## Emblem Ministry of Energy Niroo Research Institute

Add. Down Shahid Dadman Blvd., Ghods Town, Tehran, POB 14665-517, Tel. +98 21 88079400, Fax +98 21 88078296 <u>info@nri.ac.ir</u> www.nri.ac.ir

Date: 09 Jan. 2017 No.: 95/103314/308 Fax: 66412321

Dear Dr. Razavi, Managing Director of Amirkabir Re-Monitoring Power Quality Co. (Vebko)

**Subject:** Operating tests results of the three-phase tester equipment

Following letter No. H-Z-365 dated 18 Sep. 2016 this is a copy of the operating tests report of the three-phase tester equipment, manufactured by that company (without the communication tester unit based on standard IEC61850) enclosed herewith for your information under serial No. TR95017.

Regards,

Masoud Rezaei Samankandi, Reference Laboratories Center Director

## Emblem I.R. of Iran Ministry of Energy **Niroo Research Institute**

## Test Report

## **Protection Relay Reference Laboratory**

**Applicant/producer:** Amirkabir Re-monitoring Power Quality Co. (Vebko) **Product:** Protection Relay Tester – Model AMT105

This report is merely for information and <u>is not</u> a confirmation of the product. This report <u>is</u> <u>not</u> to intervene with the Evaluation & Production Standards Compliance Council inspections.

Reference Laboratories Center Transmission & Substation Research Dept. of Niroo Research Institute [Sealed]

## Emblem Niroo Research Institute

## **Protection Relay Reference Libratory**

Test Report No.: TR95017

Protection Relay Tester	
Operation & Accuracy Tests (Verification) *	

Test Runner: Farshid Mansourbakht Test Confirmation Officer: Farshid Mansourbakht Supervisor: (Name of Entity/company): Dr. Farzad Razavi (Vebko Co.) Date: 07 Jan. 2017

Laboratory: Protection Relay Reference Address: Protection Relay Laboratory, Niroo Research Institute, End of Shahid Dadman Blvd., Ghods Town, Tehran Tel. /Fax: +98 2188079401-5 (extension 4978-4256)/88078296 Website: www.nri.ac.ir Test Site: Protection Relay Laboratory

Applicant: Amirkabir Re-monitoring Power Quality Company (Vebko) Application Letter No.: H-Z-365 Application Date: 18 Sep. 2016 Sample Receive Date: 18 Sep. 2016

Standard No.: -Test Method: Declaration Assessment - Operating Non-standard Methods: -

Test Report No.: TR95017 Sample Registration Code: STR95017-1,2

Sample Description: Protection Relay Tester Equipment Manufacturer/Client: Amirkabir Re-monitoring Power Quality Co. (Vebko) Model: AMT105 Type of Design: Without Non-conventional (IEC61850 Protocol) relays tests Serial No.: 95011226 (STR95017-1), 95011236 (STR9501717-2)

The results are only true of the sample tested.

- This report is not to be duplicated without the permission of the laboratory.
- \* The operating tests conducted have to do with the study of electoral particulars and equipment limits and are not in compliance with IEC 61850 communicational requirements, environmental tests, mechanical, electromagnetic compatibility, etc.

Technical Director, Test Runner [Signed]

Technical Director, Test Confirmer, Niroo Transmission & Distribution Research Center [Signed & Sealed] Contents

Title	Page
1- Summary of Tests Results	4
2- Plaque & Particulars	5
3- Technical particulars of the sample tested	6
4- General Remarks	6
5- A Summary of Test Method and Description of Test Results	7
5-1- Measurement Tests and Evaluation of Operating Accuracy	9
5-1-1- Measurement of burden and the adjusted current rate accuracy in (AC, DC) current supplies	9
5-1-2- Measurement of burden and the adjusted voltage accuracy in (AC, DC) voltage supplies	11
5-1-3- Measurement of voltage phase angle accuracy and adjusted current in voltage and current supplies	14
5-1-4- Measurement of accuracy of frequency	15
5-1-5- Measurement of accuracy of BO/BI/CURRENT/VOLTAGE INJECTION times	16
5-1-6- Measurement of burden of input power supply of tester	20
5-1-7- Measurement of input power supply range	20
5-1-8- Burden measurement of digital and analog inputs	20
5-1-9- Measurement of DC voltage supply power	20
5-1-10- Measurement of general waves of voltage and current waves	21
5-1-10-Measurement of time differences of synchronization with GPS time clock	24

## 1- A Summary of Test Results

#	Name of Test	Type of test	Standard	Test Result
1	Measurement of burden and adjusted current rate accuracy in (AC,	Type-based	Operating and	Conforming to specifications
	DC) current supplies		verification	of manufacturer
2	Measurement of burden and adjusted voltage accuracy in (AC, DC)	Type-based	Operating and	Conforming to specifications
	voltage supplies		verification	of manufacturer
3	Measurement of voltage phase angle accuracy and adjusted current	Type-based	Operating and	Conforming to specifications
	in voltage and current supplies		verification	of manufacturer
4	Measurement of accuracy of frequency	Type-based	Operating and	Conforming to specifications
			verification	of manufacturer
5	Measurement of accuracy of BO/BI/CURRENT/VOLTAGE	Type-based	Operating and	Conforming to specifications
	INJECTION times		verification	of manufacturer
6	Measurement of burden of input power supply of tester	Type-based	Operating and	Conforming to specifications
			verification	of manufacturer
7	Measurement of input power supply range	Type-based	Operating and	Conforming to specifications
			verification	of manufacturer
8	Burden Measurement of digital and analog inputs	Type-based	Operating and	Conforming to specifications
			verification	of manufacturer
9	Measurement of DC Voltage Supply Power	Type-based	Operating and	Conforming to specifications
			verification	of manufacturer
10	Measurement of general waves of voltage and current waves	Type-based	Operating and	Conforming to specifications
			verification	of manufacturer
11	Measurement of time differences of synchronization with GPS time	Type-based	Operating and	Conforming to specifications
	clock		verification	of manufacturer

#### 2- Plaque & Particulars



#### **3- Technical Specifications of Tested Sample** Table P.5/24

Description		Technics Specificallin
	Range	4N(1mV-15EV),step 5.01mV
Voltage Outputs(AC)	Power	32 VA per shared
	Acraracy	48.22% at a190 mV
	Hamps	4X(196V-298V),stage0.87wiV
Solitana DamaterDC3	Power	06-W per channel
course conformations	Accaracy	+0.24% or +100 mV
and the second second	Voltage	3 1% (0 Volus 21 VIAC)
Dutornas (THD)	Carrent(Ission)	11 195-92 Carriere 210 A (AC)
	Range	DC.1-1500 Hz
Ludnush unde	Accuracy	+0.000% ur +1 ralitz
Partie Treatment	Range	Min.5 reg up to watep 0.01 me
case constructi	Accornery	42.5% at 42.5 mil
and the last little states	Hamps	Min 1 mm ag ta -e
Pulse Tisse(Current injention)	Accuracy	43.5% or siL1 mi
-	Hange	Mix 200 pa
Time Measurement(80/AI)	Accurrecy	48.1% wr 4200 jan
Tener Time Synchronization with	Function startap tine datay	Min 15 minutes after power ON
ters unit think	Accaracy	Typical = 1.5 pagest = 12.8 pic
	Harape	Min 1 result in w
Palas Tinss(Voltage Injection)	Asservey	(all 5% or a 10 µ0) dr DC
	Barrier	0-160° step (0.01°
Phase sugle	Accuracy	(all 1% or all 1% S) Voltage
	Harge	63214 or 127 00 Carries 63218mA-32 A Junp 0.01mA
Carrent Outputs(AC)		DATE A
1 March 19 M	Fawer	and Table or a Table
	Actables	AND DOLLARS AND ADDRESS OF ADDRESS ADDRESS ADDRESS ADDRESS ADD
and and a second second	Bange	6X32 A
Current Outputs(DC)	Power	1007W par charrel
CONTRACTOR OF A	Accapacy	49-20% or 1246A
Narreat Operating Power Sugply	Vullage Barege	170-285 V AC
Max power supply limit V	oltage	365 V AC
Power Supply rating Pr	NUT .	1801 YA
- AUX DC power supply r	gentle	30.W

#### 4- General Remarks

The clients will have the rights to officially object to the results and or test method within one month after issuance date of test report. Should any mistakes affecting the results on the part of the laboratory is proved, the test will be re-conducted free of charge. The samples tested will be kept in the laboratory for six months after test or no objections will be heard.

The sampling operation was carried out by the client; therefore, the laboratory will bear no responsibility about sampling and the related issues.

The test results are only true the sample delivered by the client and **are not** to be looked upon as a confirmation of the product.

#### 5- A Summary of Test Method and Description of Test Results

The measurement was conducted using PMMI POWER-MULTIMETER manufactured by AVO Company with  $\pm 0.05\%$  accuracy. The voltages and currents read were acquired under nominal burden and in compliance with the technical specifications of the current and voltage supplies. The insulation test was carried out by SEFELEC RMG 500 dielectric power test device and the resistance of protective earth was measured using CHAUVIN ARNOU 4-wire micro-ohm.

The technical specifications of AVO PMMI measurement device:



The technical specifications of NORMA D6000 power analyzer measurement device are given in the following table.



#### 5-1- Measurement Tests and Evaluation of Operating Accuracy

#### 5-1-1- Measurement of burden and the adjusted current rate accuracy in (AC, DC) current supplies

In the tests for each adjusted tap of max, min and middle current of the software (considering the current feedback), the injected current and the variable ohm resistive load of each tap (equals zero) were changed and increased in output in order to reach the value 3V AC/DC (based on the manufacturer's specifications) for output

voltage in both ends of terminals of the equipment tested. (Total burden application considering the resistance of wires and joints).

The values of 3-phase current channels in both un-laden and full-laden states were then registered and read. The max error was calculated and contrasted with the values purported by the manufacture as per contents of the following table.

A (ma							and the second sec	
	1 32	0 3 44	10.01	7 30 000	25	0.022	NO 25% IN ADVICE	Patr
	18.0	25.00	0 25.00	8 25,224	24	0.094	+0.32% or show	PAT
	20.0	0 VB (80	0 20.00	20.018	18	0.090	+0.25% or s3reft	Pall
	15.0	14.00	6 15.00	0 10.010	10	0.067	ALL STOR OF STREET.	PAR
	10.0	0.00	10.00	2 10.000	11	6.030	+0.28% = z1 -A	FAR
	5.00	4.007	0 8.000	1 5.0000		0.080	10.38% or 1344	PAR
	2.06	1.900	v 2.002	1 2.0020	2.5	8.105	10.29% or 1346	PAR
	1.00	0.998	1.001	D 1.00031	2.2	0.000	10.25% or 13%4	PAS
nA	500.0	6 499.2	H 800.2	0 500.28	1.76	0.352	ADDIN to ADDA	FAIL
(res)	100.0	0 10.4	9 10.4	00.48	0.61	0.610	40.28% at \$255A	Page
	90.0	3 48.7	40.78	40.78	0.22	E 440	10.28% 01.28%	140
	10.0	0.00	9.05	0.09	0.08	0.000	MODES IN KENA	FAB
-	_							_
3			C Curre	nt Charm	IL ACLUM	STATISTICS.	amon	-
Rx pr	CUT		6	10	4.4 641	NE	Parmiesibis	RESUL
					[mA]	0.084	ERROR	
w (conse)	10.00	2 31.99	5 32.00	30.007	20	0.004	1 205 0 1204	PA0.
	20.05	20.00	3 25.00	10.024		0.098	10.23% IF L31%	
	10.00	14.00	20.00	10.000	10	0.013	10 Million and an	1000
	-10.00	14 56	10.00	15.000		0.043	the art of the Karlow.	22.00
	-10.00	4.000	10.00	10.001	4.0	5.020	ALC: NOT THE REAL OF	
	0.10	1 1000	0 3 000	1 1 0000	-	0.000	of this or show	22.27
	1.00	1.898	2 0.000	2 1 00000	100	0.100	of the second	24.00
10.0	1.00	0.000	0.9999	454 (21	1.80	0.103	of the second	
(rave)	102.0	0 03 00	100.00	07.75	2.42	3 100	AP NOT THE ADDR.	2400
-	72.70	40.00	48.00	10.00	1.04	3 0.00	ALC: NOT THE REAL	24.55
	99.04	. 48.00	40.09	40,08	1.01	1.000	IN STREET OF STREET	
NOR	10.00	listive lo	att increa	so in each	tap to acitie	ve Max 3	V ma. NAX 5 out	100 V.A
NOR	10.00	distive lo	DC Gar	nent Gharro	tap to achie	We Max 3	V ma. MAX 5 out	A.V 021
Note	SUDE THE JEE	lative lo	DC Gar Ib	nent Gharro Is:	tap to achie ma Accounty A A mas (m4)	We Max 3 (Un Latter %E	V ma. MAX 5 out Permissible EXROR	RESULT
Note A	90.00 1940 / 001 EUT 32.03	ta 12.030	DC Car Ib 30,058	nent Charve In: 02.008	tap to achie en Accoraty A A mas (pr4) 30	We Max 3	V ma. MAX 5 out Permission ENKOR 10 275 or sime	RESULT
Note A	10.00 EUT 12.00 25.00	ta 12/036 25/023	DC Car Ib 32 038 25 025	ie in each rent Charve ie 12.036 25.025	tap to achie en Accornery A A mas (mA) 20 20	We Lader %E 0.113 0.002	V ma. MAX 5 out Permissible EXMAN 10 JTN or sink 10 JTN or sink	RESULT PHES
Note A	10.00 200.00 20.00 20.00 20.00	ta 12.036 25.023 20.078	DC Car Ib 30,058 29,055 20,019	ie in each ie 32 006 25 025 20 019	tap to antitie re Accounty A A mas (m4) 20 20 19	We Max 3 (Us Lader %E 0.113 0.000 0.000	V ma, MAX 5 out Permission ENKOR 10 2014 or street 20 2014 or street 20 2014 or street	RESULT PASS PASS PASS
Note A	EUT 25.00 25.00 15.00	ta 52:036 25:023 20:078 15:013	DC Car Ib 30,008 25,003 20,018 15,013	le in each le 12 026 25 025 20 019 15 013	tap to active re Accountly A A max (mA) 30 20 10 13	We Max 3 WE 0.113 0.000 0.005 0.007	V ma, MAX S out Permissible EXION 10 20% or strek 10 20% or strek 10 20% or strek 10 20% or strek	RESULT PASS PASS PASS
Note A	EUT 12.02 25.03 15.00 15.00	la 12.030 25.023 20.018 15.013 10.029	DC Car Ib 32 038 25 035 20.010 15.013 10.006	te in each te 12 036 25 025 20 019 15 013 10 066	tap to active m Accountly A A max (mA) 30 20 10 13 5	We Max 3 WE 0.113 0.000 0.005 0.007 0.000	V ma, MAX S out Permissible ERNOR 10 20% or silvek 10 20% or silvek	RESULT PADS PADS PADS PADS
Nige A	10.00 EUT 12.00 25.00 15.00 15.00 5.00	la 12:030 25:023 20:019 15:013 10:029 4:3907	DC Gar b 22 038 29 03 20.010 15.013 10.009 4.0002	10 In each In: 12 036 25 025 20 019 15 013 10 066 4 9002	tap to antile RE Accounty A A max [m4] 30 22 10 13 5 0.8	We Max 3 We Lader %E 0.113 0.000 0.000 0.007 0.007 0.000 0.010	V mma, MAX S out Permissible EXNOR 10 20% or silvek 10 20% or silvek	RESULT RESULT PASS PASS PASS PASS PASS
Note A	19.00 TRAJET 12.02 25.00 15.00 10.00 5.00 2.00	la 12:030 25:023 20:019 15:013 10:029 4:9902 1:9355	DC Gar b 20 000 29 003 20 010 16 013 10 000 4 9000 1,908	ee in each ie 32 036 25 005 20 019 15 013 10 006 4 0000 1 5488	tap to antile m Accounty A A max (m4) 30 22 19 13 5 0.8 12	No Max 3 (Un Laden %E 0.113 0.000 0.005 0.007 0.000 0.016 0.000	V mai, MAX S out Permissible ENROR 10 27% or block 10 25% or slock 10 25% or slock	RESULT RESULT PASS PASS PASS PASS
Note A	EUT 12.02 25.03 25.03 15.00 15.00 5.00 5.00 1.00	14 92:030 25:023 25:023 15:013 15:013 10:025 4:9902 1:9385 0 00050	DC Gar b 20 000 20 000 20 010 16 013 10 000 4 0000 1,0088 0 98000	ee in each ment Charme ic 32,006 25,005 20,019 15,013 10,005 4,0000 1,5668 0,94830	tap to antile en Accounty A A man (mA) 30 20 10 10 5 0.8 .12 1.7	We Max 3 (Un Lader %6 0.113 0.000 0.000 0.000 0.000 0.000 0.000 0.000	V mea, MAX 5 outh Permissible ENROR 40.20% = sibes 40.20% = sibes	RESULT RESULT PASS PASS PASS PASS PASS
Note A	EUT 12.03 25.03 25.03 15.00 15.00 1.00 1.00	14 92-030 25-023 25-023 15-013 10-029 4-9902 1-9988 0 00630 0001 200	DC Gar b 20 008 29 003 20 019 16 013 10 009 4 9002 1 9002 0 90030 0 90030	ee in each ment Charm le 32,006 25,005 20,019 15,013 10,005 4,0000 1,5668 0,99830 0,99830	tap to actile en According (eA) (eA) 30 22 19 13 5 0.8 1.2 1.7 1 1	We Max 3 (Un Lader %6 0.113 0.000 0.000 0.000 0.000 0.000 0.170 0.590	V ma, MAX 5 out Permissible ENKOR 01 20% or stand 20 20% or stand 20%	RESULT PASS PASS PASS PASS PASS PASS
Note A	93.00 170.00 120.01 25.00 15.00 15.00 1.00 1.00 1.00 1.00	ta 22.030 23.030 23.031 15.03 10.032 4.9932 1.9353 0.99530 0.99530 0.99530	DC Gar b 20 036 20 036 20 010 16 033 10 056 4 9602 1.9855 0 98040 501.40 99 40	ee in each rent Chares is 22.006 25.005 20.019 15.013 10.006 4.0000 1.5468 0.99830 50.000 50.000	top to active ex Accountly AA mass (mA) 20 20 99 10 5 0.8 12 1.7 1.7 1.8 0.4	Max 3 (Un Laden %E 0.113 0.000 0.000 0.000 0.000 0.000 0.000 0.100 0.100 0.100 0.000	V men. MAX 5 out Permission EMO(8) 40.20% or size/s 50.20% or size/s	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
A RA	51.00 170.00 170.00 120.00 15.00 10.00 1.00 100.00 100.00	ta 122.030 23.031 23.031 15.013 15.013 10.035 4.932 1.935 0.9012 0.9010 0.90120000000000000000000000	DC Gar b 22 036 25 035 20 010 16 013 10 005 4 9002 1,98030 501 40 92 40 92 40 92 40 92 40	ee in each rent Chares le 22.000 25.000 25.000 15.013 10.006 4.0000 1.5668 0.99830 50.000 50.00 50.40 50.40	top to active en Accountly AA mass (mA) 20 20 10 10 5 0.8 12 1.7 6 8 0.8 12 1.7 6 8 0.8 12 1.7 6 8 0.8 12 1.7 10 10 10 10 10 10 10 10 10 10 10 10 10	Max 3 (Un Laden %E 0.113 0.000000	V men. MAX 5 out Permission EXNOR 40.2751 + 30445 40.2751 + 30455 40.2751 + 304555 40.2751 + 304555 40.2751 + 3045555 40.2751 + 304555 40.2751 + 30455	RESULT PADS PADS PADS PADS PADS PADS PADS PADS
hole A	ELIT 12.03 25.03 25.03 15.03 15.03 10.03 1.00 1.00 5.00 1.00 5.00 1.00 5.00 1.00	14 12/020 25/023 25/023 25/023 25/023 15/013 10/025 4 /9022 17/9385 0 /06650 001 ED0 26 /00 50 /00 50 /00	DC Car b 20.036 29.035 20.010 15.013 10.005 4.9002 1.9085 0.98000 501.80 92.40 51.27	e in each rent Chann ic 32,038 25,025 23,025 23,025 23,025 4,000 15,013 10,006 4,000 15,005 0,93830 0,93830 0,93830 0,93830 50,42 86,27	tap to active ## Accounty A A max (#A) 30 10 13 5 0.8 .32 1.7 1.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0	Nes Max 3 (Un Lader %E 0.113 0.005 0.007 0.000000	V men. MAX 5 out Permissible ENNOR 01 2016 - science 40 2016 - sci	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
A note	ELIT 32.03 25.03 25.03 25.03 32.00 15.00 5.00 2.00 1.00 5.00 5.00 5.00 1.00 5.00 1.00 5.00 1.00 5.00 1.00 5.00 1.00 5.00	ta 32:030 25:023 25:023 25:023 25:023 15:013 10:025 4:0902 11:022 20:018 0:00630 0:00500 0:0050 0:00500000000	EC Gar 18 30,098 25,035 20,010 16,013 10,009 4,9002 1,985 0,98000 501,80 92,40 50,27 11,50	e in each nem Chann 12 006 23 000 13 010 15 013 10 006 4 0000 1 0 99830 90 40 50 27 11 40	tap to active # A coursely (mA) 20 20 20 20 20 20 20 20 20 20	Nes Max 3 (Un Lader %E 0.113 0.000 0.007 0.000 0.007 0.000 0.000 0.010 0.000 0.010 0.0000 0.000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000000	V men. NAX 5 out Permission END 60 20% or 20% 60 20% or 20%	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
A mA	EUT 32.00 25.00 32.00 32.00 3.00 3.00 1.00 5.00 5.00 5.00 5.00 5.00 5.00 5	ta 12:020 25:023 25:023 25:023 20:018 15:013 10:025 4:9902 10:025 0:0650 0:0650 0:0650 0:0650 0:0650 0:0650 0:0650 0:0650 11:502	EC Gar 18 30,038 25,035 20,010 16,013 10,005 4,9002 1,9858 0,98000 501,80 92,40 50,27 11,50 DC Cur	e in each e 32 006 23 009 15 013 10 006 4 0000 1 09880 099880 50 40 50 40 50 40 1.55 e 1.55 e e 1.55 e e e e e e e e e e e e e	tap to active #A Accuraty A A mas (m4) 20 20 10 5 0.8 52 1.7 18 0.8 520 500 5500 Fs Accuraty	We Max 3 (Un Lader %E 0.113 0.002 0.005 0.007 0.000000	V men. MAX 5 out Permission EXRO 60 20% or size/s 40 40% or si	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Note A	90.0 90.0 12.02 25.03 25.03 15.03 5.00 2.00 1.00 5.00 5.00 5.00 5.00 5.00 5.00 5	ta 32:030 25:023 25:023 25:023 15:025 4:0902 10:025 4:0902 10:025 0:006030000000000	DC Car b 20 036 20 036 20 010 16 013 10 506 4 9062 1 98600 501 80 92 40 50 27 11 50 05 Car 16 10	e in audi ie 32 008 25 005 20 019 15 015 4 0000 1 0000 0 00000 0 0000 0 00000 0 00000 0 000000	tap to activ #A.mas (jnA) 20 13 5 0.8 12 1.7 (a 0.8 1.2 0.8 1.2 0.8 1.50 1.50	Ne Max 3 (Un Lader %E 0.113 0.0000 0.000000	V men. NAX 5 out Purnission EMORE 10 JPN or 20MA 10 JPN or	RESULT RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Notes A	90.0 2007 22.00 25.00 25.00 15	la 12 12 25 25 25 25 25 25 25 25 25 25 25 25 25	DC Car b 22 005 20 005 20 005 20 005 10 005 4 005 10 005 4 005 10 005 501 80 92 40 50 27 11 50 05 Car 10 05 Car 10 05 Car 10 05 Car 10 05 Car 10 05 Car 10 05 10 05 100 100 100 100 100 100 100 100 100 1	e in each ic 22.038 25.005 28.019 15.019 15.019 10.006 4.0000 1.5468 0.99330 50.40 50.50 50.50 50.50 50.50 50.50 50.50 50.50 50.50 50.50 50.50 5	tap to active A A mas (pA4) (pA4) 20 10 12 13 5 0.8 12 1.7 1.8 0.8 0.22 1.7 1.8 0.22 0.9 1.2 1.7 1.8 0.22 0.9 1.2 1.7 1.8 0.22 0.9 1.2 1.7 1.8 0.9 1.2 1.7 1.8 0.2 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.9 1.7 1.8 0.8 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	Min Laden %6 0.113 0.000000	V men. MAX 5 out Permission EXROR 65 20% or 10% 40 20% or 10% 40 20% or 20% 40 20% or 20%	400 V.A RESULT 9488 9488 9488 9488 9488 9488 9488 948
Notes	9000 ELIT 12:02 25:03 15:03 15:03 15:03 15:03 10:030 50:0050 5	la 122.035 25.023 25.023 25.023 25.023 15.013 15.013 15.013 15.013 10.025 4.0902 0.00650 0.00650 0.00650 0.00650 11.502 1	DC Car 15 30 008 20 019 16.013 10.005 1.005 1.005 0.005 1.005 0.005 11.00 0.014 0.005 11.00 0.014 0.005 11.00 0.017 11.00 0.017 11.00 0.017 11.00 0.017 11.00 0.017 11.00 0.017 11.00 0.017 11.005 0.005 0.017 10.005 0.017 10.005 0.05	e in each ie 22.006 23.000 23.000 23.000 23.000 10.006 4.0000 10.006 4.0000 10.006 96.40 9	top to active #A Accuracy (psk) 20 20 20 20 20 20 20 20 20 20	Ma Lader 5.6 0.113 0.0000 0.000000	V men. MAX 5 out Permission CONCIP 01 2016 - control 01 2016 - con	RESULT RESULT PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS
Note A A Conge	90.0 200 200 200 200 200 200 200 200 200	la 22 036 25 025 25 025 20 078 15 073 15 073 10 025 4 9932 0 96630 50 205 50 205 11 502 12 025 32 024 22 025 32 024 32 024 32 025 32 025 32 025 32 025 32 025 32 025 32 025 32 025 32 025 35 025 3	DC Gar tb 20,000 20,003 20,003 20,003 10,005 4,9002 1,9085 0,9002 1,9085 0,9002 501,80 92,40 501,80 92,40 501,27 11,50 05 Gar 16 50,27 11,50 05 Gar 16 50,27 11,50 05 Gar 20,010 20,000 20,010 20,000 20,000 20,000 20,0000000000	e in each ie 12 026 25 025 28 025 28 025 28 025 28 025 28 025 28 025 20 016 15 013 10 006 4 0806 0 98 40 56 27 11 50 80 40 56 27 11 50 80 40 80 40 80 80 40 80 40 80 80 40 80 80 40 80 80 80 80 80 80 80 80 80 80 80 80 80	tap to active #A.coursely A.A.mass (jnA1) 201 201 201 103 5 5 0.8 122 1.7 1.8 0.8 1.22 0.8 1.22 0.8 1.22 0.8 1.22 0.8 1.22 0.8 1.22 0.8 1.22 0.8 1.22 0.8 1.22 0.8 1.22 1.57 1.50 2.50 1.57 1.50 1.	Min Lader %6 0.113 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000	V men. MAX 5 out Permission EXECUTE 10.27% or 20% 10.27% or 20%	RESULT PASS
Note A A A	90.0 90.0 20.0 20.0 20.0 20.00	la 32 036 25 021 25 021 20 078 15 073 10 002 10 100 50 100 50 400 50 400 50 400 50 400 50 400 50 201 11.502 la 22 074 13 502 11.502	ad increa DC Gar is 30,000 25,000 25,000 10,000 4,0000 1,0056 4,0000 501,80 502,80	e in each nen Chann 22 026 22 026 23 019 13 013 10 006 4 0000 1 1566 0 99830 00 40 00 40 00 00 00 00 00 00 00 00 00	tap to active A A mass (pA4) (pA4) 20 10 12 13 5 0.8 1.7 1.8 0.8 1.7 1.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0	We Max 3 (Un Lader %E 0.113 0.0000 0.00000 0.0000 0.00000 0.00000 0.00000 0.00000 0.00000000	V men. MAX 5 duth Permission EXROR 40.2751 or 2044 40.2751 or 2044 40.2751 or 2044 40.2755 or 2044	1100 V.A RESULT PASS PASS PASS PASS PASS PASS PASS
Ndle A A A	90.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0	ta 12 2031 25,021 20,021 20,021 10,025 4,0922 4,0922 4,0922 50,056 50,05650 50,0550 50,050 50,000 50,050	10 C Gar 10 C Gar 10 C Gar 10 C Gar 20 C Gar 20 C Gar 10 C G	e in each 12 039 23 039 23 039 23 039 23 039 23 039 13 039 10 005 1 3005 1 3	top to actile #A Accuracy (psk) 20 10 13 5 0.8 12 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	(Un Lader %6 0.119 0.006	V men. MAX 5 out Permission CONCIL 0.20% or 20% 40.20% or 20%	110 V A RESULT PASS PASS PASS PASS PASS PASS PASS PASS PASS
Note A A Conge A	90.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0	14 52 036 25 025 25 025 20 028 10 0028 4 0992 10 008 50 000 50 0000 50 000 50 000 50 000 50 000 50 000 50 000 50 000 50 000 50 000 50 000 500 5	DC Car b DC Car b DC Car b DC Car 10 D13 10 D05 20 010 10 D13 10 D05 20 000 20 4 0005 20 4 0005 20 4 0005 20 4 005 20 20 0 11 D0 20 20 0 20 0 20 0 20 0 20 0 20 0 20	e in each rent Channe le 32.036 25.037 15.013 10.006 4.5006 0.93330 20.000 20.000 20.000 20.000 20.000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.0000 20.00000 20.00000000	tap to active #A Accuracy (pA) 20 20 10 13 5 0.8 12 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.6 0.8 1.2 1.7 1.6 0.8 1.2 1.7 1.6 0.8 1.2 1.7 1.6 0.8 1.2 1.5 0.8 1.5 1.5 0.8 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	Unit Laden NE 0.0000 0.0000 0.000000	V mes. NAX 5 out Permission EXECT 1 10 JUN = 2044 40 JUN = 204	400 V.A 8459ULT 84888 8488 8488 84888 8488 8488 8488 8488 8488 8488 8488 8488
Note	90.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0	ta 12 2036 25:223 25:223 20:028 20:028 10:029 4:9982 20:028 20:028 10:029 10:00	DC Car b DC Car b D2 COE 25 COS 25 COS 20 COE 25 COS 26 CO 20 COE 20 COE 2	e in each rent Chann 12 006 23 007 20 019 13 013 10 006 4 1006 0 4100 50 42 1 1500 50 42 1 1.500 50 427 11.50 80 80 80 80 80 80 80 80 80 80 80 80 80	tap to actile a Accordiy (pA) (pA) (pA) 22 13 5 08 13 5 08 12 13 5 08 12 17 18 12 17 18 122 17 18 22 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 09 13 5 08 12 13 5 08 12 15 08 15 15 08 15 15 15 15 15 15 15 15 15 15	(Unit Laident     KE     (11)	V men. MAX 5 duth Permission EXROP 40.2751 or 10-04 40.2751 or 10-04 40.2751 or 10-04 40.2751 or 10-04 40.2755 or	1100 V.A RESULT RESU
NGB ange A	90.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0	ta 12 232 25,223 25,223 20,225 20,225 20,225 20,225 15,023 10,025 30,06630 50,26630 50,26630 50,26630 50,2663 20,2664 22,2074 22,2074 22,2074 22,2074 16,206 20,2074 22,2074 24,2002 24,20074 24,20076	ad increa DC Cur Ib D2 COR 25 CCS 25	e in each rent Channe ie 32 039 25 039 25 039 25 039 20 019 15 013 10 065 4 0000 1 5013 0 068 4 0000 1 5013 0 048 50 4 000 1 5027 11.50 96 4 0 95 4 0 10000000000000000000000000000000000	top to actile #A Accuracy (psk) 20 20 20 10 13 5 0.8 .12 1.7 18 0.8 .12 1.7 18 0.8 .12 1.7 18 0.8 .12 .17 18 0.8 .12 .17 18 0.8 .12 .17 .5 .08 .12 .17 .5 .08 .12 .17 .5 .08 .12 .17 .5 .08 .12 .17 .5 .08 .12 .5 .08 .12 .5 .5 .5 .5 .5 .5 .5 .5 .5 .5	(III Laiden (KE	V men. MAX 5 out Permission CONTR 0.20% or 20% 40.20% or 20%	400 V.A 4450 V.A 4450 4400 44500 44500 44500 44500 44500 44500 44500 44500 44500 44500 44500 445000 4450
NGB ange A	90.0 100	la 02/236 25/221 20/28 25/221 20/28 20/28 10/26 20/28	DC Car b DC Car b DC Car b DC Car 10 DC 20 DC 20 DC 10 DC 20	e in each rent Channe le 22.026 23.020 23.020 15.013 10.006 4.1000 20.020 20.020 20.020 20.020 20.020 20.020 20.020 10.0000 10.000 10.000 10.000 10.000 10.00000 10.0000 10.00000 10.00000000	tap to active #A.coursely A.A.mass (prA1) 20 10 13 5 0.8 12 1.7 1.8 0.8 1.22 1.7 1.8 0.8 0.8 1.22 0.8 1.22 0.8 0.8 1.22 0.8 0.8 1.22 0.8 1.22 0.8 0.8 1.22 0.8 1.22 0.8 1.22 1.7 1.60 0.8 1.22 1.7 1.60 1.5 0.8 1.22 1.7 1.60 1.5 0.8 1.22 1.7 1.60 1.5 1.50	Unit Laden NE 0.113 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000	V mes. NAX 5 out Permission EXECT 1 10.27% or 20% 40.27% or 20	HEDULT  HEDULT
Notes A	90.0 90.0 90.0 90.0 90.0 90.0 90.0 90.0	te 12 2036 25 223 25 223 25 223 20 218 20 218 20 218 15 029 20 218 20 20 21 20 2	add Increas       DC Carl       b       32 COSE       25 COS       26 COS       27 COS       28 COS       29 COS       20 COS       20 COS       20 COS       20 COS	e in each nen Chann E 22.026 23.026 23.029 23.019 13.013 10.006 4.1006 0.91830 00.420 0.91830 00.420 0.91830 0.92.074 13.003 4.25.025 22.074 25.025 10.003 4.25.025 10.003 4.25.025 20.014 15.003 10.003 4.0505 0.056610 0.056100 0.056100 0.056100 0.056100 0.056100 0.056100 0.0561000 0.05610000000000000000000000000000000	tap to active A A mass (pA4) 22 13 5 0.8 12 1.7 1.8 0.8 0.20 1.502 M A mass (pA4) 1.2 1.7 1.8 0.8 0.20 1.502 M A A mass (pA4) 1.2 1.5 0.8 0.8 1.5 0.8 0.8 1.5 0.8 0.8 1.5 0.8 0.8 0.8 1.5 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8	Ke	V men. MAX 5 out Permission EXAMPLE 40.20% or sizeA 40.20% or sizeA 4	100 V.A RESULT PASS
Notes A	90.0 100	La D2 055 25 021 25 021 25 021 15 073 15 073 10 055 10 055 0 18 00 50 18 00 50 18 00 50 201 11 502 La 25 05 10 25 05 100	ad increa DC Car b D2 COR 25 C25 25 C25 20 C10 16 C13 10 CCC 20 C00 501 80 501 80 501 80 501 80 502 70 11 50 502 70 11 50 20 Car B 32 D16 52 20 52 20 50 4 50 4 50 4 50 4 50 50 50 50 50 4 50 4	e in each ren Chann ie 32.028 25.028 25.028 25.028 0.96530 50:050 50:050 50:00 50:00 50:00 50:00 50:00 50:00 50:00 50:00 50:00 10.003 20.014 15.003 10.003 20.014 15.003 10.003 20.014 15.003 20.014 20.014 15.003 20.014 2	top to actile #A Accuracy (psk) 20 10 13 5 0.8 12 13 5 0.8 12 13 14 0.8 1220 150	Ke	V men. MAX 5 out Premine the EXEMPT 41.275 is a stand 40.275 is a	HEBULT HEBULT HASS PASS PAS PA PA PA PA PA P
Notes and a set of the	90.0 100	la 02/236 25/221 20/28 25/221 20/28 20/28 10/26 20/28	ad increa DC Car b DC Car b DC Car 20 005 20 005 10 005 20 005 0 0000 20 005 0 0000 20 005 0 0000 0 0000 0 0000 DC Car b DC Car b Car b DC Car b DC CA CA CA CA CA CA CA CA CA CA CA CA CA C	e in each rent Channe le 32.026 25.025 25.025 30.019 15.013 10.006 4.1500 50.420 50.420 50.420 50.420 50.420 50.420 50.420 11.30 80.277 10.003 10	tap to active # Accuracy (pA) 20 20 10 13 5 5 0.8 12 1.7 1.8 0.8 12 1.7 1.8 0.8 12 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.7 1.8 0.8 1.2 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	Ke	V mes. NAX 5 out Press Max 5 out 10 27% in 20% 40 27% in 20% 20% in 20% 40 27% in 20%	HEDULT HEDULT HEDULT HEDULT HEDULT HEDULT HEDULT HEDULT HADD

#### 5-1-2- Measurement of burden and the adjusted voltage accuracy in (AC, DC) voltage supplies

In the tests for each adjusted tap of max, min and middle voltage of the software (considering the voltage feedback), the applied voltage and the variable ohm resistive load of each tap (equals zero) were changed and increased in output in order to cut off the output voltage (in 350mA current) (based on the manufacturer's specifications)

The values of 3-phase voltage channels in both Un-laden and full-laden states were registered and read and the max error calculated and contrasted with the values purported by the manufacture as per contents of the following tables.

	EUI	Va	Vb	Vc	min	Δ	%E	Permissible ERROR	RESULT
V	000.00	100.02	100.05	100.00	100.00	V[mV]	0.05		
V 4	200.00	199.83	199.85	199,83	199.83	-170	-0.08	±0.25% or ±100 mV	PASS
	175.00	1/4.86	1/4.84	174.83	174.83	-170	-0.10	±0.25% or ±100 mV	PASS
	150.00	149.84	149.86	149.85	149.84	-160	-0.11	±0.25% or ±100 mV	PASS
	120.00	119.9	119.88	119.87	119.87	-130	-0.11	±0.25% or ±100 mV	PASS
1	100.00	99.875	99.892	99.888	99.875	-125	-0.13	±0.25% or ±100 mV	PASS
	75.00	74.924	74.919	74.905	74.905	-95	-0.13	±0.25% or ±100 mV	PASS
	50.00	49.946	49.922	49.909	49.909	-91	-0.18	±0.25% or ±100 mV	PASS
	25.00	24.93	24.948	24.932	24.93	-70	-0.28	±0.25% or ±100 mV	PASS
	10.00	9.938	9.9555	9.9495	9.938	-62	-0.62	±0.25% or ±100 mV	PASS
	5.00	4.9378	4.9556	4.9403	4.9378	-62.2	-1.24	±0.25% or ±100 mV	PASS
	2.00	1.9394	1.9628	1.9545	1.9394	-60.6	-3.03	±0.25% or ±100 mV	PASS
	1.00	0.93702	0.96021	0.9516	0.93702	-62.98	-6.30	±0.25% or ±100 mV	PASS
mV 5	00.00	442.09	469.03	457.62	442.09	-57.91	11.58	±0.25% or ±100 mV	PASS
1	00.00	76.4	87.9	77.7	76.4	-23.6	23.60	±0.25% or ±100 mV	PASS
4	50.00	44.97	45.59	46.47	44,97	-5.03	10.06	±0.25% or ±100 mV	PASS
1	10.00	3.97	5.18	5.18	3.97	-6.03	60.30	±0.25% or ±100 mV	PASS
Note 1:	Cutput	Load adje	DC Volt	age Ch	annels A	ccurac	y (Un l	-aden)	0 mA),
Note 1: Range	EUT	Va	DC Volt	age Ch Vc	annels A <sup>min</sup>		y (Un l %E	_aden)	RESULT
Range V	EUT 200.00	Va 199.91	DC Volt Vb 199.87	age Ch Vc 199.8	annels A min	Accurac V[mV] -130	y (Un I %E -0.06	Laden) Permissible ERROR 10.25% or ±100 mV	RESULT
Range V	EUT 200.00 190.00	Va 199.91 189.92	DC Volt Vb 199.87 189.88	age Ch Vc 199.89	annels A min ) 199.87 ) 189.88	ACCUITAC V[mV] -130 -120	y (Un I %E -0.06 -0.06	-aden) Permissible ERROR 10.25% or ±100 mV ±0.25% or ±100 mV	RESULT PASS PASS
Range V	EUT 200.00 190.00 175.00	Va 199.91 189.92 174.93	DC Volt Vb 199.87 189.88 174.88	age Ch Vc 199.89 189.89 174.89	annels A min ) 199.87 ) 189.88 ) 174.88	Accurac V[mV] -130 -120 -120	y (Un I %E -0.06 -0.06 -0.07	aden) Permissible ERROR 10.25% or ±100 mV 10.25% or ±100 mV 10.25% or ±100 mV	RESULT PASS PASS PASS
Range V	EUT 200.00 190.00 175.00 150.00	Va 199.91 189.92 174.93 149.94	DC Volt Vb 199.87 189.88 174.88 149.91	age Ch Vc 199.89 189.89 174.89 149.92	annels A min ) 199.87 ) 189.88 ) 174.88 ! 149.91	ACCUFAC V[mV] -130 -120 -90	y (Un I %E -0.06 -0.06 -0.07 -0.06	Laden) Permissible ERROR 10.25% or ±100 mV 10.25% or ±100 mV 10.25% or ±100 mV 10.25% or ±100 mV	RESULT PASS PASS PASS PASS
Range V	EUT 200.00 190.00 175.00 150.00 120.00	Va 199.91 189.92 174.93 149.94 119.96	DC Volt Vb 199.87 189.88 174.88 149.91 119.93	age Ch Vc 199.8 189.8 174.8 149.9 149.9	annels A min ) 199.87 ) 189.88 ) 189.88 ) 174.88 ; 149.91 ; 119.93	ACCUFAC A V[mV] -130 -120 -120 -90 -70	y (Un I %E -0.06 -0.06 -0.07 -0.06 -0.06	aden) Permissible ERROR ±0.25% or ±100 mV ±0.25% or ±100 mV ±0.25% or ±100 mV ±0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS
Range V	EUT 200.00 190.00 175.00 150.00 120.00 100.00	Va 199.91 189.92 174.93 149.94 119.96 99.962	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942	age Ch Vc 199.83 189.86 174.85 149.92 119.94 99.951	annels A min ) 199.87 ) 189.88 ) 174.88 ) 174.88 ; 149.91 ; 119.93 ; 99.942	ACCUFAC A V[mV] -130 -120 -120 -90 -70 -58	y (Un I %E -0.06 -0.06 -0.07 -0.06 -0.08 -0.06	aden) Permissible ERROR ±0.25% or ±100 mV ±0.25% or ±100 mV ±0.25% or ±100 mV ±0.25% or ±100 mV ±0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS
Note 1: Range V	EUT 200.00 190.00 175.00 150.00 120.00 100.00 75.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956	age Ch Vc 199.83 189.83 174.85 149.92 119.94 99.951 74.954	annels A min ) 199.87 ) 189.88 ) 174.88 ! 149.91 ! 119.93 99.942 74.954	ACCUITAC V[mV] -130 -120 -120 -90 -70 -58 -46	y (Un I %E -0.06 -0.06 -0.07 -0.06 -0.06 -0.06 -0.06	aden) Permissible ERROR ±0.25% or ±100 mV ±0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS
Range V	EUT 200.00 190.00 175.00 150.00 120.00 100.00 75.00 50.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95	age Ch Vc 199.83 189.83 174.83 149.92 119.94 99.951 74.954 49.97	annels A min ) 199.87 ) 189.88 ) 174.88 ! 149.91 i 119.93 99.942 i 74.954 49.95	ACCURAC V[mV] -130 -120 -120 -90 -70 -58 -46 -50	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10	aden) Permissible ERROR t0.25% or ±100 mV t0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V	EUT 200.00 190.00 175.00 150.00 120.00 75.00 50.00 25.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964 24.966	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948	age Ch Vc 199.8 189.8 174.8 149.9 119.9 99.951 74.954 49.97 24.954	annels A min ) 199.87 ) 189.88 ) 174.88 1 149.91 1 119.93 99.942 74.954 49.95 24.948	ACCUFAC A V[mV] -130 -120 -90 -70 -58 -46 -50 -52	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21	Laden) Permissible ERROR 10.25% or ±100 mV 10.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V	EUT 200.00 190.00 175.00 120.00 120.00 100.00 75.00 50.00 25.00 10.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964 24.966 9.9953	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911	age Ch Vc 199.83 189.86 174.85 149.92 119.94 99.951 74.954 49.97 24.954 9.9896	annels A min ) 199.87 ) 189.88 ) 174.88 ) 199.87 ) 199.87 ] 199.87	ACCUFAC A V[mV] -130 -120 -90 -70 -58 -46 -50 -52 -10.4	y (Un I %E -0.06 -0.06 -0.07 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10	Laden) Permissible ERROR t0.25% or ±100 mV t0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V	EUT 200.00 190.00 175.00 150.00 120.00 100.00 75.00 50.00 25.00 10.00 5.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964 24.966 9.9953 4.9926	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911 4.993	age Ch Vc 199.83 189.84 174.85 149.92 119.94 99.951 74.954 49.97 24.954 9.9896 4.9964	annels A min ) 199.87 ) 189.88 ) 174.88 : 149.91 4 119.93 99.942 74.955 24.948 9.9896 4.9926	A V[mV] -130 -120 -120 -90 -70 -58 -46 -50 -52 -10.4 -7.4	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10 -0.15	aden) Permissible ERROR 10.25% or ±100 mV ±0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V	EUT 200.00 190.00 175.00 150.00 120.00 100.00 75.00 50.00 25.00 10.00 5.00 2.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.984 24.966 9.9953 4.9926 1.9977	DC Volt Vb 199.87 189.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911 4.993 1.9931	age Ch Vc 199.83 189.86 174.85 149.92 119.94 99.951 74.954 49.97 24.954 9.9896 4.9964 1.9931	annels A min ) 199.87 ) 189.88 ) 174.88 : 149.91 4 119.93 99.942 ; 74.854 49.95 24.948 9.9896 4.9926 1.9931	A V[mV] -130 -120 -90 -70 -58 -46 -50 -52 -10.4 -7.4 -6.9	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10 -0.15 -0.34	aden) Permissible ERROR t0.25% or ±100 mV t0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V	EUT 200.00 190.00 175.00 150.00 120.00 100.00 75.00 25.00 10.00 5.00 2.00 1.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964 24.966 9.9953 4.9926 1.9977 0.99631	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911 4.993 1.9931 0.99966	age Ch Vc 199.83 189.86 174.85 149.92 119.94 99.951 74.954 49.97 24.954 9.9896 4.9964 1.9931 0.99925	annels A min ) 199.87 ) 199.87 ) 199.87 ) 199.88 9 174.88 9 174.88 9 174.88 9 174.88 9 199.9 9 99.42 74.954 49.95 24.948 9 9.896 4.9926 1.9931 0 0.99631	ACCUFAC V[mV] -130 -120 -90 -70 -58 -46 -50 -52 -10.4 -7.4 -6.9 -3.69	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10 -0.15 -0.34 -0.37	aden) Permissible ERROR 10.25% or ±100 mV 10.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V	EUT 200.00 190.00 175.00 120.00 100.00 75.00 25.00 10.00 5.00 2.00 1.00 5.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964 24.966 9.9953 4.9926 1.9977 0.99631 499.27	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911 4.993 1.9931 0.99966 496.37	age Ch Vc 199.83 189.86 174.85 149.92 119.94 99.951 74.954 9.9896 4.9964 1.9931 0.99925 494.69	annels A min ) 199.87 ) 189.88 ) 174.88 ) 199.87 ) 199.87 ] 199.87 ] 199.87 ] 199.87	ACCUFAC V[mV] -130 -120 -120 -90 -70 -58 -46 -50 -52 -10.4 -7.4 -6.9 -3.69 -5.31	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10 -0.15 -0.34 -0.37 -1.06	aden) Permissible ERROR t0.25% or ±100 mV t0 25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V mV	EUT 200.00 190.00 175.00 120.00 100.00 50.00 25.00 10.00 5.00 2.00 1.00 5.00 2.00 1.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.984 24.9964 1.9977 0.99631 4.9927 97.76	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911 4.993 1.9931 0.99966 496.37 94.67	age Ch Vc 199.83 189.86 174.85 149.92 119.94 99.951 74.954 49.97 24.954 9.9896 4.9964 1.9931 0.99925 494.69 98.86	annels A min ) 199.87 ) 189.88 ) 174.88 149.91 119.93 9.422 74.954 49.95 24.948 9.9896 4.9926 1.9931 9.0.99631 494.69 94.67	ACCUFAC 4 V[mV] -130 -120 -90 -70 -58 -46 -50 -52 -10.4 -7.4 -6.9 -3.69 -5.31 -5.33	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10 -0.21 -0.10 -0.34 -0.37 -1.06 -5.33	Laden) Permissible ERROR 10.25% or ±100 mV ±0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V mV	EUT 200.00 190.000 150.000 150.000 150.000 25.00 10.000 5.00 2.00 1.00 500.00 100.00 5.000	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964 24.966 9.9953 4.9926 1.9977 0.99631 499.27 97.76 44.97	DC Volt Vb 199.87 189.88 174.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911 4.993 1.9931 0.99966 496.37 94.67 45.59	age Ch Vc 199.84 189.88 174.85 149.92 119.94 99.951 74.954 49.97 24.954 4.9964 1.9931 0.99925 4.9964 1.9931 0.99926 4.94.69 98.86 46.47	annels A min ) 199.87 ) 199.87 ) 199.88 ) 174.88 1 199.33 99.942 74.954 4.955 24.948 9.9896 4.9926 1.9931 0.099631 494.69 94.67 44.97	ACCUFAC 4 V[mV] -130 -120 -90 -70 -58 -46 -50 -52 -10.4 -7.4 -6.9 -3.69 -5.31 -5.33 -5.03	y (Un l %E -0.06 -0.06 -0.07 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10 -0.21 -0.15 -0.34 -0.37 -1.06 -0.37 -1.06 -0.37 -0.06 -0.07 -0.06 -0.07 -0.06 -0.07 -	Laden) Permissible ERROR t0.25% or ±100 mV ±0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Range V mV	EUT 200.00 190.00 175.00 150.00 25.00 25.00 10.00 25.00 1.00 500.00 2.00 1.00 500.00 100.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 74.967 49.964 24.966 9.9953 4.9926 1.9977 0.99631 4.9927 97.76 44.97 3	DC Volt Vb 199.87 189.88 174.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9914 4.993 1.9931 0.99666 496.37 94.67 45.59 5.9	age Ch Vc 199.8 189.8 174.8 149.5 119.9 99.95 74.954 49.97 24.954 49.959 4.9969 4.9969 4.9969 4.9969 9.886 46.47 6.28	annels A min ) 199.87 ) 199.87 ) 199.88 ) 174.88 (149.91 (1993) 99.942 (74.954) 49.955 (24.948) 9.9896 4.9926 1.9931 9.0.99631 494.69 94.67 44.97 3	CCUITAC A V[mV] -130) -120 -120 -90 -70 -58 -46 -50 -52 -10.4 -7.4 -6.9 -3.69 -5.31 -5.33 -5.03 -7	y (Un l %E -0.06 -0.07 -0.10 -0.10 -0.15 -0.05 -0.06 -0.05 -0.06 -0.06 -0.06 -0.06 -0.06 -0.07 -0.07 -0.07 -0.06 -0.06 -0.05 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.07 -0.07 -0.06 -	aden) Permissible ERROR t0.25% or ±100 mV t0.25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS
Note 1: Range V	EUT 200.00 190.00 175.00 120.00 120.00 50.00 25.00 25.00 10.00 500.00 100.00 100.00	Va 199.91 189.92 174.93 149.94 119.96 99.962 24.966 9.9953 4.9926 9.9953 4.9926 9.9953 4.9927 97.76 44.97 3	DC Volt Vb 199.87 189.88 174.88 149.91 119.93 99.942 74.956 49.95 24.948 9.9911 4.993 1.9931 0.99966 496.37 94.67 45.59 5.9	age Ch Ve 199.8/ 189.88 174.83 1149.92 49.99 49.99 57.4.954 49.97 24.954 49.97 4.954 4.9954 1.9931 0.99922 4.9664 4.9958 6.28	annels A min ) 199.87 ) 199.87 ) 199.88 ) 174.88 (149.91 (149.91 (149.93 (149.95) (1	xxccuracc ↓ y in eac ↓ y in y -1x20 -120 -120 -120 -120 -120 -200 -58 -46 -50 -52 -10.4 -6.9 -5.31 -5.33 -5.03 -7	y (Un I %E -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.06 -0.10 -0.21 -0.10 -0.21 -0.34 -0.34 -0.34 -0.34 -0.35 -0.34 -0.35 -0.35 -0.35 -0.35 -0.35 -0.35 -0.35 -0.35 -0.35 -0.35 -0.35 -0.06 -0.10 -0.15 -0.34 -0.35 -0.36 -0.37 -0.06 -0.34 -0.37 -0.06 -0.37 -0.06 -0.34 -0.06 -0.37 -0.06 -0.34 -0.06 -0.37 -0.06 -0.37 -0.06 -0.06 -0.06 -0.06 -0.07 -	aden) Permissible ERROR t0.25% or ±100 mV t0 25% or ±100 mV	RESULT PASS PASS PASS PASS PASS PASS PASS PAS

		1	AC Volta	age Cha	nnels A	ccurac	y (Full	Laden)	
Range	EUT	Va	Vb	Vc	min	Δ V [mV]	%E	Permissible ERROR	RESUL
v	150.00	1. 1	149.79	149.76	149.76	-240	-0.16	±0.25% or ±100 mV	PASS
	100.00	99.525,	99.873	99.823	99.823	-177	-0.18	±0.25% or ±100 mV	PASS
	75.00	1-	74.927	74.88	74.88	-120	-0.16	±0.25% or ±100 mV	PASS
	60.00	-	59.98	59.999	59.98	-20	-0.03	±0.25% or ±100 mV	PASS
	50.00		49.948	49.933	49.933	-67	-0.13	±0.25% or ±100 mV	PASS
	40.00	-	39.92	39.92	39.92	-80	-0.20	±0.25% or ±100 mV	PASS
	25.00		24,949	24.931	24.931	-69	-0.28	±0.25% or ±100 mV	PASS
	10.00		9.9611	9.9611	9.9611	-38.9	-0.39	±0.25% or ±100 mV	PASS
	5.00	-	4.9645	4.9513	4.9513	-48.7	-0.97	±0.25% or ±100 mV	PASS
	2.00	-	1.954	1.9521	1.9521	-47.9	-2.40	±0 25% or ±100 mV	PASS
	1.00	0.656	0.95728	0.93941	0.93941	-60.59	-6.06	±0.25% or ±100 mV	PASS
mV	500.00		461.33	461.33	461.33	-38.67	-7.73	±0.25% or ±100 mV	PASS
	100.00	-	95.43	101.1	95.43	-4.57	-4.57	±0.25% or ±100 mV	PASS
	10.00		7.8	8.3	7.8	-2.2	-22.00	±0.25% or ±100 mV	PASS
	1.00	-	1.2	1.2	1.2	-0.2	-20.00	±0.25% or ±100 mV	PASS
Not	1:Outpu	t Load a	djusted to	cause cut	off operat	tion in ea	ch voltag	e level for full laden(35	(Am C
		Accord	ling to man	nufacturer	declaratio	n. MAX S	out = 33	VA per phase	
					PREASURE AND LADES	100206000000000000000000000000000000000			
		100 1	AC Volt	age Cha	annels A	Accurac	y (Un L	.aden)	
Range	EUT	Va	Vb	Vc	min	∆ V[mV]	%E	Permissible ERROR	RESULT
V	150.00	149.87	149.84	149.85	149.84	-160	-0.11	±0.25% or ±100 mV	PASS
	100.00	99.934	99.845	99.948	99.845	-155	-0.16	±0 25% or ±100 mV	PASS
	75.00	74.94	74.955	74.984	74.94	-60	-0.08	±0.25% or ±100 mV	PASS

							V[mV]			
	V	150.00	149.87	149.84	149.85	149.84	-160	-0.11	±0.25% or ±100 mV	PASS
		100.00	99.934	99.845	99.948	99.845	-155	-0.16	±0 25% or ±100 mV	PASS
		75.00	74.94	74.955	74.984	74.94	-60	-0.08	±0.25% or ±100 mV	PASS
		60.00	59.94	59.98	59.999	59.94	-60	-0.10	±0.25% or ±100 mV	PASS
		50.00	49.949	49.948	49.933	49.933	-67	-0.13	±0.25% or ±100 mV	PASS
		40.00	39.962	39.958	39.958	39.958	-42	-0.11	±0.25% or ±100 mV	PASS
		25.00	24.975	24.975	24.977	24.975	-25	-0.10	±0.25% or ±100 mV	PASS
		10.00	9.9915	9.9899	9.9923	9.9899	-10.1	-0.10	±0.25% or ±100 mV	PASS
		5.00	4.9956	4.995	4,9949	4.9949	-5.1	-0.10	±0.25% or ±100 mV	PASS
		2.00	1.9893	1.9907	1.9907	1.9893	-10.7	-0.53	±0 25% or ±100 mV	PASS
	3	1.00	0.99835	0.99773	0.9941	0.9941	-5.9	-0.59	±0.25% or ±100 mV	PASS
	mV	500.00	500.6	500.4	502.3	500.4	0.4	0.08	±0.25% or ±100 mV	PASS
	1	100.00	100.03	99.75	100.84	99.75	-0.25	-0.25	±0.25% or ±100 mV	PASS
	/	10:00	10.32	9.07	10.05	9.07	-0.93	-9.30	±0.25% or ±100 mV	PASS
1	/	1.00	2.2	2.2	2.2	2.2	1.2	120.00	±0.25% or ±100 mV	PASS
10	1 . LA	1 1000 100								

5-1-3- Measurement of voltage phase angle accuracy and adjusted current in voltage and current supplies

In the tests for each adjusted tap of voltage and three-phase current, the phase angle was registered by PMMI equipment.

Then the values of 3-phase voltage channels in both Un-laden and full-laden states were registered and read and the max error calculated and contrasted with the values declared by the manufacture as per contents of following table:

EUT	Me	asured pl	hase An	gle	calculated	calculat	ed Pen	nissible	REF Ph	ase Measuring
Va=Vb=Vc	Va phase	ve phar	se p	Vc	%E	ΔΦ°	E	RROR	Accu	racy (PMM1)
phase										
1 V	0.00	242	57 1	22.58	2.15	2.58	±25	6 or ±2°	±2 <sup>#</sup> with	0.01 <sup>e</sup> resolution
5 V 60 V	0.00	240	79 1:	20.74	0.62	0.74	±0.53	6 or ±0.1°	±0.5° with	0.01° resolution
100 V	0.00	240.1	07 1	20.01	0.01	0.00	+0.55	6 or ±0.1*	1.105* with	0.01% resolution
140 V	0.00	240.	06 1:	20.00	0.00	0.00	±0.5%	6 or ±0.1°	±0.05° with	n 0.01° resolution
EUT	Measu	red phase	e Angle(	un ladde	n) calc	ulated o	alculated	Permissib	le REF	Phase Measuring
la=lb=lc	la	lb	lc	Ic(lad	den)	%E	ΔΦ9	ERROR	Ac	curacy (PMM1)
balance 3	prase	phase	DEG		100					
100 mA	0.00	247.74	124.93	123.	38 4	4.11	4.93	±2% or ±2	2 ±22 v	with 0.01° resolution
500 mA	0.00	242.70	122.28		1	1.90	2.28	±2% or ±2	¢ ±0.5%	with 0.01° resolutio
1 A	0.00	242.00	121.98	121.	86 1	1.65	1.98	±2% or ±2	e ±0.05#	with 0.01# resolution
2 A	0.00	241.18	121.14	120		0.95	1.14	±2% or ±2	¢ ±0.05*	with 0.01° resolutio
10 A	0.00	240.28	120.32	120		0.23	0.52	±2% of ±2	10.05%	with 0.01° resolution
15 A	0.00	240.19	120.20		0	0.17	0.20	±2% or ±2	±0.05*	with 0.01° resolutio
30 A	0.00	240.10	120.10		C	0.08	0.10	±2% or ±2	±0.05°	with 0.01° resolutio
		Frequ	uano	vot	Voltan	e Cha	noels	Accura		
EUT	1	REF		AF	14	E P	Armia	aibia El	ROR	RESINT
[HZ]				mHz.						
1.00	0.9	89500	a -	0.500	0.05	00	(0,003	5.0125	neta:	PASS
2.00	1.0	00000	1 4	0.001	0.00	00	+0.002*	Norst	mitz	PASS
5.00	5.0	00011	0.0	0.015	0.00	00	0.002	N IN 21	mitte	PASS
10.00	10.0	20000	3 0	003	0.00	00	10,002	% ar ±1	mHz	PASS
15.00	15	00014	1 0	1.140	0.00	00	10.002	Nor et	intell	PASS
20.00	20	00007	· . D	1.070	0.00	04	0.002	% ar #1	mHz	PASS
30.00	30.	00025	10 100	1.260	0.00	00 10	0.000	h of all	mHz []	(PASS))
40.00	40.	00014	1 0	1,140	0.00	04 ;	0.002	Nor st	mHz	PASS
60.00	60)	00014	0.00	1.140	0.00	03	0.802	5 cr 11	metal	PASS
00.00	60.	00024	0	1240	0.00	04	0.0021	% or all	rists	PASS
70.00	70	00042	0.00	420	0.00	06	0.002	Nor st	Hills:	PASS
80.00	80.	00095	. 0	950	0.00	12 1	0.0021	6 or st	mitte	PASS
80.00	00	00065	100	050	0,00	07	0.0021	L of all	mHg	PASS
100.00	100	.0004	1 1	400	0.00	04	0.0021	s ar st	mHz	PASS
150.00	150	.0005	110	.000	0,00	03	0.002	N OF #1	weter 1	PASS
200.00	200	.0008	0	800	0.00	04	0.0025	6 or s1	mH2	PASS
303.00	300	0007	10	700	0.00	02: 4	0.0034	10.00	mille	PASS
400.00	400	.0042	4	200	0.00	11 .	0.0024	6 00 43	milda.	PALS
1000.00	11100	0.000	110	000	0.000	00111	0.0024	1000	-	PASS
1200.00	120	0.007	7	000	0.000	06 +	0.0024	Loret	at the second	PASS
1400.00	140	0.019	1121	000	0.00	Set 114	0.0074	Ciarge C	and and	PASE
1500.00	150	0.000	- 6	000	0.000	041	0.0000	100.00	and an other	PARE
1.500.00			1	200	0.000		of the second second	- ar 11	THE R.	1,400

#### 5-1-4-Measurement of Frequency Accuracy

The range and frequency were registered for each adjusted tap of voltage.

Then the values of 3-phase voltage channels in both Un-laden and full-laden states were registered and read and the max error was calculated and compared with the values purported by the manufacture as per contents of following table.

				And and a second s	_
RUT	POLP .	Generalited	AT	Permissible ERROR	Read
Deeal	[real]	768	[teal]		
1.00	0.90	-10	-0.10	A2 374 OF AD T HTM	PASS
8.00	4.90	4	+0.10	12.8% or x0.1 mm	PASS
10.00	9.90		-0.10	12.0% or 20.1 mm	PASS
20.00	20.20	1	0.20	12,0% or 10.1.mm	PASS
00.00	102.00	2	2.00	12.8% or 10.1 mil	PASS
	$\square$	, a			

### 5-1-5-Measurement of BO/BI/CURRENT/VOLTAGE INJECTION Times Accuracy

In the tests the accuracy of variant times of operation of digital outputs, inputs (to register the operation of protection relay), voltage injection and current were evaluated and measured within a definite time and contrasted with the values purported by the manufacture.

The details of results and wave shapes are described as follows:

		C Voltage Ge	ineration pu	Ise time ACCURACY	
EUT	REF	Calculated	AT	Parmissible ERROR	Result
[pea]	Drest	SE	Diel.		
1.00	0.08	-2.00	-30.00	10.5% or 150 µm	PASS
3.00	2.08	-0.67	28.00	\$0.0% or ±50 µk	PASS
6.00	5.00	0.00	0.00	eti 5% or añil µe	PASS
10.00	10.00	0.00	0.00	10.5% W 450 Lts.	PASS
20,00	20:00	0.00	0.00	all 5% or all0 Lie	PASS
	A	C Voltage Ge	neration pu	Iss time ACCURACY	
EUT	REF	Calculated	AT	Permissible ERROR	Result
proj	[2014]	THE .	[14]		10.150.00
1.00	0.94	-6.00	-80.00	a1.0% or a100 up	PASS
3.00	2.08	-0.67	20.00	#1.8% or a100 pm	PARE
5.00	5.04	0.80	40.00	#1.5% or #100 µ#	PASS
10.00	10.00	0.00	0.00	#1.8% OF #100 µk	PASS
20.00	20.20	1.00	200.00	a1.5% or e100 µa	PASS



201	REF	Calculated	AT	Permissible ERROR	Result
[ms]	[ma]	NE	Des3		
5.00	5.72	14.40	0.72	s2.5% or s2.5 me.	PASS
10.00	12:30	23.00	236	±2.5% or ±2.5 ms	PASS
15.00	17.60	18.67	2.50	x2.5% or s2.5 ma	PASS
20.00	22.20	11.00	2.20	12.5% or s2.5 ms	PASS
Note	:Min effective	pulse time is	6 ms for 8	lectro mechanical BO.	
	<b>Binary Inpu</b>	t pulse time	measuri	ING ACCURACY	
rput pulse firee	Measured	Calculated	AT.	Permissible ERRDR	Result
[and]	(en)	「新用・	1000		
5.44	5.40	-0.74	-40.00	x0.1% or x200 µk	PASS
12.20	12.00	-1,84	200.00	10.1% or \$200.9%	PASS
22.20	22.20	0.00	0.00	x0.1% or x200 µ8	PASS

E



#### 5-1-6- Measurement of burden of input power supply of tester

In the test the input voltage was adjusted in the nominal value and the current values were adjusted for the max adjustable value i.e. 3X64 A.

V input power supply = 230 V nominal

Input Voltage	Input Current	Input Active Power	Input Reactive Power
223.1	10.86 A	1766.1 W	179.69 VAR

#### 5-1-7- Measurement of Input Power Supply Range

In this test the effective operating range of the tester was evaluated and measured by changing the AC input voltage.

V input power supply = 230 V nominal

Normal operation power supply voltage range =170-285 V AC, Max Voltage = 365 V AC

Input Voltage	EUT status	Result
169VAC	Start operation/3X32 A generation , FUN ok	PASS
290 V AC	Operation Cut off	PASS
277 VAC	Operation Resumed/FUN ok	PASS
365 VAC	Operation Cut off/after decrease to normal voltage, Fun ok	PASS

#### 5-1-8- Burden Measurement of digital and analog inputs

In the test the input voltage was adjusted at nominal values and the value of sink current was registered. V input power supply = 150 V nominal

Input Voltage	Sink Current	Calculated Power
150 V AC	0.92 mA	138 mVA
150 VDC	0.98 mA	147 mW

#### 5-1-9- Measurement of DC Voltage Supply Power

In this test the input voltage was adjusted at nominal values and the max capacity of power supply was evaluated and measured decreasing the variant resistance.

V AUX power supply = 220 V DC

Set Voltage	load Current	Calculated Power
220	240 mA	52.8 W

# 5-1-10- Measurement of Voltage and Current General Waves Distortion (Measurement of Harmonic Components)

In the test, at first the domain of frequencies higher than main frequency of the voltage and current was measured as per following table (in the different selected taps in range) through oscilloscope and FFT Fourier analysis by series shunt in full laden state.

Voltage (50 Hz/sine wave)	Harmonic Amplitude measurement (db)@ frequency(Hz)	Measured Absolut Value	Harmonic Order	Distortion Factor @ each point
10 V AC	20.0db@ 50 Hz	10V	HI	100%
10 V AC	-43db @ 100 Hz	7.09mV	H2	0.7%
10 V AC	-20.8db @ 150 Hz	91.2mV	Н3	9.12%
10 V AC	-43.8db@200Hz	6.456mV	H4	0.64%
10 V AC	-43db @ 250 Hz	6 mV	H5	0.6%
10 V AC	-48db @ 300 Hz	3.98mV	H6	0.398%
10 V AC	-48db@400Hz	3.98mV	H8	0.398%
10 V AC	-19db@750Hz	112.2mV	H15	11.2%
10 V AC	-43db@2KHz	6.45mV	H40	0.64%
10 V AC	-19.4db@3.25kHz	107mV	H65	10.7%
10 V AC	-33.8db@6.55kHz	20.4mV	H131	2.04%
		Post 2.300	CURSON Type Source Martin Altz 4,800	
			Curson 4,85kH -22,0 lf -22,0 lf -22,0 lf	in 1



The zoom of part of uplink amplitude of sine wave in time scale 0.2ms approximately equals to 100µs in each timespan.

Also voltage and current waves THD shapes were measured using a HIOKI 3196 power analyzer (with  $\pm 0.5\%$  rdg.  $\pm 0.2\%$  f.s accuracy) in 1<sup>st</sup> to 20<sup>th</sup> orders.

Voltage (50 Hartine wave)	Measured THD	Declared Specification	Recal
100 mV AC	8,74%	≤ 7% (@ Vehage ≥1 V(AC)	-
0.50 V AC	1.75%	≤ IN St Votage≥1 V(AC)	
1 Y AC	0.9%	≤1% @ Valage ≥1 V(AC)	PASS
19 V AC	0,1%	S 1% @ Vultage 21 V(AC)	PASS
20 V AC	0.05%	<1% @ Voltage 21 VIAC)	PASS
SI V AC	0.02%	S1% @ Voltage 21 VIAC)	PASS
HO V AC	0.02%	S IN @ Voltage 21 V(AC)	PASS
140 V AC	0.02%	S 1% @ Voltage 21 V(AC)	PASS

The current harmonics were measured through voltage of two heads of series shunt in 3196 voltage input (the current was adjusted in 3VAC voltage in nominal laden by resistive laden.)

Current (50 Habite wave)	Monarel T2ID	Declared Specification	Revalt
100 mA AC	3.41%	≤ 1% St Current ≥10 A (AC)	- 100
0.50 A AC	3.79%	± 1% @ Current ≥10 A (AC)	ine.
LAAC	3.79%	5 1% @ Carrent 210 A (AC)	
2 A AC	2.07%	S 1% @ Camere 230 A (AC)	- 140
1 A AC	1.61%	5 1% @ Catters ≥10 A (AC)	- 040
IO A AC	0.99%	51% @ Cumint 210 A (AC)	PASS
20 A AC	0.91%	5 1% @ Current 210 A (AC)	PASS
30 A AC	0.74%	S 1% @ Current 210 A (AC)	PASS
-	2-1E	and the second second	100.000

#### 5-1-10-Measurement of time differences of synchronization with GPS time clock

Having synchronized with GPS time clock (through exterior module connection) and final synchronization of tester time the two equipped relay tester simultaneously produced a DC rising edge (zero to 30V). The time difference was measured through Tektronix digital oscilloscope – TDS 2014 1GS/s-100MHz model.

**Note:** Having been turned on and connected to a GPS exterior antenna, the required time for successful and sustainable synchronization with GPS time clock was 15 minutes for either equipment. During this time, the operator was not permitted to sync injection through the software.

As the time differences of pulse start were measured between both equipment (located far from each other in both heads of transmission line to test the distal protective plans), each tester synchronized with GPS time clock and the numerical values of the same magnitude.



Fig. Full edge of two stair waves image (symbolic)



Fig. Time difference for crossing zero with 1µs time scale)