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TEST REPORT

Product Name : Solar Hybrid Inverter
Model Number : HESP4860S100-H

Prepared for	:	SRNE Solar Co.,Ltd
Address	:	4-5F,Building13A,Taihua Wutong Industrial Park ,Gushu Development Zone ,Hangcheng Street,Baoan, Shenzhen, China PR.
Prepared by	:	EMTEK (SHENZHEN) CO., LTD.
Address	:	Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China. Tel: (0755) 26954280 Fax: (0755) 26954282
Report Number	:	ENS2410100183P00101R
Date(s) of Tests	:	August 26, 2024 to September 20, 2024
Date of issue	:	September 20, 2024

TEST REPORT
IEC 61727: 2004
Photovoltaic (PV) systems - Characteristics of the utility interface
IEC 62116: 2014
Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters

Report Reference No.....:	ENS2410100183P00101R
Compiled by (name + signature) ...:	Xavier Qiu / Engineer
Approved by (name + signature) ...:	Paladin Hu / Manager
Date of issue .....:	September 20, 2024
Total number of pages	52 pages

Testing Laboratory name.....:	EMTEK(SHENZHEN) CO., LTD.
Address .....:	Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China
Testing location/ address.....:	Same as above
Applicant's name .....:	SRNE Solar Co.,Ltd
Address .....:	4-5F,Building13A,Taihua Wutong Industrial Park ,Gushu Development Zone ,Hangcheng Street,Baoan, Shenzhen, China PR
Test specification:	
Standard .....:	IEC 61727: 2004 IEC 62116: 2014
Test procedure .....:	IEC report
Non-standard test method.....:	N/A
Test Report Form No......:	IEC61727A IEC62116A
Test Report Form(s) Originator .....:	EMTEK
Master TRF .....:	Dated 2013-06
Test item description ..... :	Solar Hybrid Inverter
Trade Mark.....:	SRNE
Manufacturer .....:	SRNE Solar Co.,Ltd
Address .....:	4-5F,Building13A,Taihua Wutong Industrial Park ,Gushu Development Zone ,Hangcheng Street,Baoan, Shenzhen, China PR
Model/Type reference .....:	HESP4860S100-H
Firmware Version .....:	V2.85
Ratings .....:	See the rating label.

Possible test case verdicts:

- test case does not apply to the test object.....: N(/A. Not applicable)
- test object does meet the requirement .....: P (Pass)
- test object does not meet the requirement .....: F (Fail)

Testing .....:

Date of receipt of test item.....: September 20, 2024

Date (s) of performance of tests.....: August 26, 2024 to September 20, 2024

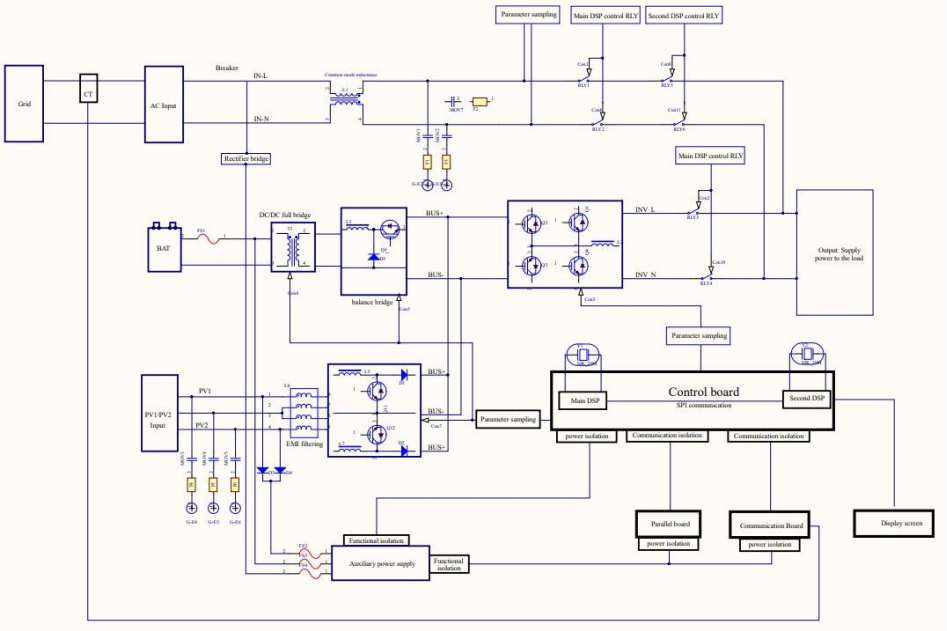
General remarks:

"(see Attachment #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.
The tests results presented in this report relate only to the object tested.
This report shall not be reproduced except in full without the written approval of the testing laboratory.
List of test equipment must be kept on file and available for review.
Additional test data and/or information provided in the attachments to this report.
Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

The IEC61727 does not provide any limits of accuracy for the utility voltage and frequency measurement of the PV-system. Therefore the values for tolerances given in the grid-connected inverter regulations of the Metropolitan Electricity Authority (MEA 2015).

General product information:

In the inverter or grid-connected mode, the DC voltage of the energy storage battery and the DC voltage of the solar panel are boosted to a stable DC voltage through the DC-DC module, and then the DC voltage is converted to AC voltage through the DC-AC module. The input and output of each module have the EMC filtering function, and the AC output voltage is converted to a set of relays to supply power to the load. Or through three groups of relays for redundant switching to achieve the grid-connected function, this redundant design can ensure the reverse control of the machine under abnormal conditions; When the mains and solar panels charge the battery, the input and output are filtered by EMC, and the mains end is controlled by three sets of redundant relays. The AC voltage is converted to DC voltage by AC-DC module to charge and store energy for the battery. Meanwhile, the solar photovoltaic panel converts DC voltage to DC voltage by DC-DC module to charge and store energy for the battery. The reverse control integrated machine realizes the conversion and utilization of energy through the joint work of DC-DC, DC-AC and AC-DC functional modules.

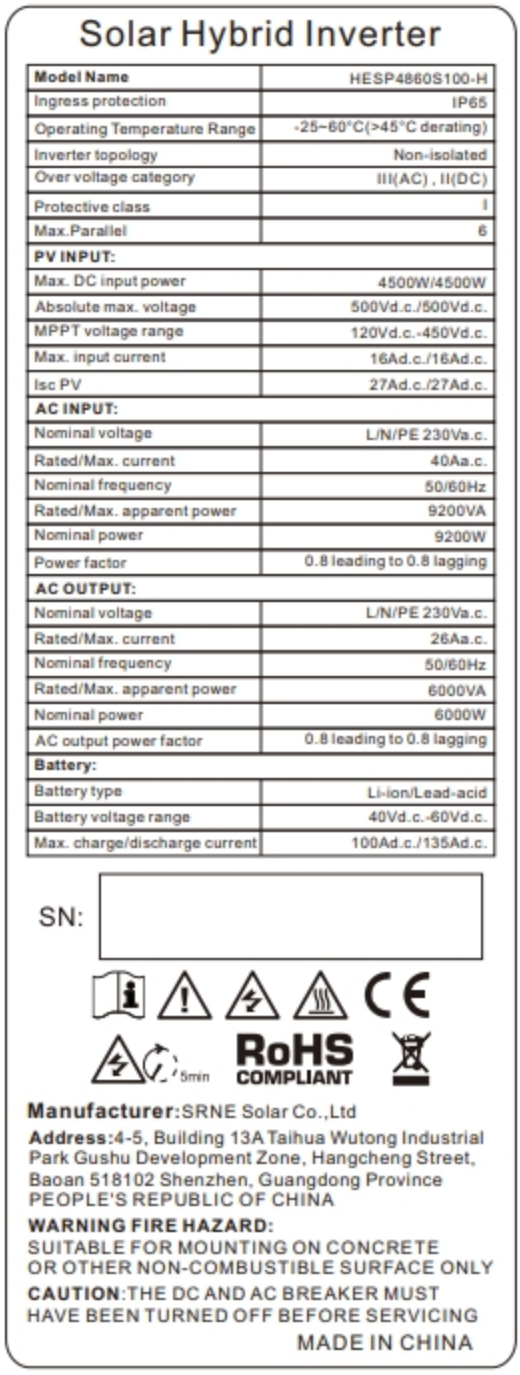


Block diagram

The electrical parameters are shown in Table 1:

PV INPUT:	
Max. DC input power	4500W/4500W
Absolute max. voltage	500Vd.c./500Vd.c.
MPPT voltage range	120Vd.c.-450Vd.c.
Max. input current	16Ad.c./16Ad.c.
Isc PV	27Ad.c./27Ad.c.
AC INPUT:	
Nominal voltage	L/N/PE 230Va.c.
Rated/Max. current	40Aa.c.
Nominal frequency	50/60Hz
Rated/Max. apparent power	9200VA
Nominal power	9200W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	L/N/PE 230Va.c.
Rated/Max. current	26Aa.c.
Nominal frequency	50/60Hz
Rated/Max. apparent power	6000VA
Nominal power	6000W
AC output power factor	0.8 leading to 0.8 lagging
Efficiency	
Maximum conversion efficiency	97.5%
European efficiency	97%
Protect	
General parameters	
Dimensions (W×H×D)	556*345*182mm
Weight (including hanger)	22.1kg
Self-consumption at night	< 100W
Range of working temperature	-25~+60
Cooling method	Heat sink + intelligent fan cooling
Communication	RS485 / CAN / USB / Dry contact

Copy of marking plate:



Solar Hybrid Inverter

Model Name	HESP4860S100-H
Ingress protection	IP65
Operating Temperature Range	-25~60°C(>45°C derating)
Inverter topology	Non-isolated
Over voltage category	III(AC) , II(DC)
Protective class	I
Max.Parallel	6
PV INPUT:	
Max. DC input power	4500W/4500W
Absolute max. voltage	500Vd.c./500Vd.c.
MPPT voltage range	120Vd.c.-450Vd.c.
Max. input current	16Ad.c./16Ad.c.
Isc PV	27Ad.c./27Ad.c.
AC INPUT:	
Nominal voltage	L/N/PE 230Va.c.
Rated/Max. current	40Aa.c.
Nominal frequency	50/60Hz
Rated/Max. apparent power	9200VA
Nominal power	9200W
Power factor	0.8 leading to 0.8 lagging
AC OUTPUT:	
Nominal voltage	L/N/PE 230Va.c.
Rated/Max. current	26Aa.c.
Nominal frequency	50/60Hz
Rated/Max. apparent power	6000VA
Nominal power	6000W
AC output power factor	0.8 leading to 0.8 lagging
Battery:	
Battery type	Li-ion/Lead-acid
Battery voltage range	40Vd.c.-60Vd.c.
Max. charge/discharge current	100Ad.c./135Ad.c.

SN:

5min RoHS COMPLIANT

Manufacturer:SRNE Solar Co.,Ltd
Address:4-5, Building 13A Taihua Wutong Industrial Park Gushu Development Zone, Hangcheng Street, Baoan 518102 Shenzhen, Guangdong Province PEOPLE'S REPUBLIC OF CHINA
WARNING FIRE HAZARD:
SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY
CAUTION:THE DC AND AC BREAKER MUST HAVE BEEN TURNED OFF BEFORE SERVICING
MADE IN CHINA

Interface protection settings with deviations according the On-grid PV inverter regulations of the Metropolitan Electricity Authority (MEA)

(Thailand MEA)

Parameter	Max. clearance time*	Trip setting
Over voltage (level 2)	0.05s	230V +135% (280V)**
Over voltage (level 1)	2.0s	230V +110% (253V)
Under voltage (level 1)	2.0s	230V -15% (195.5V)
Under voltage (level 2)	0.1s	230V -49.5% (114V)**
Over frequency	0.1s	52Hz

Under frequency	0.1s	47Hz
Reconnection time	At least 120s	
Permanent DC-injection	0.5% of rated inverter output current	
Loss of main IEC 62116:2008	Inverter shall detect and disconnect within 2s	
* Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the "reconnect" feature. ** The inverter can be adjusted for overvoltage trip setting up to 280V.		

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

SECTION 4: Utility compatibility			
4	General The quality of power provided by the PV system for the on-site AC loads and for power delivered to the utility is governed by practices and standards on voltage. flicker. frequency. harmonics and power factor. Deviation from these standards represents out-of-bounds conditions and may require the PV system to sense the deviation and properly disconnect from the utility system. All power quality parameters (voltage. flicker. frequency. harmonics. and power factor) must be measured at the utility interface/ point of common coupling unless otherwise specified.	Noticed	P
4.1	Voltage. current and frequency The PV system AC voltage. current and frequency shall be compatible with the utility system.	Derived from tests	P
4.2	Normal voltage operating range Utility-interconnected PV systems do not normally regulate voltage; they inject current into the utility. Therefore. the voltage operating range for PV inverters is selected as a protection function that responds to abnormal utility conditions. not as a voltage regulation function.	Derived from tests	P
4.3	Flicker The operation of the PV system should not cause voltage flicker in excess of limits stated in the relevant sections of IEC 61000-3-3 for systems less than 16 A or IEC 61000-3-5 for systems with current of 16 A and above.	See table 4.3	P
4.4	DC injection The PV system shall not inject DC current greater than 0.5 % of the rated inverter output current. into the utility AC interface under any operating condition.	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015) See table 4.4	P
4.5	Normal frequency operating range The PV system shall operate in synchronism with the utility system. and within the frequency trip limits defined in MEA.	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015)	P

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict
		See table 4.5 and 5.2.2	
4.6	Harmonics and waveform distortion Low levels of current and voltage harmonics are desirable; the higher harmonic levels increase the potential for adverse effects on connected equipment. Acceptable levels of harmonic voltage and current depend upon distribution system characteristics. type of service. connected loads/apparatus. and established utility practice. The PV system output should have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system. Total harmonic current distortion shall be less than 5 % at rated inverter output. Each individual harmonic shall be limited to the percentages listed in clause 3.1.1 of MEA.	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015) See tables 4.6 (1) and 4.6 (2)	P
4.7	Power factor The power factor base on products.		P
SECTION 5: Personnel safety and equipment protection			
5	General This Clause provides information and considerations for the safe and proper operation of the utility-connected PV systems.	Noticed	P
5.1	Loss of utility voltage To prevent islanding. a utility connected PV system shall cease to energize the utility system from a de-energized distribution line irrespective of connected loads or other generators within specified time limits. A utility distribution line can become de-energized for several reasons. For example. a substation breaker opening due to fault conditions or the distribution line switched out during maintenance. If inverters (single or multiple) have DC SELV input and have accumulated power below 1 kW then no mechanical disconnect (relay) is required.	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015)	P
5.2	Over/under voltage and frequency Abnormal conditions can arise on the utility system that requires a response from the connected photovoltaic system. This response is to ensure the safety of utility maintenance personnel and the general public. as well as to	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015)	P

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Clause	Requirement – Test	Result - Remark	Verdict

	avoid damage to connected equipment. including the photovoltaic system. The abnormal utility conditions of concern are voltage and frequency excursions above or below the values stated in this Clause. and the complete disconnection of the utility. presenting the potential for a distributed resource island.	See table 5.2.1 and 5.2.2	
5.2.1	Over/under voltage When the interface voltage deviates outside the conditions specified in Table 2. the photovoltaic system shall cease to energize the utility distribution system. This applies to any phase of a multiphase system. All discussions regarding system voltage refer to the local nominal voltage. The system shall sense abnormal voltage and respond. The following conditions should be met. with voltages in RMS and measured at the point of utility connection. (see clause 5.2.1 Table 2 – Response to abnormal voltages) The purpose of the allowed time delay is to ride through short-term disturbances to avoid excessive nuisance tripping. The unit does not have to cease to energize if the voltage returns to the normal utility continuous operation condition within the specified trip time.	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015) See table 5.2.1	P
5.2.2	Over/under frequency When the utility frequency deviates outside the specified conditions the photovoltaic system shall cease to energize the utility line. The unit does not have to cease to energize if the frequency returns to the normal utility continuous operation condition within the specified trip time. When the utility frequency is outside the range of ±1 Hz. the system shall cease to energize the utility line within 0.1 s. The purpose of the allowed range and time delay is to allow continued operation for short-term disturbances and to avoid excessive nuisance tripping in weak-utility system conditions.	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015) See table 5.2.2	P
5.3	Islanding protection The PV system must cease to energize the utility line within 0.3 s of loss of utility.	The following deviations were used: a) Metropolitan Electricity Authority (MEA 2015)	P
5.4	Response to utility recovery	The following deviations were	P

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Clause	Requirement – Test	Result - Remark	Verdict

	Following an out-of-range utility condition that has caused the photovoltaic system to cease energizing. the photovoltaic system shall not energize the utility line for 120 s after the utility service voltage and frequency have recovered to within the specified ranges.	used: a) Metropolitan Electricity Authority (MEA 2015) See table 5.2 (1) and 5.2 (2)	
5.5	Earthing The utility interface equipment shall be earthed /grounded in accordance with IEC 60364-7-712.	Stated in the manual.	P
5.6	Short circuit protection The photovoltaic system shall have short -circuit protection in accordance with IEC 60364-7-712.	Stated in the manual.	P
5.7	Isolation and switching A method of isolation and switching shall be provided in accordance with IEC 60364-7-712.	Stated in the manual.	P

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

Test overview:		
Clause	Test	Result
1	Response to protection operation - fault condition tests (according VDE0126-1-1:2006)	P
4	Type test:	
4.3	Voltage Fluctuations and Flicker	P
4.4	Monitoring of DC-Injection	P
4.5	Normal frequency operating range (see 5.2.2 below)	P
4.6	Harmonics and waveform distortion	P
4.7	Power factor	P
5.2.1	Voltage monitoring	P
5.2.2	Frequency monitoring	P
6.1	Islanding protection	P

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

1. Response to protection operation - fault condition tests							P
	Ambient temperature (°C) .....:		26				—
No.	Component no.	Fault	Test voltage (V)	Test time	Fuse no.	Fuse current (A)	Result
1	Output	Short circuit	500Vdc	5S	--	--	EUT shut down immediately. No hazards.
2	Ventilation hole	Blocked	500Vdc	350min	--	--	EUT work normally, no hazard.
3	Fan for inductors	Blocked	500Vdc	300min	--	--	EUT work normally, no hazard.
4	Fan for IGBT heating dissipation	Blocked	500Vdc	115min	--	--	After 20mins,EUT worked at lower power. No hazards.
5	All fans	Blocked	500Vdc	35min	--	--	After 20mins,EUT worked at lower power. No hazards.
6	Output	Overload	500Vdc	4h	--	--	EUT limit output power by software overload is impossible.
7	Output	Incorrect phase sequence	500Vdc	10s	--	--	EUT can't start. LCD display ‖AC_grid phaseseque _fault‖. No hazards.
The errors in the control circuit simulate that the safety is even under one error ensured,							
Addendum – Shutdown device							
If no galvanic separation between AC and DC (PV): Two relays in series on each active phase are necessary to fulfil the basic insulation or simple separation based on the PV working voltage,							Two relays in series on each active phase
Note: s-c: short circuit; o-c: open circuit before start-up The errors in the control circuit simulate that the safety is even ensured during a single fault,							

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

4.3 Voltage fluctuation and flicker the On-grid PV inverter regulations of the Metropolitan Electricity Authority(MEA 2015)				P
Test conditions:	Maximum permissible voltage fluctuation (expressed as a percentage of nominal voltage at 100 % power) and flicker as per EN 61000-3-5			
	Starting	Stopping	Running	
Limit	3.3%	3.3%	Pst = 1.0	Plt = 0.65
Test value	*	*	*	*
Inverter > 16A				
Limit	dc% =3.3		Pst = 1.0	Plt = 0.65
Test value L1	0.301		0.039	0.042
Test value L2	-		-	-
Test value L3	-		-	-

Note:
The stationary deviance of dc% is more relevant than the dynamic deviance of dmax at starting and stopping. Mains Impedance according EN61000-3-11: Rmax = 0.24Ω; jXmax= 0.15Ω @50Hz (|Zmax| = 0.283/0.4717Ω)

Calculation of the maximum permissible grid impedance at the point of common coupling based on dc: Zmax = Zref * 3.3% / dc(Pn)
The tests should be based on the limits of the EN 61000-3-11 for more than 16A.

4.4 Monitoring of Permanent DC-Injection the On-grid PV inverter regulations of the Metropolitan Electricity Authority(MEA 2015)			P
MEA Limit:	0.5% of Inom		
Output power:	33%	66%	100%
As % of rated AC current, L1:	0.00395	0.00326	0.00291
As % of rated AC current, L2:	--	--	--
As % of rated AC current, L3:	--	--	--

Note:
Testing must be performed according to WI 10.4.-03.doc rev D. The internal temperature of the EUT must be stabilized. No temperature drift of more than 2K within 1 hour is allowed.

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Clause	Requirement – Test	Result - Remark	Verdict

4.6	TABLE: Harmonic Current Limit Test The grid-connected inverter regulations of the Metropolitan Electricity Authority(MEA 2015)								P
	Condition of test						Power(kW)		
	supplying power to balance linear loads 33% ±5%						1.98		P
	supplying power to balance linear loads 66 %±5%						3.96		P
	supplying power to balance linear loads 100 %±5%						6.00		P
	Output Current Harmonics Measurement							Limit (% of output current)	Result
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase		
	(A)	(%)	(A)	(%)	(A)	(%)			
1	8.725	33.444	17.354	66.522	26.080	99.973	L1	-	P
2	0.025	0.097	0.047	0.181	0.037	0.141	L1	<1%	P
3	0.020	0.077	0.036	0.139	0.049	0.186	L1	<4%	P
4	0.006	0.022	0.008	0.029	0.017	0.064	L1	<1%	P
5	0.011	0.041	0.015	0.056	0.013	0.051	L1	<4%	P
6	0.005	0.017	0.010	0.039	0.012	0.044	L1	<1%	P
7	0.019	0.072	0.020	0.076	0.021	0.080	L1	<4%	P
8	0.005	0.018	0.008	0.030	0.008	0.031	L1	<1%	P
9	0.025	0.098	0.033	0.125	0.037	0.143	L1	<4%	P
10	0.005	0.018	0.007	0.025	0.008	0.029	L1	<1%	P
11	0.077	0.295	0.107	0.409	0.120	0.458	L1	<2%	P
12	0.005	0.019	0.007	0.027	0.006	0.024	L1	<0.5%	P
13	0.057	0.220	0.090	0.344	0.110	0.421	L1	<2%	P
14	0.005	0.018	0.006	0.022	0.006	0.024	L1	<0.5%	P
15	0.042	0.160	0.078	0.299	0.096	0.369	L1	<2%	P
16	0.005	0.018	0.006	0.021	0.006	0.023	L1	<0.5%	P
17	0.029	0.112	0.064	0.244	0.083	0.319	L1	<1.5%	P
18	0.005	0.018	0.006	0.023	0.006	0.023	L1	<0.375%	P
19	0.020	0.076	0.056	0.214	0.077	0.293	L1	<1.5%	P
20	0.004	0.017	0.005	0.021	0.006	0.023	L1	<0.375%	P
21	0.013	0.049	0.047	0.181	0.067	0.258	L1	<1.5%	P
22	0.004	0.017	0.005	0.020	0.006	0.022	L1	<0.375%	P
23	0.009	0.033	0.040	0.152	0.060	0.228	L1	<0.6%	P
24	0.004	0.016	0.005	0.020	0.006	0.023	L1	<0.15%	P
25	0.005	0.019	0.034	0.130	0.054	0.205	L1	<0.6%	P
26	0.004	0.016	0.005	0.019	0.006	0.023	L1	<0.15%	P
27	0.004	0.017	0.029	0.110	0.047	0.180	L1	<0.6%	P
28	0.004	0.015	0.005	0.019	0.006	0.022	L1	<0.15%	P
29	0.004	0.015	0.024	0.093	0.041	0.156	L1	<0.6%	P
30	0.004	0.014	0.005	0.018	0.006	0.022	L1	<0.15%	P
31	0.004	0.015	0.020	0.078	0.037	0.140	L1	<0.6%	P
32	0.003	0.013	0.004	0.017	0.006	0.023	L1	<0.15%	P
33	0.003	0.013	0.018	0.070	0.032	0.122	L1	<0.6%	P
34	0.003	0.013	0.004	0.016	0.006	0.022	L1	<0.15%	P
35	0.003	0.013	0.015	0.058	0.028	0.108	L1	<0.3%	P
36	0.003	0.012	0.004	0.015	0.005	0.020	L1	<0.075%	P
37	0.003	0.012	0.013	0.049	0.024	0.093	L1	<0.3%	P
38	0.003	0.011	0.004	0.014	0.005	0.018	L1	<0.075%	P
39	0.003	0.011	0.012	0.048	0.023	0.087	L1	<0.3%	P

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Clause	Requirement – Test	Result - Remark	Verdict

40	0.003	0.011	0.003	0.013	0.004	0.017	L1	<0.075%	P
THDi	--	0.122	--	0.214	--	0.272	L1	≤ 5%	P

4.6	TABLE: Voltage Harmonics								P
	Condition of test						Power(kW)		
	supplying power to balance linear loads 33% ±5%						1.98		P
	supplying power to balance linear loads 66 %±5%						3.96		P
	supplying power to balance linear loads 100 %±5%						6.00		P
	Output Voltage Harmonics Measurement							Limit (% of output current)	Result
Order	33% of rated output current		66% of rated output current		100% of rated output current		Phase		
	(V)	(%)	(V)	(%)	(V)	(%)			
1	229.815	99.920	230.134	100.058	230.457	100.199	L1	-	P
2	0.010	0.004	0.010	0.004	0.010	0.004	L1	<2%	P
3	0.045	0.020	0.076	0.033	0.047	0.021	L1	<4%	P
4	0.011	0.005	0.011	0.005	0.009	0.004	L1	<2%	P
5	0.009	0.004	0.011	0.005	0.064	0.028	L1	<4%	P
6	0.008	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
7	0.008	0.004	0.011	0.005	0.033	0.015	L1	<4%	P
8	0.009	0.004	0.010	0.004	0.011	0.005	L1	<2%	P
9	0.009	0.004	0.009	0.004	0.013	0.006	L1	<4%	P
10	0.009	0.004	0.009	0.004	0.012	0.005	L1	<2%	P
11	0.012	0.005	0.017	0.007	0.017	0.008	L1	<4%	P
12	0.009	0.004	0.009	0.004	0.010	0.005	L1	<2%	P
13	0.011	0.005	0.015	0.007	0.023	0.010	L1	<4%	P
14	0.009	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
15	0.011	0.005	0.016	0.007	0.016	0.007	L1	<4%	P
16	0.008	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
17	0.010	0.004	0.014	0.006	0.019	0.008	L1	<4%	P
18	0.009	0.004	0.009	0.004	0.010	0.004	L1	<2%	P
19	0.010	0.004	0.014	0.006	0.020	0.009	L1	<4%	P
20	0.009	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
21	0.009	0.004	0.014	0.006	0.017	0.007	L1	<4%	P
22	0.008	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
23	0.009	0.004	0.013	0.006	0.017	0.008	L1	<4%	P
24	0.009	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
25	0.008	0.004	0.012	0.005	0.018	0.008	L1	<4%	P
26	0.009	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
27	0.008	0.004	0.012	0.005	0.015	0.007	L1	<4%	P
28	0.008	0.004	0.009	0.004	0.008	0.004	L1	<2%	P
29	0.009	0.004	0.011	0.005	0.014	0.006	L1	<4%	P
30	0.008	0.004	0.009	0.004	0.009	0.004	L1	<2%	P
31	0.009	0.004	0.011	0.005	0.015	0.007	L1	<4%	P
32	0.008	0.004	0.009	0.004	0.008	0.004	L1	<2%	P
33	0.008	0.004	0.010	0.004	0.013	0.006	L1	<4%	P
34	0.008	0.004	0.008	0.004	0.008	0.004	L1	<2%	P
35	0.009	0.004	0.009	0.004	0.012	0.005	L1	<4%	P
36	0.008	0.004	0.009	0.004	0.008	0.004	L1	<2%	P

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

37	0.008	0.004	0.009	0.004	0.012	0.005	L1	<4%	P
38	0.008	0.004	0.009	0.004	0.008	0.004	L1	<2%	P
39	0.008	0.004	0.009	0.004	0.011	0.005	L1	<4%	P
40	0.008	0.004	0.008	0.004	0.009	0.004	L1	<2%	P
THDv	--	0.071	--	0.100	--	0.115	L1	≤ 5%	P

4.7 Power Factor the On-grid PV inverter regulations of the Metropolitan Electricity Authority(MEA 2015)	P

Load (%)	Location	Measured	Limit
10	L1(230.1Vac)	0.935	N/A
	L2(230Vac)	--	
	L3(230Vac)	--	
50	L1(230.4Vac)	0.996	>0.90
	L2(230Vac)	--	>0.90
	L3(230Vac)	--	>0.90
100	L1(230.9Vac)	0.999	>0.90
	L2(230Vac)	--	>0.90
	L3(230Vac)	--	>0.90

Note:
The PV system shall have a lagging power factor greater than 0.95 when the output is greater than 50% of the rated inverter output power.

5.2.1 Voltage monitoring 1.8.4.7 Under and Over Voltage Protection(MEA: 2013) 1.11.4.10 Response to utility recovery the grid-connected inverter regulations of the Metropolitan Electricity Authority(MEA 2015)	P

First Level

Test conditions:	Output power: 6kW Frequency: 50 Hz									
	Under Voltage					Over Voltage				
Parameter	/	Voltage (V)				/	Voltage (V)			
Set Value	/	195.5V				/	253V			
Measured trip value(V)	Phase	All	L1	L2	L3	Phase	All	L1	L2	L3
	1	--	195.4	--	--	1	--	253.3	--	--
	2	--	195.3	--	--	2	--	253.5	--	--
	3	--	195.2	--	--	3	--	253.5	--	--

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

	4	--	195.2	--	--	4	--	253.4	--	--
	5	--	195.2	--	--	5	--	253.5	--	--
Parameter	/	Time(s)				/	Time(s)			
Limit	/	≤2.0s				/	≤2.0s			
Disconnection time (Sec)	230V to 195.5 V	All	L1	L2	L3	230V to 253V	All	L1	L2	L3
	1	--	1.02	--	--	1	--	1.03	--	--
	2	--	1.02	--	--	2	--	1.03	--	--
	3	--	1.03	--	--	3	--	1.02	--	--
	4	--	1.03	--	--	4	--	1.02	--	--
	5	--	1.02	--	--	5	--	1.03	--	--
Reconnection time (Sec)	At least 120s	131.1				At least 120s	131.1			
Second Level										
Test conditions:	Output power: 6kW Frequency: 50 Hz									
	Under Voltage					Over Voltage				
Parameter	/	Voltage (V)				/	Voltage (V)			
Set Value	/	114V				/	280V			
Measured trip value(V)	Phase	All	L1	L2	L3	Phase	All	L1	L2	L3
	1	--	113.8	--	--	1	--	280.1	--	--
	2	--	113.7	--	--	2	--	280.6	--	--
	3	--	113.6	--	--	3	--	280.4	--	--
	4	--	113.3	--	--	4	--	280.8	--	--
	5	--	113.2	--	--	5	--	280.6	--	--
Parameter	/	Time(ms)				/	Time(ms)			
Limit	/	≤100ms				/	≤50ms			
Disconnection time (mSec)	230V to 114V	All	L1	L2	L3	230V to 280V	All	L1	L2	L3
	1	--	82	--	--	1	--	47	--	--
	2	--	81	--	--	2	--	47	--	--

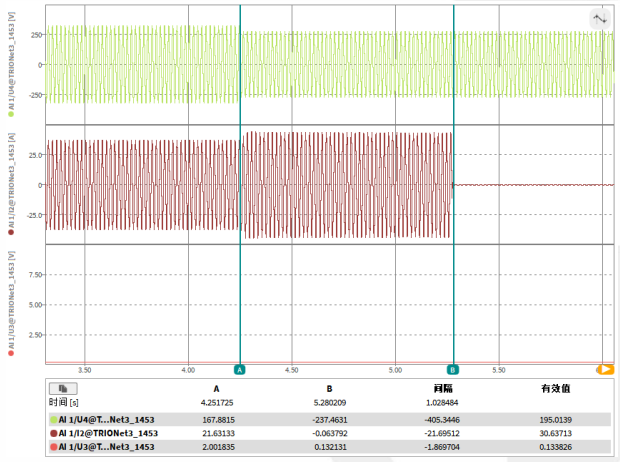
IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

	3	--	82	--	--	3	--	45	--	--
	4	--	88	--	--	4	--	46	--	--
	5	--	80	--	--	5	--	46	--	--
Reconnection time (Sec)	At least 120s	130.1				At least 120s	130.1			

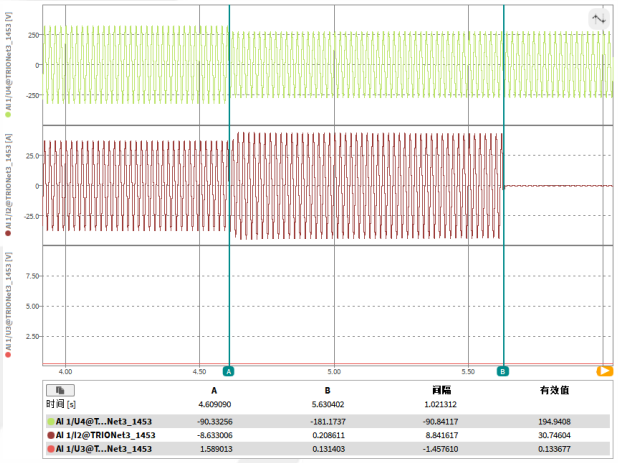
Note:

The tests are according MEA: 2013. The voltage setting of EUT are set for the tests as stated to 195.5V, 253V for undervoltage and 114V, 280V for overvoltage.

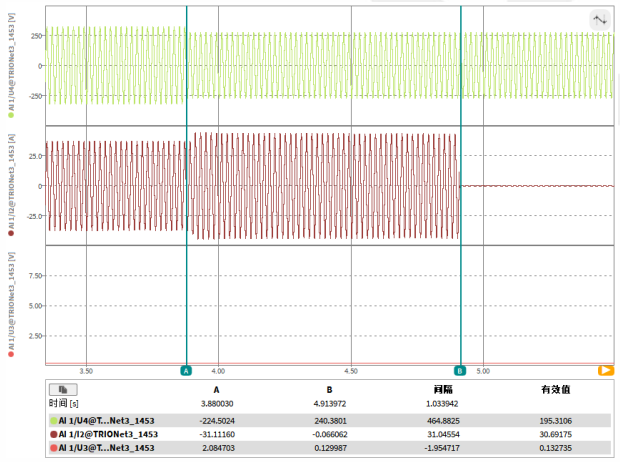
Response to utility recovery is according to the appropriate IEEE or IEC standard test methods.



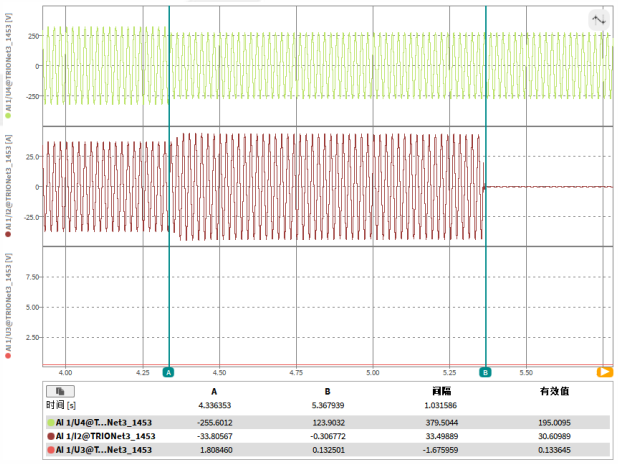
No.1 Under Voltage First Level (Phase L1)



No.2 Under Voltage First Level (Phase L1)

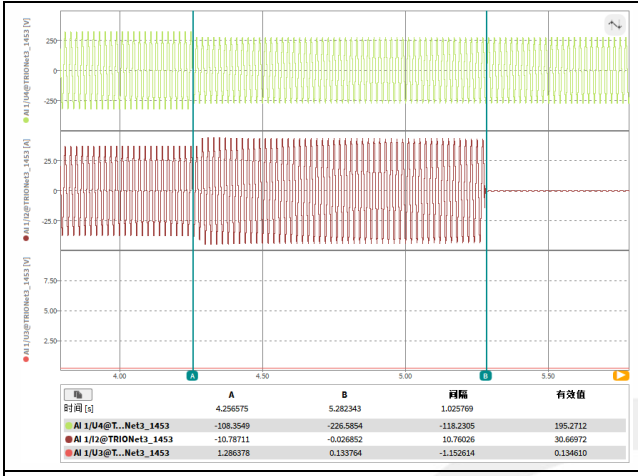


No.3 Under Voltage First Level (Phase L1)

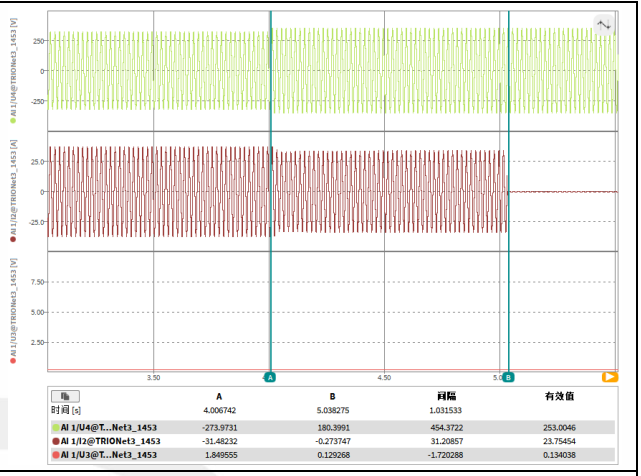


No.4 Under Voltage First Level (Phase L1)

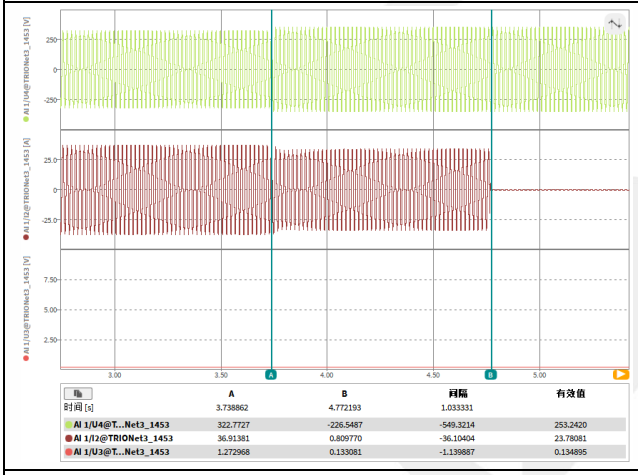
IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict



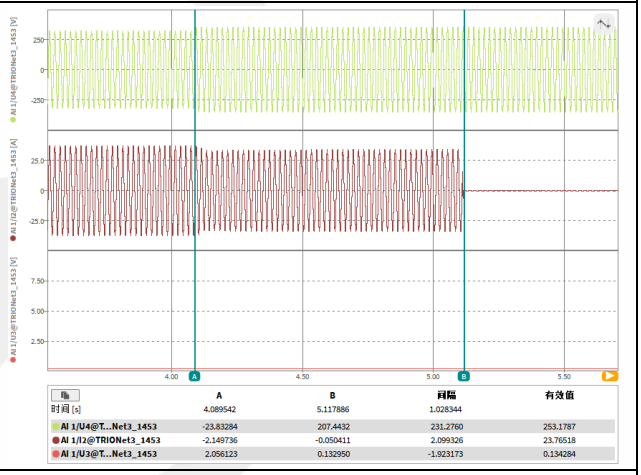
No.5 Under Voltage First Level (Phase L1)



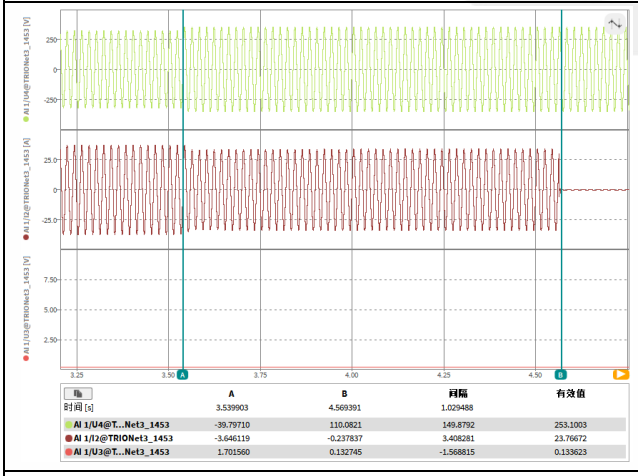
No.1 Over Voltage First Level (Phase L1)



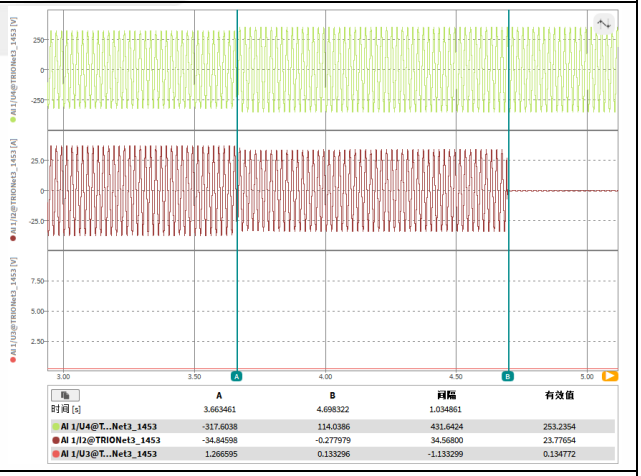
No.2 Over Voltage First Level (Phase L1)



No.3 Over Voltage First Level (Phase L1)

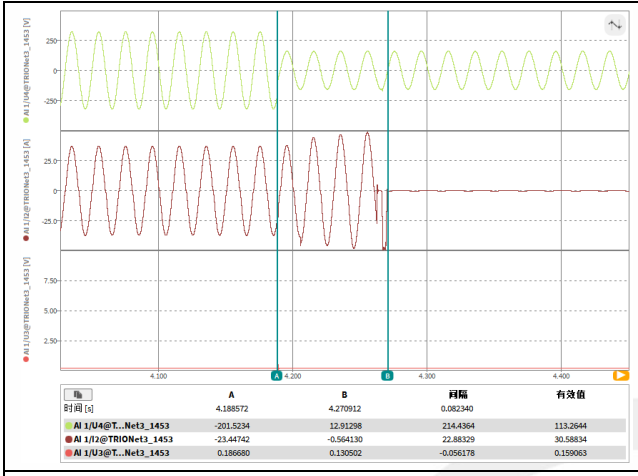


No.4 Over Voltage First Level (Phase L1)

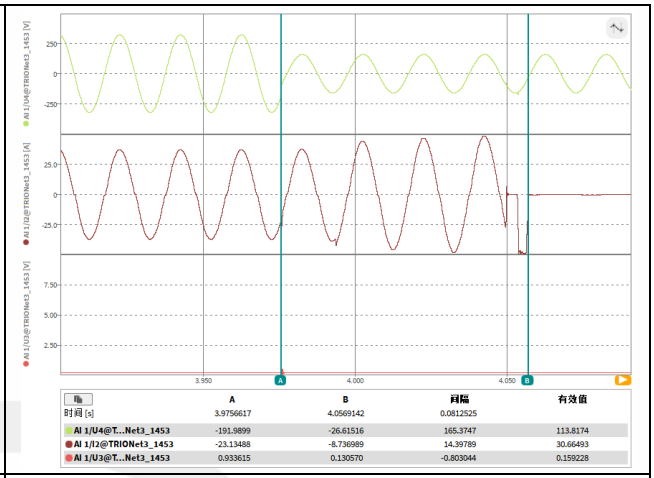


No.5 Over Voltage First Level (Phase L1)

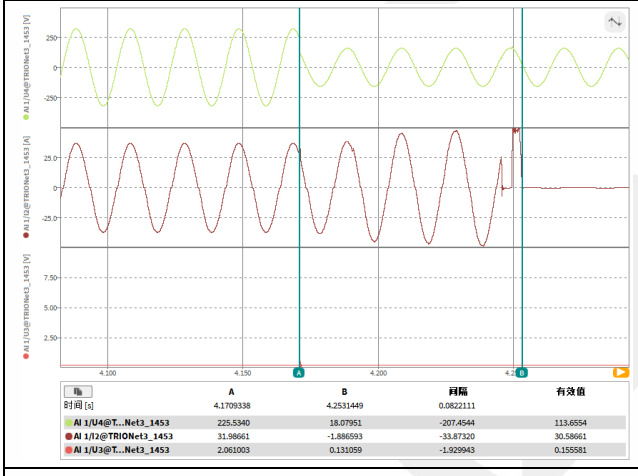
IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict



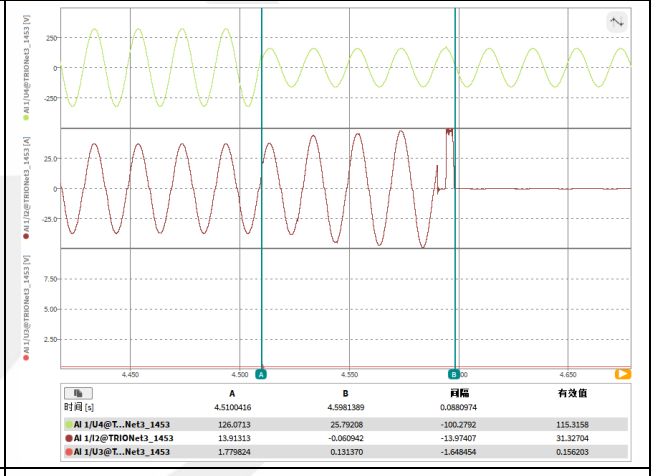
No.1 Under Voltage Second Level (Phase L1)



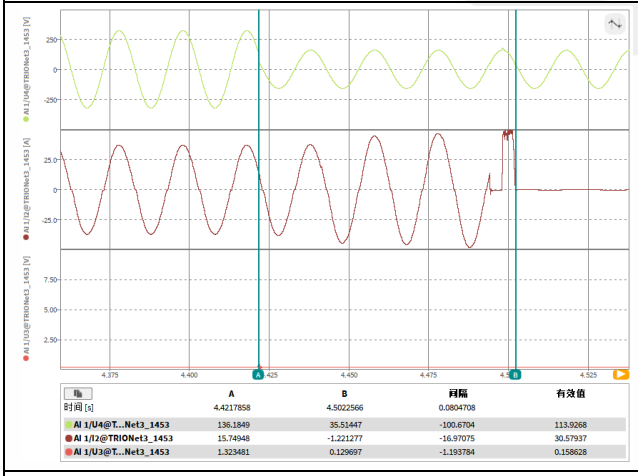
No.2 Under Voltage Second Level (Phase L1)



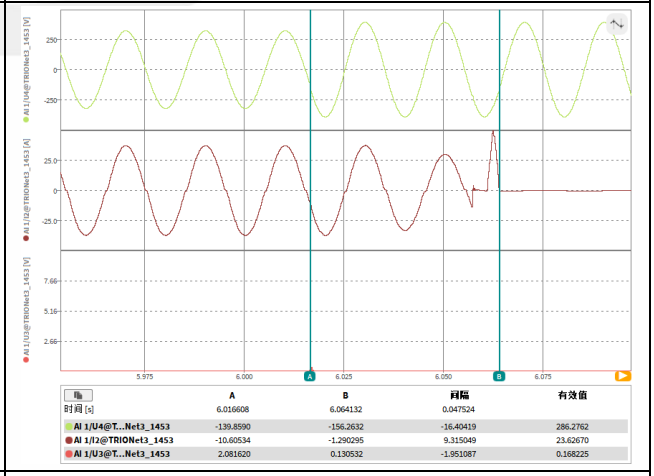
No.3 Under Voltage Second Level (Phase L1)



No.4 Under Voltage Second Level (Phase L1)

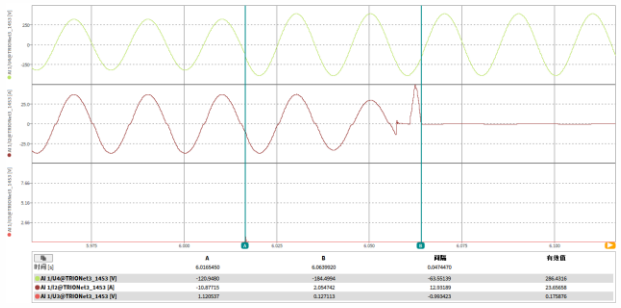


No.5 Under Voltage Second Level (Phase L1)

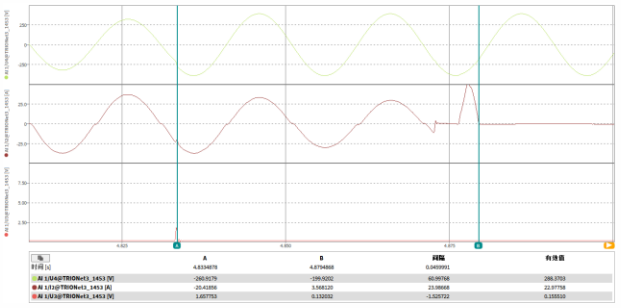


No.1 Over Voltage Second Level (Phase L1)

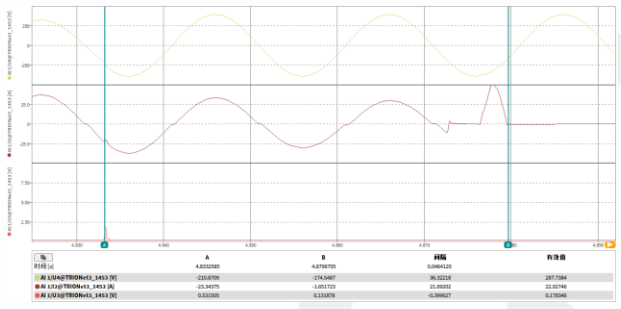
IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict



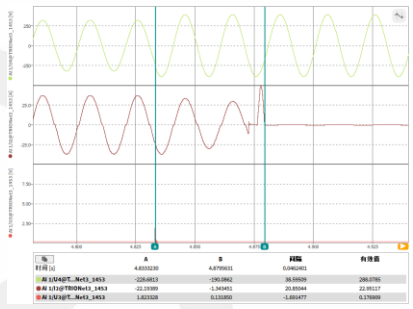
No.2 Over Voltage Second Level (Phase L1)



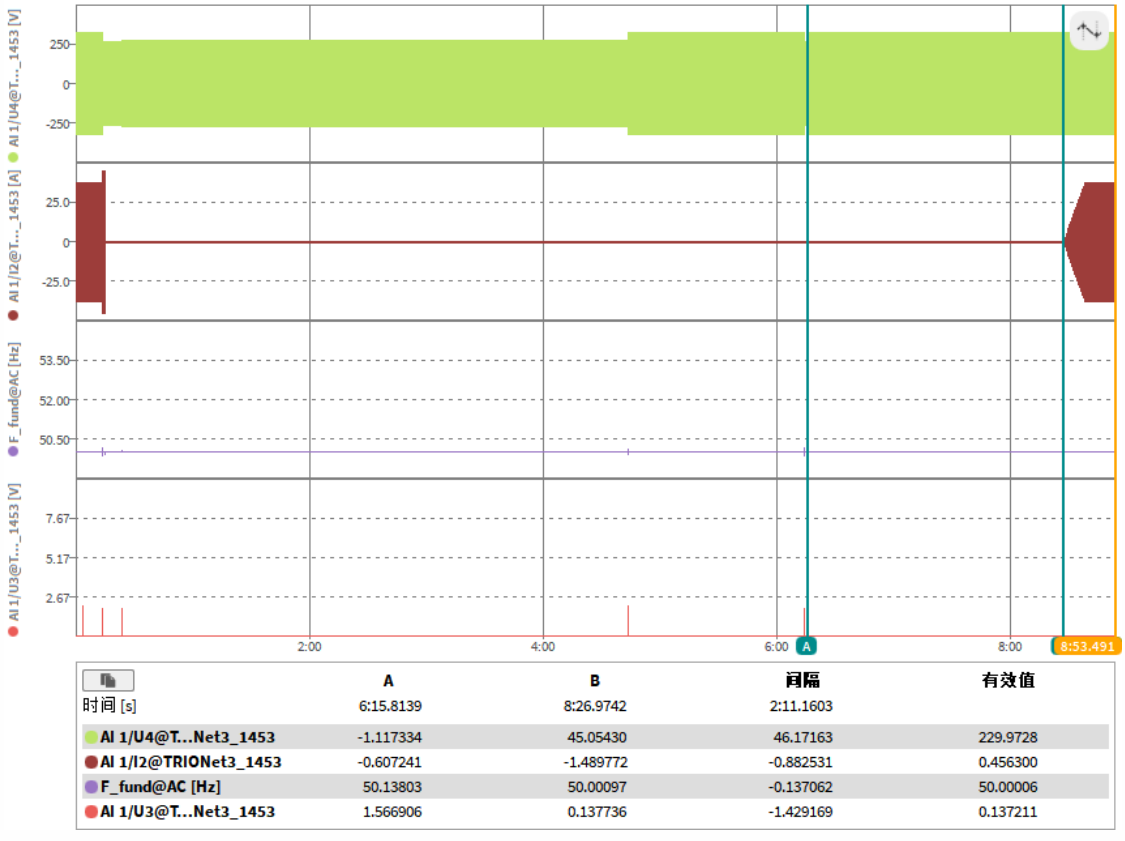
No.3 Over Voltage Second Level (Phase L1)



No.4 Over Voltage Second Level (Phase L1)



No.5 Over Voltage Second Level (Phase L1)



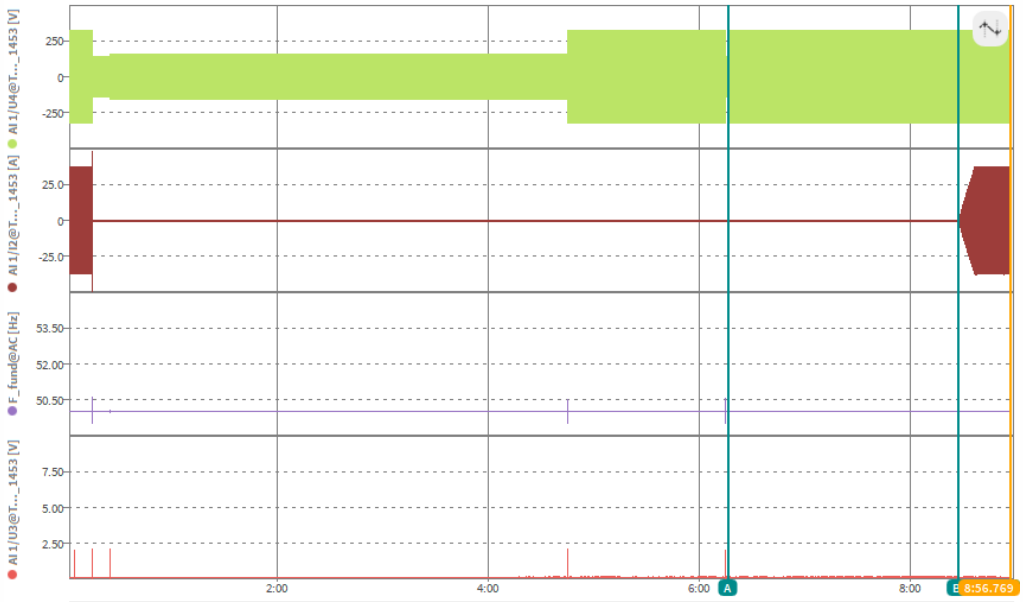
	A	B	间隔	有效值
时间 [s]	6:15.8139	8:26.9742	2:11.1603	
AI 1/U4@T...Net3_1453	-1.117334	45.05430	46.17163	229.9728
AI 1/I2@TRIONet3_1453	-0.607241	-1.489772	-0.882531	0.456300
F_fund@AC [Hz]	50.13803	50.00097	-0.137062	50.00006
AI 1/U3@T...Net3_1453	1.566906	0.137736	-1.429169	0.137211

Reconnection after Under Voltage First Level

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

	A	B	间隔	有效值
时间 [s]	6:13.3903	8:24.5242	2:11.1338	
AI 1/U4@T...Net3_1453	10.09130	-311.6706	-321.7619	229.9717
AI 1/I2@TRIONet3_1453	-0.609668	-0.084808	0.524860	0.431131
F_fund@AC [Hz]	49.90765	50.00077	0.093121	50.00006
AI 1/U3@T...Net3_1453	1.560492	0.135958	-1.424533	0.136980

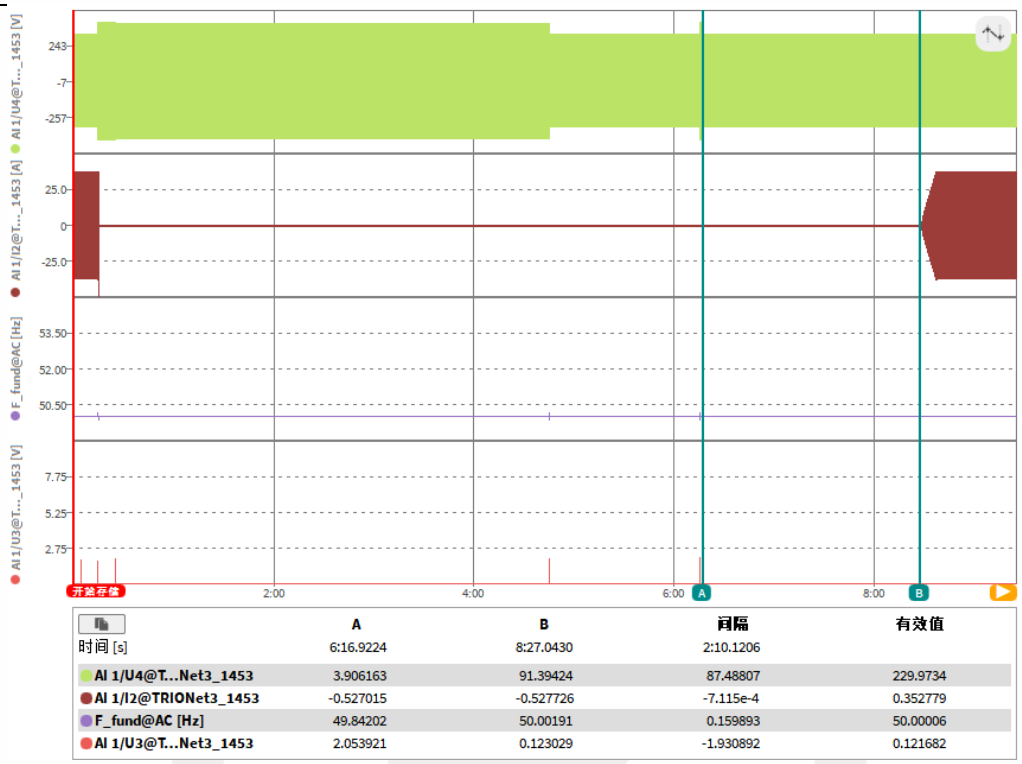
Reconnection after Over Voltage First Level



	A	B	间隔	有效值
时间 [s]	6:16.7763	8:26.8913	2:10.1150	
AI 1/U4@T...Net3_1453	-0.513560	-324.5288	-324.0152	229.9754
AI 1/I2@TRIONet3_1453	-0.459120	-0.337508	0.121612	0.361105
F_fund@AC [Hz]	50.53274	50.00100	-0.531742	50.00007
AI 1/U3@T...Net3_1453	1.373308	0.120549	-1.252758	0.121181

Reconnection after Under Voltage Second Level

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict



Reconnection after Over Voltage Second Level

Note:
U1(V) U2(V) U3(V): voltage of EUT; I1(A) I2(A) I3(A): current of EUT;U4(V):signal

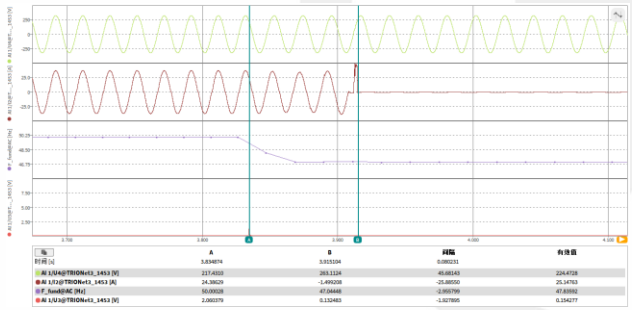
5.2.2 Frequency monitoring					P
Test conditions:	Any output power level				
	Under Frequency		Over Frequency		
Parameter	--	Frequency(Hz)	--	Frequency(Hz)	
Output Voltage	--	Un	--	Un	
Set value	--	47.00	--	52.01	
Measured trip value	1	46.98	1	52.01	
	2	46.98	2	52.02	
	3	46.99	3	52.00	
	4	46.98	4	52.01	
	5	46.98	5	52.01	
Parameter	--	Time [ms]	--	Time [ms]	

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

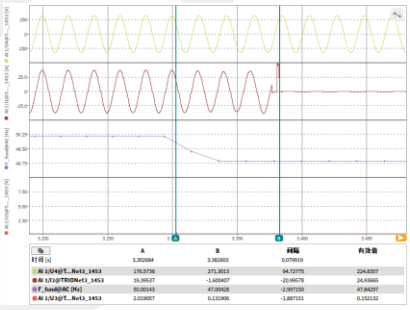
Limit	--	<= 100ms	--	<= 100ms
Disconnection time	47.40Hz to 46.90Hz	80	51.60 Hz to 52.10 Hz	77
		79		84
		80		86
		77		82
		85		73
Reconnection time(Sec)	at least 120s	131.1	at least 120s	131.2

Note:
Set all other parameter to the normal operating conditions for inverter.
Suddenly increase testing voltage to overfrequency trip setting -/+0.1 Hz and maintain this value until the inverter stop energize. All the time it takes to cut off the power must be within 0.1s.

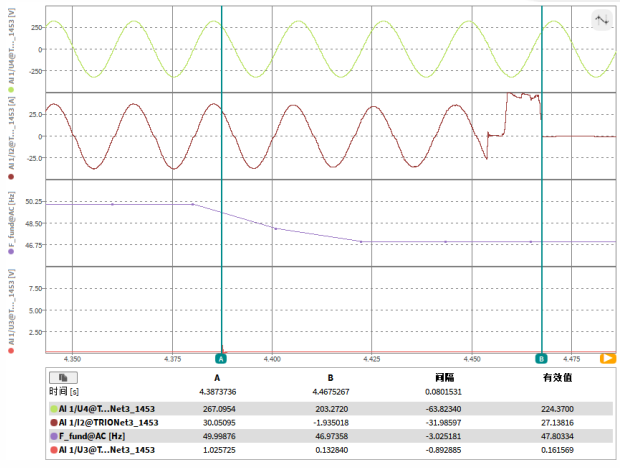
Response to Utility Recovery Test:
The test methods shall be in accordance with IEEE 1547.1-2005 clause 5.10 and evaluation criteria refer to clause 3.2.4 in this regulation.



No.1 Under Frequency

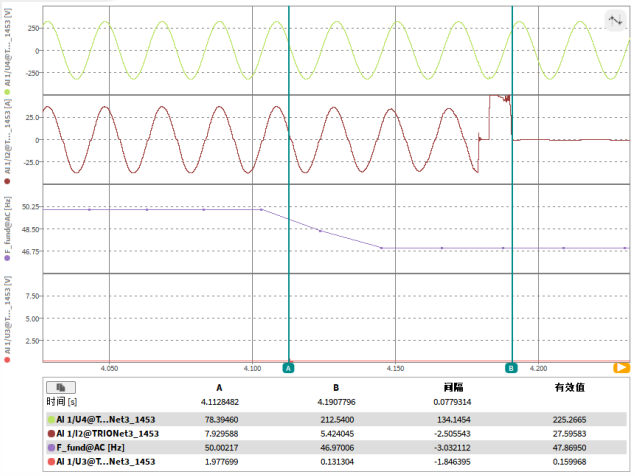


No.2 Under Frequency



	A	B	间隔	有效值
时间 [s]	4.3873736	4.4675267	0.0801531	
AI 1/U4@T...Net3_1453	267.0954	203.2720	-63.82340	224.3700
AI 1/I2@TRIONet3_1453	30.05095	-1.935018	-31.98597	27.13816
F_fund@AC [Hz]	49.99876	46.97358	-3.025181	47.80334
AI 1/U3@T...Net3_1453	1.025725	0.132840	-0.892885	0.161569

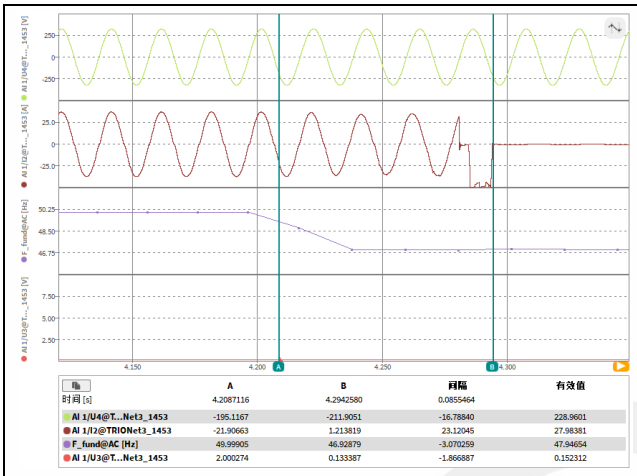
No.3 Under Frequency



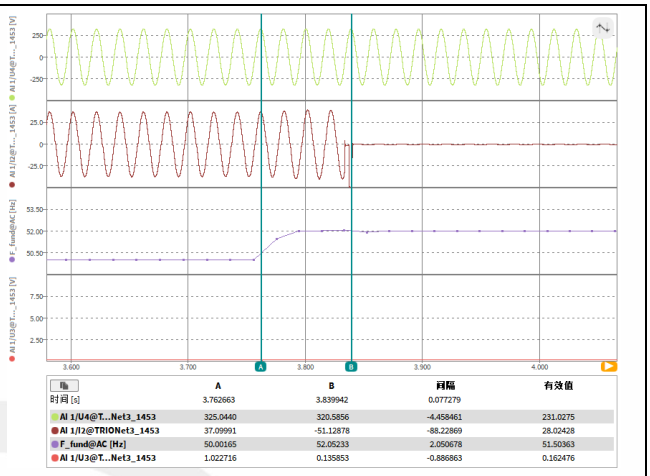
	A	B	间隔	有效值
时间 [s]	4.1128482	4.1907796	0.0779314	
AI 1/U4@T...Net3_1453	78.39460	212.5400	134.1454	225.2665
AI 1/I2@TRIONet3_1453	7.929588	5.424045	-2.505543	27.59583
F_fund@AC [Hz]	50.00217	46.97006	-3.032112	47.86950
AI 1/U3@T...Net3_1453	1.977699	0.131304	-1.846395	0.159968

No.4 Under Frequency

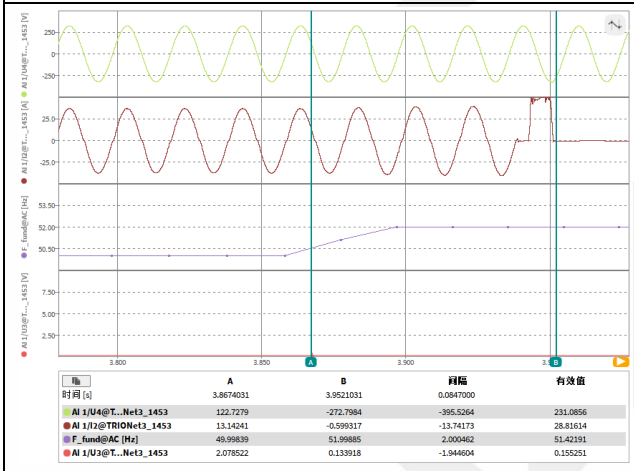
IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict



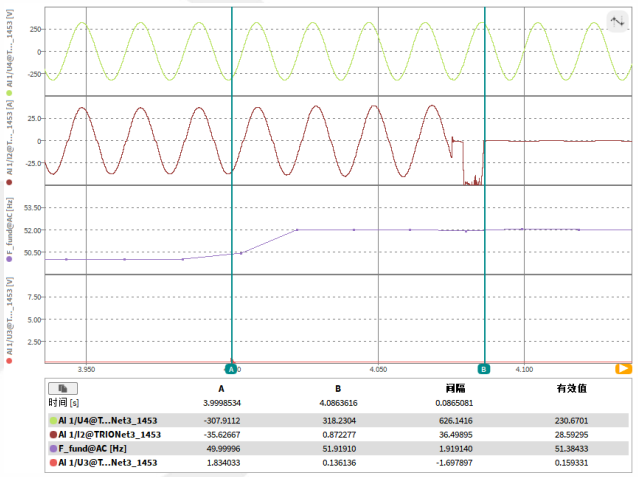
No.5 Under Frequency



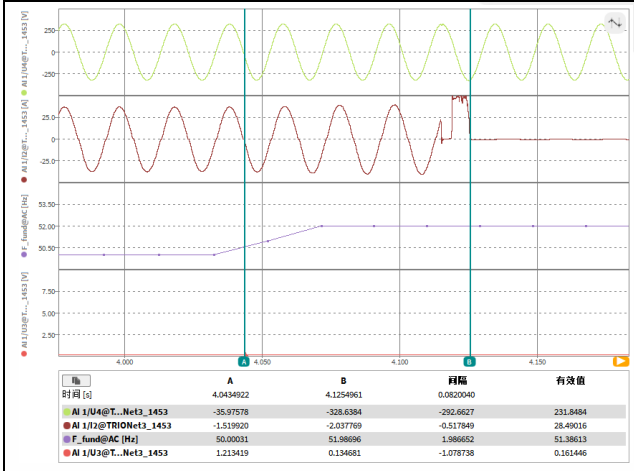
No.1 Over Frequency



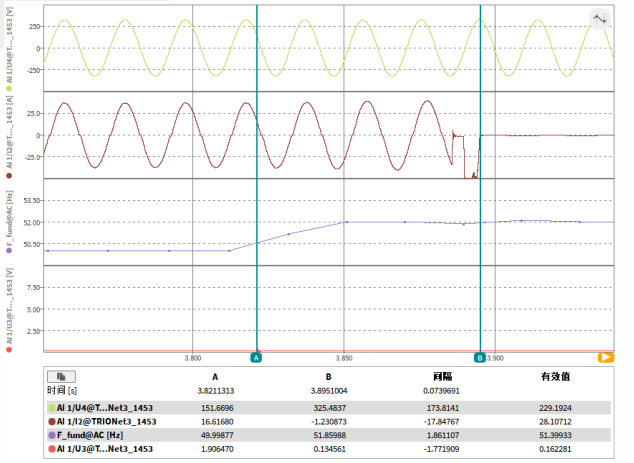
No.2 Over Frequency



No.3 Over Frequency



No.4 Over Frequency



No.5 Over Frequency

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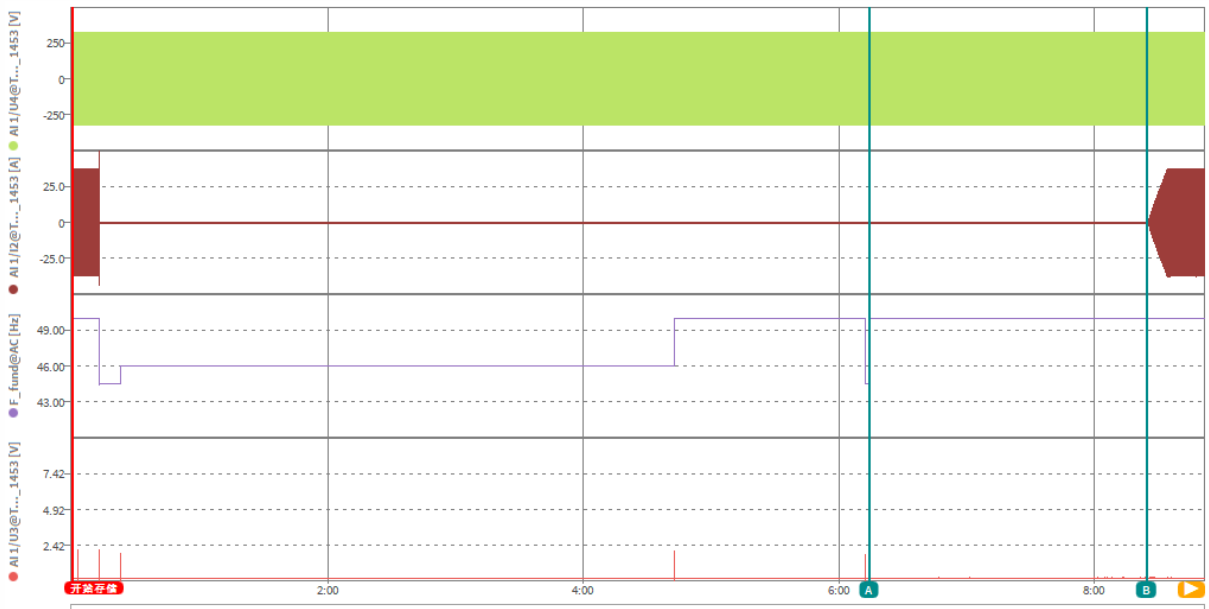
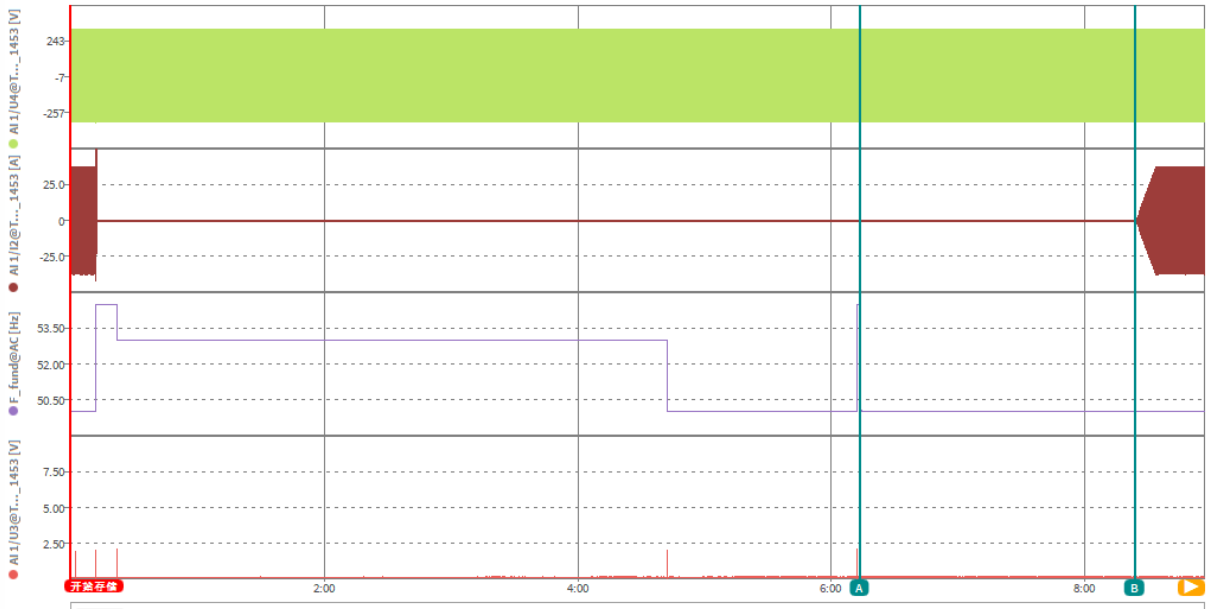
Clause	Requirement – Test	Result - Remark	Verdict



	A	B	间隔	有效值
时间 [s]	6:14.6272	8:24.8842	2:10.2570	
AI 1/U4@TRIONet3_1453 [V]	0.125950	-252.6043	-252.7303	229.9762
AI 1/I2@TRIONet3_1453 [A]	-0.542534	-0.487057	0.055477	0.379010
F_fund@AC [Hz]	44.56428	50.00065	5.436367	49.99927
AI 1/U3@TRIONet3_1453 [V]	1.777068	0.118977	-1.658090	0.119905

Reconnection after Under Frequency:



	A	B	间隔	有效值
时间 [s]	6:13.7913	8:23.8919	2:10.1007	
AI 1/U4@TRIONet3_1453 [V]	3.966416	90.36525	86.39884	229.9766
AI 1/I2@TRIONet3_1453 [A]	-0.543633	-1.418419	-0.874786	0.389385
F_fund@AC [Hz]	54.42817	49.99831	-4.429859	50.00078
AI 1/U3@TRIONet3_1453 [V]	2.053656	0.122474	-1.931182	0.121801

Reconnection after Over Frequency

Note:/

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Clause	Requirement – Test	Result - Remark	Verdict

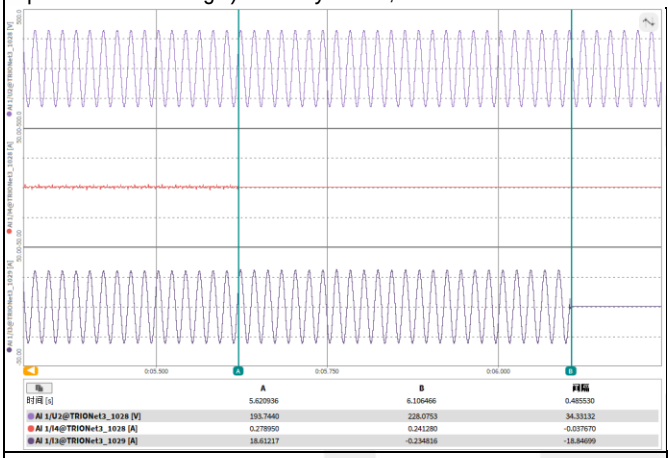
Clause	Test	Result
	Type test:	
6.1	Islanding protection according table 6 - Load imbalance (real. reactive load) for test condition A (EUT ouput = 100%)	P
6.1	Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	P
6.1	Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	P

6.1	TABLE: Islanding protection (EUT output = 100%)								P
Test conditions			Frequency: 50+/-0.1Hz UN=230+/-3Vac Distortion factor of chokes < 2% Quality =1						
Disconnection limit			2s for MEA						
No	1) PEUT (% of EUT rating)	Reactive load (% of QL in 6.1.d) 1)	2) PAC (% of nominal)	3) QAC (% of nominal)	Run on Time (ms)	PEUT (kW)	Actual Qf	V (V)	Remarks5)
1	100	100	0	0	0.48	6.00	1.00	380	BL
2	100	100	-5	-5	0.12	6.00	1.02	380	IB
3	100	100	-5	0	0.47	6.00	1.03	380	IB
4	100	100	-5	5	0.10	6.00	1.06	380	IB
5	100	100	0	-5	0.13	6.00	0.96	380	IB
6	100	100	0	5	0.13	6.00	1.01	380	IB
7	100	100	5	-5	0.12	6.00	0.93	380	IB
8	100	100	5	0	0.26	6.00	0.94	380	IB
9	100	100	5	5	0.13	6.00	0.97	380	IB
Parameter at 0% per phase			L= 0.214mH		R= 0.129Ω			C= 1439.8μF	
IAC fundamental current at balance condition			L1: 0.12A		L2: 0.09A			L3: 0.12A	

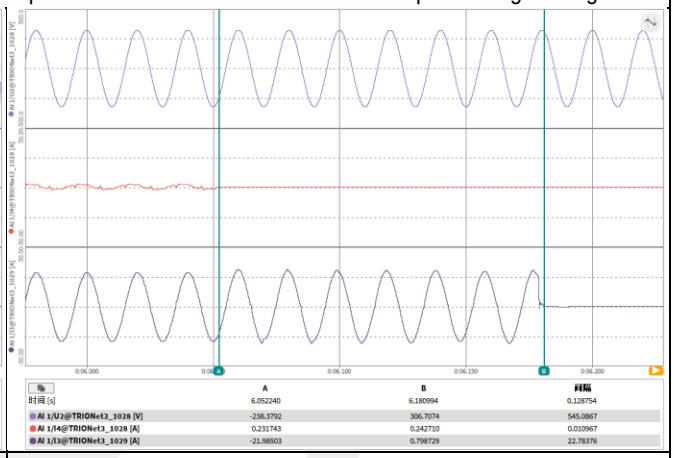
Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) PEUT: EUT output power
2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 %

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

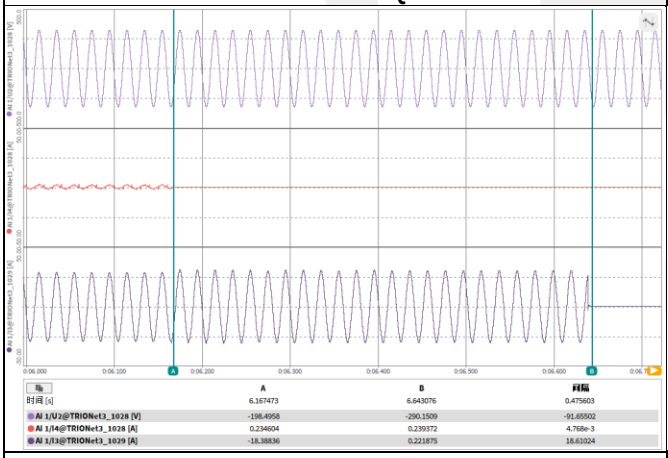
test condition value.
4) BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum5)
EUT input voltage 6) = 100% of rated input voltage range
5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0.9 × (Y – X). Y shall not exceed 0.8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.



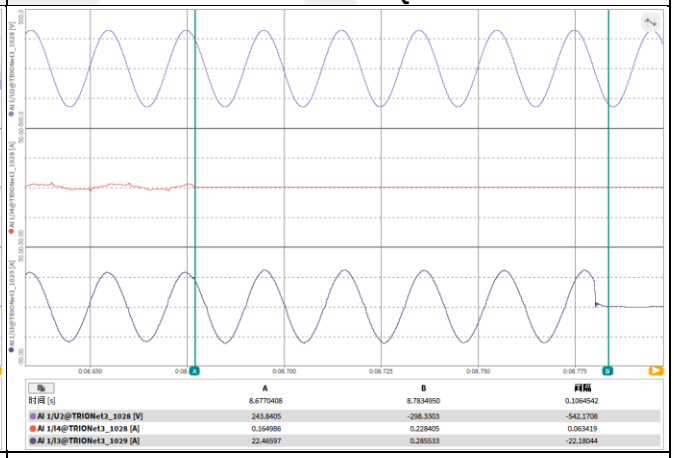
Disconnection at PAC 0% and QAC 0% reactive load



Disconnection at PAC -5% and QAC -5% reactive load



Disconnection at PAC -5% and QAC 0% reactive load



Disconnection at PAC -5% and QAC +5% reactive load

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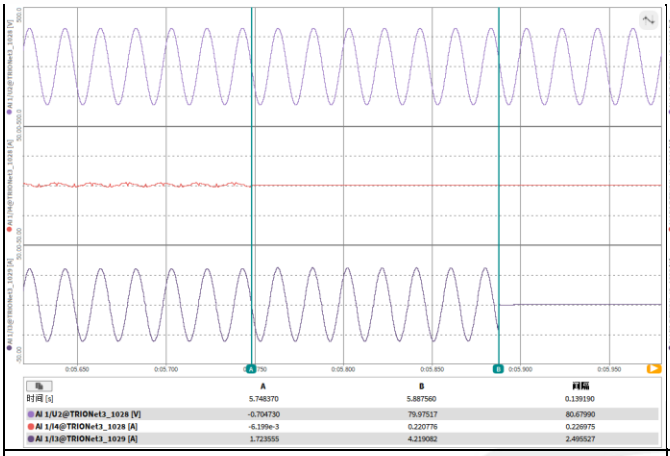
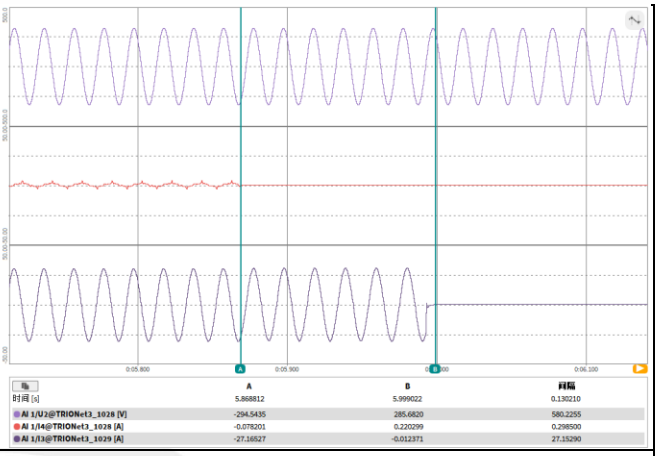
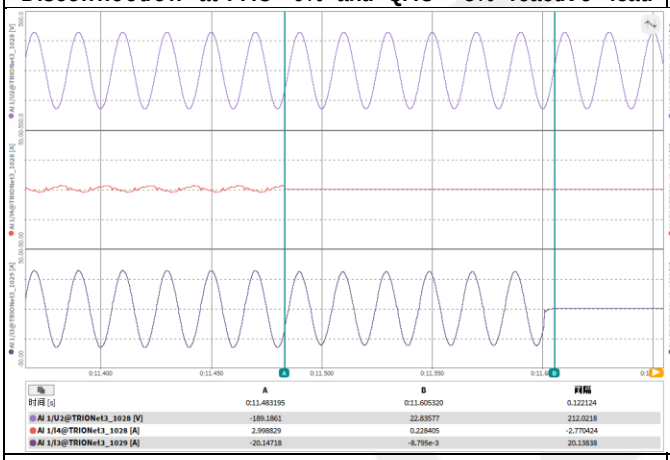
Clause	Requirement – Test	Result - Remark	Verdict



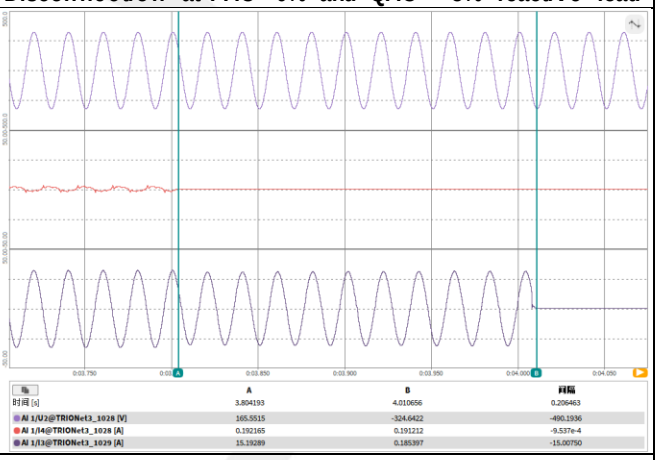
Disconnection at PAC 0% and QAC -5% reactive load



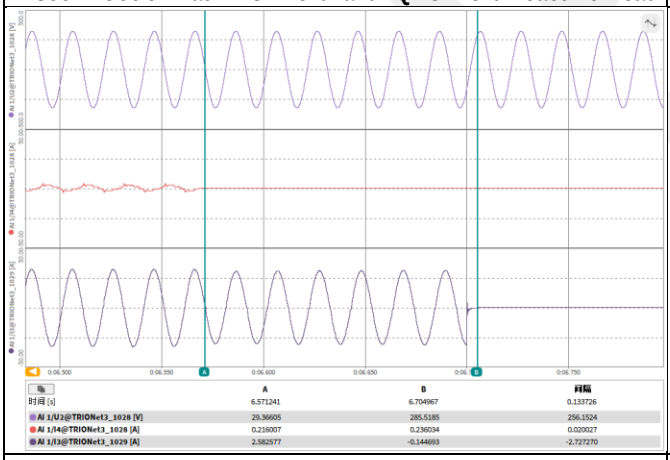
Disconnection at PAC 0% and QAC +5% reactive load



Disconnection at PAC +5% and QAC -5% reactive load



Disconnection at PAC +5% and QAC 0% reactive load



Disconnection at PAC +5% and QAC +5% reactive load

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Attention:

For Thailand only picture with all three current phases L1. L2 and L3 are accepted

All relays are direct coupled and open directly by receiving the islanding signal from the controller.

Note:

U1(V): voltage of EUT; I1(A). I4(A): current of EUT; I2(A) Grid side EUT current

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

6.1	TABLE: **Islanding protection (EUT output = 66%)**								**P**
Test conditions		Frequency: 50+/-0.1Hz UN=230+/-3Vac Distortion factor of chokes < 2% Quality =1							
Disconnection limit		2s for MEA							
No	1) PEUT (% of EUT rating)	Reactive load (% of QL in 6.1.d) 1)	2) PAC (% of nominal)	3) QAC (% of nominal)	Run on Time (ms)	PEUT (kW)	Actual Qf	V (V)	Remarks5)
1	66	66	0	-5	0.13	3.96	0.97	290	IB
2	66	66	0	-4	0.16	3.96	0.97	290	IB
3	66	66	0	-3	0.22	3.96	0.98	290	IB
4	66	66	0	-2	0.27	3.96	0.98	290	IB
5	66	66	0	-1	0.36	3.96	0.99	290	IB
6	66	66	0	0	0.95	3.96	1.00	290	BL
7	66	66	0	1	0.27	3.96	1.00	290	IB
8	66	66	0	2	0.21	3.96	1.00	290	IB
9	66	66	0	3	0.16	3.96	1.01	290	IB
10	66	66	0	4	0.14	3.96	1.01	290	IB
11	66	66	0	5	0.12	3.96	1.01	290	IB

Parameter at 0% per phase	L= 0.177mH	R= 0.15Ω	C=2642µF
IAC fundamental current at balance condition	L1: 0.15A	L2: 0.15A	L3: 0.13A

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) PEUT: EUT output power
2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum 5)
EUT input voltage 6) = 66% of rated input voltage range
5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0.9 × (Y – X). Y shall not exceed 0.8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

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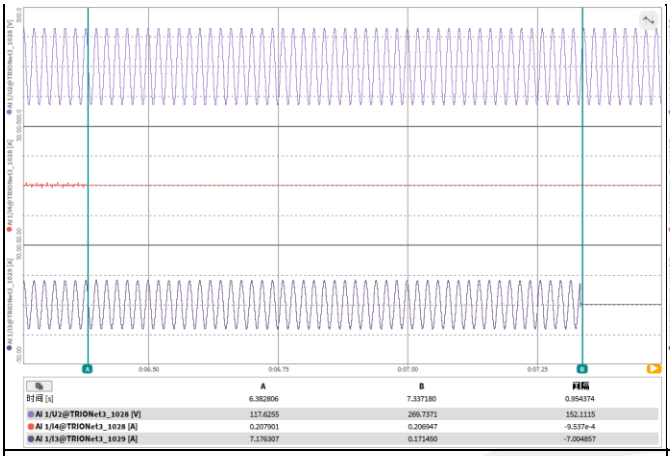
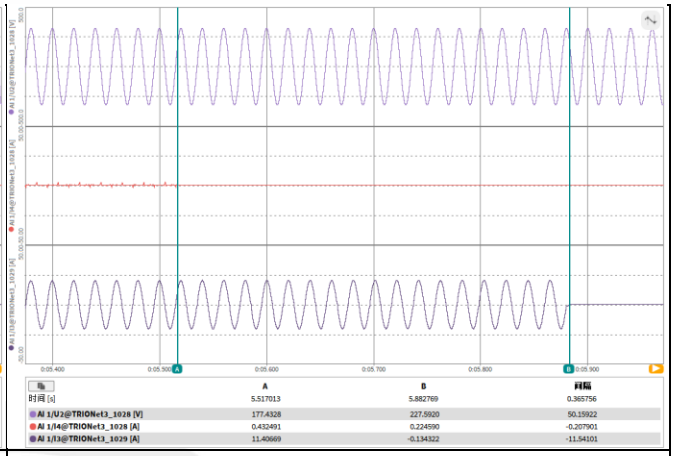
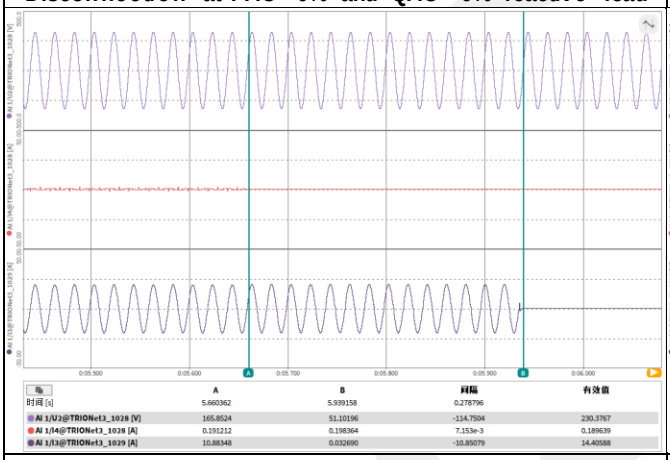
Clause	Requirement – Test	Result - Remark	Verdict



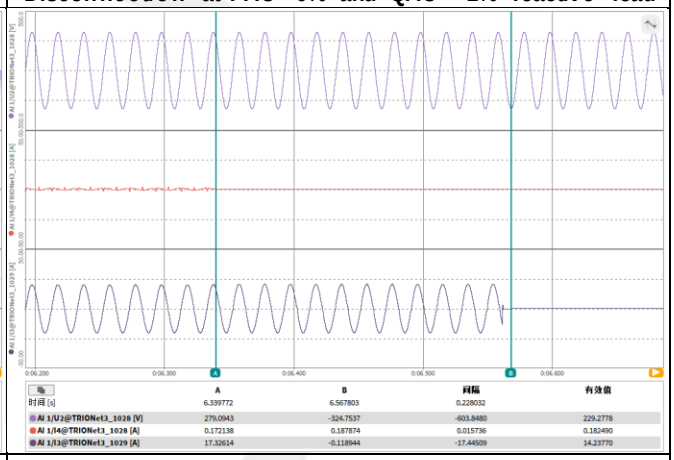
Disconnection at PAC 0% and QAC 0% reactive load



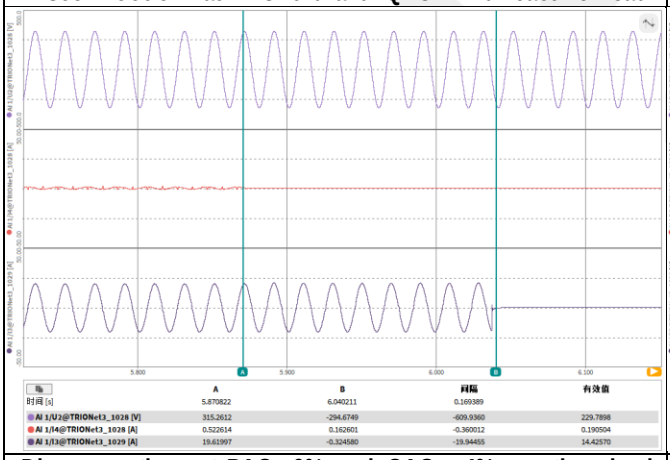
Disconnection at PAC 0% and QAC -1% reactive load



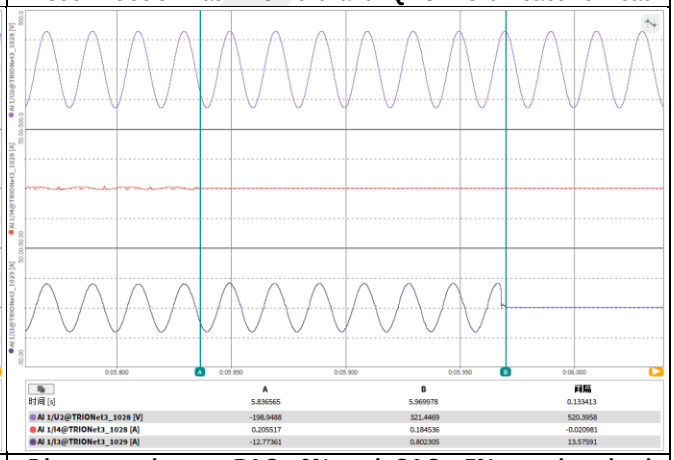
Disconnection at PAC 0% and QAC -2% reactive load



Disconnection at PAC 0% and QAC -3% reactive load



Disconnection at PAC 0% and QAC -4% reactive load



Disconnection at PAC 0% and QAC -5% reactive load

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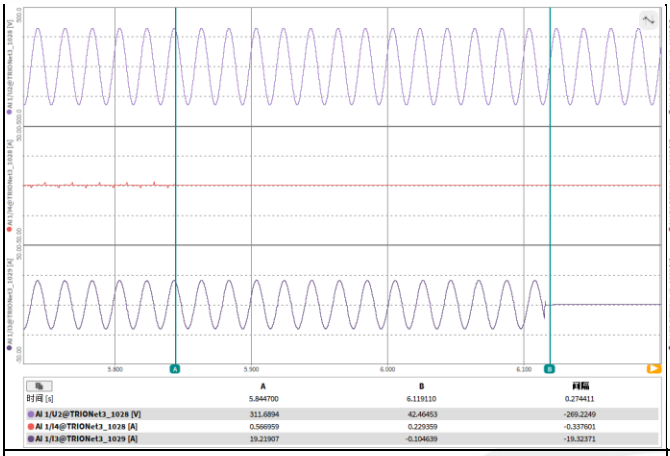
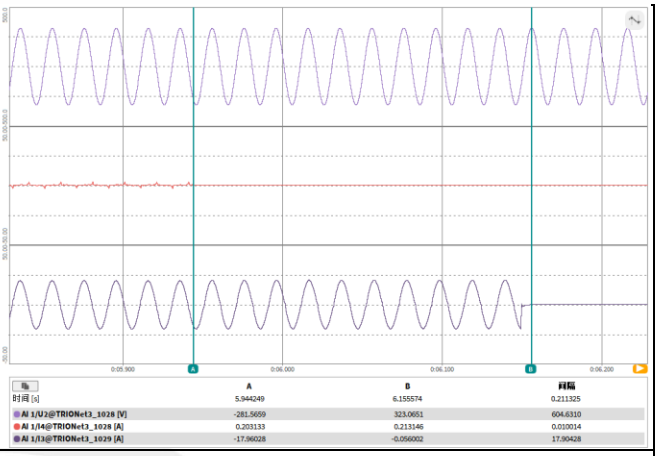
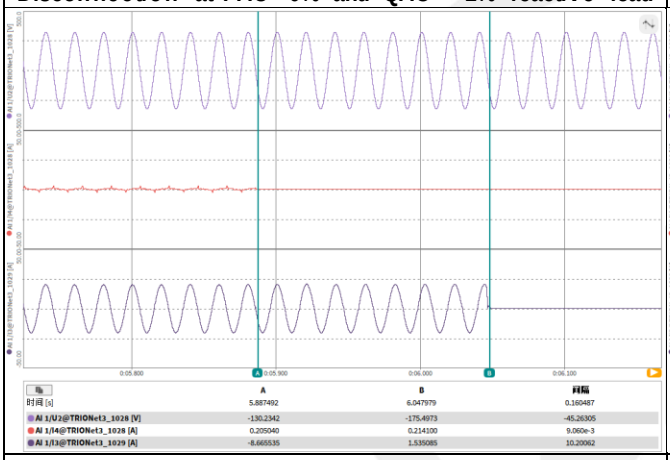
Clause	Requirement – Test	Result - Remark	Verdict



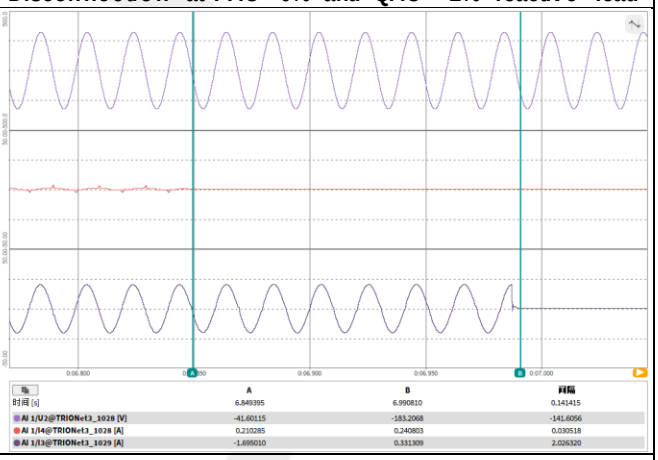
Disconnection at PAC 0% and QAC +1% reactive load



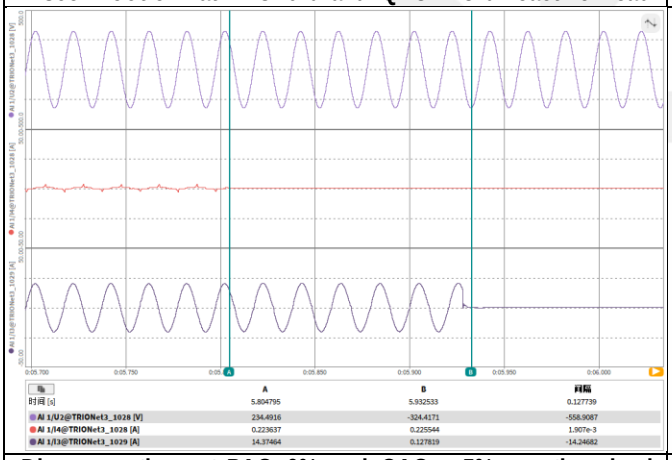
Disconnection at PAC 0% and QAC +2% reactive load



Disconnection at PAC 0% and QAC +3% reactive load



Disconnection at PAC 0% and QAC +4% reactive load



Disconnection at PAC 0% and QAC +5% reactive load

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Attention:
For Thailand only picture with all three current phases L1. L2 and L3 are accepted
All relays are direct coupled and open directly by receiving the islanding signal from the controller.

Note:
U1(V): voltage of EUT; I1(A). I4(A): current of EUT; I2(A) Grid side EUT current

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

6.1	TABLE: **Islanding protection (EUT output = 33%)**								**P**
Test conditions		Frequency: 50+/-0.1Hz UN=230+/-3Vac Distortion factor of chokes < 2% Quality =1							
Disconnection limit		2s for MEA							
No	1) PEUT (% of EUT rating)	Reactive load (% of QL in 6.1.d) 1)	2) PAC (% of nominal)	3) QAC (% of nominal)	Run on Time (ms)	PEUT (kW)	Actual Qf	V (V)	Remarks5)
1	33	33	0	-5	0.19	1.98	0.97	180	IB
2	33	33	0	-4	0.23	1.98	0.97	180	IB
3	33	33	0	-3	0.25	1.98	0.98	180	IB
4	33	33	0	-2	0.33	1.98	0.98	180	IB
5	33	33	0	-1	0.43	1.98	0.99	180	IB
6	33	33	0	0	0.44	1.98	1.00	180	BL
7	33	33	0	1	0.17	1.98	1.00	180	IB
8	33	33	0	2	0.16	1.98	1.01	180	IB
9	33	33	0	3	0.14	1.98	1.01	180	IB
10	33	33	0	4	0.12	1.98	1.02	180	IB
11	33	33	0	5	0.11	1.98	1.02	180	IB

Parameter at 0% per phase	L= 0.415mH	R= 0.135Ω	C= 1284μF
IAC fundamental current at balance condition	L1: 0.08A	L2: 0.12A	L3: 0.15A

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) PEUT: EUT output power
2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) QAC: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum 5)
EUT input voltage 6) = 33% of rated input voltage range
5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0.9 × (Y – X). Y shall not exceed 0.8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

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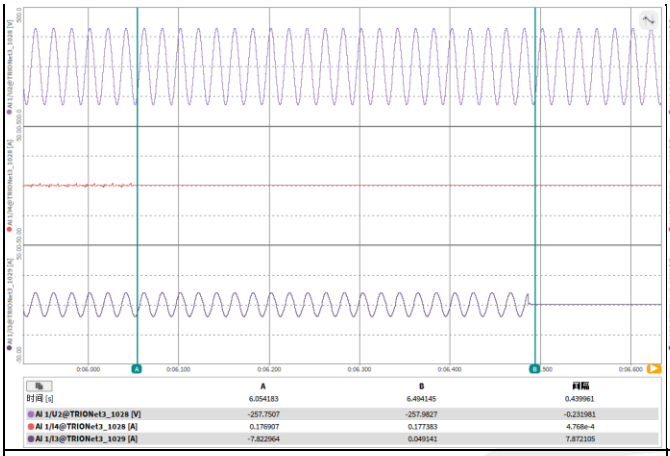
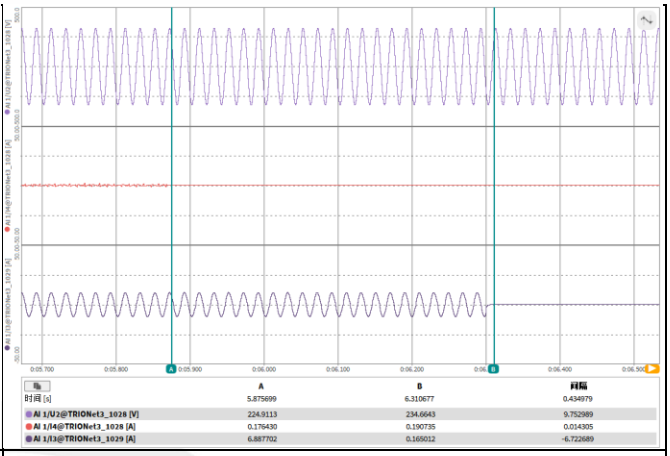
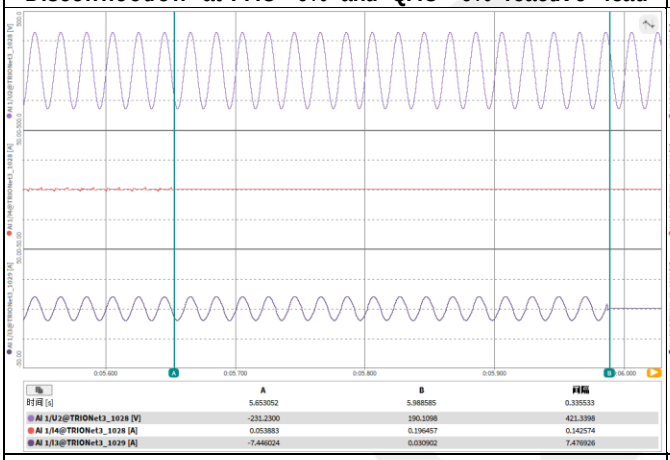
Clause	Requirement – Test	Result - Remark	Verdict



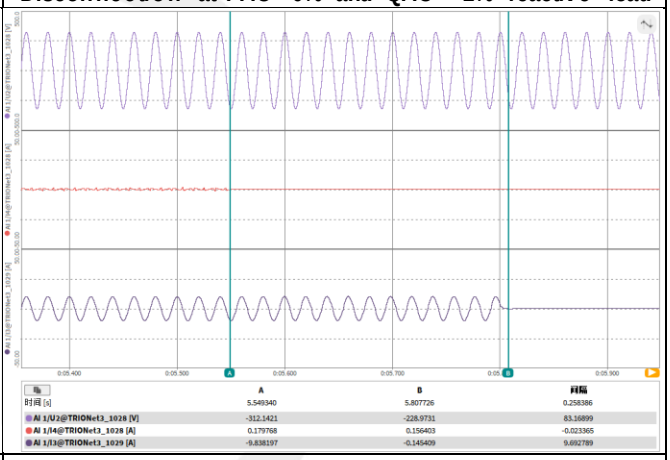
Disconnection at PAC 0% and QAC 0% reactive load



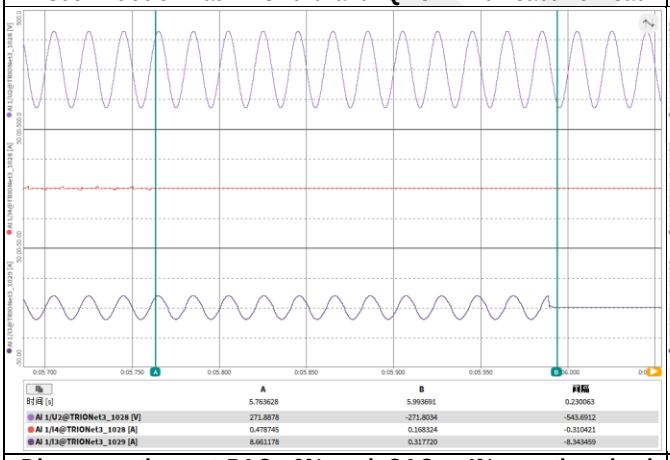
Disconnection at PAC 0% and QAC -1% reactive load



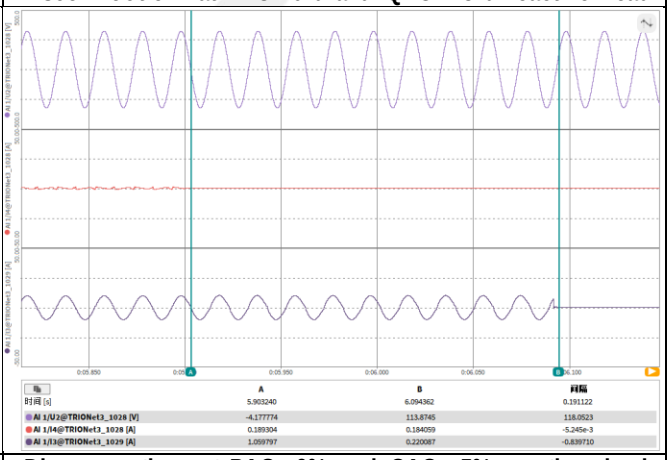
Disconnection at PAC 0% and QAC -2% reactive load



Disconnection at PAC 0% and QAC -3% reactive load



Disconnection at PAC 0% and QAC -4% reactive load



Disconnection at PAC 0% and QAC -5% reactive load

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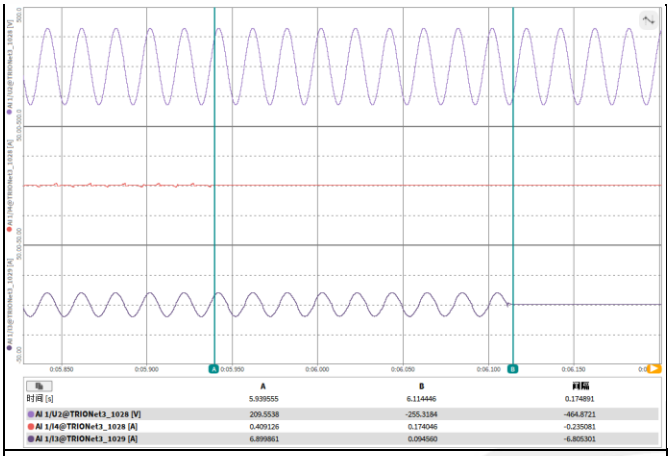
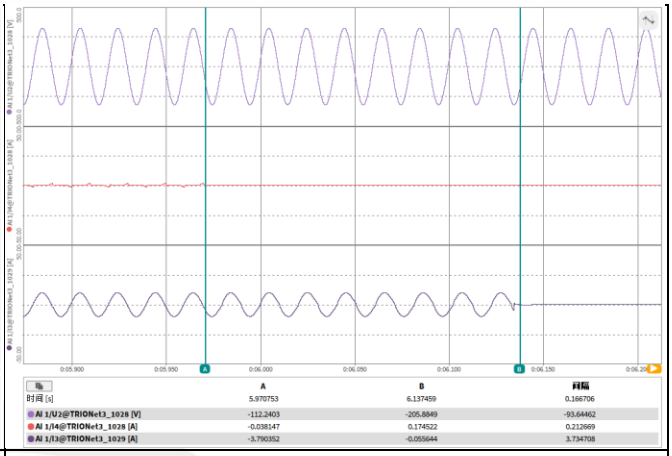
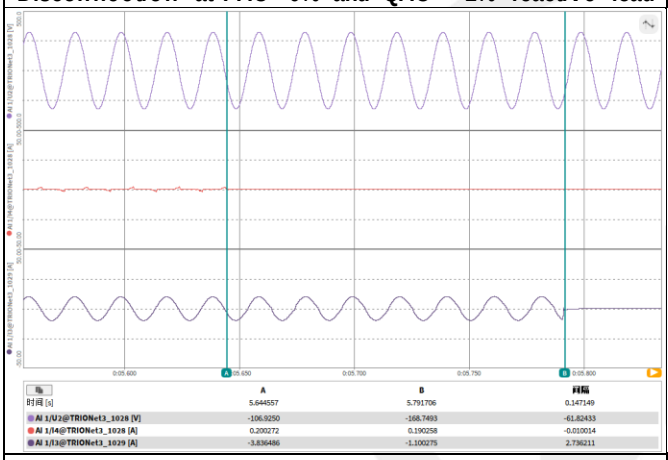
Clause	Requirement – Test	Result - Remark	Verdict



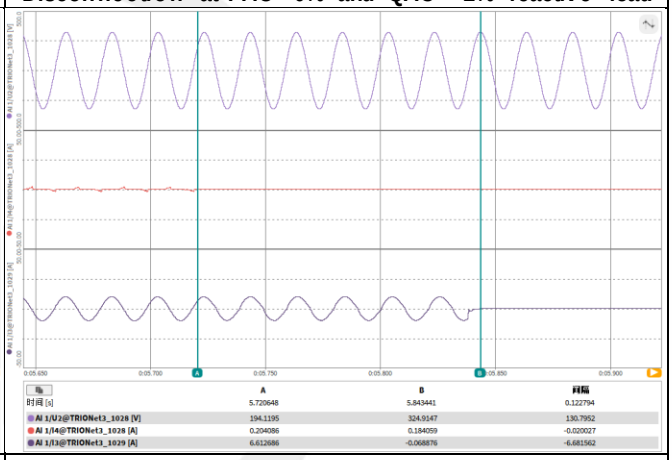
Disconnection at PAC 0% and QAC +1% reactive load



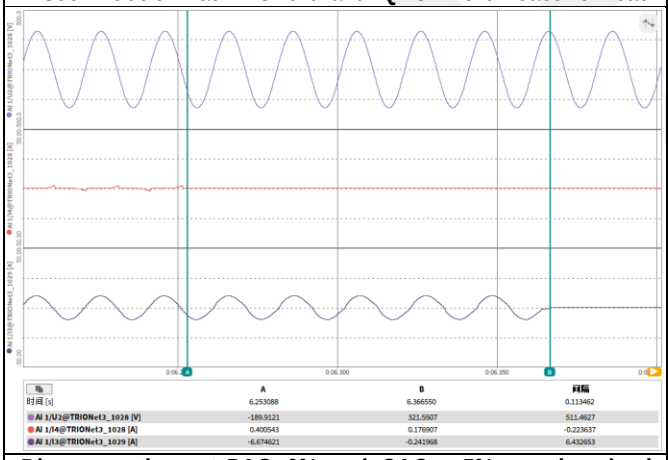
Disconnection at PAC 0% and QAC +2% reactive load



Disconnection at PAC 0% and QAC +3% reactive load



Disconnection at PAC 0% and QAC +4% reactive load



Disconnection at PAC 0% and QAC +5% reactive load

/

Attention:
For Thailand only picture with all three current phases L1. L2 and L3 are accepted
All relays are direct coupled and open directly by receiving the islanding signal from the controller.

Note:
U1(V): voltage of EUT; I1(A). I4(A): current of EUT; I2(A) Grid side EUT current

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

7	TABLE: list of critical components				
Item	Name	Manufacturer/ trademark[2]	Type / model[2]	Technical data and securement means	Mark(s) of conformity[3]
1	Adhesive-Type Label (not shown)	3M COMPANY	PS32(L)	Adhesive-Type, Min. 80°C	cURus
2	Enclosure of 48V main part	NanGongHuiLi	SR-HESP4860S100-H	345*500*177.8 mm thickness:1.2mm. made of SGCC	NR
		FoShanShi KeTu			NR
		HuiZhou DeHai			NR
		DongGuan DiYe			NR
3	Heat-sink	Dongguan Hailiang Precision Hardware Co., Ltd.	HESP4860S100-H	240x86x368_AL6063_V1.0	NR
		DongGuan World JiXie			NR
4	Heat-sink (Transformer Inductance Box)	Shenzhen Zhengqin Hardware Products Co., Ltd.	HESP4860S100-H	HESP4860S100-H _105X76.5X290 _AL6063_106142_V1.0	NR
5	AC input overload protector	topstone	98-40-P1B1PRBNB	_40A	cURus
6	AC terminal	Dongguan Telian Electronics Co., Ltd.	PA12DS	WTA65-05-6P	cURus
7	PV terminal	Dongguan Telian Electronics Co., Ltd. UL 94 V-0	PA12DS	WTA65-05-6P	cURus
8	heat shrink tube	CHANGYUAN ELECTRONICS GROUP CO LTD	Various	600V ,125℃, VW-1	cURus
9	All PCB	Various	Various	PCB_SR-HESP4860S100-H(230V)_6.0KW (MPPT*2)_2.0m	cURus cETLus

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

				m_2_288*365mm_288*365mm_V2.0	
		interchangeable	Various	PCB_SR-HESP4860S100-H(230V)_6.0KW_PV INPUT(MPPT*2)_1.6mm_1123*86mm_4256*176mm_V4.0	cURus
10	Grouding wire	Shenzhen Mingmou	1015	10AWG 600V 105℃	cURus
11	AC wire	Shenzhen Mingmou	1015	10AWG 600V 105℃	cURus
12	PV wire	Shenzhen Mingmou	1015	10AWG 600V 105℃	cURus
13	Control board communication board cable layout	Shenzhen Mingmou	1007	24AWG 600V 105℃	cURus
14	insulation sheet on heat sink	SABIC JAPAN L L C	FR60	UL94V-0, 130°C Film	cURus
15	Fan on enclosure	Shenzhen Huaxia Hengtai Electronic Co Ltd	08025VE12MCLD2	12V_2.76W_5000RPM-RD_80*80*25mm_IP68_NMB	cURus
		CROWN ELECTRONICS. CO.,LTD	NDH3649_06025SA12NBLD1	12V_1.8W_4700RPM-RD_60*60*25mm_NMB	cURus
16	CPU 1 on control board	Texas Instrument	TMS320F28069_PZT_LQFP-100	60MHz,3.3V, -40~105℃ U50	NR
17	Optocoupler on control board	Texas Instrument	ISO1050DUBR	Viso: 5000Vrms, Cl 6.1mm, Cr 6.8mm, DUB-8,105℃ U25	cURus
18	Optocoupler on control board	LITE ONTECHNOLOGY CORPORATION	LTV-816S-TP-C	200-400%_5000V U32, U33, U35, U36, U37, U39	cURus
19	Transformer on	SRNE Sloar	high-frequency	22*18*19.5mm,	See 5.0

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

	com board	Co., Ltd.	transformer EE19	90℃(105℃) T1	
20	Relay on com board	Xiamen Hongfa	HF32FA-005-ZS2	250Vac, 5A, 5000Vac,85℃ RY2	cURus
		Panasonic	DSP2a-DC5V	250Vac, 5A, 5000Vac,85℃ RY2	cURus
21	Relay for grid disconnection (RLY1-6)	Xiamen Hongfa VDE 40043143	HF165FD-G/12-HY1STF	DC12V_77.4mA _40A (RLY1-6)	cURus
		Xiamen Hongfa VDE 40043143	AHES3191Q	DC12V_77.4mA _40A (RLY1-6)	cURus
22	Relay on PV board(RLY1-2)	Xiamen Hongfa VDE 40043143	HF36F/012-HST	DC12V_44.4mA _10A	cURus
23	Y capacitor on Main board	SHENZHEN SHI HONG VDE 40043430	Y213Y5V1D103 M	Y2_0.01uF_300 VAC_M_P=10m m(C2,C4,C17,C 40,C16,C39)	Subassembly
		Various	Various	Y2_0.01uF_300 VAC_M_P=10m m(C2,C4,C17,C 40,C16,C39)	cURus
24	X Capacitor on Main board	SHENZHEN SHI HON VDE 40044173	HMKP474K310 NFAD_HMKP	474K310V_26.5 *19*10mm_P=2 2.5mm(C269,C1 50)	cURus
		Xiamen Faratronic Co.,Ltd. VDE 40044173	MKP62 474K310V	474K310V_26.5 *19*10mm_P=2 2.5mm(C269,C1 50)	cURus
25	Fuse for AC APS	Xiamen SET Electronics Co.,Ltd.	Y3	Thermal-link(Radial Shape) GP Y3 125 ℃5 A 250 Vac,Tinned Copper Wire, Total Length 70 mm, Outside of Lead Wire 63 mm(F1,F2,F3)	cURus
26	Fuse- battery for 48V series	HOLLYLAND CO LTD VDE 40017057	L63A	65V 63A, interrupting 500A, 125℃	cURus

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

27	FUSE for MOV	Xiamen SET Electronics Co.,Ltd. VDE 40017057	CAH0412501	5A/250VAC F2,F3,F4	cURus
28	MOV fuse on PV small board	Xiamen SET Electronics Co.,Ltd. VDE 40017057	CAH0412501	5A/250VAC F1,F2,F3,F5	cURus
29	Electrolytic capacitor at the battery	SamYoung Electronics Co., Ltd.	ALUMINUM ELECTROLYTIC CAPACITORS	2200uF_M_63V _Φ18*40_P=7.5 mm_105℃ _10000HNXA	
30	The MOV for AC input is on the motherboard	Brightking 40027827	20D561K	102KD20-P10_1000V_P=10mm	cURus
		Xiamen SET Electronics Co., Ltd. VDE 40027827	MOV20D561KT	102KD20-P10_1000V_P=10mm	cURus
31	Electrolytic capacitor on bus	SamYoung Electronics Co.,Ltd.	LELON ELECTRONICS CORP	470uF_M_500V _105℃ _35*50_P=10mm_2000H_1.75A	NR
		AISHI	ELH2WM681R50LT LH	470uF_M_500V _105℃ _35*50_P=10mm_2000H_1.75A	NR
32	Film capability	Hongfarad Electronics Co.. L td	HAPK256J180V HAPK	180V,25uF, -40-105℃ C35	NR
		Xiamen FaratronicCo.,Ltd.	C6AE2156	180V,25uF, -25-105℃ C35	NR
33	IGBT- INV Circuit	Wuxi NCE Power Co., Ltd	NCE80TD65BT	80A_650V_1.7V _TO-247	NR
		Wuxi China Resources Huajing Microelectronics Co., Ltd	NCE80TD65BT	80A_650V_1.7V _TO-247	NR
34	Diode- INV Circuit	Wuxi NCE Power Co., Ltd	APT60DQ60B	600V_60A_S(G) _TO247(D27,D94)(D25)	NR
35	MOS- DC	Wuxi NCE	IRFP4468	190A_100V_R0	NR

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

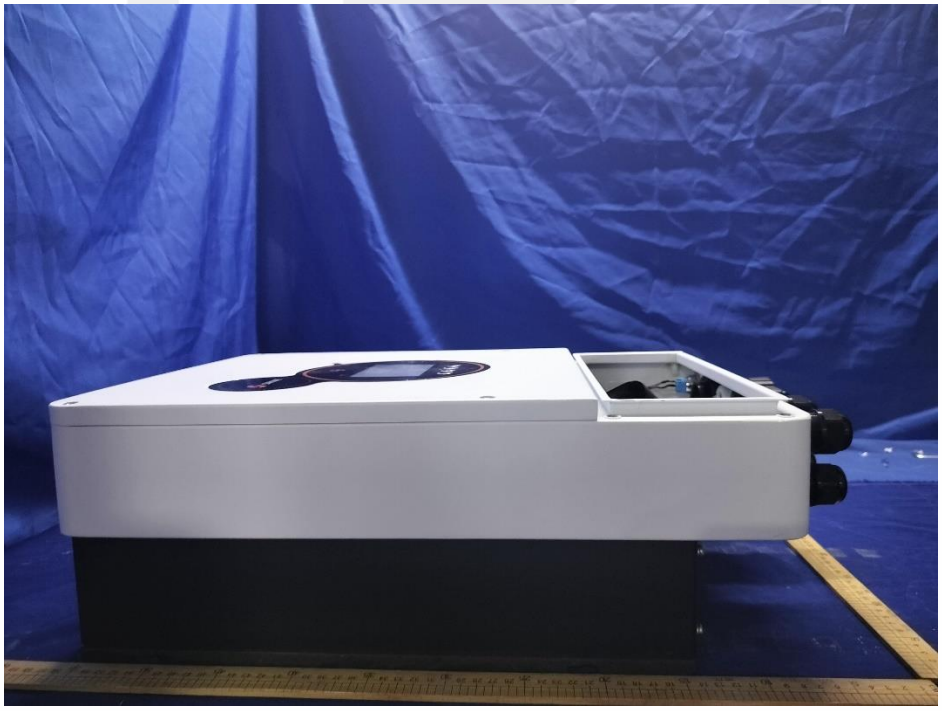
	Circuit	Power Co., Ltd		02_ N_TO-247(Q5,Q6,Q11,Q16,Q38,Q39,Q40,Q41)	
		China Resources Microelectronics (Chongqing) Co., Ltd	IRFP4468	190A_100V_R002_ N_TO-247(Q5,Q6,Q11,Q16,Q38,Q39,Q40,Q41)	NR
36	IGBT- PV Circuit	IR WORLD HEADQUARTERS: 233 Kansas St.	NCE80TD65BT	80A_650V_1.7V_TO-247(Q48,Q37)	NR
		Onsemi	NCE80TD65BT	80A_650V_1.7V_TO-247(Q48,Q37)	NR
37	Diode- PV Circuit	IR WORLD HEADQUARTERS: 233 Kansas St.	APT60DQ60B	600V_60A_S(G)_TO247(D27,D94)	NR
		Xi'an Huayi Microelectronics Co., Ltd.	APT60DQ60B	600V_60A_S(G)_TO247(D27,D94)	NR
38	Transformer BATT on transformer inductance box	Renesas Electronics Corporation	EE5525*2P	35uH_5%_2:8_DMR40_55*55*67mm_HES4855_NTC	NR
		DaXin Electronic Technology Co., Ltd	EE5525*2P	35uH_5%_2:8_DMR40_55*55*67mm_HES4855	NR
39	Inductor on transformer inductance box (L4A)	SRNE Sloar Co., Ltd.	NPF226060*2P	500uH_0%_14.5mR_1.5mm*3P*45T_73*52*72mm_HES4855-H	NR
		DaXin Electronic Technology Co., Ltd	NPH226060	500uH_0%_14.5mR_1.5mm*3P*45T_73*52*72mm_HES4855-H	NR
40	Inductor (L4) on Main board	SRNE Sloar Co., Ltd.	NPF141060	760uH ±8%_1.3mm*2*75T_20*31*56mm_HES4855	NR
		HuiZhou DeLi Technology Co.,	NPF141062	760uH ±8%_1.3mm*2*	NR

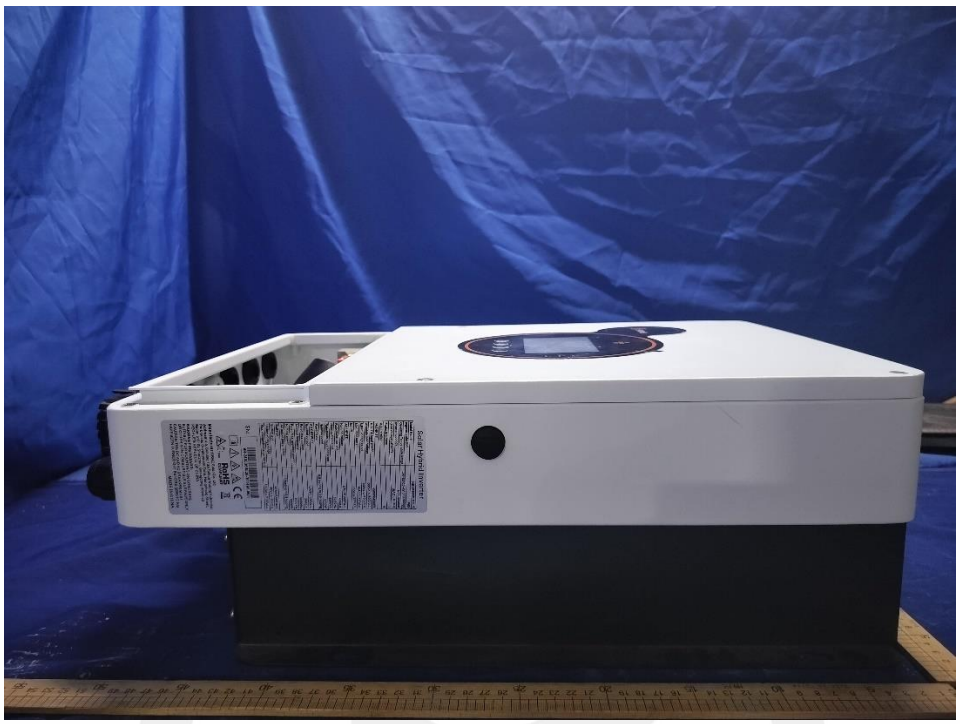
IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

		Ltd		75T_20*31*56mm	
41	Inductor on transformer inductance box (PV1)	SRNE Sloar Co., Ltd.	NPF226060*2P	1.08mH_1.5mm*2P*63T_66*68*43mm__HES4860-H_PV1	NR
		DaXin Electronic Technology Co., Ltd	NPF226060*2P	1.08mH_1.5mm*2P*63T_66*68*43mm__HES4860-H_PV1	NR
42	Inductor on transformer inductance box (PV2)	SRNE Sloar Co., Ltd.	NPF226060*2P	1.08mH_1.5mm*2P*63T_66*68*43mm_HES4860-H_PV2	NR
		DaXin Electronic Technology Co., Ltd	NPF226060*2P	1.08mH_1.5mm*2P*63T_66*68*43mm_HES4860-H_PV2	NR
43	Common mode inductance on the motherboard(L5)	Endela Electronics (Shenzhen) Co.,Ltd	L-28-0044	777uHMIN_7TS_0℃～130℃;42A_B_ROHS(L5)	NR
44	The main auxiliary power transformer(T2) is located on the motherboard	Endela Electronics (Shenzhen) Co.,Ltd	EC28	47uH_±5%_9:9:5:4:9:9_PC40_30.5*25*31.5mm_HES4855	NR
45	AC auxiliary power transformer(T1) on the motherboard	Endela Electronics (Shenzhen) Co.,Ltd	EC28	290uH_±8%_R_42：40：22：8_PC44_30.5*25*31.5mm	NR
46	PV auxiliary power transformer(T12) on the motherboard	Endela Electronics (Shenzhen) Co.,Ltd	EC28	290uH_±8%_R_40：22：8_PC40_30.5*25*31.5mm	NR
NOTES:					

1) Not all item numbers are indicated (called out) in the photos, as their location is obvious.
2) Various“ means any type, from any manufacturer that complies with the "Technical data and securement means" and meets the "Mark(s) of conformity" can be used.
3) Indicates specific marks to be verified, which assures the agreed level of surveillance for the component. "NR" - indicates Unlisted and only visual examination is necessary. "See 5.0" indicates Unlisted components or assemblies to be evaluated periodically refer to section 5.0 for details.

Picture

Overall view

Side view 1

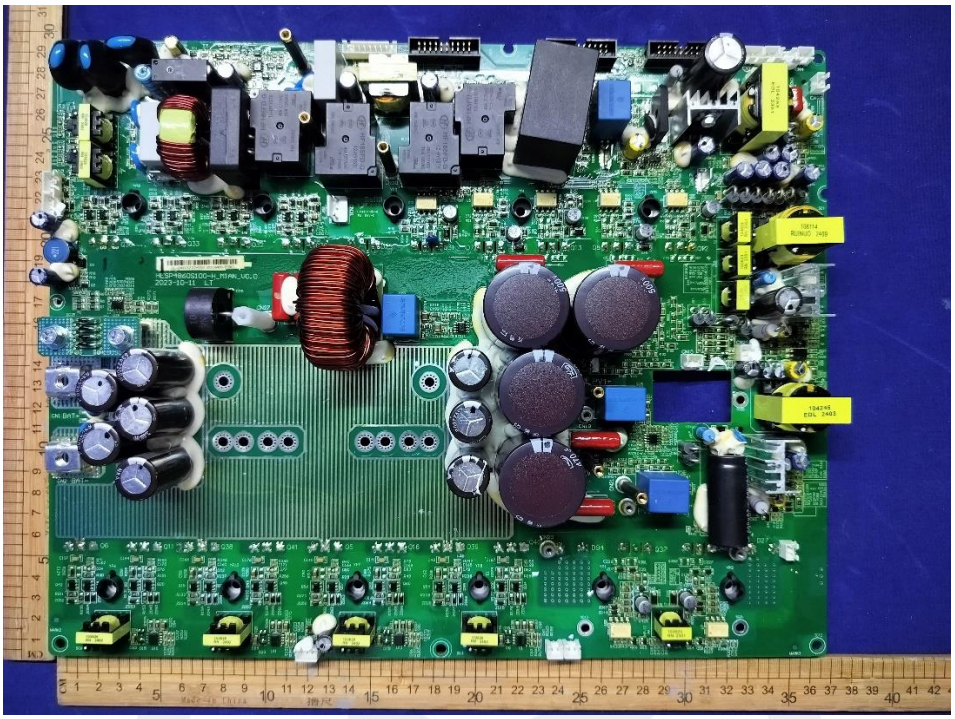
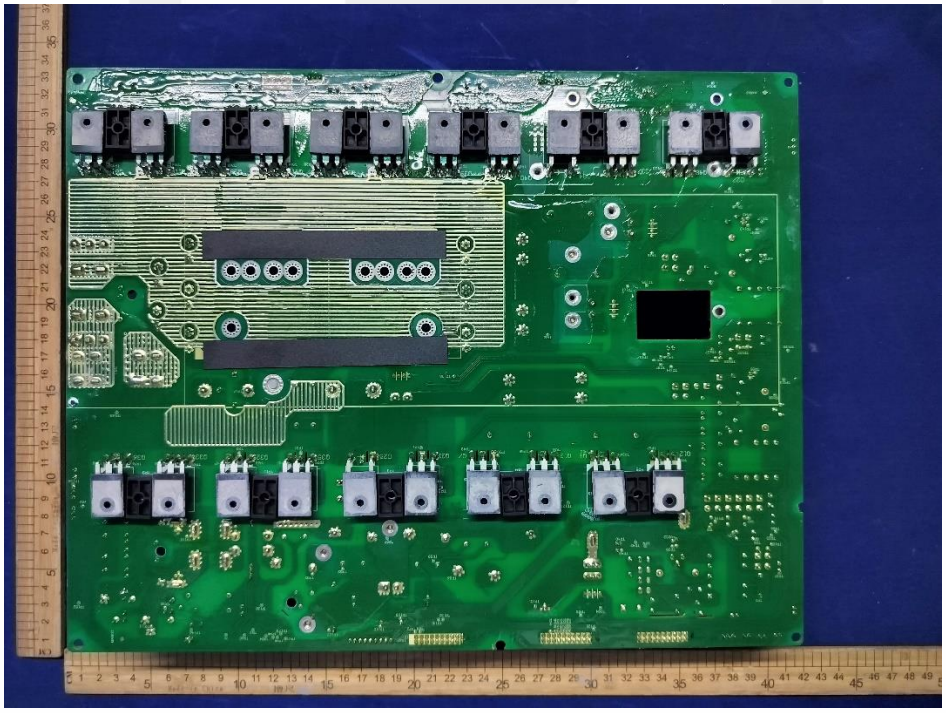
Picture

Side view 2

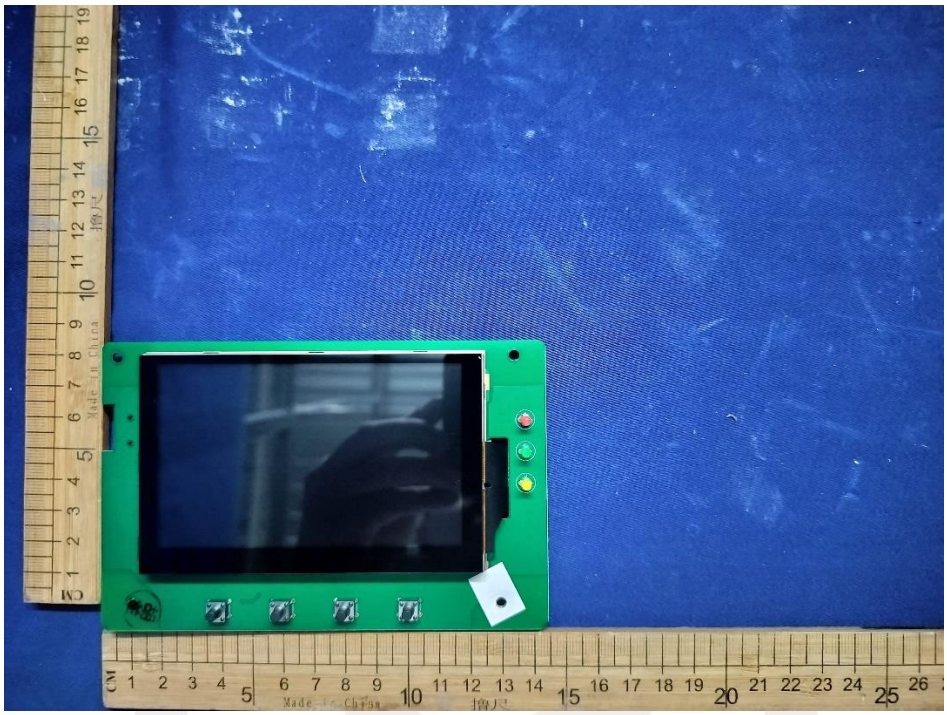
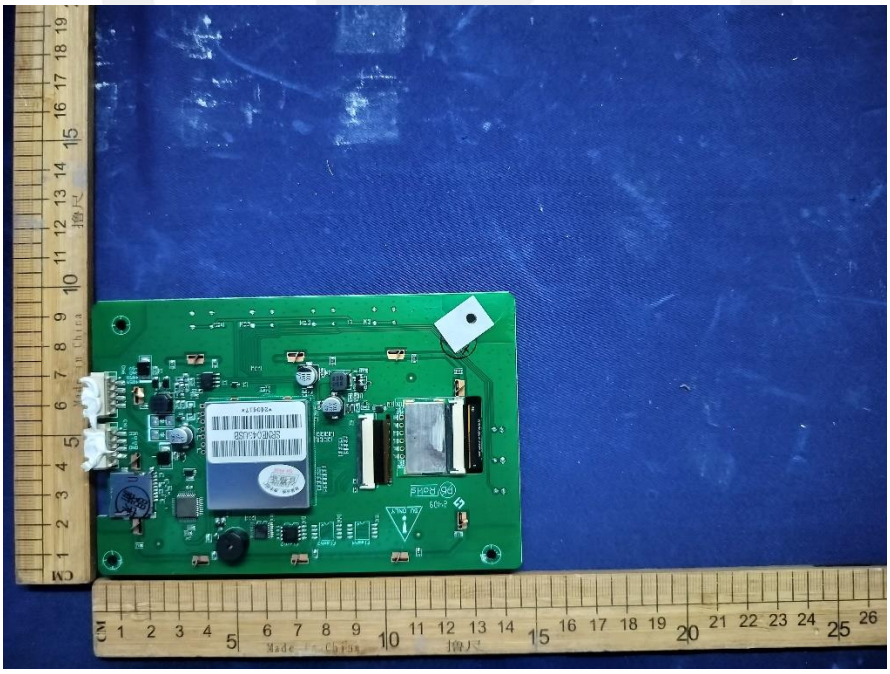
Bottom view

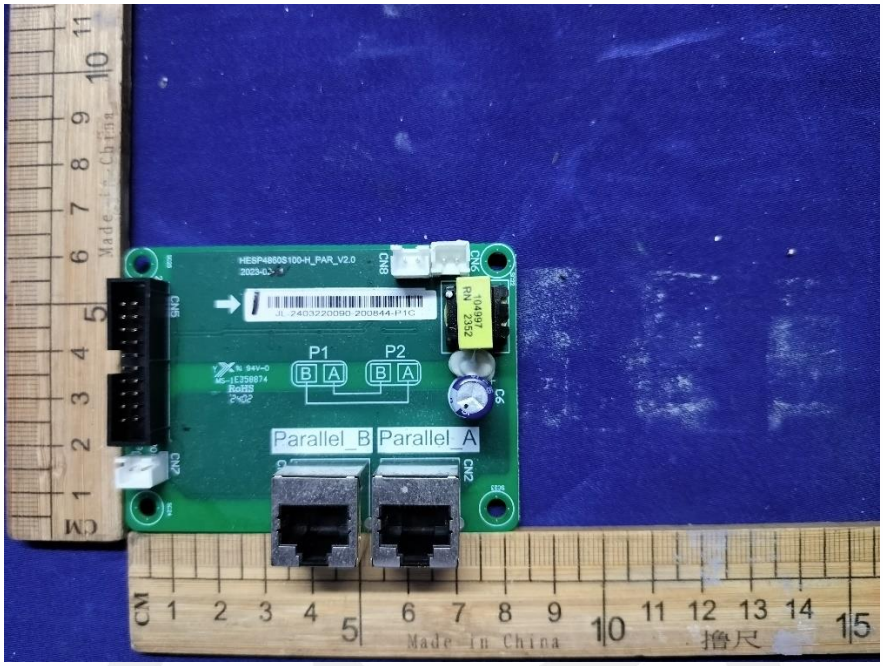
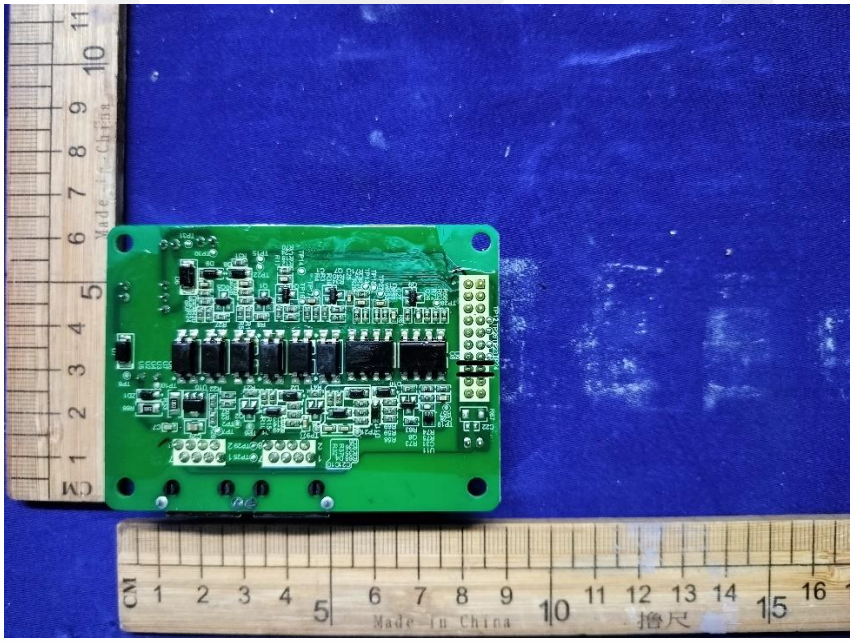
Picture

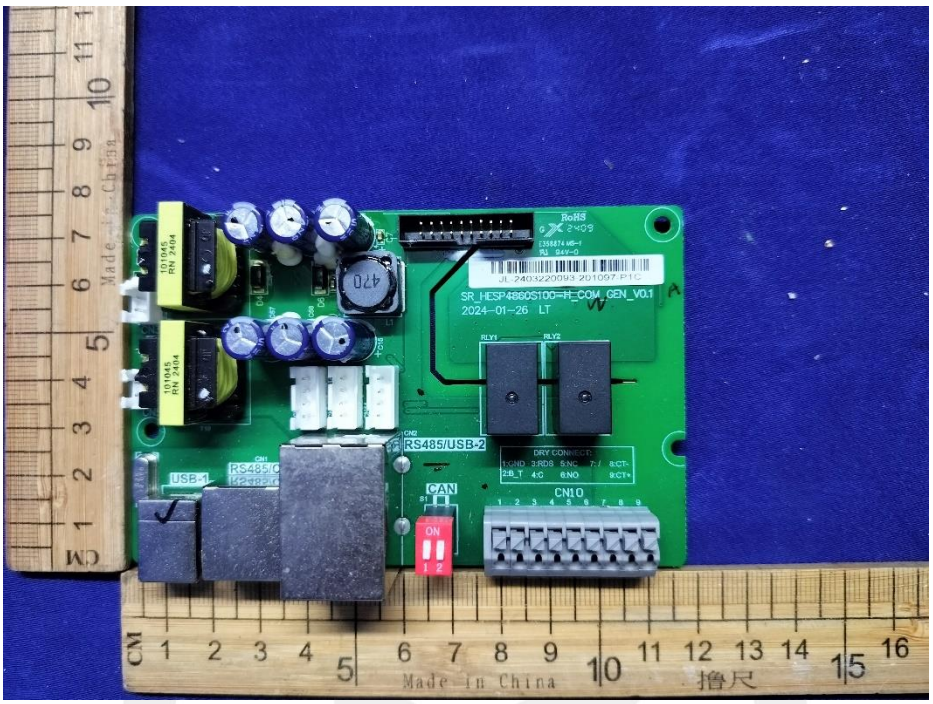
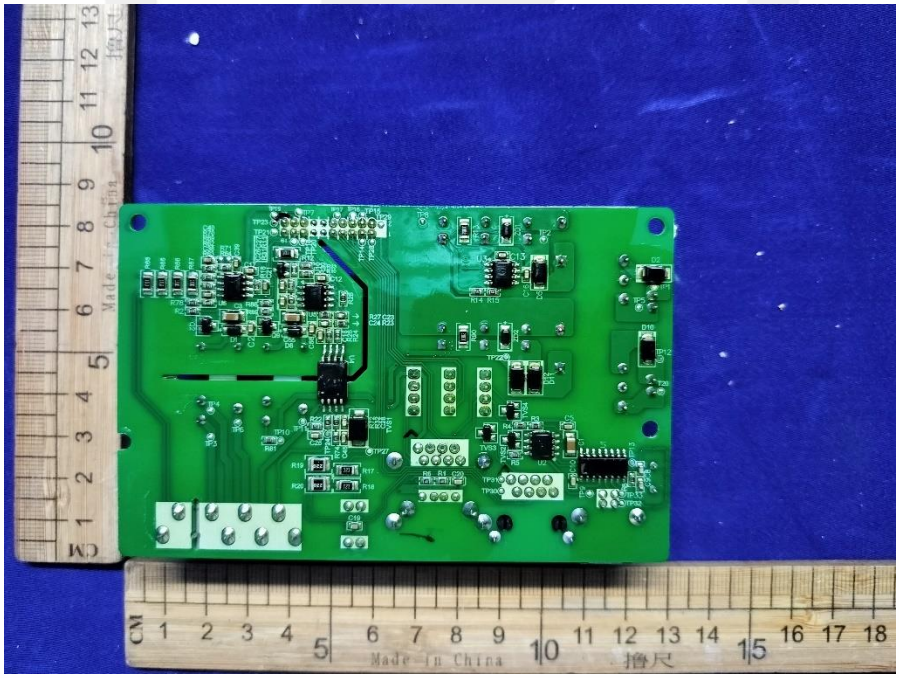
Back view

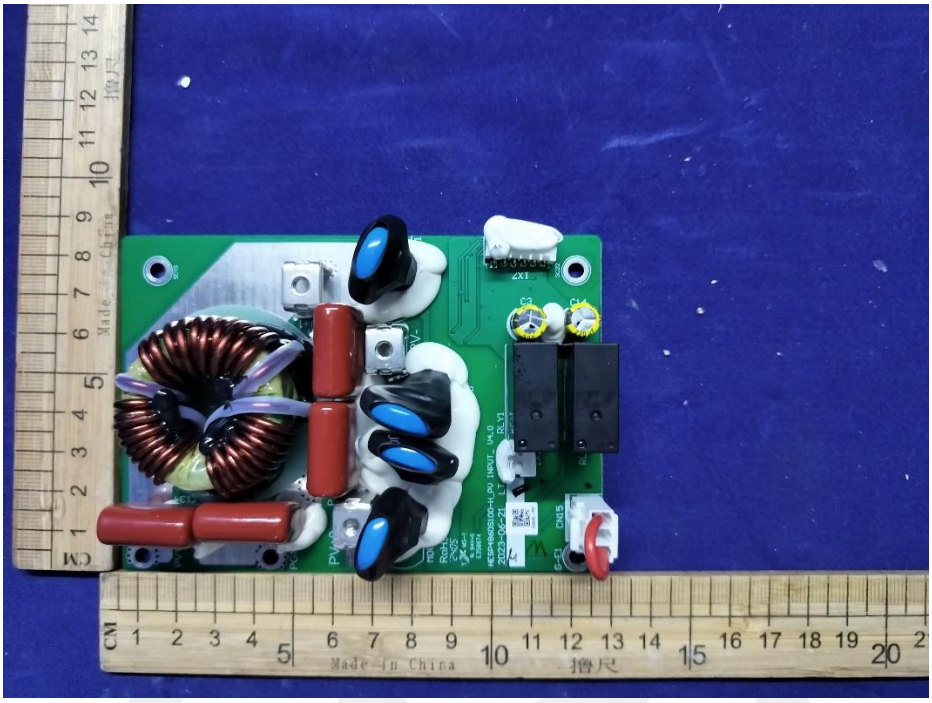
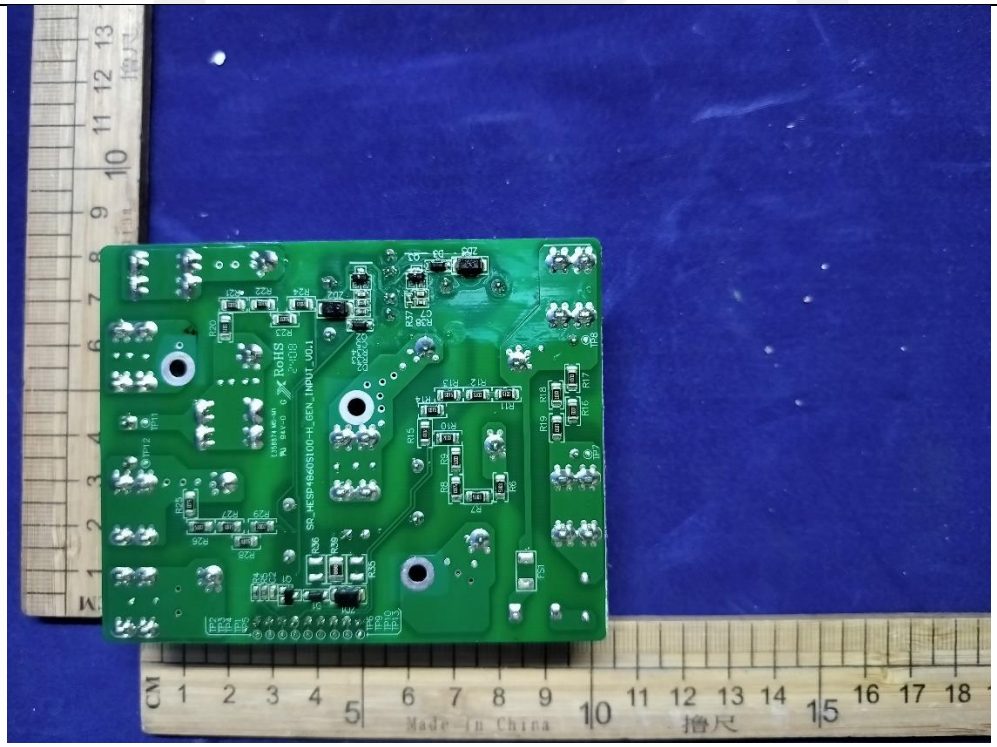
Top view

Picture

PCB view 1

PCB view 2

Picture

LCD view 1

LCD view 2

Picture

Communication board 1

Communication board 2

Picture

PCB view 3

PCB view 4

Picture

PCB view 5

PCB view 6

Equipment of test				
Equipment name	Trade name	Model	S/N	Cal. Due. Date
Power Analyzer	YOKOGAVA	WT3000	EP-011	2025/09/28
Programmable DC Power supply	Kewell	TVS-630kW	EP-027	--
Programmable AC Source	APC	AFG-S-33800	EP-026	--
Programmable RLC Load	Qunling	ACLT-38160H	EP-028	--
Digital oscilloscope	YOKOGAVA	DL850	EP-001	2025/10/06
Differential probe	CYBERTEK	VP5200	EP-003	2025/10/06
Current probe	YOKOGAVA	CT-1000	EP-012	2025/10/06
Current probe	YOKOGAVA	CT-1000	EP-013	2025/10/06
Current probe	YOKOGAVA	CT-1000	EP-014	2025/10/06
Three phase impedance network	Teseq	CCN 1000-3	EE206-1	2025/10/06
Signal conditioning Unit	Teseq/Germany	INA2197/37A	EE206-2	N/A
Three phase impedance network	Teseq/Germany	INA 2196/75A	EE206-3	N/A

Annex IV
Laboratory Accreditation Certificate

China National Accreditation Service for Conformity Assessment

LABORATORY ACCREDITATION CERTIFICATE

(Registration No. CNAS L2291)

EMTEK (Shenzhen) Co., Ltd.

(Legal Entity: EMTEK (Shenzhen) Co., Ltd.)

Building 69, Majialong Industry Zone,

Nanshan District, Shenzhen, Guangdong, China

is accredited in accordance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories(CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence to undertake the service described in the schedule attached to this certificate.

The scope of accreditation is detailed in the attached schedule bearing the same registration number as above. The schedule forms an integral part of this certificate.

Effective Date：2022-10-29

Expiry Date：2028-10-28

Signed on behalf of China National Accreditation Service for Conformity Assessment

China National Accreditation Service for Conformity Assessment (CNAS) is authorized by Certification and Accreditation Administration of the People's Republic of China (CNCA) to operate the national accreditation schemes for conformity assessment. CNAS is a signatory of the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA) and the Asia Pacific Accreditation Cooperation Mutual Recognition Arrangement (APLAC MRA).

The validity of the certificate can be checked on CNAS website at http://www.cnas.org.cn/english/findanaccreditedbody/index.shtml

Finger 3 Laboratory Accreditation Certificate

End of report

声 明
Statement

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This report is invalid without the signature of the authorized approver and "special seal for testing".

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3．本报告的检测结果仅对送测样品有效，委托方对样品的代表性和资料的真实性负责；

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6．对本检验报告若有异议，请于收到报告之日起 20 日内提出。

Objections shall be raised within 20 days from the date receiving the report.