOM relay PSL, it's defined LED 1 with any start input to turn on if any element is picked up. At this stage, this option can be used to detect pickups.

	Latching Latching Latching Latching		LED 2 DDB #065 LED 3 DDB #066 LED 4 DDB #067	
	Latching		LED 4 DDB #067	*
			DDB #067	
	Latching	K	LED 5 DDB #068	+
				*
	Non - Latching	\langle	LED 6 DDB #069	*
VTS FastBlock DDB #350 VTS Slow Block DDB #351	Non - Latching	C	LED 7 DDB #070	*
V-1 Start DDB #331	Non - Latching	$\left \right $	LED 8 DDB #071	*

Dealing with it, you can assign a contact to the relay pickup. In this case, you can select the "Use binary trigger condition as specified below" option in "Trigger", for example, record the pickup time by connecting the output of the relay contact to the default binary input C1.

In the next step, form the drop off process in the same way but with the process of increasing the voltage. The "Step Ramp" is also selected here. The start value is lower than the setting value, for example, 45 volts. Keep in mind that depending on the moment of the drop off process, you can set "Step Time" to a low value such as 500 milliseconds. In "Step Value", enter the value of 200 millivolt and in the "Final Step" section, the nominal value remains in force.

Detail View: (S	3: Drop Off)										
Analog Ou	It Binary Ou	nt Trigger S	Serial Report	Setting	M -	•					
State Type		itart Time Ref. Fi State Name: Drop Off	rom This State	Step Ramp Settin Step Time	500.0 ms	Ramp Type – Step Value Rate Value	Concernment of the second s	Simple mode (L1 Voltage Ramp on: None		v	
Set Mode and Fai Set Mode : General: Direct	ultType			Ramp Description Number Of Step Ra Total Time: 47.00 s No Error In Step Ra	mps: 94			Current Ramp on: None	e set Value) 0	∽ ffset Value	
Start Value		Cor	n. in Frea Step	Step Values —				Offset Value —			
Signal	Amplitude	Phase	Freque	Signal	Amplitude	Phase	Freque	Signal	Amplitude	Phase	Frequency
V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E	45.00 V 45.00 V 45.00 V	0.00 * -120.00 * 120.00 *	50.00 Hz 50.00 Hz 50.00 Hz	VL1-E: VL1-E VL2-E: VL2-E VL3-E: VL3-E	200.0 mV 200.0 mV 200.0 mV	0.00 * 0.00 * 0.00 *	0.000 Hz 0.000 Hz 0.000 Hz	VL1-E: VL1-E VL2-E: VL2-E VL3-E: VL3-E	0.000 V 0.000 V 0.000 V	0.000 1/s 0.000 1/s 0.000 1/s	0.000 Hz 0.000 Hz 0.000 Hz
Binary Outputs				Final Values							
				Signal	Amplitude	Phase	Freque				
Binary Inputs -	Trigger Condi	tion		VLI-E: VLI-E	63.51 V	0.00 *	50.00 Hz				
Show Time from	n This State	Show Only La	st Change	VL2-E: VL2-E	63.51 V	-120.00 °	50.00 Hz				
C1 OT	n Final Step) Any () 1 (0 0 081	VL3-E: VL3-E	63.51 V	120.00*	50,00 Hz				

In "Trigger", you can select the space key or changing a binary from 1 to 0 as a state termination of drop off state.

Finally, the operating time is recorded. It is highly recommended to first create a state for prefault to return the condition to normal again. The state trigger is a "Time" or "Space Key Press" as you wish. Now in the final state, to measure the operating time, set the "State Type" to "Normal" mode with a voltage below the operating limit for three-phase.

Analog Ou	It Binary Out	t Triggre	Serial	Report Settin	g M 🚽
State Type State Type: Normal	e 🗌	tart Time Ref. F State Name: Time Test		Comm	ger Setting nent
Set Mode and Fau Set Mode : General: Direct	ultType ~			Bin	Space Key Press Use Binary Trigger Condition as Specified Below tary Trigger Condition tary Trigger Condition tary Trigger Condition tary Trigger Condition
Analog Output Ch Signal	Amplitude	Co Phase	on. in Fre Frequ	ea Steo	C1:Trip : 0->1 ~
V L1-E: V L1-E V L2-E: V L2-E V L3-E: V L3-E Binary Outputs - Binary Inputs - Show Time from	40.00 V 40.00 V 40.00 V	0.00 * -120.00 * 120.00 *	50. 50. 50.		rigger Logic Minimum Time : 0.000 s lelay after Binary Trigger : 0.000 s ror/Trigger Overcurrent Overcurrent Trigger Overcurrent Enor Percent 0.00 % Threshold 0.000 A

This state trigger can also be the relay tripping contact, which is assigned to one of the binary inputs by default, or it can be recorded by pressing space when it sees the relay LED. However, due to the high accuracy, it is recommended to use binary status change.

(· · · · ·			In the second
Analog Out	Binary Ov Trig	ger Serial	Report Setting
Comment		*0	1
State Terminat	ion		
Space Key Pr			
Use Binary Tri	gger Condition as Speci	fied Below	
Binary Trigger	Condition		
Trigger Logic :	O AND 💿	OR	
	(ESS)		
C1:Trip :	0->1 ~		
Trigger Logic I	Animum Time :	0.0	00 s
Delay after Bin	ary Tripper	0.0	00 s
Error/Trigger			
Overcurrent			
Land the second second second			
Overcurrent 6			00.00
Overcurrent I Percent		0	.00 %

At the end of the test, it's time to apply the settings to record the values in the "Measurement View".

First enter the name, ramp status, state completion condition, signal to be checked, signal type, nominal value and tolerance for the state in which the pickup is registered, i.e., state 2. If the values are entered correctly, you will see the amount of voltage recorded for the three-phase pickup in the "Act" column. Also, in "Dev" the recorded error and in the "Assessment" section the green confirms the test result. Follow this for the state in which the drop off is recorded.

N	leasurement	View ×						<u>v</u> .							
l	Name	Ramp State	Condition	Signal	Signal Type	Nom.	Dev	Dev+	Act.		Dev.	Assessment	T Act.	T Act. Final Step	User Comment
7	Pickup	S2: Pickup	End of State	VL1-E: VL1-E	Amolitude	50.60 V	1.000 V	1.000 V		51.00 V	0.79	+	22.92 s	423.2 ms	
	Drop Off	S3: Drop Off	End of State	VL1-E: VL1-E	Amolitude	50.60 V		2.000 V		52.20 V	3.16		21.46 s	463.2 ms	

You can now record the operating time assessments in "Time Assessment". Here you also enter the state name, states or conditions that should be ignored in this review, start and end conditions, nominal value and tolerance limit. In this section, if all the items are entered correctly, you can see the operating time in "T Act" column. Also, the error is specified in "T Dev" and you can make sure of the correct operation in the "Assessmen".

	Name	Ignore before	Ignore After	Start	Stop	T Nom.	T Dev	T Dev.+	T Act.	T Dev.	Assessment	User Comment
F1	Time Test	S5: Time Test	S5: Time Test	S5: Time Test	C1: Trio 0>1	4.000 s	1,000 s	1.000 s	4.036 s	0.91 %	+	

After this step, by selecting "Parameters" and then clicking on "Reports", you can select the elements that you want to display in "Report Settings" and have the output as a file.



164 : DIRECTIONAL OVERCURRENT PROTECTION FUNCTION TEST IN MICOM P141 RELAY

If a fault current is able to rotate on both sides in the relay protection zone, the directional overcurrent (DOC) is required to detect the direction, allowing it to trip or block depending on the situation. For this purpose, the relay uses a comparison of phase angle and fault current with reference values. In addition, RCA (Relay Characteristic Angle) is used to provide maximum sensitivity to performance in the relay protection zone.

In the MiCOM P141 relay, the RCA value is in the range of -95 to +95 degrees using the "I> Char Angle" parameter.

In general, the following formula is established in the mentioned relay:

Directional forward-90° < (angle(I) - angle(V) - RCA) < 90°</th>Directional reverse-90° > (angle(I) - angle(V) - RCA) > 90°

The DOC function (function 67) test is performed based on the settings of the first stage in setting group number 1.

In "Setting" section and in the "Group 1 Overcurrent" subset, the forward element is activated with a current of 1 amp and a time setting of 250 milliseconds. Other current stages are disabled.

It is possible to use the voltage transformer supervision (VTS), to block DOC element. This is done in "I>Blocking" cell so that if it's set to 1, the VTS blocks the DOC function and if it's set to zero, the stage becomes a non-directional function if the VTS function operates. Finally, it's important to pay attention to the 45-degree characteristic in the current section.

For example, to test the operation of phase A in the 1-amp mode, if element 35.24, the first stage of the directional overcurrent, is set to "Directional Fwd", the current should flow out of terminal C2 but into C2 if set to "Directional Rev".

Note that terminals C3 and C2 are used for the 1-amp mode of phase A test and terminals C1 and C2 are used for the 5amp mode of phase A test.

If cell 35.52 (V Deo OC Status) isn't in Disabled mode, there is an overcurrent function for operation mode with voltage control, or if the element of cell 3502, the first stage of overcurrent, is in "Directional Fwd" or "Directional Rev" mode, voltage input is required. For example, directional overcurrent testing on phase A, a nominal voltage is injected into terminals C20 and C21.

Before considering each case, it is checked which output and LED are used for the DOC protection function. Thus, Programmable Scheme Logic (PSL) is used. It's possible that a specific contact is provided for the operation of each phase. Activating trigger which records error, is also checked for these two functions.

If you want to manually test the overcurrent function without using "XRIO" or "CSV" files, just double-click on the "Overcurrent" block in "General Test Object" and select the directional in "Relay Parameters" tab, the relay's setting is written in "Elements" tab. The characteristic angle is entered in "Define Element Directional Behavior" section. Note that RCA is in relay and to convert it to Maximum Torque Angle (MTA), you need a 90 degree clockwise shift.

In the first step of the test, at the best characteristic angle inject a current, twice as many as the current value is in cell 3503 into the relay and compare the operating time with what the software predicted. Continue this operation by injecting the quadruple current. You can also select the shot points to ensure that the relay doesn't work in the blocking zone and follow this test at the angular boundaries of the directional characteristic.

Note that for fixed and reverse time characteristics, a delay of 0.02 to 0.08 seconds must be considered for the acceptable relay operating range, respectively.

If you run the test on fault type L1, L2 and L3, the setting current should not act in a way that its reversal from the other two phases causes tripping.

The next step is to enter the current and angle settings in "PickUp-DropOff". You can use "Medium Detail View" to display the characteristic curve completely. By making settings in the "Trigger" tab, you can select contacts or other elements to record test results.

165 : DIRECTIONAL EARTH FAULT (DEF) PROTECTION FUNCTION TEST IN MICOM P141 RELAY

If the earth fault current in the protected zone is able to rotate from both sides, it is necessary to use the DEF function so that the fault direction is specified. One of the common systems that require such protection is parallel feeders or ring networks.

For earth fault standard protections, there are two options available for polarization including zero sequence or residual voltage and negative sequence.

Here, zero sequence is used. Since at the creation time of earth fault, residual voltage is created, it is possible to use this element to polarize directional elements. This process is called zero sequence polarization, residual voltage polarization or Neutral Displacement Voltage Polarization.

Since under normal conditions due to reasons such as imbalance, low precision of VT or equipment error, there may be small amounts of residual voltage, there is an option to specify the threshold for this element which can be seen as IN>VNPol set in relay settings. P141 relay receives this voltage from Residual Voltage input which is provided by open triangle connection or VT.

Using IN2>Char Angle parameter, the RCA value in MiCOM P141 relay is set at -95 to +95 degrees range.

Generally, the following relation is established in the mentioned relay:

Directional forward: $-90^{\circ} < (angle(IN) - angle(VN + 180^{\circ}) - RCA) < 90^{\circ}$ Directional reverse: $-90^{\circ} > (angle(IN) - angle(VN + 180^{\circ}) - RCA) > 90^{\circ}$

Directional earth fault function test or 67N function is executed based on the settings of the first stage in the number 1 settings group. Note that EF1 and EF2 functions can be activated in MiCOM P141 relays. In EF1, the measured current is used directly; also, current transformers or Residual Connection are used as well. In EF2 the residual current calculated from the sum of the three-phase currents is used. This is why EF2 is used.

In Settings section, the activation state of this element is indicated by Standard Inverse curve in forward direction while the 200 mA setting is indicated by a 0/275 TMS. Also, a -60 degree performance angle is considered. In the end, the polarization voltage threshold is recorded to be 5 volts.

It is possible to use the Voltage Transformer Supervision element (VTS) to block the performance of directional residual current element. This is done in IN2>Blocking cell; if number 1 is selected, the VTS blocks the performance of directional residual current and if number zero is selected, in case of VTS performance, stage turns into a non-directional factor.

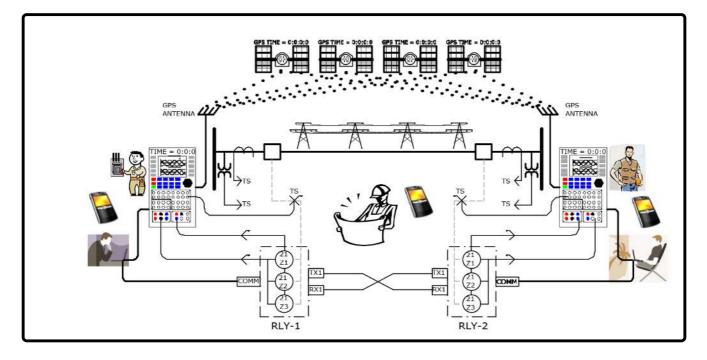
Before considering any case, it is examined to see which output and LED are used for the performance of directional residual current protection. To do so, PSL or Programmable Scheme Logic is used. It is possible that a separate contact is considered for the performance of each phase. Also, fault trigger record activation is checked for this factor as well.

If the user wishes to test a directional residual current function manually and without using XRIO or CSV files, they only need to double-click on Overcurrent element in General Test Object window and by selecting the directional element in Relay Parameters tab, enter the setting values in Elements tab. Residual section is used for this purpose. Also, in Define Element Directional Behavior section the operation angle is entered. Here, this angle is set at -60 degrees.

In the first step of the test, a current twice the one specified in the settings section is injected into the relay in the best operation angle which is -60 degrees, and the operation time is compared to the time predicted by the software. This process can be continued by injecting 4 times the specified current. Also, some shots can be set to ensure inactivity of the relay in the blocking area and the test can be continued at the border of operation angles by adding new points.

The next step is to enter the current setting and the angle in pickup and drop off section. To do this, Medium Detail View window can be used which gives a complete indication of the characteristic. The process of specifying Pickup and Drop off can be completed first for the current value and then the angle values. By specifying the settings in setting and trigger tabs, other contacts or elements can be selected to specify the test results.

166 : END-TO-END TEST



End to End test is an approach used for protective schemes that consist of two or more relays that are in connection to exchange information related to trip and blocking. These schemes are used for more accurate detection of faults and faster isolation of the system. This test can be used to thoroughly analyze the protective scheme and make sure of its proper performance.

In End to End tests, two or more test devices are used on each side to simulate the fault.

To successfully perform an End to End test, the following elements are needed:

- A test device on each side
- A hardware piece to synchronize the two devices, like a GPS satellites.

-A file that is exported from the relay software to be used in the test device. This file can be of CSV, XRIO, TEXT or other formats.

A communication equipment such as a phone or a two-way radio to communicate with the other post

With this introduction, we are going to analyze the software and hardware aspects of a longitudinal differential test on End to End platform.

Hardware Preparation

In hardware section, two test devices are needed for performing an End to End test. Each of these devices needs to be equipped with a GPS antenna. After examining the maps and isolating the piece of equipment for the test, the required inputs and outputs should be specified. For example, binary inputs AMT105 can be used to specify the pickup contact and trip. Binary outputs can be used in cases such as Circuit Breaker status simulation.

In the next step, the test device voltage and current injection cables should be connected to the relay or test block to replace CT and PT for injecting the desired amounts. The GPS antenna is connected to the back of the device to use the GPS time as the base time. In End to End test, it is also possible to use other bases such as IRIG.

To make sure that the breaker contact position is properly simulated by the test device, put the breakers in the right position. It should be noted that if other groups are working on the Circuit Breaker simultaneously, it is necessary to use the test plug to make sure that no trip is going to go on the Circuit Breaker.

Software Preparation

In software section, before anything, it is necessary to connect to the relay and save the setting and config files as well as the records submitted for event and disturbance somewhere safe so that if there is a problem, they can be used as a backup. In the next step, export the file needed to enter the test device from the relay. As mentioned before, this file can be of different formats such as CSV, TEXT, XRIO, etc.

An example for End to End test to analyze longitudinal differential protection

Old longitudinal differential relays used the ratio of differential current to restrain current and if this ratio was higher than the specified settings, the trip was issued while in modern differential protective relays, a characteristic named alfa plain is used. In this design, the vector ratio of remote current to local for every current phase and negative and zero sequence currents are used.

Here, to better present the End to End test method, a longitudinal differential protective test is performed on 7sd610 relays of Siemens Company. In this test, 7SD61 relays of Siemens with MLFB: 7SD61014BB990BJ0 and version 4.77 frameware is used.

In the first step, we are going to review the prerequisites for performing the test described above. After making sure that everything is ready, first Vebko AMPro software is run and after ensuring that the laptop is connected to the amp105, the device IP is entered and the connection is made.

Before beginning the test, it is suggested to ensure that the wiring is appropriate by injecting a current as big as 10 percent of the nominal current and reading the injected values from the relay. This can be done by simply clicking on "Test Hardware Congif" option. Then, the intended current must be specified in "Current Output" section, current injection channels are specified and the injection duration is selected. By clicking on the triangle at the top of the screen, the injection will keep going as long as the specified duration.

The first part of the End to End test is related to ensuring stability or in other words, that if equal currents are injected from the two sides or in an external fault state, a trip is not issued. To test this state, "Sequencer" room is opened. At this point, the user needs to prepare the conditions for injecting values from both sides. It is possible to do so by selecting "Hardware Configuration" and specifying the two current groups in "Current Output Signal" section. Here, the first set is indicated by "IL1", "IL2" and "IL3" which are located in front of X3, X1 and X2 elements, respectively. Now, the second set is activated in front of Y3, Y1 and Y2. To avoid confusion, it is better to change the values in front of X3, X1 and X2 to "Not Used" in "Voltage Output Signal" section.

The intended inputs are activated in "Binary/Analog Input" header. By default, binary input 1 is set on the trip. For example, we set binary 2 for start and type "Start" phrase in front of "Label". If the user wishes to adjust the output signal, for reasons such as specifying the state of the key, they can do so by using the binary output header.

"Save last actual data" option in "Extra Settings" section can be used to save the last injection data. Since longitudinal differential test, especially in "Search" section, needs a long time and this can lead to overheating of the device, it is possible to activate "Maximum fan during test" option so that the fan works at its maximum speed during current injection and avoids overheating of the device and stopping the test.

By clicking on "Test Object Parameters" and then clicking on "Device", it is possible to enter information about the test such as the title of the test, the manufacturer company, the relay type, the primary and secondary voltages and some other information that are needed in the report. It should be noted that it is possible to add the information related to the rows at the left side of this window after performing the test but the information related to the rows on the right side must be specified before initiating the test.

In the next step, the current value is to be entered in accordance with the differential settings as well as the turns ratio and CT polarity of the sides. For example, suppose that the line current is 100 amps and the CT conversion ratio of the primary side is 600 to 1 while the turns ratio of the other side is 800 to 1 and the polarity is set at "Toward Line" for both sides. It is possible to perform mathematical operations in all cells of the Vebko software without the need to use a calculator. By entering a value in a cell and right-clicking on it and then selecting "Equal Magnitudes" option, it is possible to enter the same value in all cells of a current injection side. Then the same process can be repeated for the other side.

Now, since during a stability test the currents on both sides need to be equal in accordance with the CT turns ratio and have a 180 degree difference, the currents from one side are taken as the basis and a 180 degree difference is considered for currents from the other side. To do so, the current angle of one of the cells is entered and "Balance angle" option is

used to apply the angle difference for the other phases. It is possible to view the amount and direction of the current values in "Vector View" window.

By default, the currents are considered momentary but it is possible to select average values by selecting "Setting" header and then "RMS" option. If the stability test is only applied for one phase, it is possible to mark the checkbox for the corresponding phase so that only the signals related to that phase are displayed.

In the next step, the test start conditions are adjusted. In this section, by selecting "Start Condition Repetition" option, a new page opens. In "Start Test Condition" section, the third option is related to the coordination of GPS for initiating the test. "Start Time" and "Next Full" options are related to the start time of the test and the duration of pause before every injection, respectively. If "Next full" option is unchecked, the injections will be done repeatedly and without any pause.

In this section, a time should be specified as the test start time in coordination with the other side which is remote post. Before anything, it is necessary to ensure that the device and the GPS are synchronized by clicking on "Start Sync" option. If the user is using a 32-bit windows, clicking on "Set Windows Time with GPS" option, will cause the computer clock to be synchronized with the GPS. In "Data" section it is possible to view the information including the GPS time and latitude and longitude. Also, in "Satellite signal level" and "Satellite signal level history" section, it is possible to view other information related to the power and intensity of the signals received from the GPS.

After applying the settings, by clicking on "Start" the test beings at the specified time. By applying these settings, it is possible to start current injection and ensure the stability of the condition.

In the end, the file is saved and by selecting "Parameters" menu and then clicking on "Report", after selecting the elements that are going to be added to the report, "Ok" option is selected. This will open the "Report" header so that by using the "Export Report" option or pressing "CTRL+P" keys, the report can be printed or saved as a file. It is worth mentioning that if the user is using a PDF management software, it is better for them to use "CTRL+P" shortcut so that the gap between the pages is removed and the report looks more well-organized.

In the next step, "AMT Differential" room is used to perform the main test. Here, "Hardware Configuration" page is opened and the currents of the remote side or the other post are set at "Not Used" in "Output Target" section. It is also possible to save this combination of current channels by clicking on "Export" option at the bottom of the screen to use it in future tests.

Now, by clicking on "Test Object Parameters" option, "Import from list" option from the "File" menu or the icon labeled "L" letter is selected.

In this section, by entering the relay name in "Search" box, it is possible to select the XRIO or RIO corresponding to that relay and the software version. Here "7SD61" is entered. By double-clicking on the related "XRIO", "File" menu and then "Load Relay Setting" is selected. In "Relay Config Type" section, the configuration type received from the relay is selected which is different for every brand. In "Config File Path" section, the path of this file is given to the software. Here, we are receiving the XRIO file using DIGSI 4 software of Siemens Company. By clicking on "Ok", it is necessary to ensure that the relay parameters are entered correctly by viewing the number located in front of "Parameter Values Imported". By clicking on "Ok" and closing the windows, the graph will be entered to the differential characteristic window.

Before beginning the test, the "Test Object Parameters" window is opened again and "7SD61" subcategory is opened by clicking on the plus sign. In "Relay Parameter Section (Local Relay)" it is possible to view the information related to the local relay or the current post in different subcategories. In subcategory "Setting Group A", it is possible to view the settings of different functions. By going to subcategory "87 DIFF PROT", it is possible to examine the activity status of this parameter, time and current settings of pickup and trip, the inrush settings and the parameter related to the charge of the line.

In "Relay parameter section (Remote relay)" section, it is possible to view the information related to the relay of the opposite post. Here, parameters with a green check mark in "State" section in front of them are the elements that are active in the relay of the opposite side. In this section, it is possible to receive the information about the relay of the opposite side from the setting file, xml file or even orally from the operator of the remote post and enter it into the "Value" field.

Now, once more, "Test Object Parameter" is selected and "Line Differential" block is opened by double-clicking on it. The important point here is that the values entered for primary and secondary in "Protected Object" section must be the same in both local and remote posts. Also, these values need to be reviewed especially in "CT Nominal Values" section to ensure that the turn's ratios are correct.

Also, it is possible to view the test status graphically along with the parameters on it by opening "Medium Detail View" window from the "View" menu. After finishing this stage, it is time to perform different tests. To start, "On GPS" option is selected after selecting "Start Condition Repetition". In this section, by clicking on "Start sync", the satellite signals are detected and the time synchronization is done which may take up to few minutes. Keep in mind that normally, Shot Test and Search Test are performed in this Room. The first test examines the performance and non-performance in the Trip and No Trip area, respectively, and the second test examines the boundary between the TRIPPING and NO TRIP area. Specify the points by interpolating to measure the curve drawn in this environment and the actual performance of the relay. In the next step, after coordinating with the opposite side, some points are put on the differential characteristic and after adding them to the test table, it is possible to compare their coordination which is a combination of "ibias" and "idff" to ensure that the conditions are the same.

By clicking on the cog icon at the bottom of the differential characteristic window, it is possible to use the features that help the user to better supervise the test

Now, by returning to "Start Condition" tab, in "On GPS" section, a time is considered as the start time after coordination with the opposite side and then by unchecking "Next full" option whose function has been explained before, the test is initiated. To perform the "Search Test", you must first draw lines called "Search Line" in different parts of the chart. To drag the "Search Line" in the "Differential Characteristic" window, hold down "Ctrl" and left-click the mouse. Draw the direction you want on the characteristic curve. You will see that the "Search Line" information drawn is displayed in the "Search Test" line table. After drawing these lines, the information of these lines should be given to the opposite side so that the lines drawn on both sides are exactly the same and their order is the same. After dragging the "Search Line" and making adjustments in the Start-Condition window By testing a few points on the search line, it interpolates the characteristic curve and determines the exact location of the characteristic curve. At the end of the test and saving the file, it is enough to open the report setting window by selecting the parameters Have the result as an output file.

167 : DRAWING THE DISTANCE CHARACTERISTICS AND PRACTICAL EXAMPLE OF DRAWING THE QUAD CHARACTERISTIC IN SIEMENS 7SA522 RELAY

Protection relays with Distance function are used to protect lines against faults in the network. In order to test this function, we must first draw its characteristic. Using Rio or Xrio is a simple solution to transfer settings and configure this function from relay and simulation of the distance characteristic in the test device. Using digital relays such as Import Rio and Xrio to draw protection characteristic will surely simplify the process of testing functions, including Distance.

However, in the case of older relays such as static samples, in some cases, we still have to use step-by-step drawing and manual impedance characteristic. In addition, in some cases, we may not be able to get relay output in the form of files such as Xrio, CSV and Text for reasons such as software restrictions.

In these cases, it is enough to open the Distance block from the Test Object Parameters section and use the Zone Settings header to draw the distance characteristic. At the top of the table, the New, Edit, Delete and Add duplicate options allow creating new zones, editing zones, deleting zones, and overwriting the zone, respectively. You can also have complete management over each zone using navigation options. In zone Details, you can also see details about trip time, impedance and values related to the duration of the operation and see the tolerance value.

To get started, simply click on the New option to create a new zone. By default, this zone is marked as the tripe area for all fault loops. By selecting each zone and clicking on edit option, you can have a complete management of the type of distance element or specify the Trip and No Trip area. Impedance characteristics can be adjusted in the form of Quad and Mho type or lens in the relay. You can also use the default shapes for these three characteristics.

Any added element can be a line or arc. Each element can be drawn by entering a point and angle. In the case of the Mho characteristic, the circle drawing is performed using the central point, radius and angle.

After adding zones using different elements, you can specify the number, label, zone type and loop fault for it. Keep in mind that four different type can be specified for zones as follows:

Tripping: It is used for zones that based on the relay settings, points inside trips.

Starting: Used for zones that only lead to pickup of distance function. This pickup can lead to tripe after a certain time.

Extended: This zone is only activated under certain conditions (for example enabling recloser or teleprotection schemes)

Non-Tripping: In these zones, the relay will not issue trip command.

It is also possible to disable the zones created in this list. After drawing the zones, trip time and related faults can be entered for each zone.

Drawing the distance characteristic (zone 1 forward direction) in siemens 7SA522 relay

For example, we will review drawing the Quad characteristic of a Siemens 7SA522 relay sample here. Keep in mind that by going to the Setting Group section in Digsi 4 software and choosing Distance Protection and then, General Settings you can view the distance characteristic of the relay by selecting the Graph option.

In the Distance Zones section, you can see the values related to different parameters of the Distance characteristic in different zones. Here, zones 1 to 3 in forward direction, zone 4 in reverse direction and finally zone 5, is non-directional.

Considering the overall characteristic of distance for this relay, which is as follows, as well as the directional characteristic in page R and X, it is necessary to pay attention to the following points:

- In general, six independent zones and one extra control zone are defined for each impedance fault loop in this relay.

- The process of defining lines is based on the parameters R, X and $\phi \text{Dist.}$

- It is possible to include a cut area to define Load Encroachment.

- Reach element R value can be defined separately for phase-to-phase and phase-to-ground faults so that we can see wider coverage of faults for ground faults.

- For zone 1, another angle a can also be defined to avoid overreach caused by changing angles or more. This angle is not applicable to other zones.

- ϕ Dist, defined in the relay address 1211 and referred to as Distance Angle or Distance angle, shows the rotation angle in the Distance component. This element is used for both Quad and MHO characteristics and can be adjusted to the same value as the line angle (element 1105).

Now it's time to drawing the distance characteristic.

By revisiting the Zone Settings section and clicking on the New option, we select the Quad characteristic for the relay. Here, the value R moves the center of the line over the horizontal axis and the X value moves the center of the line over the vertical axis. The specified angle is also cause the line to rotate.

The first line, while passing through the R axis with the value R1, that is, the resistance of zone 1 passes., has a ϕ Dist angle, which here is equal to the load angle of 82 degrees. In this way, we enter the value R equal to 24.899, X value equal to 0 and the angle value is 82 degrees.

The second line is the horizontal line (taking alpha equal to zero degrees) with the specifications R=0, the value X is 6.211 and the angle is 180 degrees.

The third line that passes through the source is also draw by the specifications R=0, X=0 and the angle derived from the manual, that is 300 degrees.

The fourth line that passes through the source has a 22-degree angle in according to the manual. For this purpose, we enter the value R=0, X=0 and the angle at 338 degrees.

The fifth line is draw by considering the value R equal to zero, X equal to -6.211 and the angle equal to zero.

By entering the above coordinates, zone 1 is created as Forward. Creating characteristics for reverse and non-directional zones also follows this process.

By drawing the distance characteristic, it is possible to start the Shot Test and Search Test process in order to ensure the accuracy of the graphical characteristic.

168 : DRAWING THE LOAD ENCROACHMENT CHARACTERISTIC

A region may be defined as Load Encroachment, along with the graphical distance characteristic. The Load Encroachment scheme prevents the impedance area from entering the distance characteristic and finally prevents unwanted trip. This area usually overlaps with the trip area and is often activated only for three-phase fault loops.

For this purpose, after adding the protection zones, add two more zones to be used as Load Encroachment Blinder. We place these zones on "Non tripping" and fault loop on L1-L2-L3. This characteristic requires three elements that can be Line Cartesian, Arc Cartesian or Arc Polar type. For each element, just hit add Element and select its type.

For example, in the Siemens 7SA522 relay, we drawing the specifications of Load Encroachment by using elements 1241, 1242, 1243 and 1244. For this purpose, we need three "Line Cartesian" components. The first component is a line that extends through the source, with coordinates R=65.36, X=58.85 and an angle of 42+180=222 degrees. The second component with R=65.36 and X=0 has an angle of 270 degrees, perpendicular to the horizontal axis. The third component of the Cartesian have coordinates R=65.36, X=-58.85 and -42 degree angle. You can create the final characteristic by disabling the Auto Close option. In order to draw the Load Encroachment characteristic on the left side of the Distance characteristic, we create three Cartesian components with specifications R=-65.36, X=-58.85 with an angle of 42 degrees, R=-65.36, X=0 with an angle of 90 degrees, and finally, R=-65.36, X=58.85 with an angle of 138 degrees. As mentioned above, during the test, we will not see trip issued in this area.

169 : DRAWING THE MHO CHARACTERISTIC IN GEC PYTC RELAY

For example, we consider the PYTC relay to manually draw the distance characteristic. PYTC is actually a model of the PYTS relay used to protect systems including underground cables, as well as systems consisting of cable and airlines combination. The Mho characteristic in this relay makes the Distance function available to protect these systems.

	DISTACE RELAY								
ТҮРЕ	MANUFA.	Fn	In	Vn	Vx	CVT RATIO CT RAT		ATIO	
PYTC	GEC	50	1	110	110	63	110	500	1
		LOAD	CHAR/	CTERISTIC				LI	NE
Z Load r	nin	R Load	lmin		<z load<="" th=""><th>Zf</th><th>max</th><th>Length</th><th>17</th></z>	Zf	max	Length	17
45.51904	762	36.4134	19206		36.87	64.22	081714	Number	
				RELAY CHAR	ACTERISTIC				
PARAMETER	SET	FING		TARGET	PARAMETER		SETTI	NG	TARGET
K1A	0.	51			кс		1		
K1B	0.	51			k2		1.5		
K1C	0.	51			К3		3.28	3	
KZA	1	0			θn(a1+a2)		20		
KZB	1	0			θph		65		
KZC	1	.0			θc		20		
KZN	1	0			a1		20		
K1N	0.6	648			a2		0		
KD	:	1			-				
				IMPEDANCI	E SETTING				
PARAMETER	SET	TING		TARGET	PARAMETER		SETTI	NG	TARGET
Z1(zone1)	5	.1			ZN		6.48	3	
Z2(zone2)	7.	65			TZ2(s)		0.4		
Z3(zone3)	16.	728			TZ3(s)		1		
ZC	5	.1			-				

The modules on this relay allow adjusting the protection zones based on different parameters.

assume the different element settings of the modules in this relay as follows:

In this case, considering the angle of the line is equal to 66 degrees, we add three Mho zones.

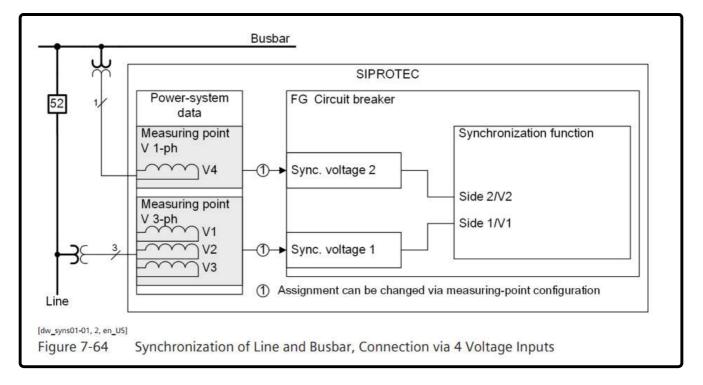
The first zone features a forward with a reach of 5.1 ohms and an angle of 66 degrees.

The second zone haves a forward characteristic of 7.65 ohms reach and an angle of 66 degrees, and finally the third zone 16.78 ohms reach with the same angle. After this, you can also manually enter the trip time for each zone.

170 : SYNCHRONIZER FUNCTION TEST IN SIPROTEC SIEMENS 7SD82 RELAY

In AMT Synchronizer, we're going to test the synchronous check function in Siemens' 7SD82 relay. This function can be used to synchronize the line and busbar, two busbars with coupling or a generator and busbar. This function, which is located in circuit breaker function group, can be used in different modes such as checking the synchronous of two systems, switching synchronous power systems, switching asynchronous power systems and switching the busbar line.

For this purpose, different stages can be used in the form of Synchrocheck Stage (with two stages) or Synchronous/Asynchronous Stage (with six stages). This function uses two voltages to check the connecting conditions. The reference voltage of the first side which is called V1 and the reference voltage of the second side which is V2. Choosing voltages to synchronize depends on the system connection on the primary side. In this test, a 4-input voltage connection is used, which includes a single-phase voltage and a three-phase combination. In this case, the voltage attached to the single-phase Measuring Point is the decisive reference.



The measured values related to this performance are displayed on the relay as primary, secondary and percentage. When the function is activated, the values of Delta V, Delta F and Delta Alpha are checked to connect the synchronous of the two systems. The settings on the relay are as follow:

Sync. operating mode = on

(_:5071:122) Max. voltage diff. V2>V1 = 5.0 V

(_:5071:123) Max. voltage diff. V2<V1 = 5.0 V

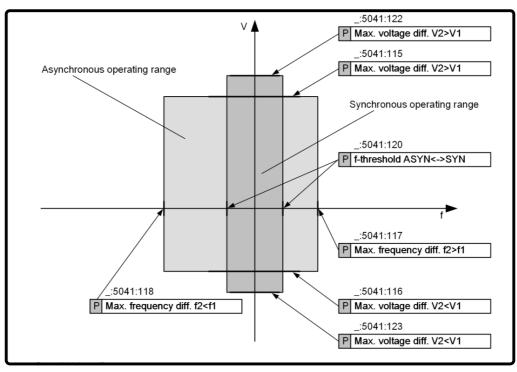
(_:5071:117) Max. frequency diff. f2>f1 = 0.10 Hz

(_:5071:118) Max. frequency diff. f2<f1 = 0.10 Hz

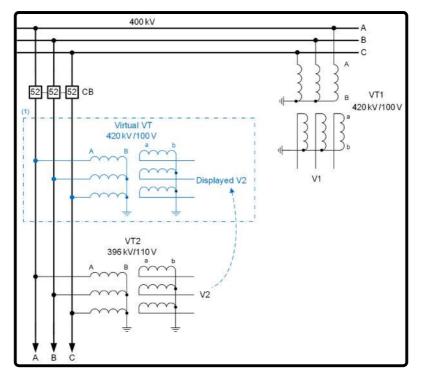
(_:5071:124) Max. angle diff. a2>a1 = 10o

(_:5071:125) Max. angle diff. a2<a1 = 10o

If we want to differentiate between synchronous and asynchronous conditions, we should use synchronous/Asynchronous stage, whose voltage-frequency diagram is as followed:



By opening the AMT Synchronizer room to enter the relay information for testing, the first task is to enter the relay nominal information in "Device". In this section, related settings for CT and VT conversion ratio are entered. Keep in mind that if there is a different VT conversion ratio between the two systems, a virtual VT should be used, according to the manual relay recipe, use a coefficient to match the conversion ratio.



In the Hardware Configuration section, 5 Input binaries are defined by default to transfer relay outputs to the test device to adjust the voltage and frequency and issue the connecting command. Considering that in this test, alarms about voltage and frequency values are read from the relay, we only configure the binary related to the command connected by the relay.

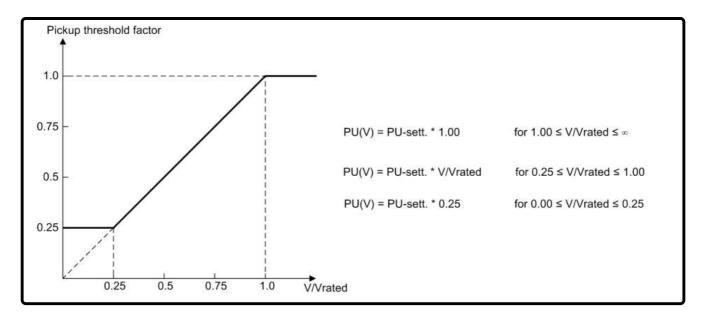
Next, in the Synchronizing Parameters window the relay settings are entered. By specifying the phase sequence, connected voltages, breaker connection settings, and secondary voltage in the Protection Device tab, it is time to reach the Synchronizing Window tab. In this section, the minimum and maximum values for voltage and frequency parameters are entered, followed by the allowed tolerances for the Phi, V and f parameters. Keep in mind that for this relay, Dead Zone is not defined as an area where no output is exported from the relay. When the settings are confirmed, it is time to do the test.

In this section, system settings 1 and 2 can be seen in the relevant tables. In addition to the possibility of manually entering specifications for two systems, it is possible to monitor the delta value of voltage, frequency and angle elements. In the next step, simply add points to the attribute and run the test. It is also possible to create points on either side of the characteristic boundary line using the Quick Test option. With the completion of the test, the selected items and elements can be viewed in the Report View window.

171: 51V FUNCTION TEST IN SIEMENS 7SD82 RELAY

In Siemens 7SD82 relay, this function can be used in function groups with three-phase voltage and current, and two inverse time stages depending on voltage and constant time with specific undervoltage conditions are considered by default.

In this test, the first stage of both categories is used. Note that in the "51V" function test, the fault detection or nondetection is done according to the voltage and current level of the test, which is "Voltage-Controlled" and "Voltage-Restrained", used as a generator differential protection support and in power systems to coordinate high current relays. In this test, as if is seen the characteristic curve is Voltage-Restrained.



In the V/V_{rated} range between 0.25 and 1, the diagram is linear, which the pickup current value is directly proportional to the voltage increase. In this regard, V is the phase-to-phase voltage measured, V_{rated} , rated voltage, PU sett setting of pickup threshold and PU(V) pickup threshold applied, according to voltage. The control voltage for each current phase is according to the table:

Current	Controlling Voltage
I _A	V _{AB}
I _B	V _{BC}
I _c	V _{CA}

The settings in the 7SD82 relay for this protection stage are performed according to the image:

21.2051.11491.1	Mode:	on	•		
21.2051.11491.2	Operate & flt.rec. blocked:	no	•		
21.2051.11491.8	Method of measurement:	fundamental comp.	•		
21.2051.11491.3	Threshold:	1.000		А	
21.2051.11491.101	Type of character. curve:	ANSI definite inverse	-		
21.2051.11491.102	Reset:	instantaneous	-		
21.2051.11491.103	Time dial:	1.00			
Add new stage	Delete stage				

If harmonics is to be included in the measurements related to this stage, select RMS Value option in the Method of Measurement section. Otherwise, in order to skip harmonics and transient conditions, select Fundamental Com, which is Siemens' suggested option.

The 1.5amp current setting value is also a good option for most applications. The current threshold parameter for lines is up to 10% and for transformers and engines up to about 20% higher than the maximum of the expected load, adjusted. In the characteristic section, select the curve according to the IEC and ANSI standards. Here the 1amp setting is used.

to reset parameter, you can also select the instant reset option or reset by modeling the movement of disk relays. The Time Dial option also allows moving the characteristic in the direction of the time axis.

The next stage in considering the undervoltage function conditions is also set as follow so that if there are sufficient voltage conditions, the activation of the function is seen.



After applying the settings on the relay and specifying the required contacts in the configuration section, it is time to test the function. Keep in mind that due to curve performance, either use the pickup contact or consider the time required in the Max Fault Time section for the 51V function performance.

In the AMT VIStarting room, to test the relay, first enter its information in the "Test Object" window. In the "Device" block, information such as the relay's name, serial number, relay operation location, "CT" and "PT" specifications are entered. Also, to enter the settings of this function, you need to double-click on the "VI Starting" block from the tree chart, and in the "VI Starting Parameters" page, enter the settings needed to display in the "VI Starting Characteristic" characteristic curve.

In the Tolerances section, you can also enter the percentage of acceptable fault to perform the test. By confirming the entered settings, it is time to perform Shot Test, Check Test and Search Test. in the "Shot Test" tab you select the type of fault and points to test and after the test is perform, you can see the evaluation results. In "Check Test", the upper and lower tolerances of the relay displayed as dashes in "VI Starting Characteristic" are tested and evaluated.

Note that the plotted "Check Line" should have cross at least one of the tolerance lines of the characteristic curve. Search Test is the last test performed on the "VI Starting" characteristic curve. The purpose of this test is to find the characteristic curve line. The "Search Line" method is the same as "Check Line". By performing the test, the software by testing several

points on the search line to the characteristic curve interpolation and determine the exact location of the characteristic

curve. Keep in mind that due to the required voltage level, by referring to the test object Parameters and then the Device block. you may need to increase the final voltage limit or V max

When the test ends and saves the file, simply select parameters to open the report setting window to get the result as an output file by selecting the parameters that need to be entered in the final report.

172 : NON-DIRECTIONAL OVERCURRENT PROTECTION TEST IN AMR RELAY (SIMPLE TEST USING TEMPLATES)

AMR modular relay of Vebko company supports various protection functions. Explanations of the capabilities and software environment of this relay have already been presented in the video related to differential protection test.

After connecting to the AMR relay at first, simply load the device's hardware configuration from the Device menu by selecting the Read Hardware from Relay option. The default password is 123456 to receive elements. At this point, a message is given to remove the signal, which if confirmed, if the current hardware is not the same as the relay hardware, the current hardware signals used in the VFC section are deleted.

It should be noted that the settings for the conversion ratio of voltage and current transformers are determined in the related card. Here the ratio of current card conversion is 200A to 1A.

(First, enter the VFC page): As mentioned earlier in the AMR software, config of some of the most widely used functions as are placed in the software as sample the user can send new settings to the relay by selecting each of them and applying the desired changes. For this purpose, a set of functions can be seen in the Relay VFC tab and in the Temp Functions section. It should be noted that by selecting each Temp Function, the blocks in the VFC are removed.

Here the non-directional overcurrent function displayed under the name OC 50/51 is selected. In configuring this function, an OC Inverse block and two OC Definite blocks are used. They have different settings and the signals of a current card are assigned to their input (from a measuring point). Finally, output signals are assigned to Binary Outputs and relay LEDs by Output and LED blocks. To change the settings, simply right-click on each block to access a set of options. Finally, the changes are sent to the relay.

In this video, by double-clicking on blocks that contain constant time stages for non-directional overcurrent function, disables them and define the 1A and TMS current settings equal to 0.1 by double-clicking on the first stage, which is defined as reverse time.

By making these changes, simply select Send Config and Setting to Relay from the Device menu again. In this way, the settings and configuration applied are moved to the relay.

In the next step, by running AMPro software and opening the AMT Overcurrent room, it is enough to go to the Object Parameters test section and create the test characteristic after entering the information. Here, a reverse time characteristic is created by 1A and TMS=0.1 current settings. Keep in mind that it is also possible to test this characteristic using the Xrio file.

In order to evaluate the performance of non-directional overcurrent function, two Trip Time and Pickup-Drop Off tests are performed. The purpose of Trip Time is to detect and evaluate the accuracy of the performance time of this function and the purpose of pickup-drop off test is to detect and evaluate the accuracy of the actual current of the performance threshold and of reset threshold of this function.

Trip Test

Three states including PreFault, Fault and PostFault are required to perform this test. PreFault time is suitable for 500 milliseconds, fault time should be greater than the maximum trip time, and Post Fault time is at least 500 milliseconds. PostFault time should be increased if the drop-off is not an instantaneous.

The suggested points for reduced time functions are 1.5 times, 2 times and 4 times the regulatory current, and for constant time curves, 1.5 and 2 times the regulatory current.

To detect the regulatory current of the second unit, two points can be added to the amount of 90 and 110 percent of the regulatory current of the second unit.

By adding points, perform the test to check the performance of this function from the point of view of time accuracy.

Pickup/Drop-off Test

In order to perform this test, first determine how the diagnosis of pickup and drop-off is performed. This process can be done through a separate contact, namely Start, Relay LED viewing, or changing the setting for instantaneous function and using the trip contact. Here we used the Contact Pickup Relay. You can also put the current fault value in the desired range. Here the fault value is considered 5% by default. The performance range of overcurrent curves in the AMR relay starts from 1.1 regulatory current in the relay. Therefore, first, by enabling the Active Range Limits option in the Overcurrent Protection Parameters window, the Imin value is set to 1.1 Iref. In the next step, the current setting value for the pickup is placed on 1.1*1=1.1 amps. (as it is shown)

By adding points, it is enough to perform the test and add the necessary elements to the report when it is finished.

173 : GOOSE MESSAGING TESTING

The new power systems, specifically power substations, are designed in such a way that protection and control schemes of IEC 61850 Generic Object-Oriented Substation Event (or GOOSE) are used in them.

GOOSE messaging can be considered as a virtual connection replacing wiring and hardware connection. Hardware systems are physically checked and tested. -While GOOSE systems can be virtually checked.

Improved GOOSE systems development needs enough information about VLAN (Virtual Local-area) networks, MAC address filtering and Logical Nodes. Moreover, it needs Ethernet traffic analysis or switch setting inspection.

Testing devices can play a major role here to make GOOSE messaging testing and inspection easier. In AMT 105 devices, testing can be easily performed using SCD files in relays and network setting.

GOOSE setting can be accessed through hardware configuration window. In this window, by selecting Import SCL option, you can import a created GOOSE configuration file. By choosing Clear SCL option entered data can be deleted so you can add another file.

After importing the file, a list of GOOSE reference information, ID, MAC address, etc. are shown. By expanding each directory, you can see a series of GOOSE. If your selected option is put in relay's output list, while you want it in input list, you can simply choose Binary In option. Contrariwise, if the tester is supposed to excite the input of the relay, you can select Binary Out, after choosing the desired option.

By choosing each option, related virtual Binary Input or Output will appear. After clicking on each binary, you will be directed to that page under Binary/Analog Input or Binary Output tab. Then you will be able to change the desired configurations.

Therefore, the created virtual binaries will act like the real binaries of the device and will be considered in the test. Here is an example of the Goose testing for the Siemens 7SA522 relay with the IEC61850 protocol and the RJ45 port with the EN100 card is done.

Note that the selected IPs for the laptop network, tester and relay must be in the same range. The IP of the test device here is 192.168.1.57 and the IP of the computer network is set to 192.168.1.2. Now it is time to register an IP for the relay in the same range in Digsi 4 software. Here "192.168.1.4" is set as an example. Keep in mind that by having an MLFB relay, all you need to do is to create an IEC 61850 Station by registering the IP and initializing it. By right-clicking on the relay title and checking the Communication Parameters section, you can make sure that the VD address, Mirror VD, IP address and Subnet Mask are correct. Here in IED name, the title DIS stands for Distance.

By opening the IEC61850 System Configurator, you can select the desired items from the Source Catalog and Destination Catalog sections and transfer them to the Goose Application section to perform Goose test. In this video, two protection items, Trip Zone 1 and Trip Zone 2, have been selected from the reference section. From the destination section, the Double position breaker item that was previously created in the Masking I / O relay is selected. Now all you need to do is to save the created file with an SCD extension.

In the next step, open the AMT Sequencer room and Click on Hardware Configuration to go to the Goose Setting section and import the file saved in the previous step. As you can see, there are three items with subcategories in the Goose Control Reference section. By opening the subcategories, the function of zone 1 is set to Binary Input 11 and the function of zone 2 is set to Binary Input 12. <u>In order to change the position of breaker in using a tester</u>, <u>Binary Output 5 is selected</u>. The C1 binary is also wired to be used as a reference for comparing the time between trip zones 1 and 2.

In the next step, you need to set the configurations for Binary Inputs. Here, Trip A and Trip B are selected to record the relay performance against Trip Zones 1 and 2, respectively. Then, it is time for Binary Output to be configured. Clicking OK will save the settings.

Now it is time to do the test. As you can see, for trips in Zone 1 and Zone 2, in addition to the physically-wired contact C1, the trip is also recorded through contacts C11 and C12. You can also send a "change status" command to the relay, by enabling or disabling Binary Output. There are different ways to check the information transference through Goose. For example, you can use Goose Inspector, IEC Browser or a software like Wireshark.

174 : GUIDE TO TRUSTING VEBKO(STABLE-TEST) SOFTWARE IN BITDEFENDER ANTIVIRUS

To trust Vebko software, after installing the software, you need to apply operations in Bitdefender antivirus:

First, enter the Protection section, then the Antivirus section and select Manage Exceptions option:

	Protection Fe	Catures ection features that work together to ensur	re your device and data are secured.
\mathbf{O}	ANTIVIRUS () Quick Scan	FIREWALL [®] CO	DEFENSE ®
	System Scan	Settings	Threat Defense
📅 Dashboard	Manage Scans		Manage Exceptions
	Quarantine	ANTISPAM 💿 🛛 🖤	Settings
Protection	Manage Exceptions	Manage Friends	SAFE FILES ()
Privacy	Rescue Environment	Manage Spammers	Protected Folders
🔊 Utilities	Settings	Settings	Application Access
-	VULNERABILITY [®]	PREVENTION	RANSOMWARE REMEDIATION (9)
Notifications		Manage Exceptions	Exceptions
My Account	Wi-Fi Security Advisor	Settings	Settings
Settings	Settings		

Select the All exceptions tab and select Add an exception option:

And in the Exceptions Options window, click on the Browse icon:

0

B Manage Exceptions	— ×
Exceptions options	
Enter the path, extension name, URL or domain here	
Browse or drag and drop the item in the field above.	
Protection Feature ③	
Antivirus	0
Online Threat Prevention	0
Advanced Threat Defense	0
ADD EXCEPTION CANCEL	

In the Select a file or folder to except window, specify the path to install Vebko software on the computer and select the software folder to be trusted:

B Bitdefe	nder	×	
Sec. 3	nder t a file or folder to ex Microsoft SDKs Microsoft Visual Studio Microsoft Visual Studio 10.0 Microsoft Visual Studio 14.0 Microsoft Visual Studio 14.0 Microsoft Visual Studio 14.0 Microsoft Web Tools Microsoft NeB Microsoft NET Microsoft NET Microsoft NeB Microsoft NeB Mi	xcept	
	ОК	CANCEL	
Manage Exceptions			— ×
Exceptions options			
rowse or drag and drop the	tem in the field above.		
Protection Feature			
On-access scan	On-demand scan Scan Embed	dded scripts	
Online Threat Prevention			

The default path where the Vebko software is installed is displayed as follows:

ADD EXCEPTION

C:\Program Files (x86)\Vebko

(

Advanced Threat Defense

In this section, by selecting vebko folder and selecting ok option as well as selecting Add Exception option, the declared path is recorded.

CANCEL

After this step, you should do one of the following steps to trust the software version compared to the version you have installed (stable/test) on your system.

By selecting the vebko_stable folder is shown in the path, proceed to trust stable version, it should be noted that the AppData folder is in Hidden mode by default and you should display it by selecting the Hidden Items option in the View tab.

C:\Users*\AppData\Roaming\Vebko_stable

Instead of *, you should select the name of your Windows account and finally by doing these steps, the software will run as trusted and antivirus will not prevent its activity.

20

B Bitdefender	×		
Select o filo or folder to event			
Select a file or folder to except Microsoft Visual Studio Microsoft Visual Studio Studie State State State State State State Microsoft Visual Studio Microsoft Visual Studio Microsoft Visual Studio Microsoft Visual Studio Studie State Microsoft Visual Studio Microsoft Visual Stud			
OK CANCEL		_	- ×
Manage Exceptions Add or remove items to be excepted from scan. + ADD AN EXCEPTION			
All exceptions Antivirus Advanced Threat Defense Online Threat Prevention			
C:\Program Files (x86)\Vebko Online Threat Prevention		Ø	
C:\Users\Admin\AppData\Roaming\VebkoData_Test Online Threat Prevention		C	1
c:\users\admin\appdata\roaming\vebkodata_test On-access, On-demand, Embedded scripts		C	1

Also, to trust the Test version, you can select the vebko_test folder in the path shown, it should be noted that the AppData folder is in Hidden mode by default and you should display it by selecting the Hidden Items option in the View tab. This step is the same as the one mentioned in the trust stable version.

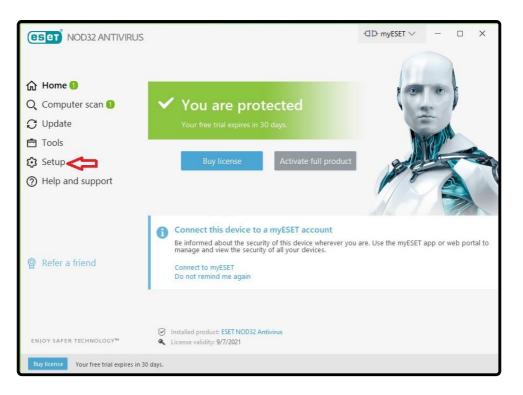
C:\Users*\AppData\Roaming\Vebko_test

Instead of *, you should select the name of your Windows account.

175 : GUIDE TO TRUSTING VEBKO(STABLE-TEST) SOFTWARE IN NOD32 ANTIVIRUS

To trust Vebko software, after installing the software, you need to apply operations in ESET NOD32 antivirus:

First, enter setup section and then the antivirus Advanced setup option:



eser NOD32 ANTIVIRUS		·dD- myESET ∨	- [ı x
	Setup			?
🟠 Home 🚺				
Q Computer scan 🜖	Computer protection All required computer protection features are active.			>
C Update				
🖻 Tools	Internet protection			
🕄 Setup	All required internet protection features are active.			*
⑦ Help and support				
@ Refer a friend			ł	ļ
ENIOY SAFER TECHNOLOGY ^{IM}	‡ ‡ Im	port/Export settings	🍄 Advanc	ed setup
Buy license Your free trial expires in 30	days.			

Then, in the Detection Engine tab, select Edit option related to Performance exclusions:

(ISET) NOD32 ANTIVIRUS			ΩX
Advanced setup		Q,	× ?
DETECTION ENGINE	REAL-TIME & MACHINE LEARNING PROTECTION		D.
Real-time file system protection Cloud-based protection			D.
Malware scans HIPS 1	Performance exclusions	Edit	0
UPDATE	Detection exclusions	Edit	0
WEB AND EMAIL	ADVANCED OPTIONS		D.
DEVICE CONTROL			
TOOLS			
USER INTERFACE			
Default		ФОК	Cancel

In the Performance exclusions window, click Add option:

(CSCT) NOD32 ANTIVIRUS			×
Performance exclusions			?
			Q,
Exclude path	Comment		
Add Edit Delete	Import		ort
Û		100	
	ОК	Cano	el

In the Add exclusion window, click on Browse option:

(CSCT) NOD32 ANTIVIRUS	×
Add exclusion	?
Path Comment	0
	OK Cancel

Then specify the path of installing Vebko software on the computer and select the software folder to be trusted:

RADI NODAS ANTIN AUS	5
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+ Diseys.in	
+ style=124g=1	
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+ The come is an exampt	
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+ 🔁 method Row Road Wanatow	
+ Senioristaporer	
+ 🚾 Cithe Coder Pedr	
+ Stapesty tas	
+ Starter	
+ Ter Monasalt Hap Vower	
+ 🔤 Warsen Office	
+ 3-94 (1996)	
+ SWeincell 30, Terrar	
+ Set Arcsstl Angel Studio	
+ 🛄 Marself Juni 2014 IIA	
+ Set Krissti Virual studio 143	
+ The second web Teals	
+ 384 Minister Met	
+ 🔤 Mod Bal Manterianov Tentov	
+ 5045554	
+	
+ Setperkenext	
+ <u>DaperCorect</u> All	
+ Theological Associations	
- molto	
+ Search Status	
+ 🔤 4/5m 7+4	
	OK Cannel

The default path where the Vebko software is installed is displayed as follows:

C:\Program Files (x86)\Vebko

In this section, by selecting vebko folder and selecting OK option, the declared path is recorded.

After this step, you should do one of the following steps to trust the software version compared to the version you have installed (stable/test) on your system.

By selecting the vebko_stable folder is shown in the path, proceed to trust stable version, it should be noted that the AppData folder is in Hidden mode by default and you should display it by selecting the Hidden Items option in the View tab.

Instead of *, you should select the name of your Windows account and finally by doing these steps, the software will run as trusted and antivirus will not prevent its activity.

(CSET) NOD32 ANTIVIRUS	×	
Add exclusion	(?)	
Path Comment	C:\Program Files (x86)\Vebko\' 0	
	OK Cancel	J
een NOD32 ANTIVIRUS		□ × (?)
		Q
Exclude path	Comment	~
C:\Program Files (x86)\Vebko*	Iron set	Front
Add Edit Delete	Import	Export
	СК	Cancel

Also, to trust the Test version, you can select the vebko_test folder in the path shown, it should be noted that the AppData folder is in Hidden mode by default and you should display it by selecting the Hidden Items option in the View tab. This step is the same as the one mentioned in the trust stable version.

C:\Users*\AppData\Roaming\Vebko_test

Instead of *, you should select the name of your Windows account

INCLUZE ANTIVIRUS				o ×
Select path				?
+ 🚞 Frogram Data				
+ Recovery				
+ SCE-MSSORSERVeR-ExtensibilityData-P/				
+ Constraint Volume Information				
- Duris				
- Admin				
+ 🧰 contro				
+ 🚞 domet				
+ 🚞 noget				
+ 🚞 templateang ne				
+ 🗊 su Objectis				
— 🚞 AppDeta				
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+ 🛄 CoScSys				
+ TUMLoche				
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+ 🚞 proventie				
+ 🚞 NuGet				
+ 🚞 scooter Settware				
+ 🚞 Sub-ine Test				
+ 🛅 Sun				
+ 🛅 Te of Smith				
🕂 🎫 telegram Desitop				
+ 🚞 Vetko				
+ 🏪 Vesko_Slable				
+ 🚞 VeckoData				
+ 🚞 vecko Usta_Stable				
+. 🔤 detko Dela, Iest				
+ 🤷 Vina Statis Gian				
			OK	Cancel

(ESET NOD32 ANTIVIRUS	□ ×
Performance exclusions	(?)
	Q
Exclude path	Comment
C:\Program Files (x86)\Vebko*	
C:\Users\Admin\AppData\Roaming\VebkoData_Test	
Add Edit Delete	Import Export
	OK Cancel

176 : GUIDE TO TRUSTING VEBKO(STABLE-TEST) SOFTWARE IN KASPERSKY ANTIVIRUS

To trust Vebko software, after installing the software, you need to apply operations in Kaspersky antivirus: First, enter the Antivirus Setting section:

Kaspersky Anti-Virus	Your protection is live now 1 recommendation Details	?	~	×
Scan	Database Upd	ate		
Reports	On-Screen Keyb	oard		
0 0	More Tools V Other products My Kaspersky	License: 31	days rem	aining

Then, in the Threats and Exclusions tab, select Manage exclusions:

← Settings				
Protection	Detect other software that can be used by criminals to d or personal data For example, programs for remote control.	lamage you	ır compu	ter
General	Suspicious Packers			
Threats and Exclusions	 Packed objects whose packing may be used to protect m Multi-packed objects 	nalicious co	de	
Reports and Quarantine	Exclusions			
Network settings	You can add exclusions and trusted applications whose activ controlled.	vity will not	be	
Interface	Manage exclusions			
Manage Settings	Exclusions: 0,			
Additional	Specify trusted applications Trusted applications: 0.			
	Save		ancel	

And in the Exclusions window, select add option

	ttings			>
Exclusions				Q (0)
	🗙 Delete 🔂 Import [🖵 Export		
File or folder	Object	File hash code	Protection components	Comment
		List is empty		
		List is empty		
		List is empty		
		List is empty		
		List is empty		
		List is empty		

In the Add new exclusion window, click on Browse option:

Threats and Exclusions settings					-		×
← Add new exclusion							0
A file or folder will not be scanned if the fol	lowing conditio	ns are met:					
File or folder							
	Browse						
Name or name mask of file or folder.							
Object							
Object name or name mask according to the Virus File hash code		example, EICAR-Test	-File).				
If the file hash is specified, the edited file is not add	Calculate						
Protection components							
All components							
Selected only							
Scan							
File Anti-Virus							
Mail Anti-Virus							
Web Anti-Virus							
				Add	Ca	ancel	

The default path where the Vebko software is installed is displayed as follows:

C:\Program Files (x86)\Vebko

By selecting the vebko folder and selecting the Select option, in the Add new exclusion window, by selecting the All components option and finally by clicking on the Add option, the declared path is recorded.

After this step, you should do one of the following steps to trust the software version compared to the version you have installed (stable/test) on your system.

It should be noted that the AppData folder is in Hidden mode by default and you should display it by selecting the Hidden Items option in the View tab.

By selecting the vebko_stable folder shown in the path:

C:\Users*\AppData\Roaming\Vebko_stable

then click on Select option, in the Add new exclusion window, by selecting all components option and finally click on add option, to trust stable version. Instead of *, you should select the name of your Windows account

It should be noted that the AppData folder is in Hidden mode by default and you should display it by selecting the Hidden Items option in the View tab., which is the same as the part mentioned in the trust stable version.

By Selecting the vebko_test folder shown in the path:

C:\Users*\AppData\Roaming\Vebko_test

Click on select option, in the Add new exclusion window, by selecting all components option and finally click on add option, to trust the test version. Instead of *, you should select the name of your Windows account.

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