TEST REPORT

EN 50438

Requirements for the connection of micro-generators in parallel with public low-voltage distribution networks

Report reference number ..... :	**PV170113N045**
Date of issue ..... ……..:	2017-03-13
Total number of pages ..... ……..:	162
Testing laboratory name ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
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Applicant's name ..... :	**VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.**
Address ..... :	1-4F, Building 5, YuSheng Industrial Park, No. 467, Section Xixiang, National Highway 107, Xixiang, Bao An District, Shenzhen, China
Test specification	
Standard ..... :	EN 50438:2013
	with deviations according the national network and system protection for Poland
Certificate ..... :	**Certificate of compliance**
Test report form number. ..... :	EN 50438:2013
Master TRF ..... :	Bureau Veritas Consumer Products Services Germany GmbH
Test item description ..... :	**Hybrid Photovoltaic Inverter**
Trademark ..... :	N/A
Model / Type ..... :	InfiniSolar E 5.5KW
Ratings ..... :	See below
Input DC voltage [V] ..... :	120 - 500
MPP DC voltage range [V] ..... :	250-450
Input DC current [A] ..... :	2 * 13,0
Output AC voltage [V] ..... :	230Vac, 50Hz
Output AC current [A] ..... :	Max. 23,9

Ratings..... :	See below.
Output DC voltage range [V]..... : [Battery charge]……..:	40-63Vdc
Input DC current [A] ..... : [Battery charge]……..:	Max.60A
Output DC current [A] ..... : [Battery discharge]……..:	Max. 150A
Output AC voltage [V] ..... :	230Vac, 50Hz
Output AC current [A]..... :	Max. 23,9
Output power [W]..... :	5500

Testing Location ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address..... :	No. 34, Chenwulu Section, Guantai Rd., Houjie Town, Dongguan City, Guangdong 523942, China
Tested by (name and signature)..... :	James Huang 
Approved by (name and signature)..... :	Ted Wu 
Manufacturer's name..... :	**VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.**
Factory address ..... :	1-4F, Building 5, YuSheng Industrial Park, No. 467, Section Xixiang, National Highway 107, Xixiang, Bao An District, Shenzhen, China

Document History

Date	Internal reference	Modification / Change / Status	Revision
2017-03-13	James Huang	Initial report was written	0

Supplementary information:

Test items particulars	
Equipment mobility..... :	Permanent connection
Operating condition..... :	Continuous
Class of equipment..... :	Class I
Protection against ingress of water.. :	IP20 according to EN 60529
Mass of equipment [kg]..... :	16,0

Test case verdicts	
Test case does not apply to the test object..... :	N/A
Test item does meet the requirement..... :	P(ass)
Test item does not meet the requirement..... :	F(ail)

Testing	
Date of receipt of test item..... :	2017-01-13
Date(s) of performance of test..... :	2017-01-13 to 2017-03-09

General remarks:

The test result presented in this report relate only to the object(s) tested. The report shall state compliance of the tested objects with the requirements of EN 50438. This report shall not be reproduced in part or in full without the written approval of the issuing testing laboratory.

”(see Annex #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

This Test Report consists of the following documents:

1. Test Report
   - 4.2. Normal operating range
   - 4.3 / 4.4. Reactive power capability and control modes
   - 4.5. Voltage control by active power
   - 4.6. Interface protection
   - 4.7. Connection and starting to generate electrical power
   - 4.8. Power quality
2. EMC test report – Annex 1
3. Pictures of the unit – Annex 2
4. Test equipment list – Annex 3

Copy of marking plate:

Model No. : INFINISOLAR E 5.5KW

Serial No. : 96131112100001

PV INPUT	Nominal operating voltage 360Vdc
	Vmax PV 500Vdc
	Isc PV 26 A
	MPP voltage 120 – 450Vdc
	MPPT voltage(rated power) 250 - 450Vdc
GRID/AC OUTPUT	Nominal operating voltage 230 Vac
	Maximum output current 23.9A
	Nominal operating frequency 50/60Hz
	Maximum power 5500W
	Power factor range 0.9 lead-0.9lag
AC INPUT	Nominal operating voltage 230 Vac
	Maximum input current 40A
	Nominal operating frequency 50/60Hz
BATTERY	Battery voltage range 40-63Vdc
	Minimum capacity 125Ah
	Maximum battery current 150A

Ambient temperature:-10~+40°C

Enclosure:IP 20

Safety class I

VDE0126-1-1 VDE-AR-N 4105

CE

WARNING:FIRE HAZARD.

SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY

Manufacturer: VOLTRONIC POWER TECHNOLOGY CORP.

General product information:

The Solar converter converts DC voltage into AC voltage.
The Solar converter is a single-phase type and only one machine is allowed on each line conductor.
The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit will also operate in case of one error.

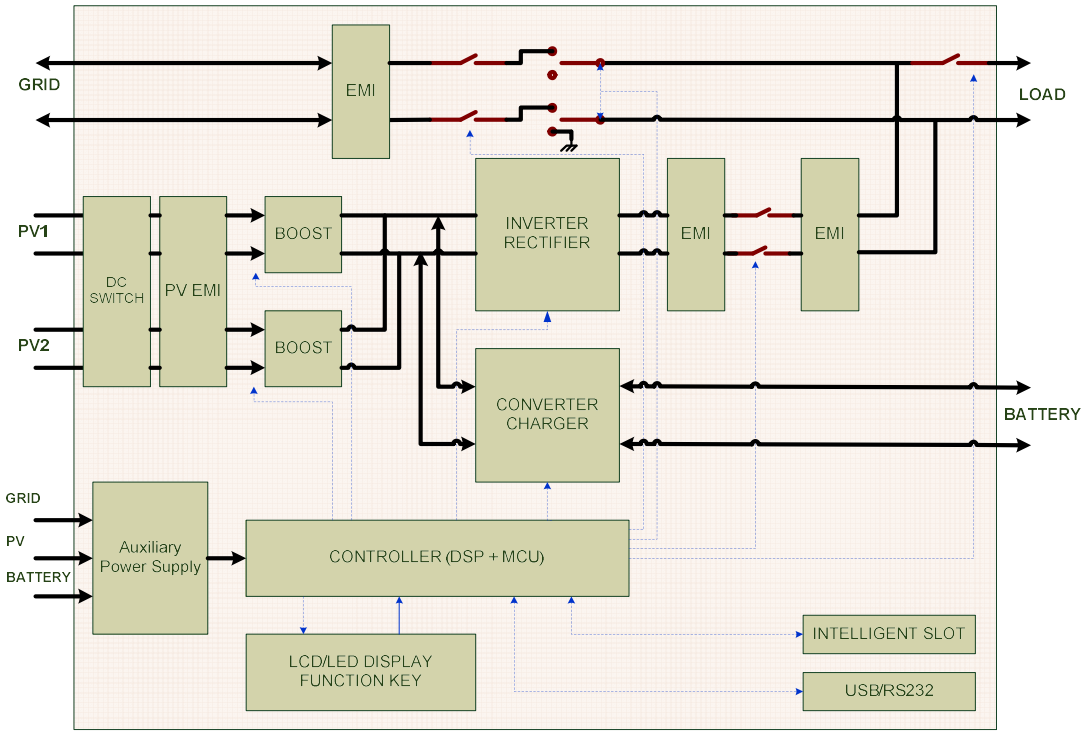

Figure 1-Block diagram

The internal control is redundant built. It consists of Main DSP(U13) and slave CPU(U24).

The Main DSP(U13) can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, In addition it tests the array insulation resistance and the RCMU circuit before each start up.

The slave CPU(U24) is using for sample the grid voltage and residual current, also can open the relays independently and communicate with Main DSP(U13).

The unit provides two relays in series on Line and Neutral conductors. When single-fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before start up. Both controllers(Main DSP(U13), Slave CPU(U24)) can open the relays.

The product was tested on:

Hardware version: 71-500723-00G

Software version: 36-001863-00G

General remarks:

The test results presented in this report relate only to the object(s) tested.
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"(see Annex #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

The following suffixes are used for variables in tables and figures:

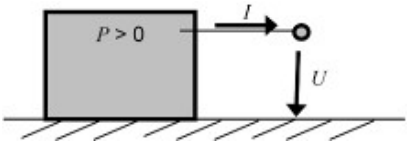
- "P_n" for the nominal active power:

  $P_n = U_n \times I_n \times \cos \varphi_n$ (single-Phase); $P_n = \sqrt{3}\ U_n \times I_n \times \cos \varphi_n$ (three-Phase)
- "P_M" for the momentary power
- "(c)" for over-excited
- "(i)" for under-excited

Active and reactive power:

The regarded system of the voltage and current vectors is the load view (Figure 2):

- If the inverter feeds to the grid the active power is measured with negative sign. For the sake of reading the document the measured active infeed power has a positive sign



- If the inverter consumes inductive reactive power the reactive power is marked "inductive" or has a positive sign.
- If the inverter consumes capacitive reactive power the reactive power is marked "capacitive" or has a negative sign.

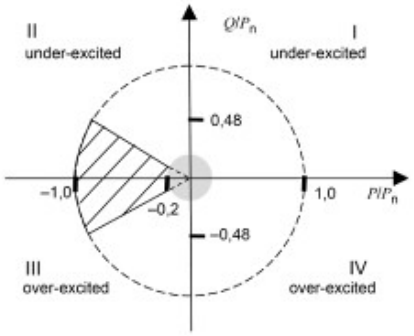


Figure 2

Default interface protection settings according EN 50438:2013:			
Parameter	**Max. disconnection time**	**Min. operate time**	**Trip value**
Over voltage – stage 1 [a]	3 s	-	230V +10% (253 V)
Over voltage – stage 2	0,2 s	0,1 s	230V +15% (264,5 V)
Under voltage	1,5 s	1,2 s	230V -15% (195,5V)
Over frequency	0,5 s	0,3 s	52 Hz
Under frequency	0,5 s	0,3 s	47,5 Hz
Reconnection settings for voltage		$0,85\ U_n \leq U \leq 1,10\ U_n$	
Reconnection settings for frequency		$47,5\ Hz \leq f \leq 50,05\ Hz$	
Reconnection time		≥ 60 s	
Active power gradient after reconnection		10 % P_n / min	
Permanent DC-injection		0,5% of rated inverter output current or 20mA	
Loss of mains according EN 62116		Inverter shall disconnect within 2 s.	
The stated currents and voltages are 'true r.m.s.'-values. The voltages in this table are - phase-to-neutral in 230 V single phase systems and 230/400 V systems, - phase-to-phase in a multiphase 230 V system.			
[a] Over voltage – stage1: 10 min-mean-value corrsponding to EN 50160. Tolerances on trip values: - Voltage: ± 1% of U_n - Frequency: ± 0,05 Hz - Disconnection time : ± 10%			

The following deviations for Poland have been applied according the EN 50438:2013:		
Parameter	**Max. clearance time**	**Trip setting**
Over voltage	0,2s	230V +15% (264,5V)
Under voltage	0,2s	230V -15% (195,5V)
Over frequency	0,2s	50Hz +4% (52,0Hz)
Under frequency	0,2s	50Hz -5% (47,5Hz)

EN 50438:2013, clause 4: Tests			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.2	Normal operating range	D.3.1 / D.3.2 / D.3.3	**P**
4.3 / 4.4	Reactive power capability and control modes	D.3.4	**P**
4.5	Voltage control by active power	D.3.5 (under consideration)	**P**
4.6	Interface protection	Functional safety / D.2.3 / D. 2.4 / D.2.5 / D.3.7	**P**
4.7	Connection and starting to generate electric power	D.3.6	**P**
4.8	Power quality	D.3.8 / D.3.9 / D.3.10	**P**

EN 50438:2013: Interface protection			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.6	Interface protection	Functional safety / D.2.3 / D.2.4 / D.2.5	**P**

4.6.3 Single fault tolerance of the interface protection system			P
	Ambient temperature [°C] .....:	24,2°C	—
	Model/type of power supply .....:	DC: 62150H-1000S AC: AFC-33045T	—
	Manufacturer of power supply.....:	DC: Chroma AC: APC	—
	Rated markings of power supply.....:	DC: 0-1000V, 15A AC: 0-300V, 45KW	—

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500723 Relay defect RY1	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 07 error code(relay fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 Relay defect RY7	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 07 error code(relay fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 Relay defect RY5	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 07 error code(relay fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 Relay defect RY6	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 07 error code(relay fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 PV1 voltage detect R147	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 PV1 voltage detect R148	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 PV1 voltage detect R151	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500723 PV1 voltage detect R152	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 PV2 voltage detect R254	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 PV2 voltage detect R255	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 PV2 voltage detect R253	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 PV2 voltage detect R251	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" PV input is found lost " on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 BUS voltage detect R160t	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 02 error code(BUS voltage under)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 BUS voltage detect R161	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 02 error code(BUS voltage under)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 BUS voltage detect R164	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 02 error code(BUS voltage under)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500723 BUS voltage detect R165	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 02 error code(BUS voltage under)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 Grid voltage detect R15	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 Grid voltage detect R16	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 Grid voltage detect R19	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 Grid voltage detect R20	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 Grid voltage detect R24	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500723 Grid voltage detect R25	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500723 PV ISO detect R264	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV ISO fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 PV ISO detect R266	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 PV ISO detect R261	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 PV ISO detect R265	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 PV ISO detect R258	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 PV ISO detect R257	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500723 PV ISO detect R269	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 Grid voltage detect C185	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 Grid voltage detect R39	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Grid voltage detect R41	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Grid voltage detect C77	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Grid voltage detect IC U13A Pin 1 to Pin 3	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Grid voltage detect C100	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Grid voltage detect R55	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid voltage falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 PV2 voltage detect R98	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 09 error code(PV input voltage exceeds the upper threshold)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 PV2 voltage detect C179	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 09 error code(PV input voltage exceeds the upper threshold)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BUS voltage detect R96	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 02 error code(BUS voltage under)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BUS voltage detect R101	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 02 error code(BUS voltage under)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BUS voltage detect R94	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 01 error code(BUS voltage over)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BUS voltage detect C180	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 01 error code(BUS voltage over)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BUS voltage detect C181	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 01 error code(BUS voltage over)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BUS voltage detect C197 t	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 01 error code(BUS voltage over)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Res R112 detect	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 22 error code(Battery high voltage fault)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 BAT voltage detect C200	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 22 error code(Battery high voltage fault)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BAT voltage detect C206	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 22 error code(Battery high voltage fault)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 BAT voltage detect C201	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 22 error code(Battery high voltage fault)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 PV1 voltage detect R116	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 09 error code(PV input voltage exceeds the upper threshold)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 PV1 voltage detect C205	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 09 error code(PV input voltage exceeds the upper threshold)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 PV1 voltage detect C204	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 09 error code(PV input voltage exceeds the upper threshold)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 PV1 voltage detect C198	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 09 error code(PV input voltage exceeds the upper threshold)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 PV1 voltage detect Diode D34 Pin 2 to Pin 3	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 09 error code(PV input voltage exceeds the upper threshold)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 GFCI detect R106	Open before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 GFCI detect R103	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 GFCI detect C194	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 GFCI detect R325	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 GFCI detect C201	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 GFCI detect C176	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 GFCI detect IC U26 Pin 1 to Pin 2	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 INV current detect R69	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 25 error code(Inverter current too high)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 INV current detect C135	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 25 error code(Inverter current too high)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 INV current detect C137	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 25 error code(Inverter current too high)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 INV current detect C117	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 25 error code(Inverter current too high)" PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 PV ISO detect D37 Pin 1 to Pin 3	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 PV ISO detect D37 Pin 2 to Pin 3	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 PV ISO detect U25 Pin 9 to Pin 10	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 PV ISO detect C154	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 PV ISO detect C27	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 PV ISO detect C156	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection
71-500722 PV ISO detect C177	Short before start-up	230V, 0,5A	480V, 0,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:" 13 error code(PV insulation resistance low fault)" PV inverter does not start-up. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 Frequency detect C55	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect C7	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect U1B Pin 1 to Pin 7	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect D22 Pin 1 to Pin 3	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect D22 Pin 2 to Pin 3	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect C53	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect C54	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 Frequency detect C63	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect U1C Pin 9 to Pin 14	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect D17 detect Pin 2 to Pin 3	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect C40	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect C41	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Frequency detect C42	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Warning message:" Power grid frequency falls below the lower threshold" on remote monitoring software PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Loss of control XL1	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	Error message:"17 error code(Communication with the main and secondary controllers is interrupted) " PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection

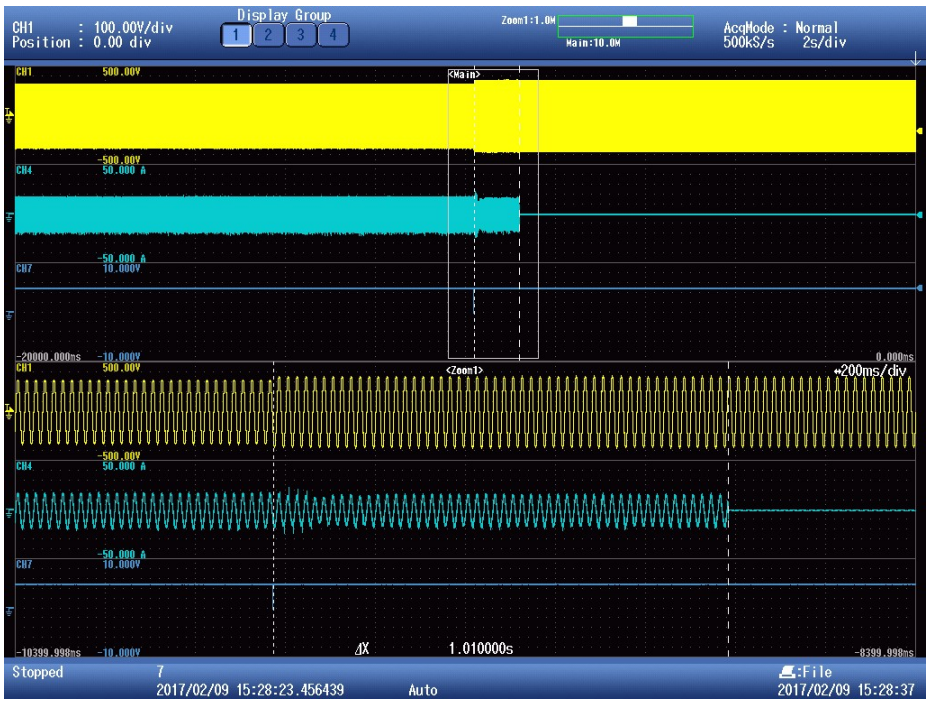
Component No.	Fault	Test condition		Test time	Fuse No.	Fault condition		Result
		AC	DC			AC	DC	
71-500722 Loss of control C112	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Loss of control XL2	Short	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	PV inverter disconnection immediately from grid. Component damage: QA1, QB1, QC1, QD1, no hazard.
71-500722 Loss of control U9 Pin 71	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
71-500722 Loss of control U9 Pin 72	Open	230V, 23,9A	480V, 12,1A	2min	--	230V, 0,5A	480V, 0,1A	PV inverter disconnection immediately from grid. No damage, No hazard, no reconnection
The errors in the control circuit simulate that the safety is even under one error ensured.								
Addendum – Shutdown device								
Each active phase can be switched. (L and N)								Yes
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.								Yes

D.2.3 Interface protection: Over- /under-voltage (default settings) D.3.6.2 Connection after trip of interface protection					P
Test conditions			Output power: 1,8kW Frequency: 50+/-0,2Hz		
Phase	Limit [V]	Trip value [V]	Voltage step [V]	Disconnection time [s]	Limit [s]
L1	110% of Un = 253,0 (stage 1)	252,7	230,0 to 255	1,010	3,0
		253,3	230,0 to 255	1,010	
		252,4	230,0 to 255	1,005	
		252,9	230,0 to 255	1,005	
		253,1	230,0 to 255	1,005	
	115% of Un = 264,5 (stage 2)	263,9	230,0 to 267	0,156	0,1 ≤ t ≤ 0,2
		263,5	230,0 to 267	0,159	
		263,7	230,0 to 267	0,146	
		263,5	230,0 to 267	0,153	
		263,5	230,0 to 267	0,141	
	85% of Un = 195,5	193,5	230,0 to 190	1,213	1,2 ≤ t ≤ 1,5
		193,5	230,0 to 190	1,213	
		193,7	230,0 to 190	1,210	
		193,5	230,0 to 190	1,211	
		193,5	230,0 to 190	1,211	

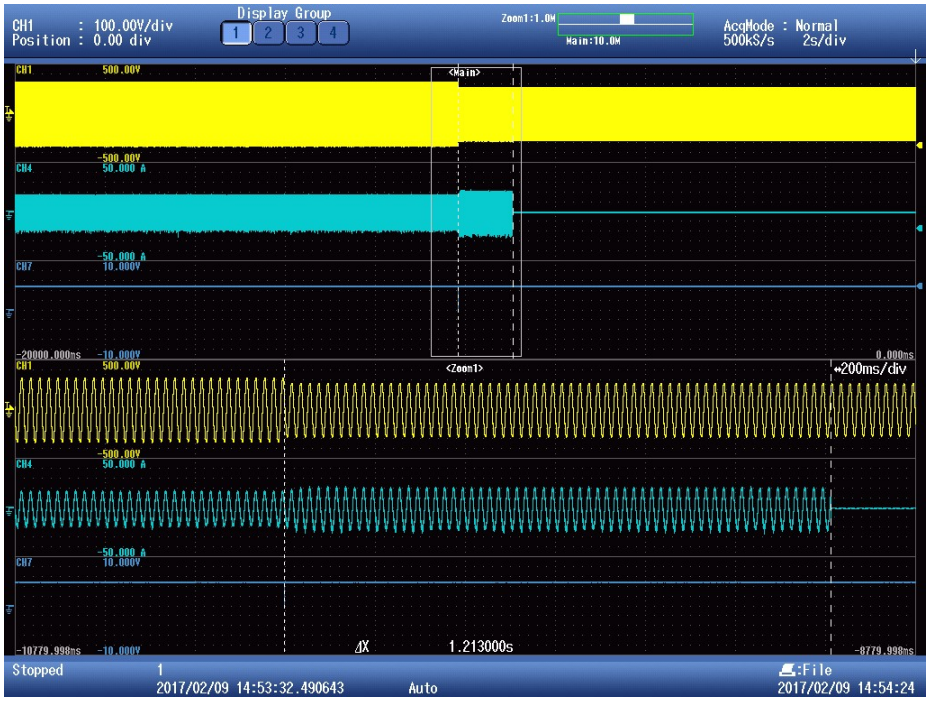
Note:

The trip values were evaluated by varying the applied voltage from U_n down to $U_{th\text{-}low}$ - 2% of U_n in steps of 0,5% of U_n for under-voltage testing as well as from U_n up to $U_{th\text{-}high}$ + 2% of U_n in steps of 0,5% of U_n for over-voltage testing. Lower and upper threshold voltage shall not fall or rise below or above 2,3V of the trip value itself. The disconnection time was measured by application of a negative voltage step from U_n to the operate value - 5% of U_n as well as positive voltage step from U_n to the operate value + 5% of U_n.

Scope pictures of the disconnection time
Over-voltage – stage 1



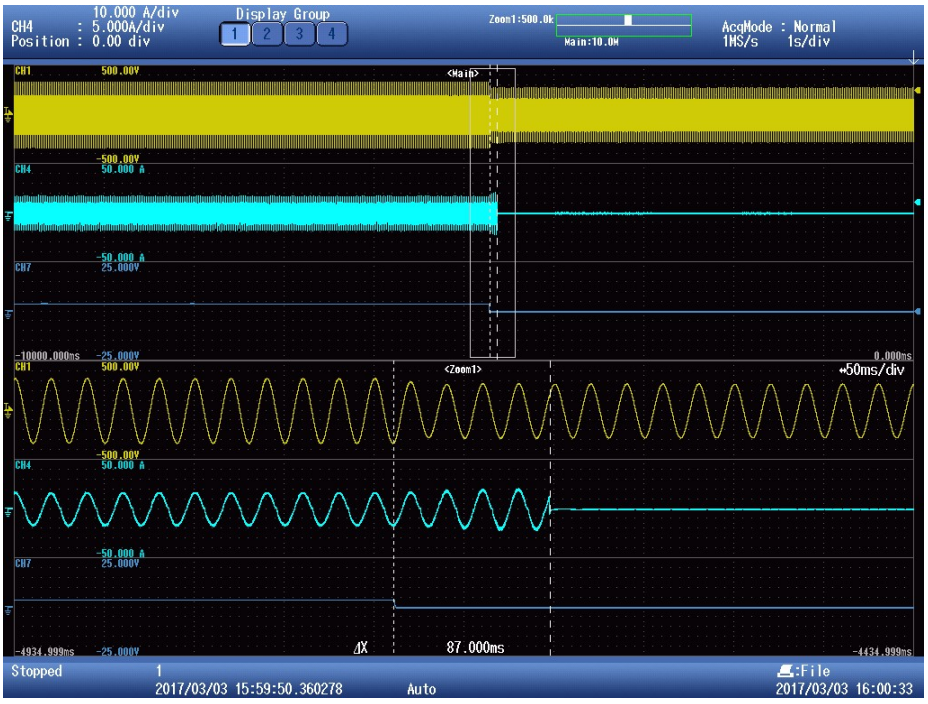
Over-voltage – stage 2

Under-voltage


D.2.3 Interface protection: Over- /under-voltage (Poland settings) D.3.6.2 Connection after trip of interface protection					P
Test conditions			Output power: 1.8kW Frequency: 50+/-0,2Hz		
Phase	Limit [V]	Trip value [V]	Voltage step [V]	Disconnection time [s]	Limit [s]
L1	115% of Un = 264,5	263,9	230,0 to 267	0,156	0,2
		263,5	230,0 to 267	0,159	
		263,7	230,0 to 267	0,146	
		263,5	230,0 to 267	0,153	
		263,5	230,0 to 267	0,141	
	85% of Un = 195,5	194,6	230,0 to 190	0,087	0,2
		194,3	230,0 to 190	0,079	
		194,7	230,0 to 190	0,071	
		194,9	230,0 to 190	0,067	
		194,1	230,0 to 190	0,069	

Note:
The trip values were evaluated by varying the applied voltage from U_n down to $U_{th\text{-}low}$ - 2% of U_n in steps of 0,5% of U_n for under-voltage testing as well as from U_n up to $U_{th\text{-}high}$ + 2% of U_n in steps of 0,5% of U_n for over-voltage testing. Lower and upper threshold voltage shall not fall or rise below or above 2,3V of the trip value itself. The disconnection time was measured by application of a negative voltage step from U_n to the operate value - 5% of U_n as well as positive voltage step from U_n to the operate value + 5% of U_n.

Scope pictures of the disconnection time
Over-voltage

Under-voltage


4.2.2 Over-voltage-stage 1: 10-min-vale corresponding to EN 50160				P
Setting values of the protection:	Trip value Setting [V]	253,0		
	Setting $T_{disconnection\ trip\ value}$ [s]	600		
	Setting $T_{disconnection}$ [ms]	100		
Test:				
		Disconnection time [s]	Limit [s]	
a)	The voltage is set to 100% U_n and held for 600 s. Thereafter the voltage is set to 112% U_n. Disconnection must take place within 600 s.			
	Phase 1:	468 s	600 s	
	Phase 2:	N/A		
	Phase 3:	N/A		
b)	The voltage is set to U_n for 600 s and then to 108% U_n for 600 s. No disconnection should take place.			
	Phase 1:	No disconnection	Disconnection should not take place.	
	Phase 2:	N/A		
	Phase 3:	N/A		
c)	The voltage is set to 106 % U_n and held for 600 s. Thereafter the voltage is set to 114 % U_n. The disconnection should last for half the period as in Point a)*			
	Phase 1:	253 s	300 s	
	Phase 2:	N/A		
	Phase 3:	N/A		

Test:

a) This test serves as proof of the measurement accuracy and the maximum set time.

b) This test serves as proof of the measurement accuracy.

c) This test serves as proof of the correct formation of the 1 minute running mean value.

Assessment criterion:

The permitted tolerance between setting value and trip value of the voltage may not exceed ± 1 % of U_N.

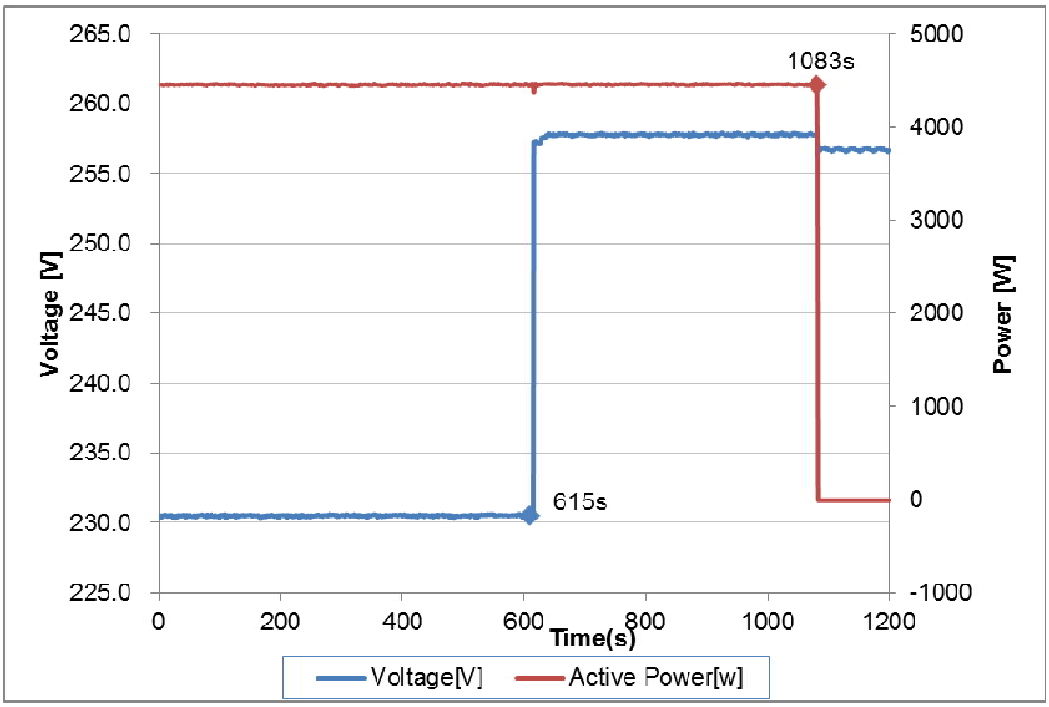
Limit values:

Rise-in voltage protection 1,1 U_N after a max. 60 s, the switch off after 200 ms.

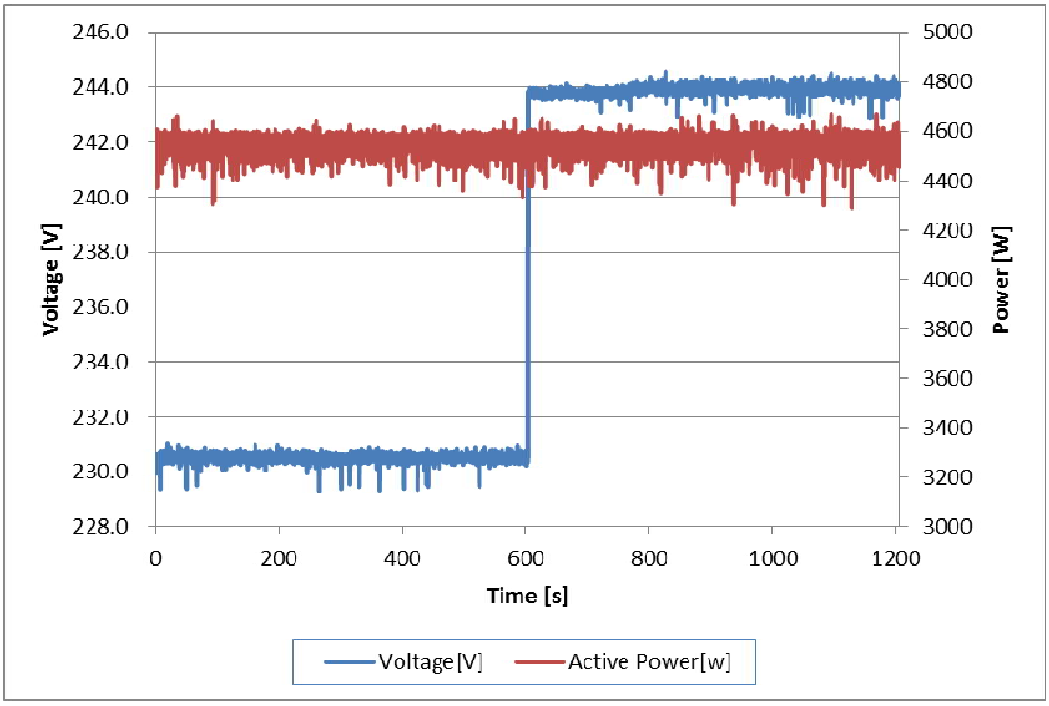
Note:

If only one integrated protection is used for the power generation systems, the value of the rise-in voltage protection of 1,1 U_N may not be changed.

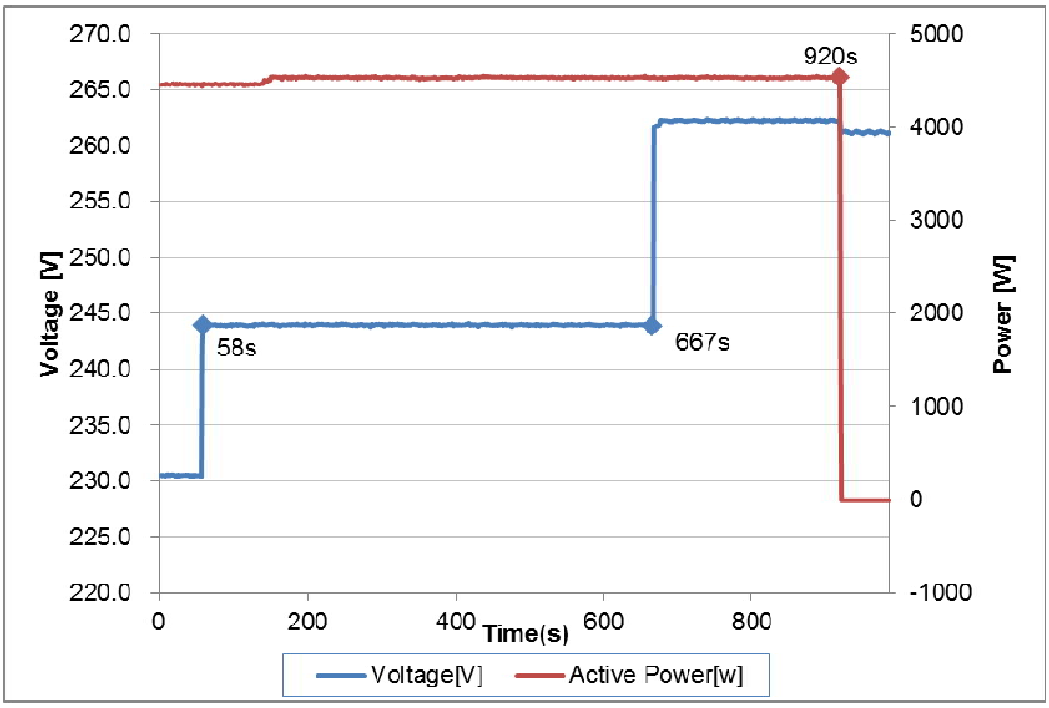
a) 100% to 112% U_n



b) 100% to 108% U_n



c) 100% to 114% U_n



D.2.4 Interface protection: Over- /under-frequency (default settings) **D.3.6.2 Connection after trip of interface protection**					**P**
Test conditions	Output power: 1,8kW U_n = 230Vac				
	Under-frequency		**Over-frequency**		
Parameter	Frequency	Time	Frequency	Time	
Limit	47,50 Hz	0,5 s	52,00 Hz	0,5 s	
Trip value [Hz]	47,48		52,00		
	47,48		52,00		
	47,48		52,00		
	47,48		52,00		
	47,48		52,00		
Disconnection time [s]	50,00Hz to 47,00Hz	0,285	50,00Hz to 52,00Hz	0,350	
		0,310		0,350	
		0,323		0,375	
		0,318		0,330	
		0,300		0,350	

Note:

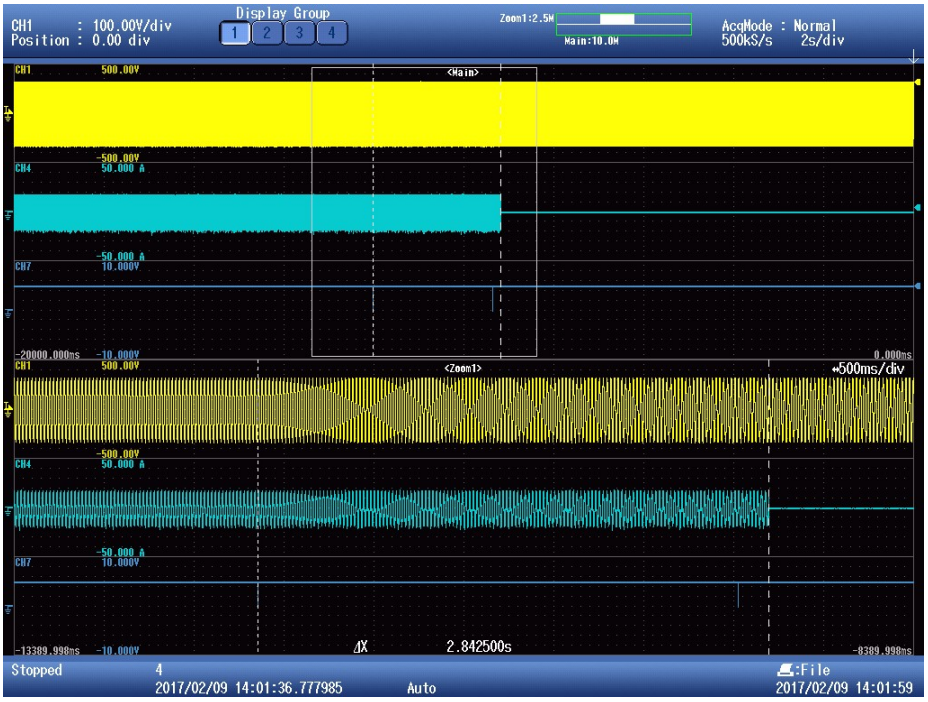
For under-frequency testing the applied frequency is varied from f_n down to $f_{th\text{-}low}$ -0,1 Hz in steps of 0,025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at switch the protection function trips and shall be within $f_{th\text{-}low}$ ± 0,05 Hz.

For over-frequency testing the applied frequency is varied from f_n up to $f_{th\text{-}high}$ + 0,1 Hz in steps of 0,025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at which the protection function trips and shall be within $f_{th\text{-}high}$ ± 0,05 Hz.

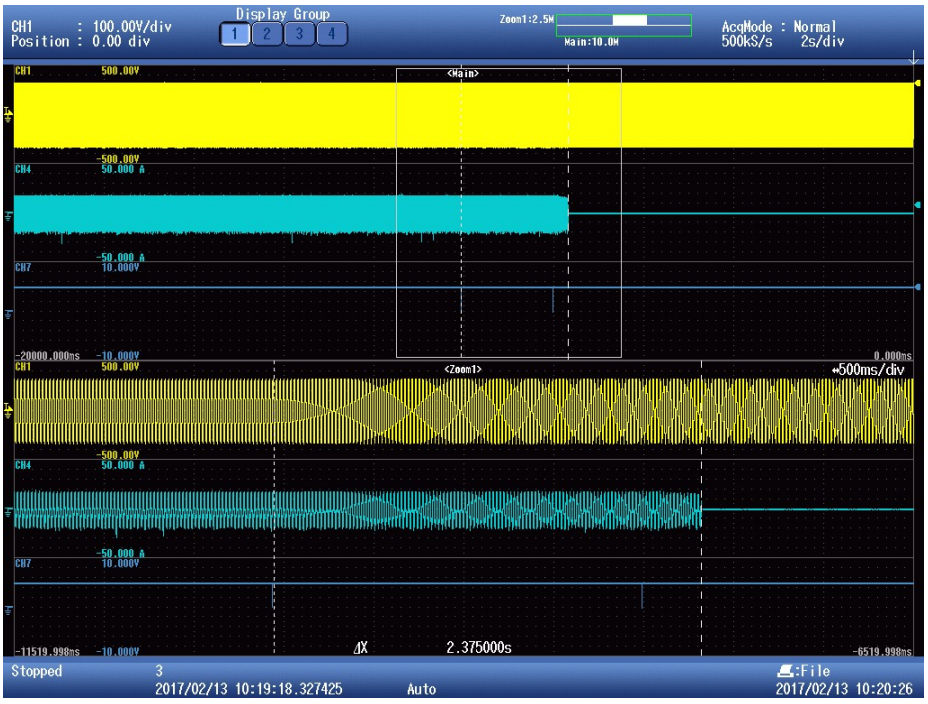
The disconnection time was measured by applying a negative or positive frequency ramp from f_n to the operate value -0,1 Hz or +0,1 Hz, e.g. from 50 Hz to 47,0 Hz. The time elapsed between the application of the frequency ramp and the opening of the interface switch was calculated by the measured time minus the 2520 ms from 50,0 Hz to 47,48 Hz.

The oscilloscope pictures below show the measured worst case disconnection times.

Scope pictures of the disconnection time
Under-frequency



Over-frequency



D.2.4 Interface protection: Over- /under-frequency (Poland settings) D.3.6.2 Connection after trip of interface protection					**P**
Test conditions	Output power: 1,8kW U_n = 230Vac				
	Under-frequency		**Over-frequency**		
Parameter	Frequency	Time	Frequency	Time	
Limit	47,50 Hz	0,5 s	52,00 Hz	0,5 s	
Trip value [Hz]	47,48		52,00		
	47,48		52,00		
	47,48		52,00		
	47,48		52,00		
	47,48		52,00		
Disconnection time [s]	50,00Hz to 47,00Hz	0,285	50,00Hz to 52,00Hz	0,350	
		0,310		0,350	
		0,323		0,375	
		0,318		0,330	
		0,300		0,350	

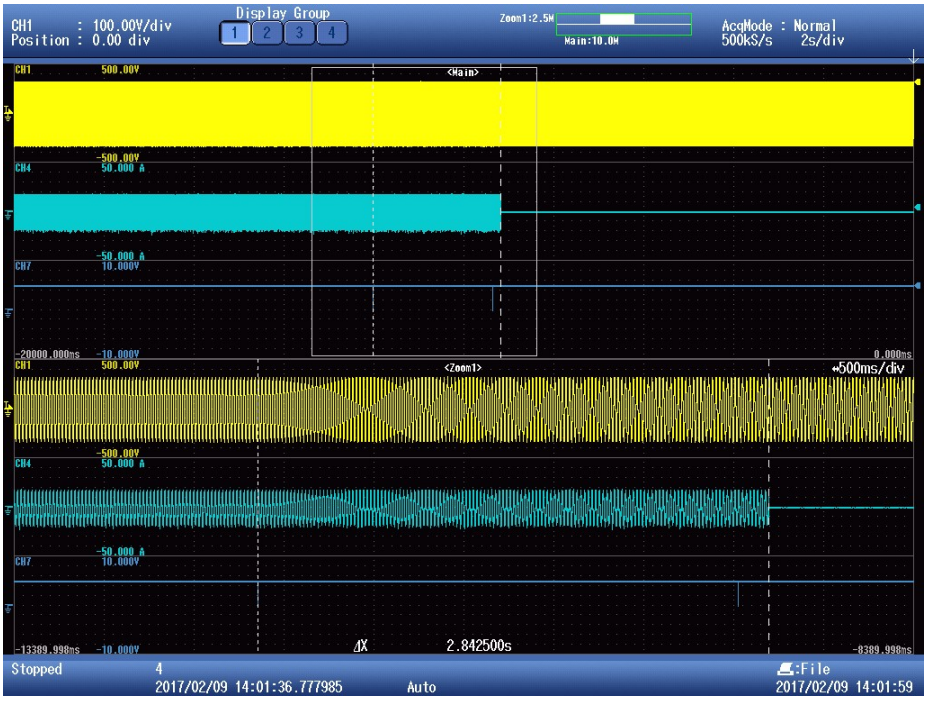
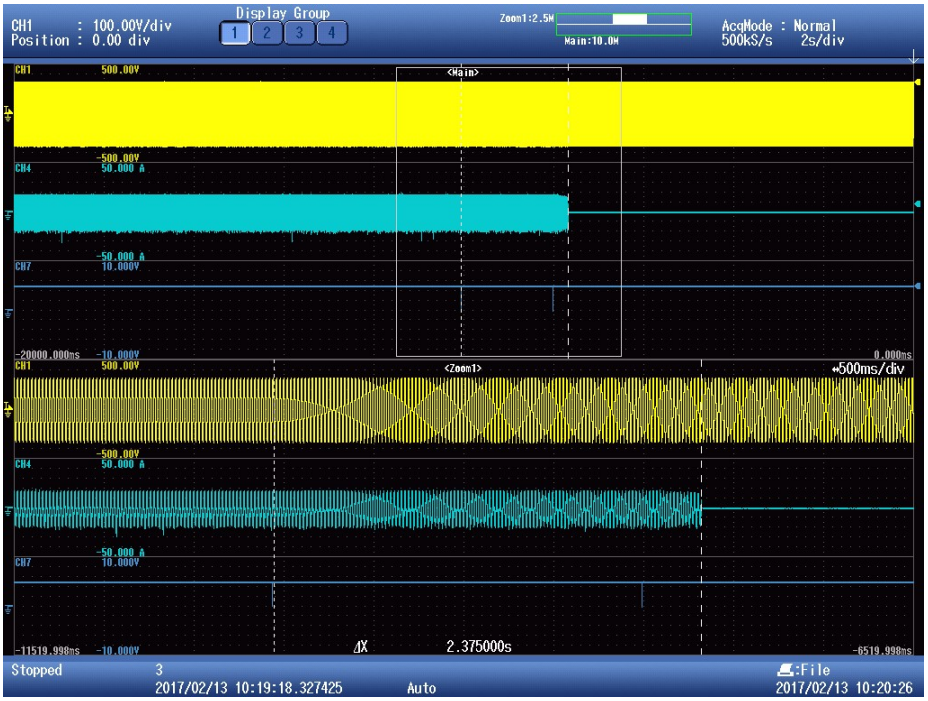
Note:

For under-frequency testing the applied frequency is varied from f_n down to $f_{th\text{-}low}$ -0,1 Hz in steps of 0,025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at switch the protection function trips and shall be within $f_{th\text{-}low}$ ± 0,05 Hz.

For over-frequency testing the applied frequency is varied from f_n up to $f_{th\text{-}high}$ + 0,1 Hz in steps of 0,025 Hz with a time duration per step exceeding the configured disconnection time. The operate value is the value of the applied frequency at which the protection function trips and shall be within $f_{th\text{-}high}$ ± 0,05 Hz.

The disconnection time was measured by applying a negative or positive frequency ramp from f_n to the operate value -0,1 Hz or +0,1 Hz, e.g. from 50 Hz to 47,0 Hz. The time elapsed between the application of the frequency ramp and the opening of the interface switch was calculated by the measured time minus the 2520 ms from 50,0 Hz to 47,48 Hz.

This function has to operate at least in the range of maximum trip settings of voltage.

Scope pictures of the disconnection time
Under-frequency

Over-frequency


D.2.5 Loss of Mains (LoM) detection

Test circuit and parameters

Parameter	Symbol	Units
EUT DC Input		
DC voltage	V_{DC}	V
DC Current	I_{DC}	A
DC Power	P_{DC}	W
EUT AC ouput		
AC voltage	V_{EUT}	V
AC current	I_{EUT}	A
Real power	P_{EUT}	W
Reactive power	Q_{EUT}	VAr
Test Load		
Resistive load current	I_R	A
Inductive load current	I_L	A
Capacitive load current	I_C	A
AC (utility) power source		
Utility real power	P_{AC}	W
Utility reactive power	Q_{AC}	VAr
Utility current	I_{AC}	A

Block diagram test circuit IEC 62116:2014

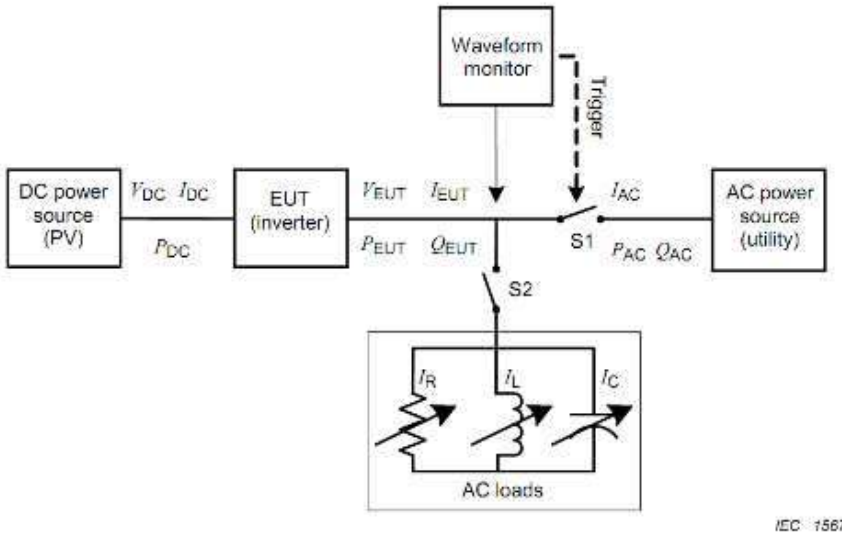


Figure 1 – Test circuit for islanding detection function in a power conditioner (inverter)

Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)	**P**

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} [1)] [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} [2)] [% of nominal]	Q_{AC} [3)] [% of nominal]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks [5)]
1	100	100	0	0	5489	330	1,005	348	BL
8	100	100	-5	-5	5489	330	1,032	111	IB
9	100	100	-5	0	5489	330	1,058	196	IB
10	100	100	-5	+5	5489	330	1,085	142	IB
13	100	100	0	-5	5489	330	0,980	89	IB
14	100	100	0	+5	5489	330	1,030	115	IB
17	100	100	+5	-5	5489	330	0,933	216	IB
18	100	100	+5	0	5489	330	0,958	107	IB
19	100	100	+5	+5	5489	330	0,981	123	IB

Parameter at 0% per phase	L= 30,47mH	R= 9,64Ω	C= 331,67µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
[1)] P_{EUT}: EUT output power
[2)] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[3)] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[5)] BL: Balance condition, IB: Imbalance condition.

Condition A:
EUT output power PEUT = Maximum [6)]
EUT input voltage [6)] = >75% of rated input voltage range

[6)] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
[7)] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 75 % of range =X + 0,75 × (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.

Scope pictures of the disconnection time
Disconnection at No. 1

Fundamental of I_{AC} at balance condition = 81mA

Note:

Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	P

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} [1)] [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} [2)] [% of nominal]	Q_{AC} [3)] [% of nominal]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks [5)]
1	66	66	0	-5	3460	260	0,983	113	IB
2	66	66	0	-4	3460	260	0,989	140	IB
3	66	66	0	-3	3460	260	0,994	421	IB
4	66	66	0	-2	3460	260	0,999	441	IB
5	66	66	0	-1	3460	260	1,004	253	IB
6	66	66	0	0	3460	260	1,009	264	BL
7	66	66	0	1	3460	260	1,014	381	IB
8	66	66	0	2	3460	260	1,019	227	IB
9	66	66	0	3	3460	260	1,024	294	IB
10	66	66	0	4	3460	260	1,029	158	IB
11	66	66	0	5	3460	260	1,034	90	IB

Parameter at 0% per phase	L=48,15mH	R= 15,29Ω	C= 209,70µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
[1)] P_{EUT}: EUT output power
[2)] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[3)] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[4)] Fundamental of I_{AC} when RLC is adjusted
[5)] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power P_{EUT} = 50 % – 66 % of maximum
EUT input voltage [6)] = 50 % of rated input voltage range, ±10 %
[6)] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 50 % of range =X + 0,5 × (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.

Scope pictures of the disconnection time
Disconnection at No. 4

Fundamental of I_{AC} at balance condition = 121mA

Note:

Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	P

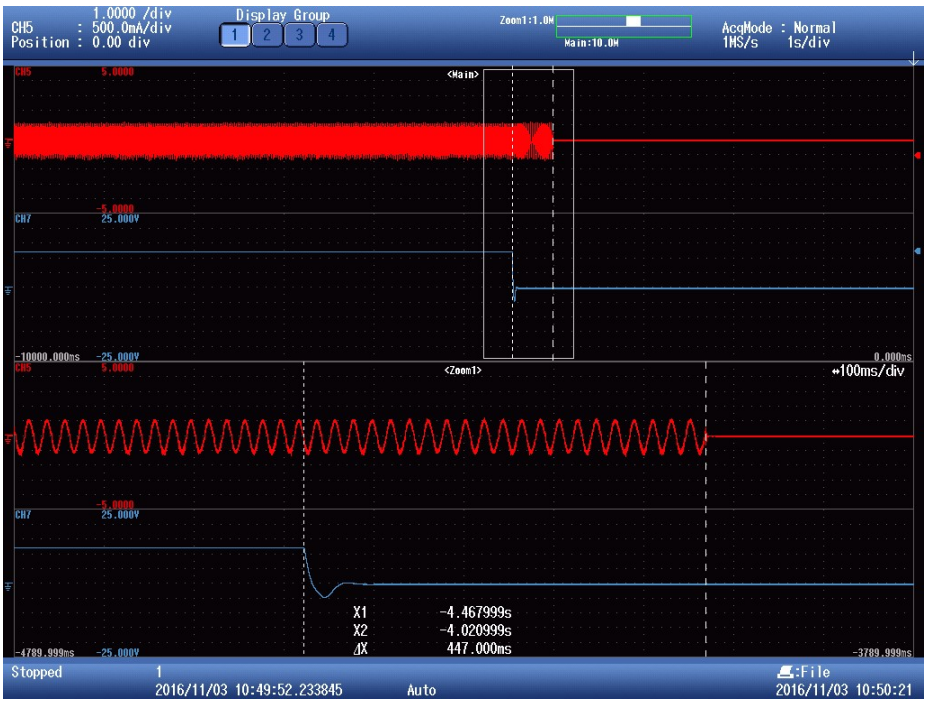
Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} [1] [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks [5]
1	33	33	0	-5	1655	176	0,984	104	IB
2	33	33	0	-4	1655	176	0,989	107	IB
3	33	33	0	-3	1655	176	0,994	121	IB
4	33	33	0	-2	1655	176	0,999	231	IB
5	33	33	0	-1	1655	176	1,004	447	IB
6	33	33	0	0	1655	176	1,009	285	BL
7	33	33	0	1	1655	176	1,014	384	IB
8	33	33	0	2	1655	176	1,019	337	IB
9	33	33	0	3	1655	176	1,024	145	IB
10	33	33	0	4	1655	176	1,029	230	IB
11	33	33	0	5	1655	176	1,034	174	IB

Parameter at 0% per phase	L= 100,47mH	R= 31,96Ω	C= 100,19µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
[1] P_{EUT}: EUT output power
[2] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[3] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[4] Fundamental of I_{AC} when RLC is adjusted
[5] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 25 % – 33 % [6] of maximum
EUT input voltage [7] = <20 % of rated input voltage range
[6] Or minimum allowable EUT output level if greater than 33 %.
[7] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 20 % of range =X + 0,2 × (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.

Scope pictures of the disconnection time
Disconnection at No. 5



Fundamental of I_{AC} at balance condition = 92mA

Note:

EN 50438:2013: Normal operating range			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.2	Normal operating range	D.3.1 / D.3.2 / D.3.3	**P**

D.3.1 Operating range			P
Setting values	Over-voltage [V]:	264,5	
	Under-voltage [V]:	195,5	
	Over-frequency [Hz]:	52,00	
	Under-frequency [Hz]:	47,50	

- Test 1: U = 195,5 V; f = 47,5 Hz; P = 1,00 Sn; cosφ = 1
- Test 2: U = 253,0 V; f = 51,5 Hz; P = 1,00 Sn; cosφ = 1

Test sequence	Voltage [V]	Frequency [Hz]	Output power [kW]	Cos φ [1]
1	197,09	47,55	5,455	0,9999
2	252,94	51,50	5,493	0,9999

Note:

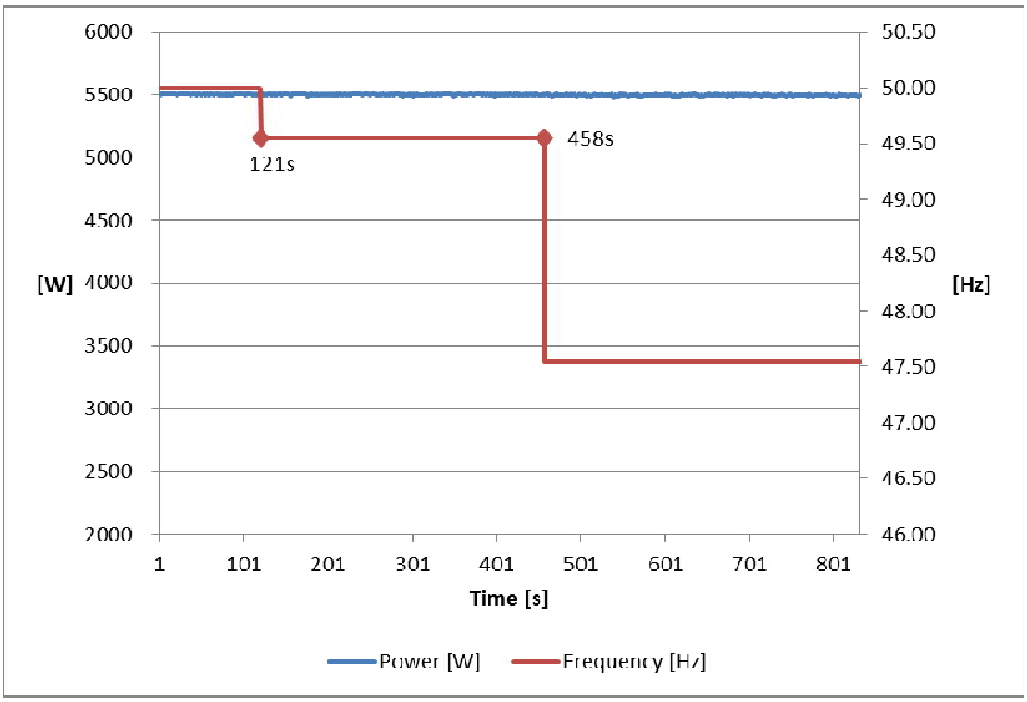
During the tests the interface protection was disabled.

Operation at reduced power is allowed during test 1, equal to the maximum power that can be supplied on reaching the maximum output current limit (P ≥ 0,85 Sn).

During the sequence of test 2, automatic adjustment to reduce power in the case of over-frequency was disabled.

D.3.2 Active power feed-in for under-frequency	P

Graph of frequency a) to b) to c):



Test:

	Switch to:		
5-min mean value (each)	a) 50 ± 0,01 [Hz]	b) - 0,4 to – 0,5 [Hz]	c) - 2,4 to - 2,5 [Hz]
Frequency [Hz]:	50,00	49,55	47,55
Active power [kW]:	5,507	5,504	5,499
$\Delta P/P_M$ [%] per 1 Hz:			0,02

Test:

Operating points b) and c) must be kept for at least 5 minutes.

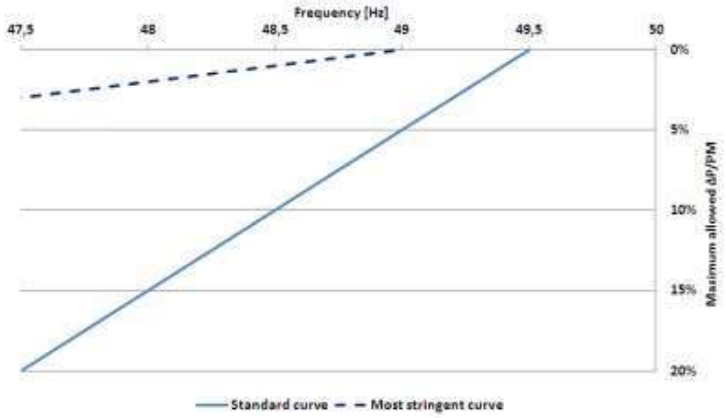
The test must be carried out at 100% P_n.

With a programmable AC source, the PGU is operated at 100% P_n and 50 ± 0,01 Hz, thereafter the frequency is reduced by 1 Hz/min. to - 0,4 to – 0,5 Hz and in addition to - 2,4 to - 2,5 Hz. A 5-min mean value is recorded both before and after the frequency change.

Assessment criterion:

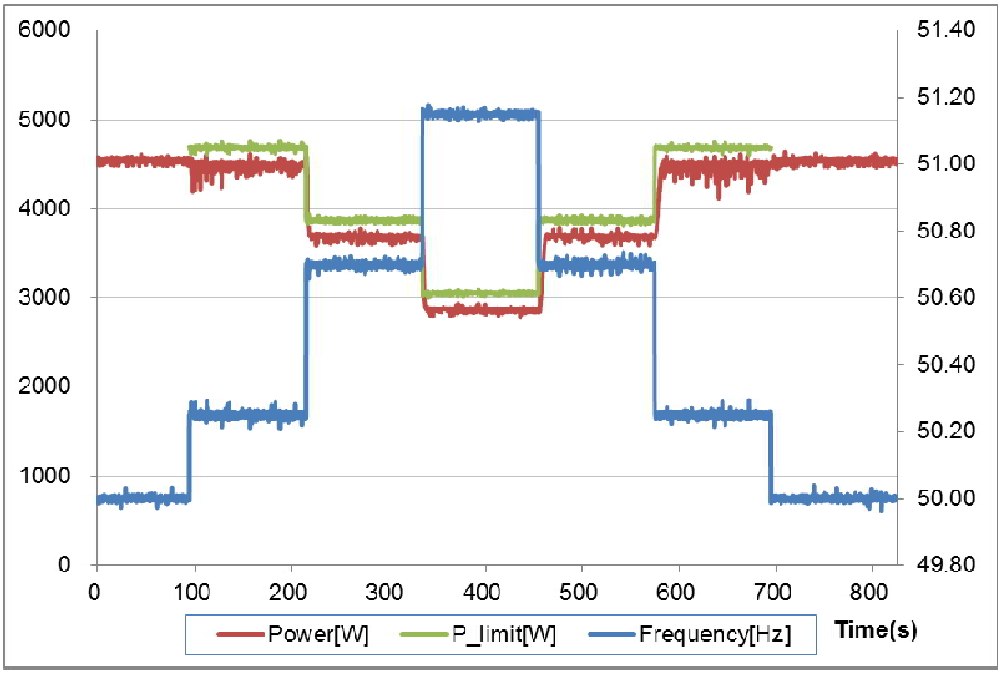
The test is passed when the micro-generator

- does not disconnect from the network on a network frequency change at the operating points a) to c),
- continues to feed in 100% P_n in b) and
- the power reduction in point c) is less or equal to the power reduction of 10 % P_M per 1 Hz drop.

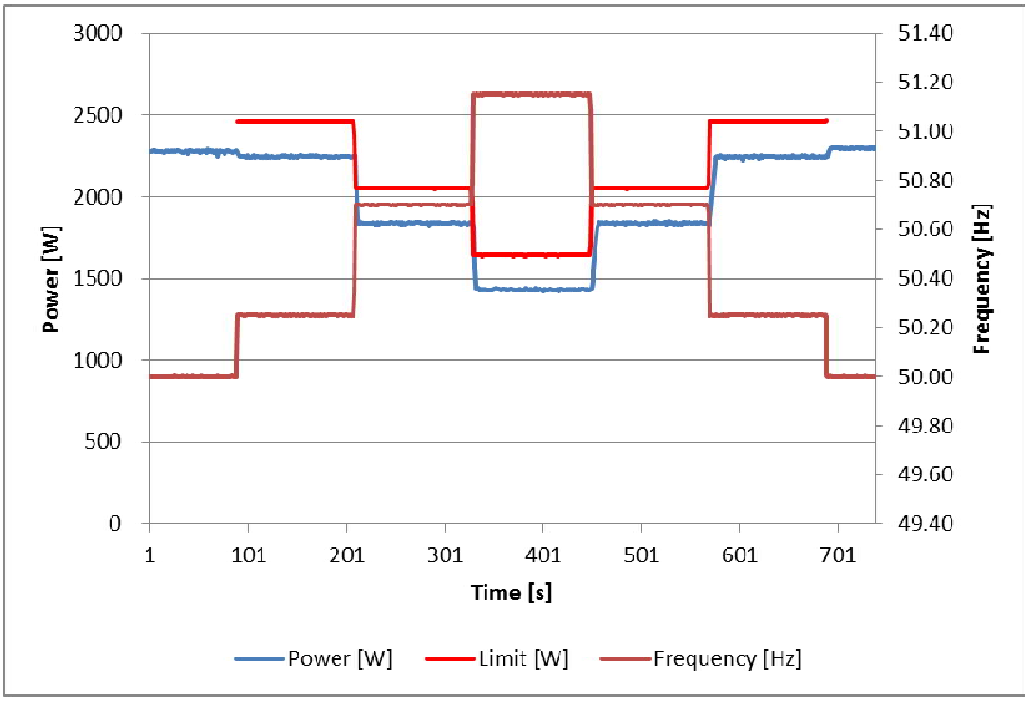


Maximum allowable power reduction in case of under-frequency

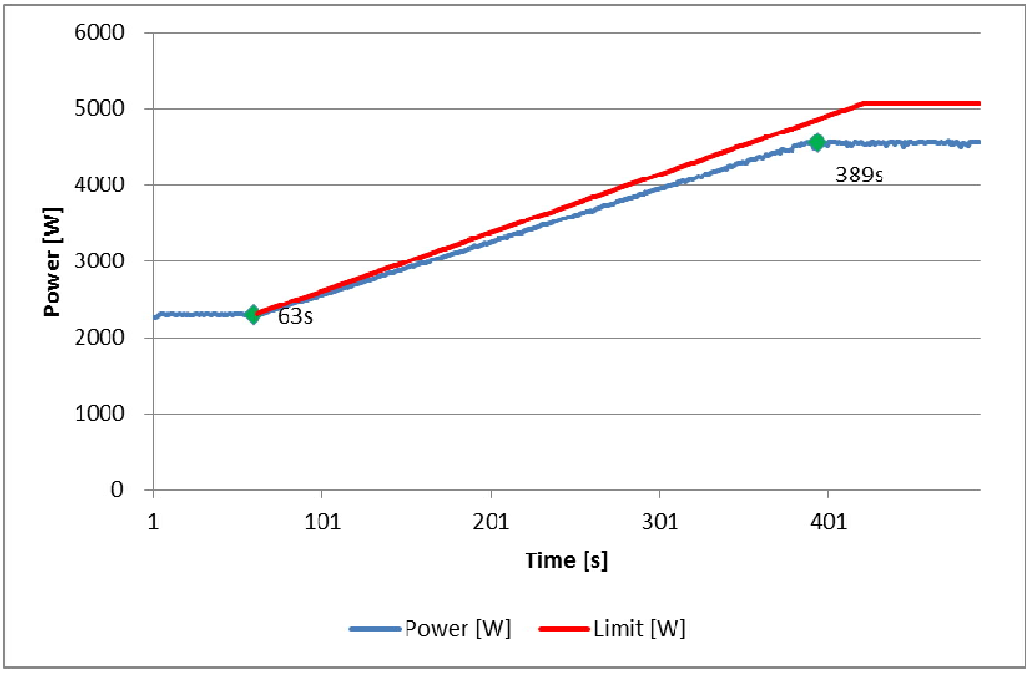
D.3.3 Power response to over-frequency							P
Test:							
1-min mean value [Hz]:	a) 50,00	b) 50,25	c) 50,70	d) 51,15	e) 50,70	f) 50,25	g) 50,00
1. Measurement a) to g): Active power output > 80% P_n							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
P_M [kW]:	N/A	4,459	3,641	2,822	3,641	4,460	N/A
P_{E60} [kW]:	4,550	4,481	3,706	2,872	3,689	4,438	4,542
$\Delta P_{E60}/P_M$ [%]:	N/A	0,46	1,40	1,09	1,05	-0,48	N/A
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_n							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	N/A
P_M [kW]:	N/A	2,232	1,822	1,412	1,822	2,232	N/A
P_{E60} [kW]:	2,277	2,246	1,840	1,433	1,827	2,230	N/A
$\Delta P_{E60}/P_M$ [%]:	N/A	0,30	0,40	0,45	0,12	-0,05	N/A
Limit $\Delta P/P_{1min}$:	+ 10 % of P_M						
Graph of Measurement 1.: Active power output > 80% P_n							



Graph of Measurement 2.:Active power output 40% and 60% after freezing > 80% P_n



Graph of power gradient:



Test:

The test is conducted for two powers. First, the test must start at a power > 80% P_n ("Measurement 1"), and in a second test, for a power between 40% to 60% P_n ("Measurement 2"). In the second test, after freezing of the P_M, the available active power output must be increased to a value > 80% P_n, and after the network frequency of 50,2 Hz is fallen below, the rise of the active power gradient must be recorded.

Point g) must be held until the micro-generator is again feeding in with the active power output available.

Assessment criterion:

For f = 50,2 Hz, the value of the P_M active power currently being generated is "frozen".

a) For adjustable micro-generators when:

1) the active power reduces between measuring points b) and f) given above with the set gradient P_M per Hz for a increasing frequency (or rises for a frequency decreasing again).

2) the maximum active power gradient occurring in point is less than the configured maximum active power per minute

3) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_n by more than ± 10%.

4) the settling time is equal or below 2 s with an intentional delay set to zero

b) For partly adjustable micro-generators

1) when they behave as in a) within their adjustment range, and

2) when, outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51,5 Hz.

EN 50438:2013: Reactive power output capability			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.3 / 4.4	Reactive power capability and control modes	D.3.4	**P**

D.3.4.1 Test of no controllable reactive power			P
Test voltage / Output power	211,6 V	230 V	248,4 V
25% P_N	0,9911c	0,9900c	0,9874c
50% P_N	0,9960c	0,9959c	0,9948c
75% P_N	0,9977c	0,9976c	0,9969c
100% P_N	0,9986c	0,9985c	0,9980c
Limit:	>0,95	>0,95	>0,95

Note:

When operating at the 25%, 50%, 75% and 100% rated power the micro-generator operates at a power factor within the range 0.95 lagging to 0.95 leading relative to the voltage waveform.

D.3.4.2.1 Test of controllable reactive power				P
Inductive supply reactive power				
Rating power (%)	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	DC power [kW]
0% -10%	0,510	-0,170	0,9480	0,587
10% -20%	1,071	-0,504	0,9048	1,176
20% -30%	1,642	-0,762	0,9069	1,779
30% -40%	2,181	-1,028	0,9044	2,354
40% -50%	2,727	-1,256	0,9082	2,942
50% -60%	3,285	-1,537	0,9056	3,554
60% -70%	3,826	-1,801	0,9047	4,157
70% -80%	4,370	-2,060	0,9044	4,730
80% -90%	4,835	-2,355	0,8989	5,251
90% -100%	4,834	-2,361	0,8984	5,252
Capacitive supply reactive power				
Rating power (%)	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	DC power [kW]
0% -10%	0,512	0,301	0,8615	0,586
10% -20%	1,076	0,499	0,9073	1,177
20% -30%	1,634	0,769	0,9048	1,766
30% -40%	2,188	1,023	0,9058	2,355
40% -50%	2,732	1,300	0,9029	2,944
50% -60%	3,286	1,566	0,9028	3,551
60% -70%	3,834	1,811	0,9042	4,145
70% -80%	4,377	2,059	0,9049	4,730
80% -90%	4,916	2,290	0,9065	5,320
90% -100%	4,936	2,269	0,9086	5,342
Cos phi=1 no reactive power supply				
Rating power (%)	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	DC power [kW]
0% -10%	0,515	0,117	0,9749	0,587
10% -20%	1,076	0,044	0,9990	1,177
20% -30%	1,637	0,080	0,9987	1,767
30% -40%	2,193	0,087	0,9991	2,356
40% -50%	2,716	0,110	0,9991	2,916
50% -60%	3,291	0,093	0,9995	3,545
60% -70%	3,840	0,073	0,9997	4,133
70% -80%	4,381	0,124	0,9995	4,715
80% -90%	4,916	0,112	0,9997	5,296
90% -100%	5,495	0,107	0,9997	5,927

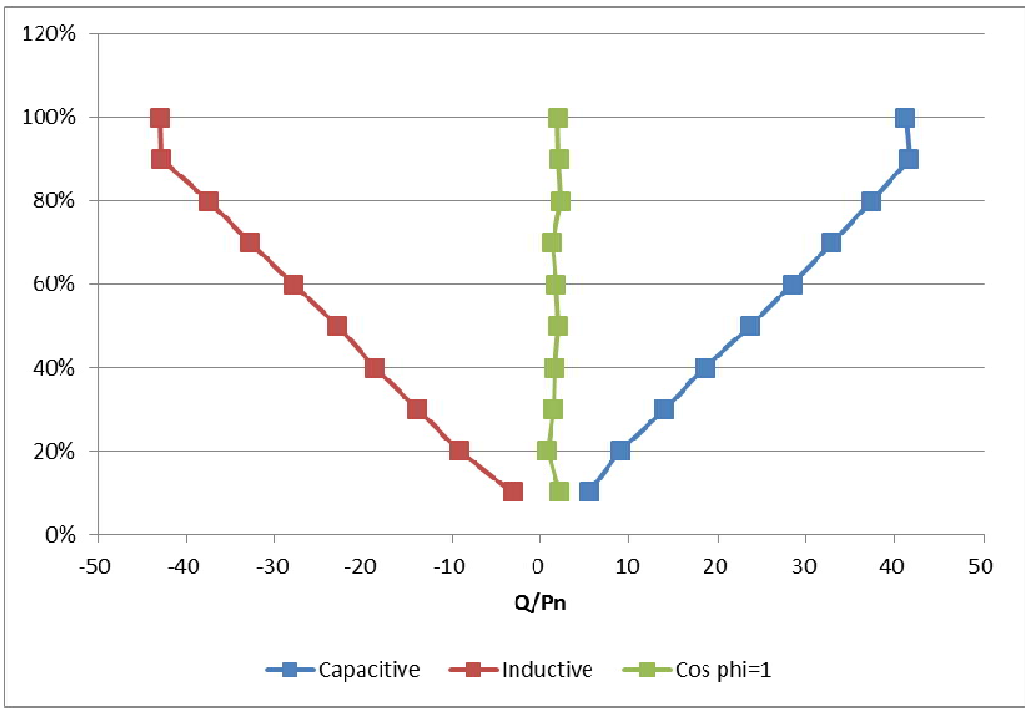
Assessment criterion:

The power factor resulting in each of the measurement points between 20 % and 90 % of the nominal power is equal to or lower than 0,90 both in over excited and under excited operation.

Note:

a) 1 min-average-values were calculated using measurements at the basic frequency in a period of 200 ms.
b) For each of the 10 active power levels, at least 3 under excited and 3 over excited reactive power levels were recorded.
c) 1 min-average-values were calculated using voltage measurements at the basic frequency in a period of 200 ms.

Diagram


120%
100%
80%
60%
40%
20%
0%
-50
-40
-30
-20
-10
0
10
20
30
40
50
Q/Pn
Capacitive
Inductive
Cos phi=1

D.3.4.2.1 Test of controllable reactive power (Alternative)	P

Test result:

Inductive reactive power absorbation

Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	DC power [kW]
0% -10%	0,447	-2,435	0,1804	0,559
10% -20%	1,074	-2,471	0,3986	1,221
20% -30%	1,647	-2,439	0,5597	1,819
30% -40%	2,187	-2,418	0,6708	2,389
40% -50%	2,752	-2,402	0,7533	2,988
50% -60%	3,313	-2,469	0,8017	3,580
60% -70%	3,874	-2,430	0,8471	4,181
70% -80%	4,409	-2,435	0,8753	4,752
80% -90%	5,003	-2,471	0,8966	5,407
90% -100%	4,924	-2,481	0,8927	5,323

Capacitive reactive power supply

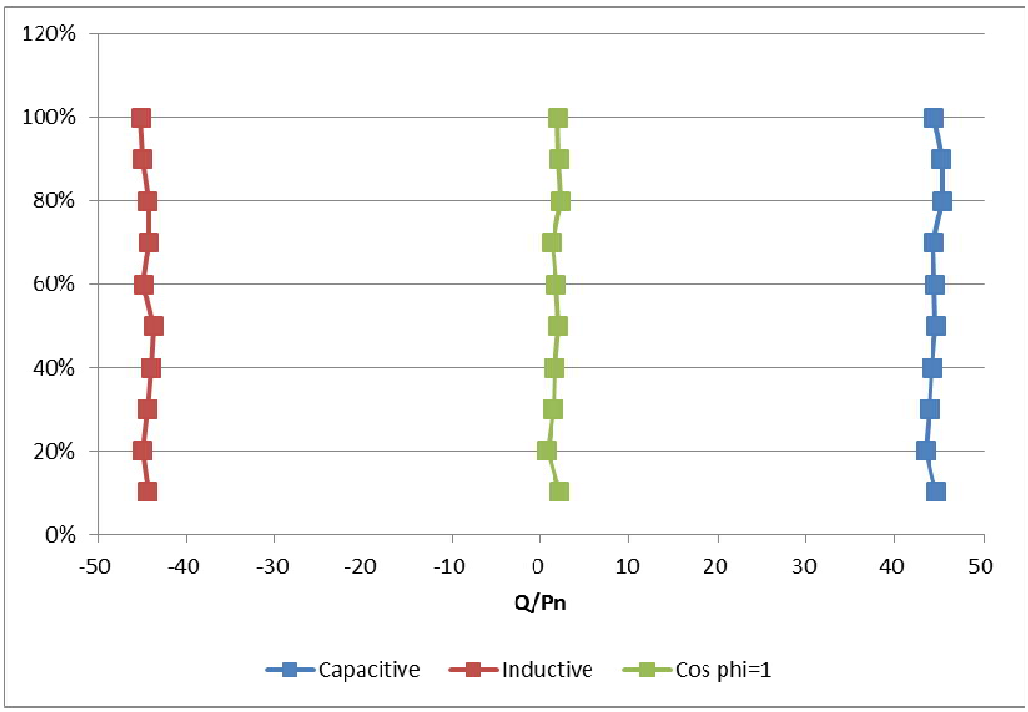
Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	DC power [kW]
0% -10%	0,457	2,454	0,1833	0,562
10% -20%	1,064	2,395	0,4060	1,190
20% -30%	1,635	2,418	0,5601	1,790
30% -40%	2,194	2,431	0,6699	2,390
40% -50%	2,977	2,455	0,7715	3,213
50% -60%	3,307	2,447	0,8039	3,566
60% -70%	3,877	2,438	0,8466	4,174
70% -80%	4,413	2,497	0,8703	4,755
80% -90%	4,948	2,493	0,8931	5,335
90% -100%	4,967	2,442	0,8974	5,352

Reactive power supply with set point Q=0

Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	DC power [kW]
0% -10%	0,515	0,117	0,9749	0,587
10% -20%	1,076	0,044	0,9990	1,177
20% -30%	1,637	0,080	0,9987	1,767
30% -40%	2,193	0,087	0,9991	2,356
40% -50%	2,716	0,110	0,9991	2,916
50% -60%	3,291	0,093	0,9995	3,545
60% -70%	3,840	0,073	0,9997	4,133
70% -80%	4,381	0,124	0,9995	4,715
80% -90%	4,916	0,112	0,9997	5,296
90% -100%	5,495	0,107	0,9997	5,927

Note:
The minimum of Q cannot be less than 43,6% of the total output power.

Diagram of reactive power absorption



D.3.4.2.5 Procedures for performing tests and recording results (Q adjustment)	P

Test: 100%P_n

	Reactive power set point Q [kVar]	Measured reactive power Q [kVar]	Measured cos φ	Deviation compared to setpoint ΔQ / PN [%]
- Qmin	-2,398	-2,429	0,9005	0,56
0	0	-0,053	0,9999	0,96
+ Qmax	2,398	2,438	0,8978	0,73

Test: 50%P_n

	Reactive power set point Q [kVar]	Measured reactive power Q [kVar]	Measured cos φ	Deviation compared to setpoint ΔQ / PN [%]
- Qmin	-2,398	-2,408	0,7492	-0,18
0	0	0,246	0,9960	4,47
+ Qmax	2,398	2,454	0,7389	1,02

Assessment criterion:

The 3 values measured for each set point to the set value is ΔQ ≤ ± 5 % of the nominal active power of the micro-generator.

Note:

a) 1 min-average-values were calculated using measurements at the basic frequency in a period of 200 ms.

b) For each of operation mode, at least 3 under excited and 3 over excited reactive power levels were recorded.

Diagram: 100%P_n

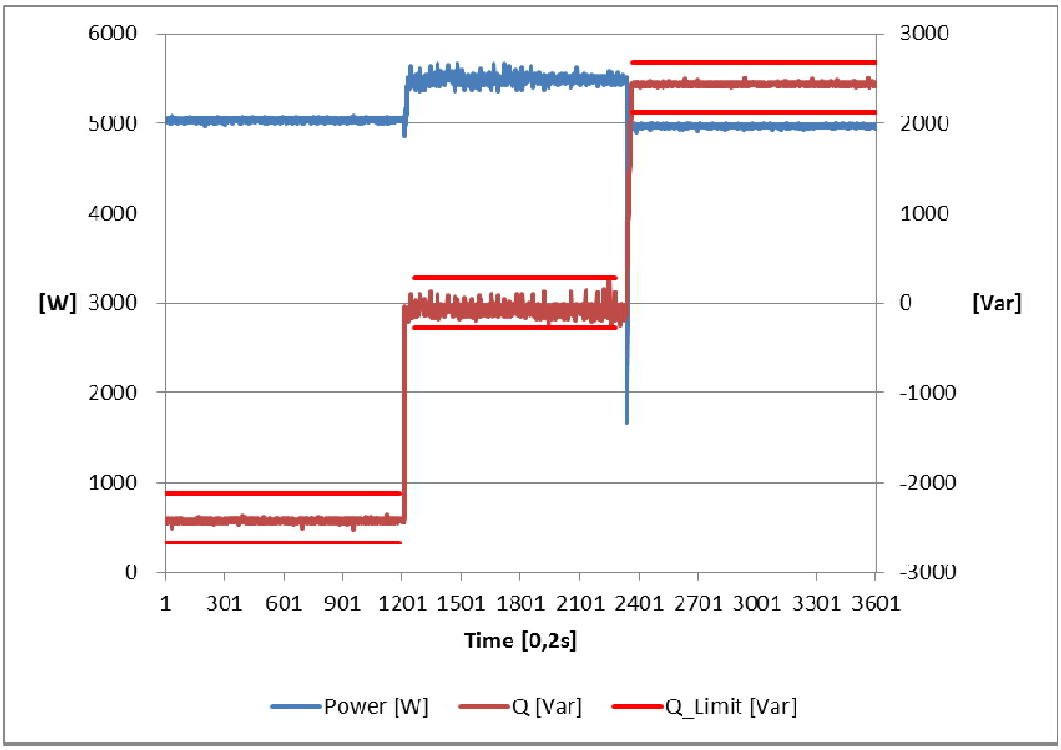
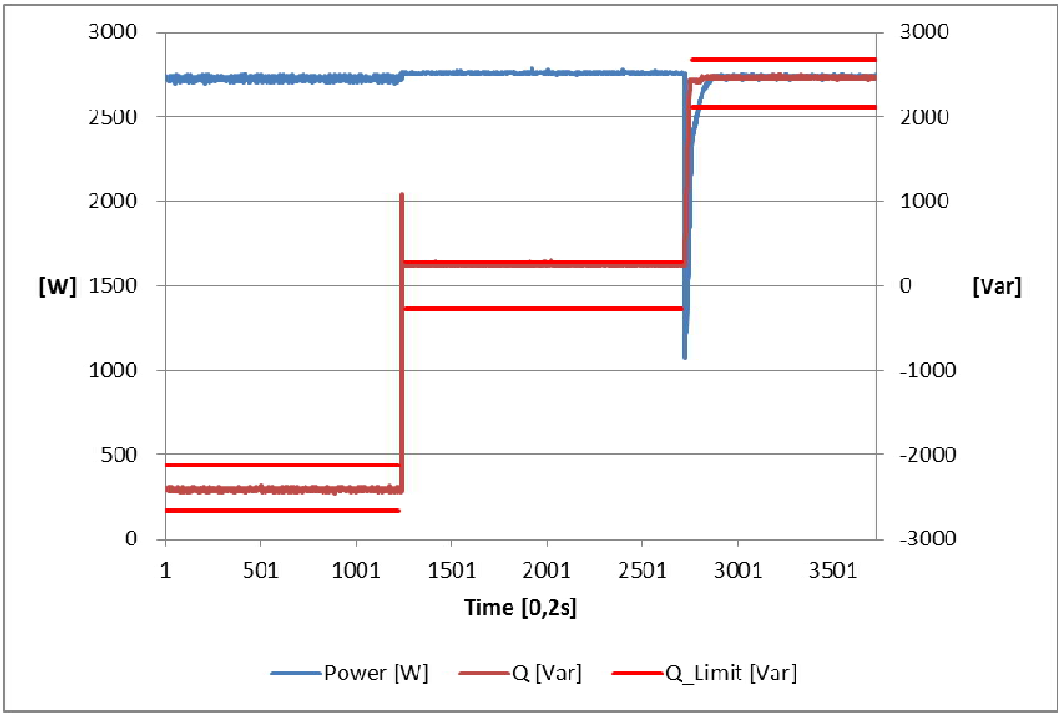


Diagram: 50%P_n



EN 50438:2013: Voltage control by active power			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.5	Voltage control by active power	D.3.5 (under consideration)	**N/A**

EN 50438:2013: Connection and starting to generate electric power			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.7	Connection and starting to generate electric power	D.3.6	**P**

D.3.6 Connection and starting to generate electrical power		P
Setting value	Min. voltage for connected to grid :	197,8
	Max. voltage for connected to grid :	250,7
	Min. Frequency for connected to grid :	47,55
	Max. Frequency for connected to grid :	50,05
	Observation time (≥60s) :	60

Test:

	Voltage conditons	
a) Start up for voltage range	<84% Un for twice of observation time	>111% Un for twice of observation time
Connection:	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	≥84% Un within twice setting observation time	≤111% Un within twice setting observation time
Reconnection time [s]	81	82
Limit:	Connected after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
c) In voltage range after voltage failture	≥84% Un for twice of setting observation time	≤111% Un for twice of setting observation time
Reconnection time [s]	82	92
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	

	Frequency conditions	
d) Start up for frequency range	<47,45 Hz for twice of setting observation time	>50,15 Hz for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	≥47,45 Hz within twice of setting observation time	≤50,10 Hz within twice of setting observation time
Reconnection time [s]	85	80
Limit:	Connected after setting delay time(≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
f) In frequency range after frequency failture	≥47,45 Hz for twice of setting observation time	≤50,10 Hz for twice of setting observation time
Reconnection time [s]	84	84
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	

Test:

Test condition b) and c): voltage within the limits of 85% to 110%Vn.

Test condition e) and f): frequency within the limits of 47,50Hz to 51,10Hz.

In order to avoid continuous starting and disengaging operations of the interface protection relay, the disengaging value of frequency and voltage functions shall be above 2 % deviating from the operate value.

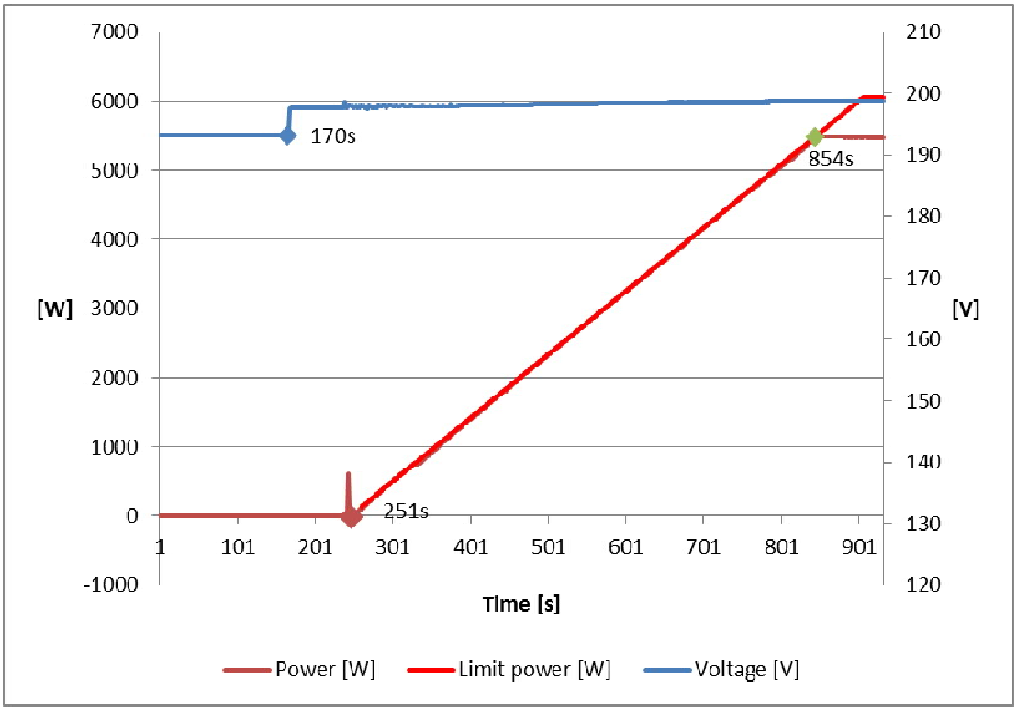
Assessment criterion:

a) the micro generator connects respectively starts generating electrical power only in the permitted range of voltage and frequency and

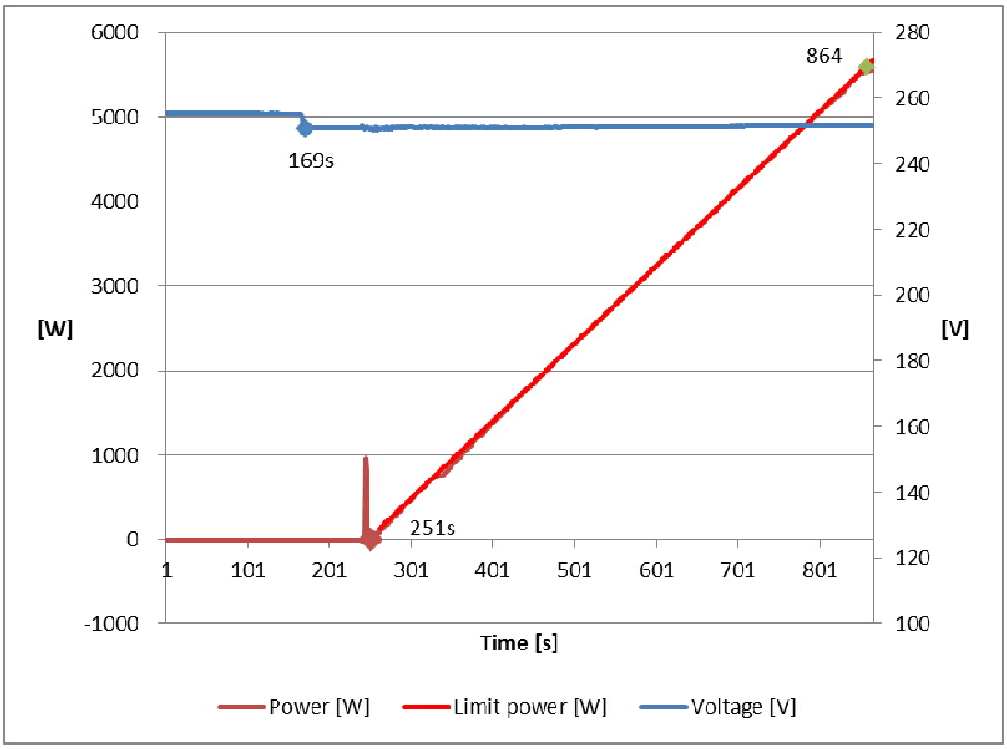
b) for adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute and

c) for non or partly adjustable generators the connection after trip of the interface protection is delayed by a randomised value between 1 min and 10 min.

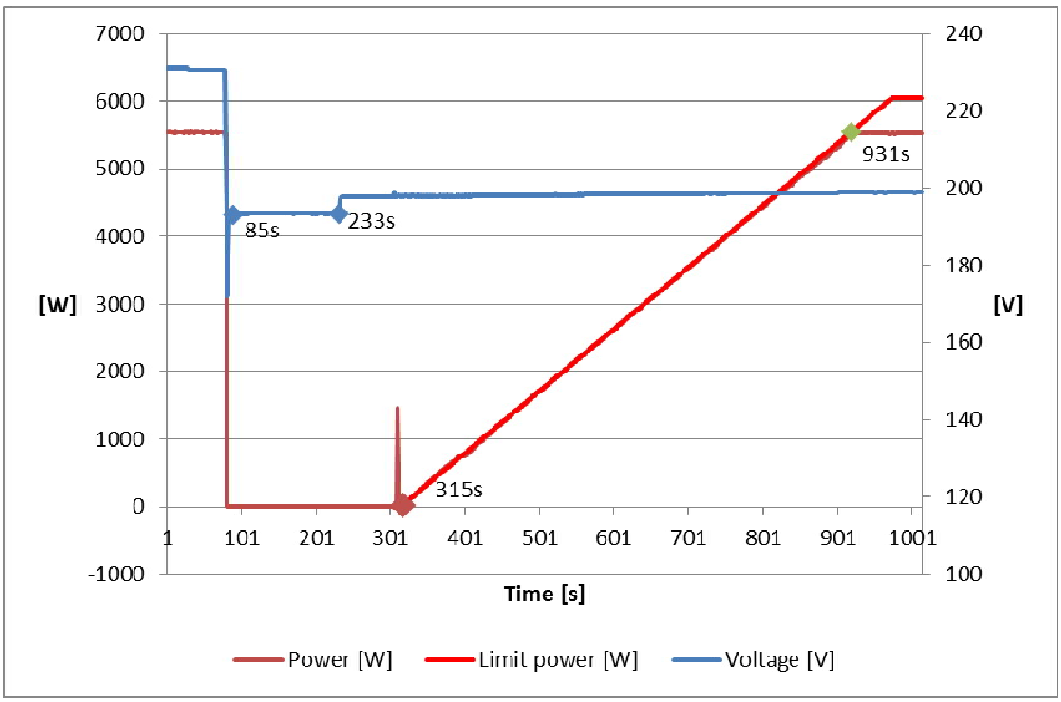
Graph of the gradual power supply: Test b) for ≥ 84% U_n



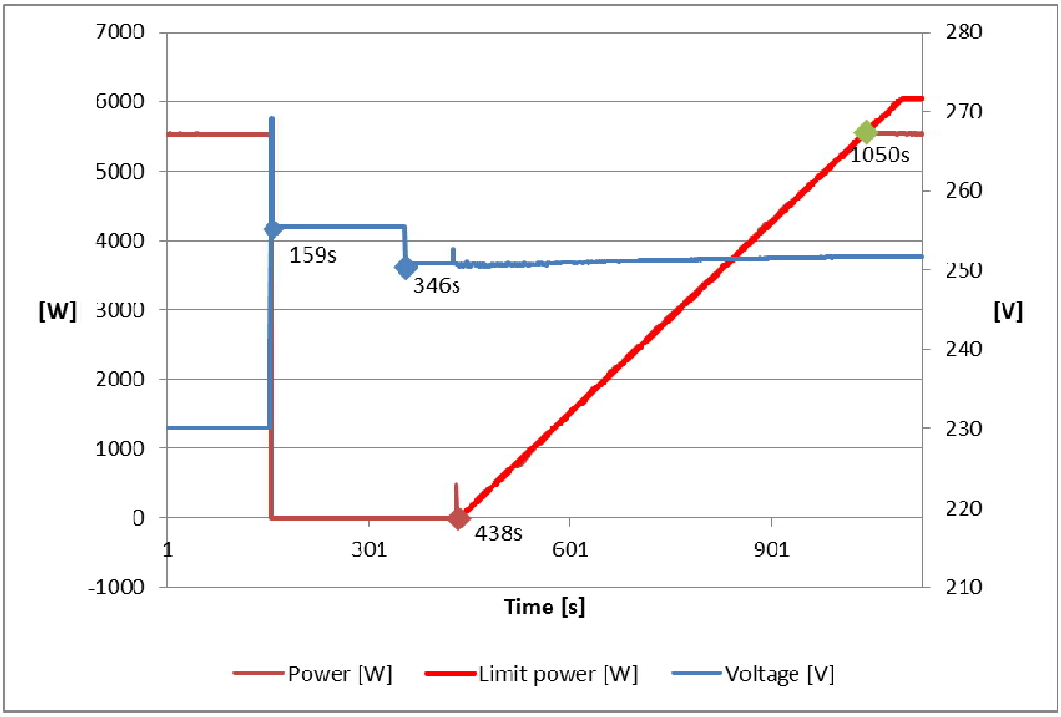
Graph of the gradual power supply: Test b) for ≤ 111% U_n



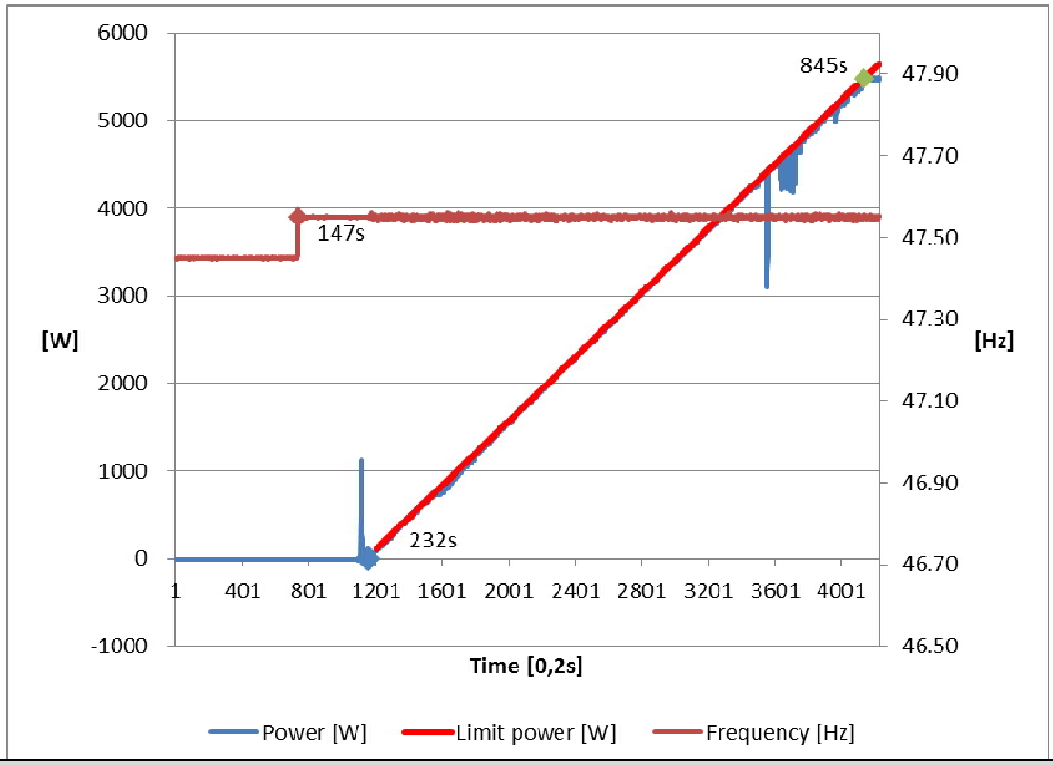
Graph of the gradual power supply: Test c) for ≥ 84% U_n



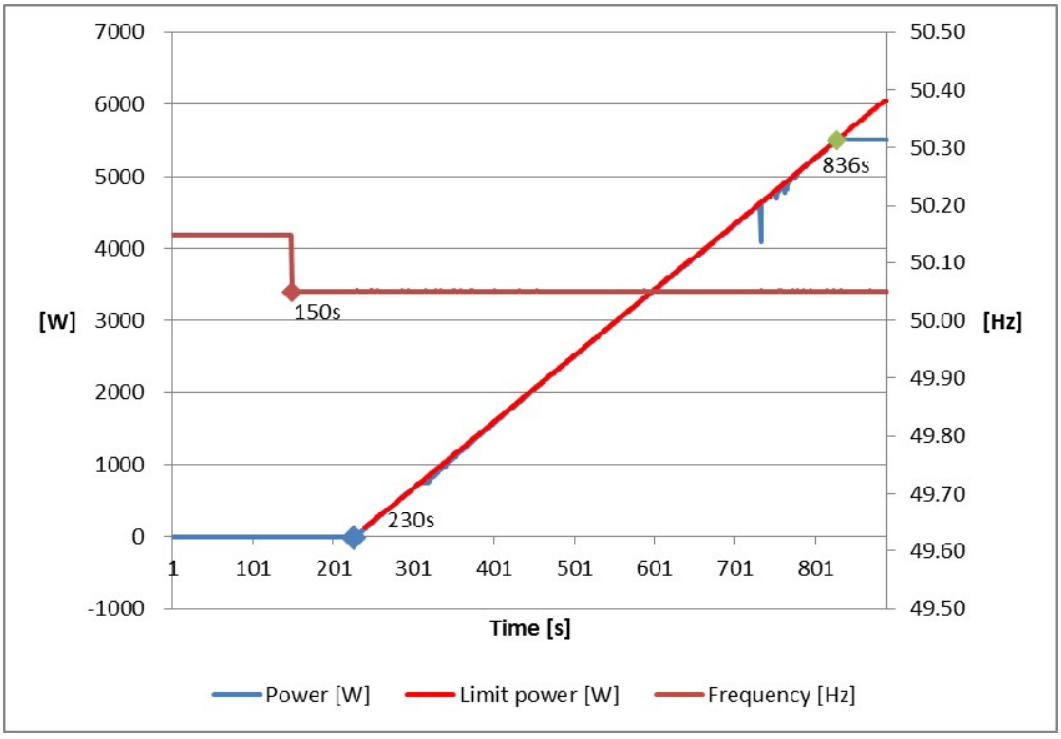
Graph of the gradual power supply: Test c) for ≤ 111% U_n



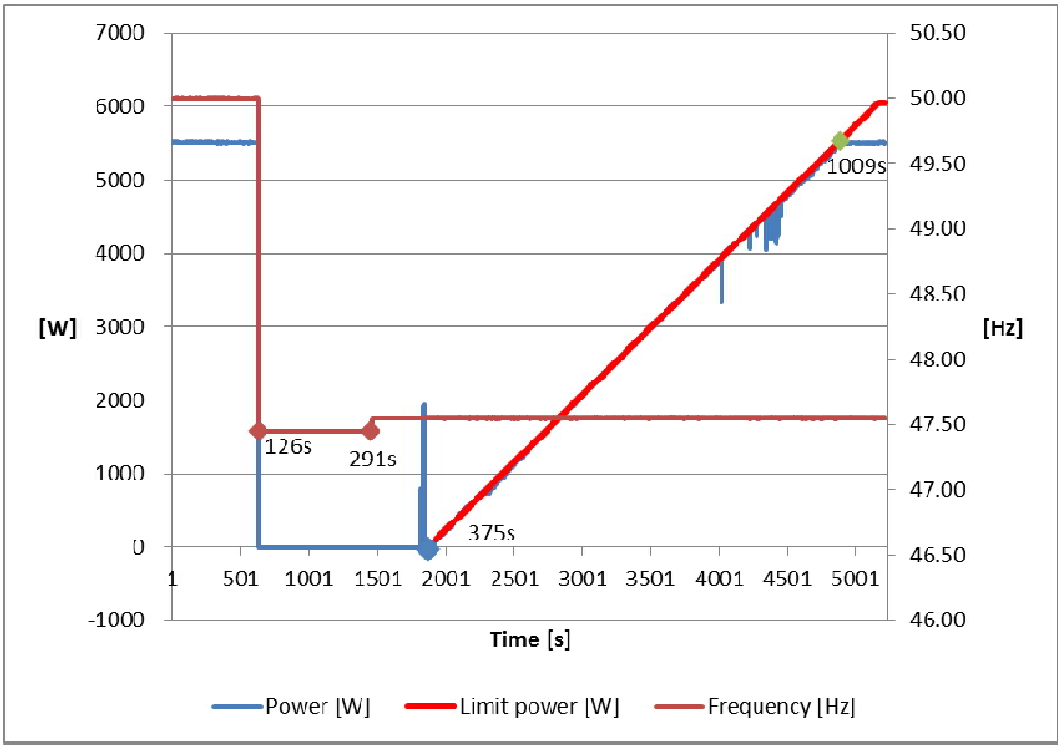
Graph of the gradual power supply: Test e) for ≥ 47,45Hz



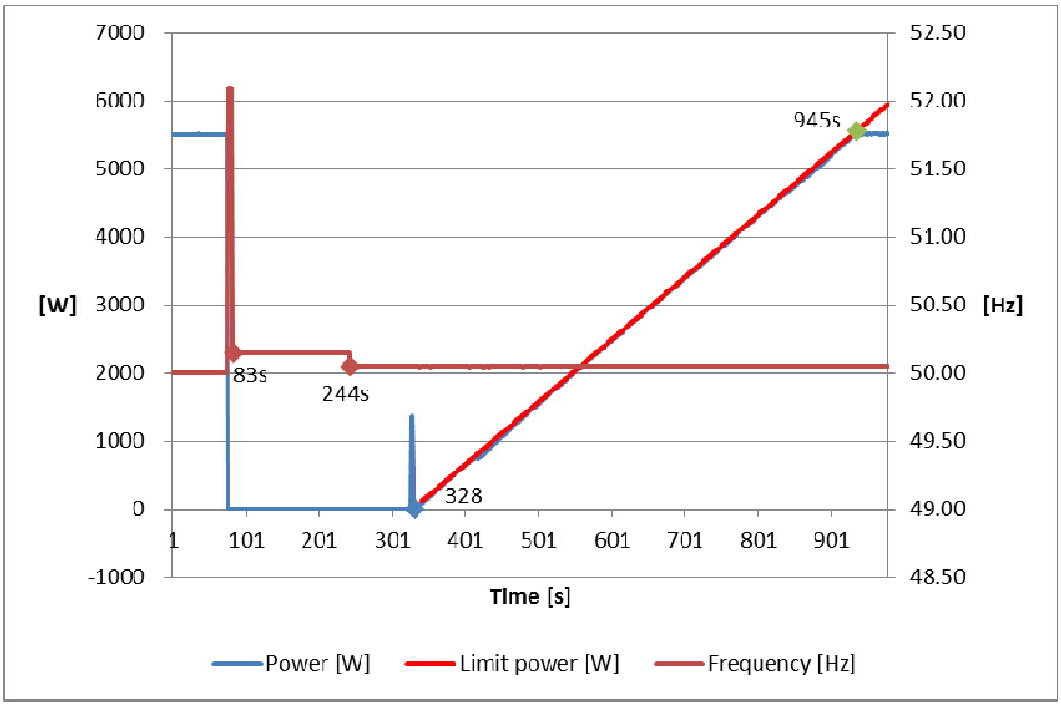
Graph of the gradual power supply: Test e) for ≤ 50,15Hz



Graph of the gradual power supply: Test f) for ≥ 47,45Hz



Graph of the gradual power supply: Test f) for ≤ 50,10Hz



EN 50438:2013: Short circuit current contribution			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.7	Short circuit current contribution	D.3.7	**P**

D.3.7 Short circuit Current Contribution	P

For a directly coupled generator			For an electronic inverter		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	Ip	N/A	20ms	27,03	17,81
Initial Value of aperiodic current	A	N/A	100ms	--	--
Initial symmetrical short-circuit current*	Ik	N/A	250ms	--	--
Decaying (aperiodic) component of short circuit current*	iDC	N/A	500ms	--	--
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,006	In seconds

Diagram

Note:

The values of voltage and current should be recorded for a period of up to 1 second when the changeover switch should be returned to the normal position. The voltage and current at relevant times shall be recorded in the type test report (Appendix 4) including the time taken for the Inverter to trip.

EN 50438:2013: Power quality			
Clause	**Test requirement**	**Test procedure acc. to Annex D**	**Result**
4.8	Power quality	D.3.8 / D.3.9 / D.3.10	**P**

D.3.8 Harmonic current emission (EN 61000-3-12)	P

Watts [kW]	5,498
Vrms [V]	230,4
Arms [A]	23,897
Frequency [Hz]	50,00

Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN61000-3-12 [%]	
				1 phase	3 phase
1st	23,862	99,789	Single Phase	-	-
2nd	0,150	0,629	Single Phase	8	8
3rd	0,393	1,644	Single Phase	21,6	N/A
4th	0,103	0,429	Single Phase	4	4
5th	0,315	1,318	Single Phase	10,7	10,7
6th	0,082	0,345	Single Phase	2,67	2,67
7th	0,255	1,066	Single Phase	7,2	7,2
8th	0,074	0,310	Single Phase	2	2
9th	0,252	1,055	Single Phase	3,8	N/A
10th	0,070	0,294	Single Phase	1,6	1,6
11th	0,208	0,868	Single Phase	3,1	3,1
12th	0,064	0,267	Single Phase	1,33	1,33
13th	0,204	0,853	Single Phase	2	2
14th	0,050	0,208	Single Phase	N/A	N/A
15th	0,155	0,650	Single Phase	N/A	N/A
16th	0,063	0,265	Single Phase	N/A	N/A
17th	0,155	0,646	Single Phase	N/A	N/A
18th	0,072	0,300	Single Phase	N/A	N/A
19th	0,117	0,489	Single Phase	N/A	N/A
20th	0,057	0,237	Single Phase	N/A	N/A
21th	0,097	0,404	Single Phase	N/A	N/A
22th	0,052	0,217	Single Phase	N/A	N/A
23th	0,079	0,329	Single Phase	N/A	N/A
24th	0,051	0,214	Single Phase	N/A	N/A
25th	0,068	0,284	Single Phase	N/A	N/A
26th	0,052	0,218	Single Phase	N/A	N/A
27th	0,056	0,234	Single Phase	N/A	N/A
28th	0,053	0,223	Single Phase	N/A	N/A
29th	0,044	0,184	Single Phase	N/A	N/A
30th	0,044	0,184	Single Phase	N/A	N/A
31th	0,041	0,171	Single Phase	N/A	N/A
32th	0,044	0,183	Single Phase	N/A	N/A
33th	0,044	0,183	Single Phase	N/A	N/A
34th	0,058	0,245	Single Phase	N/A	N/A
35th	0,056	0,234	Single Phase	N/A	N/A
36th	0,062	0,259	Single Phase	N/A	N/A
37th	0,046	0,191	Single Phase	N/A	N/A
38th	0,037	0,156	Single Phase	N/A	N/A
39th	0,037	0,153	Single Phase	N/A	N/A
40th	0,034	0,142	Single Phase	N/A	N/A
THD_{40}	--	4,108	Single Phase	13	13
PWHD	--	7,232	Single Phase	22	22

D.3.9 Voltage fluctuation and flicker					P
	Maximum permissible voltage fluctuation (expressed as a percentage of nominal voltage at 100 % power) and flicker as per EN 61000-3-3				
Value	**Pst**	**Plt 2 hours**	**d(t) $_{500ms}$**	**dc**	**dmax**
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	See below				

No.	dc[%]	dmax[%]	d(t)[ms]	Pst
1	0.15	0.84	0.00	0.55
2	0.16	0.70	0.00	0.56
3	0.20	0.65	0.00	0.56
4	0.19	0.68	0.00	0.56
5	0.16	0.69	0.00	0.58
6	0.16	0.66	0.00	0.60
7	0.16	0.64	0.00	0.61
8	0.16	0.66	0.00	0.58
9	0.13	0.63	0.00	0.55
10	0.13	0.63	0.00	0.60
11	0.16	0.65	0.00	0.60
12	0.14	0.67	0.00	0.59

Plt
0.58

Note:

Mains Impedance according EN61000-3-3: Rmax = 0,24 Ω; jXmax= 0,15 Ω @50Hz (|Zmax| = 0,472 Ω)

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 EN61000-3-3 for less than 16A.

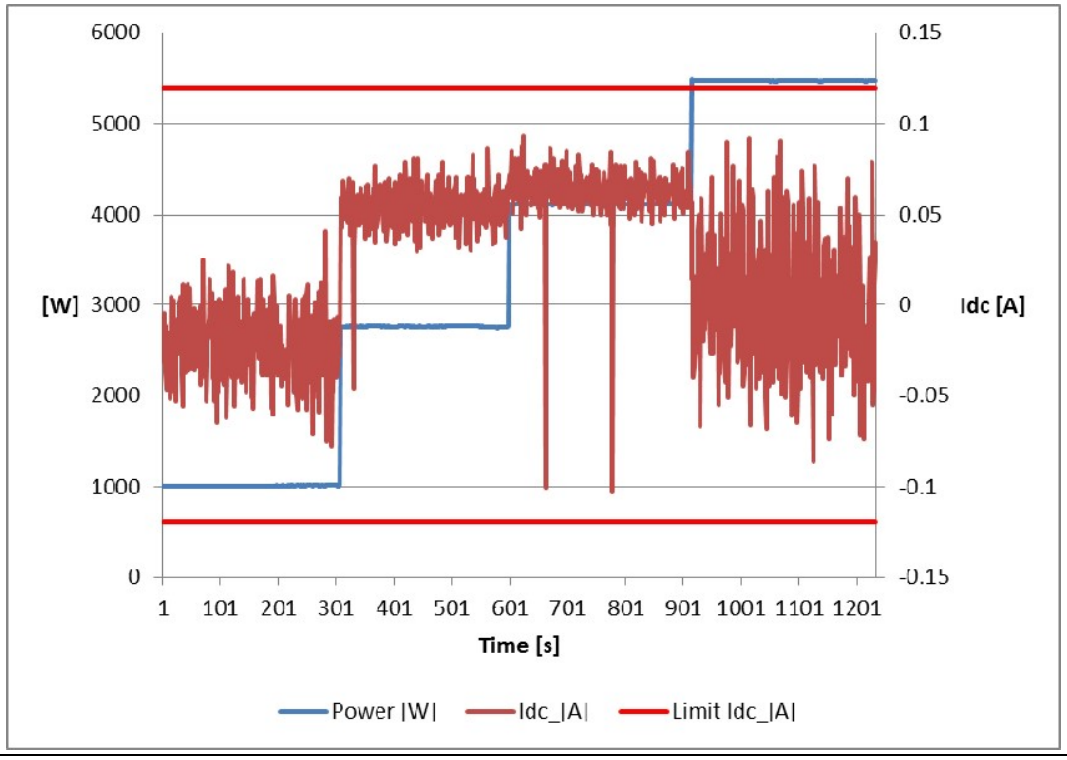
D.3.10 DC-Injection	P

Protection limit	Tested at four power levels limit 0,5% of $I_{AC;nom}$			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	-78	87	-103	92
Max. test value (phase L2) [mA]	--	--	--	--
Max. test value (phase L3) [mA]	--	--	--	--

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.

Diagram of permanent dc-injection (20% / 50% / 75% / 100%)



Annex 1

EMC test report

Dongguan NTC Co., Ltd.
Building D,Gaosheng Science and Technology park,
Hongtu road,Nancheng district ,Dongguan city,Guangdong province,China
www.ntc-c.com Tel:+86-769-2202 2444 Fax:+86-769-2202 2799

CERTIFICATE OF CONFORMITY

EC Council Directive 2014/30/EU
Electromagnetic Compatibility
Registration No.: NTC1610635E

Applicant	:	VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.
Address	:	1-4F, Building 5, YuSheng Industrial Park, No.467, Section Xixiang, National Highway 107,Xixiang, Bao An District, Shenzhen, China
Manufacturer	:	VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.
Address	:	1-4F, Building 5, YuSheng Industrial Park, No.467, Section Xixiang, National Highway 107,Xixiang, Bao An District, Shenzhen, China
Factory	:	VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.
Address	:	1-4F, Building 5, YuSheng Industrial Park, No.467, Section Xixiang, National Highway 107,Xixiang, Bao An District, Shenzhen, China
E.U.T.	:	Hybrid Solar Inverter
Brand Name	:	N/A
Model No.	:	InfiniSolar E 5.5KW
Test Report No.	:	NTC1610635E
Standard	:	EN 61000-6-3:2007+A1: 2011+AC: 2012 EN 61000-6-2: 2005+AC: 2005 EN 61000-3-12: 2011 EN 61000-3-11: 2000

CE

Iori Fan
October 29, 2016

The certificate of conformity is based on an evaluation of a sample of the above mentioned product. Technical report and documentation are at the applicant's disposal. This is to certify that the tested sample is in conformity with all provisions of Annex I of Council Directive 2014/30/EU, in its latest amended version, referred to EMC Directive. The certificate does not imply assessment of the production and does not permit the use of Lab's logo.

Dongguan Nore Testing Center Co., Ltd.
Report No.: NTC1610635E

EMC TEST REPORT

The device described below is tested by Dongguan Nore Testing Center Co., Ltd. to determine the maximum emission levels emanating from the device, the severe levels which the device can endure and E.U.T.'s performance criterion. The test results are contained in this test report. Dongguan Nore Testing Center Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

Applicant	:	VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.
Address	:	1-4F, Building 5, YuSheng Industrial Park, No.467, Section Xixiang, National Highway 107,Xixiang, Bao An District, Shenzhen, China
Manufacturer/ Factory	:	VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.
Address	:	1-4F, Building 5, YuSheng Industrial Park, No.467, Section Xixiang, National Highway 107,Xixiang, Bao An District, Shenzhen, China
E.U.T.	:	Hybrid Solar Inverter
Brand Name	:	N/A
Model No.	:	InfiniSolar E 5.5KW
Measurement Standard	:	EN 61000-6-3:2007+A1: 2011+AC: 2012 EN 61000-3-12: 2011, EN 61000-3-11: 2000 EN 61000-6-2: 2005+AC: 2005 (EN 61000-4-2: 2009, EN 61000-4-3: 2006+A2: 2010, EN 61000-4-4: 2012, EN 61000-4-5: 2014, EN 61000-4-6: 2014, EN 61000-4-11: 2004, EN 61000-4-8: 2010)
Date of Receiver	:	October 14, 2016
Date of Test	:	October 15, 2016 to October 26, 2016
Date of Report	:	October 29, 2016

This Test Report is Issued Under the Authority of :

Prepared by	Approved & Authorized Signer
Yoyo Deng / Engineer	Iori Fan / Authorized Signatory

This report shows that the E.U.T. is technically compliant with the EN 61000-6-3, EN 61000-3-2, EN 61000-3-3 and EN 61000-6-2. This report applies to above tested sample only and shall not be reproduced in part without written approval of Dongguan Nore Testing Center Co., Ltd.

TEL: +86-769-22022444 FAX: +86-769-22022799 Web: www.ntc-c.com
Address: Building D, Gaosheng Science & Technology Park, Zhouxi Longxi Road, Nancheng District, Dongguan City, Guangdong, China

TABLE OF CONTENTS

Bureau Veritas Shenzhen Co., Ltd.
Dongguan Branch

No. 34, Chenwulu Section, Guantai Rd.,
Houjie Town, Dongguan City, Guangdong
523942, China

Tel: +86 769 8593 5656
Fax: +86 769 8599 1080
Email: customerservice.dg@cn.bureauveritas.com

Revision History of This Test Report

Report Number	Description	Issued Date
NTC1610635E	Initial Issue	2016-10-29

Bureau Veritas Shenzhen Co., Ltd.
Dongguan Branch

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1. SUMMARY OF TEST RESULTS

The E.U.T. has been tested according to the following specifications:

EMISSION			
Standard	**Test Type**	**Result**	**Remarks**
EN 61000-6-3:2007+ A1: 2011+AC: 2012	Mains Terminal Disturbance Voltage Test	PASS	Uncertainty: 2.7dB
	Radiated Emission Test	PASS	Uncertainty: 3.4dB
EN 61000-3-12: 2011	Harmonic current emission	PASS	Meets the requirements.
EN 61000-3-11: 2000	Voltage fluctuations & flicker	PASS	Meets the requirements.

IMMUNITY (EN 61000-6-2: 2005+AC: 2005)			
Standard	**Test Type**	**Result**	**Remarks**
EN 61000-4-2: 2009	Electrostatic discharge immunity test	PASS	Meets the requirements of Performance Criterion B
EN 61000-4-3: 2006+A2: 2010	Radio-frequency, electromagnetic field immunity test	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-4: 2012	Electrical fast transient/ burst immunity test	PASS	Meets the requirements of Performance Criterion B
EN 61000-4-5: 2014	Surge immunity test	PASS	Meets the requirements of Performance Criterion B
EN 61000-4-6: 2014	Injected Currents immunity test	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-11: 2004	Voltage Dips and Interruptions	PASS	Meets the requirements of Performance Criterion B&C
EN 61000-4-8: 2010	Magnetic Field Immunity Test	PASS	Meets the requirements of Performance Criterion A

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Standard	**Test Type**	**Result**	**Remarks**
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EN 61000-4-3: 2006+A2: 2010	Radio-frequency, electromagnetic field immunity test	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-4: 2012	Electrical fast transient/ burst immunity test	PASS	Meets the requirements of Performance Criterion B
EN 61000-4-5: 2014	Surge immunity test	PASS	Meets the requirements of Performance Criterion B
EN 61000-4-6: 2014	Injected Currents immunity test	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-11: 2004	Voltage Dips and Interruptions	PASS	Meets the requirements of Performance Criterion B&C
EN 61000-4-8: 2010	Magnetic Field Immunity Test	PASS	Meets the requirements of Performance Criterion A

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Rating:

PV INPUT	Nominal operating voltage 360Vdc
	Vmax PV 500Vdc
	Isc PV 26 A
	MPP voltage 120 – 450Vdc
	MPPT voltage(rated power) 250 - 450Vdc
GRID/AC OUTPUT	Nominal operating voltage 230 Vac
	Maximum output current 23.9A
	Nominal operating frequency 50/60Hz
	Maximum power 5500W
	Power factor range 0.9 lead-0.9lag
AC INPUT	Nominal operating voltage 230 Vac
	Maximum input current 40A
	Nominal operating frequency 50/60Hz
BATTERY	Battery voltage range 40-63Vdc
	Minimum capacity 125Ah
	Maximum battery current 150A

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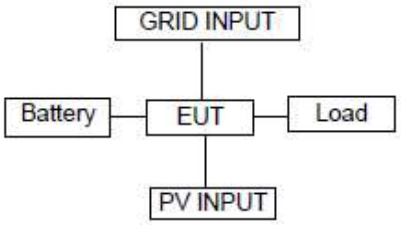
2.3 Block Diagram of Test Setup

Block diagram of connection between the E.U.T. and simulators



2.4 Test Facility

Site Description

EMC Lab : Listed by CNAS, August 14, 2015
The certificate is valid until August 13, 2018
The Laboratory has been assessed and proved to be in compliance with CNAS/CL01
The Certificate Registration Number is L5795.

Listed by FCC, August. 02, 2014
The Certificate Number is 665078.

Listed by Industry Canada, July 01, 2014
The Certificate Registration Number. Is 46405-9743

Name of Firm : Dongguan Nore Testing Center Co., Ltd.
(Dongguan NTC Co., Ltd.)

Site Location : Building D, Gaosheng Science & Technology Park,
Zhouxi Longxi Road, Nancheng District,
Dongguan City, Guangdong Province, China

2.5 Abnormalities from Standard Conditions

None

3. MEASURING DEVICES AND TEST EQUIPMENT

3.1.For Mains terminals Disturbance voltage Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 07, 2016	1 Year
2.	L.I.S.N	Rohde & Schwarz	ENV 216	101317	Mar. 07, 2016	1 Year
3.	L.I.S.N	Schwarzbeck	NNLK8129	8129-212	Mar. 07, 2016	1 Year
4.	RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	Mar. 07, 2016	1 Year
5.	Pulse Limiter	MTS-systemtechnik	MTS-IMP-136	26115-010-0007	Mar. 07, 2016	1 Year

3.2.For Radiated Emission Measurement

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 07, 2016	1 Year
2.	Antenna	Schwarzbeck	VULB9162	9162-010	Mar. 14, 2016	1 Year
3.	Positioning Controller	UC	UC 3000	N/A	N/A	N/A
4.	Color Monitor	SUNSPO	SP-140A	N/A	N/A	N/A
5.	Single Phase Power Line Filter	SAEMC	PF201A-32	110210	N/A	N/A
6.	3 Phase Power Line Filter	SAEMC	PF401A-200	110318	N/A	N/A
7.	DC Power Filter	SAEMC	PF301A-200	110245	N/A	N/A
8.	Cable	Huber+Suhner	CBL3-NN-9M	21490001	Mar. 07, 2016	1 Year
9.	Cable	Huber+Suhner	RG223U	N/A	Mar. 07, 2016	1 Year
10.	Power Amplifier	HP	HP 8447D	1145A00203	Mar. 07, 2016	1 Year

3.3.For Harmonic/ Flicker Measurement

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Three Phase Harmonic Flicker Test System	California Instruments	MX45-3PI-400-413-C TSHL-LF-SNK	1424A00547	Jul. 25, 2016	1 Year

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3.4. For Electrostatic Discharge Immunity Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	ESD Tester	TESEQ	NSG 437	432	Mar. 14, 2016	1 Year

3.5.For RF Electromagnetic Field Immunity Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Signal Generator	Agilent	N5181A	MY50142530	Aug. 31, 2016	1 Year
2.	Antenna	Schwarzbeck	VULB9162	9162-010	Mar. 14, 2016	1 Year
3.	RF Power Meter	ESE	4242	13984	Aug. 31, 2016	1 Year
4.	Power Amplifier	TESEQ	CBA 1G-150	T44029	Aug. 31, 2016	1 Year
5.	Power Sensor	ESE	51011EMC	35716	Aug. 31, 2016	1 Year

3.6.For Electrical Fast Transient /Burst Immunity Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Burst Tester	EM TEST	UCS 500N	V1104108683	Mar. 07, 2016	1 Year
2.	Coupling Clamp	EM TEST	HFK	0311-94	Mar. 07, 2016	1 Year
3.	Test Soft	EM TEST	lec. control	N/A	N/A	N/A

3.7.For Surge Immunity Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Surge Tester	EM TEST	UCS 500N	V1104108683	Mar. 07, 2016	1 Year
2.	Test Soft	EM TEST	lec. control	N/A	N/A	N/A

3.8.For Injected Currents Immunity Measurement

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	CDN	Luthi	L-801M2/M3	2015	Oct.19, 2016	1 Year
2.	C/S Test System	HAEFELY	WinPAMP	NSEMC002	N/A	1 Year

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3.9.For Voltage Dips and Interruptions Measurement

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Dips Tester	EM TEST	UCS500N	V1104108683	Mar. 07, 2016	1 Year
2.	Test Soft	EM TEST	lec.control	N/A	N/A	N/A
3.	Dips Modulator	EM TEST	V4780S2	0111-11	Mar. 07, 2016	1 Year

3.10.For Magnetic Field Immunity Measurement

(GUANGZHOU GRG METROLOGY & TEST CO., LTD.)

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Magnetic Field Tester	EMC PARTNER	TRA2000	853	Jun. 01, 2016	1 Year
2.	Variac Module	EMC PARTNER	VAR-EXT10000	041	Apr. 16, 2016	1 Year
3.	Induction Coil	EMC PARTNER	MF1000-1	150	Apr. 16, 2016	1 Year

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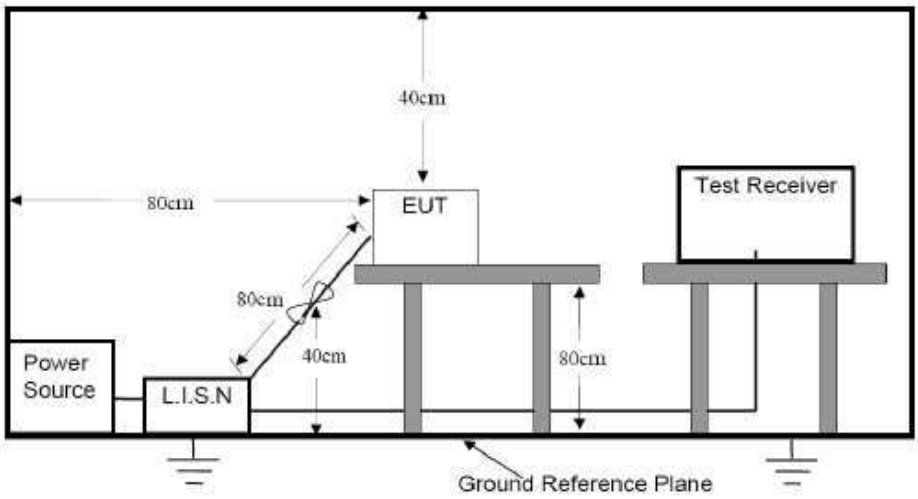
4. MAINS TERMINAL DISTURBANCE VOLTAGE MEASUREMENT

4.1 Block Diagram of Test Setup



4.2 Limit of Mains Terminal Disturbance voltage measurement

Test Standard: EN 61000-6-3

Limits for conducted disturbance at the mains port.

Frequency range	Limits (dB(uV))	
(MHz)	Quasi-peak	Average
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

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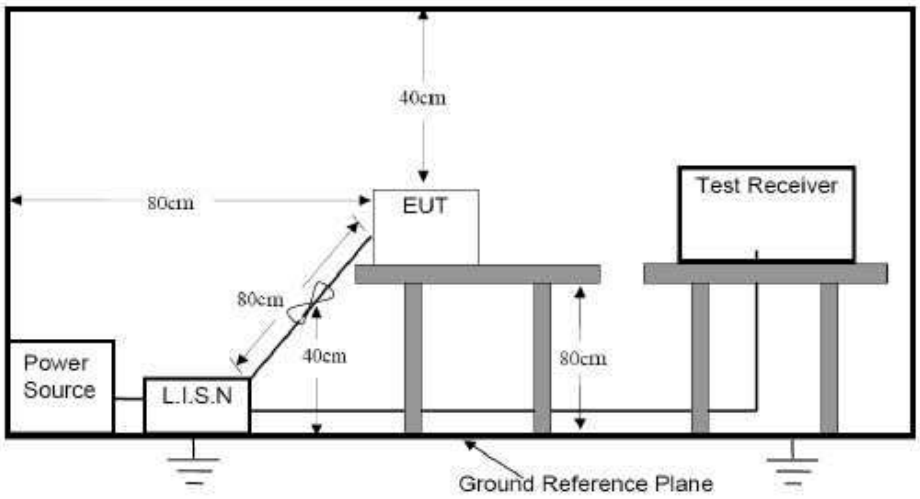
4. MAINS TERMINAL DISTURBANCE VOLTAGE MEASUREMENT

4.1 Block Diagram of Test Setup



4.2 Limit of Mains Terminal Disturbance voltage measurement

Test Standard: EN 61000-6-3

Limits for conducted disturbance at the mains port.

Frequency range	Limits (dB(uV))	
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5 to 30	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

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4.3 Test Procedure

The E.U.T. is put on the 0.8 m high table and connected to the AC mains through a Artificial Mains Network (AMN). This provided a 50ohm coupling impedance for the tested equipments. Both sides of AC line are checked to find out the maximum conducted emission levels according to the EN 61000-6-3 regulations during conducted emission test.

The bandwidth of the test receiver (R&S Test Receiver ESCI) is set at 9 KHz.

4.4 Operating Condition of E.U.T.

4.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

4.4.2 Turn on the power of all equipments.

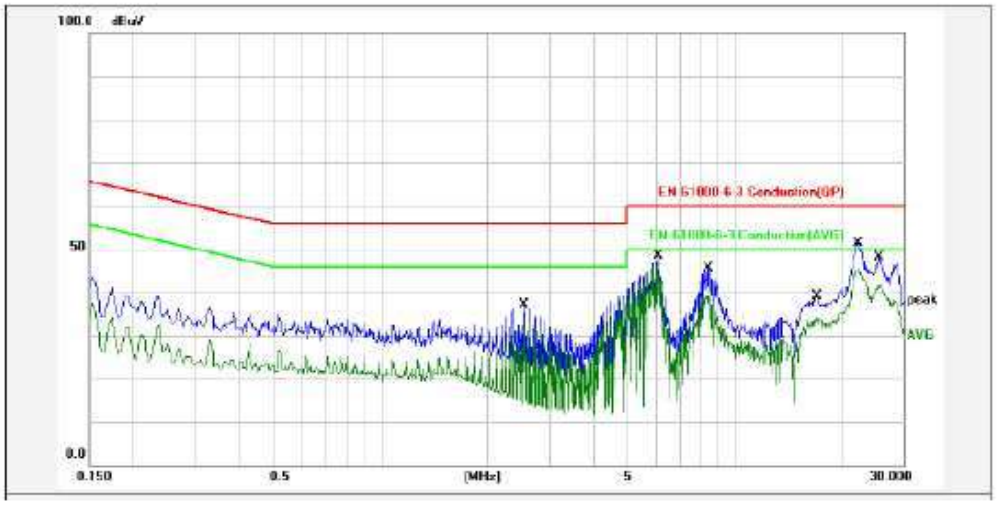
4.4.3 Let the E.U.T. work in test mode and test it.

4.5 Mains Terminal Disturbance Voltage Test Results

PASS.

Please refer to the following pages.

E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 48V
Test Mode :	Battery+Full Load	Phase:	Line



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	2.5499	10.32	26.84	37.16	56.00	-18.84	QP	P	
2	2.5499	10.32	23.69	34.01	46.00	-11.99	AVG	P	
3	6.0900	10.34	34.46	44.80	60.00	-15.20	QP	P	
4	6.0900	10.34	34.26	44.60	50.00	-5.40	AVG	P	
5	8.4539	10.35	35.27	45.62	60.00	-14.38	QP	P	
6	8.4539	10.35	29.13	39.48	50.00	-10.52	AVG	P	
7	16.9498	10.44	28.74	39.18	60.00	-20.82	QP	P	
8	16.9498	10.44	23.53	33.97	50.00	-16.03	AVG	P	
9	22.5700	10.60	40.78	51.38	60.00	-8.62	QP	P	
10	22.5700	10.60	34.80	45.40	50.00	-4.60	AVG	P	
11	25.7340	10.62	37.40	48.02	60.00	-11.98	QP	P	
12	25.7340	10.62	31.02	41.64	50.00	-8.36	AVG	P	

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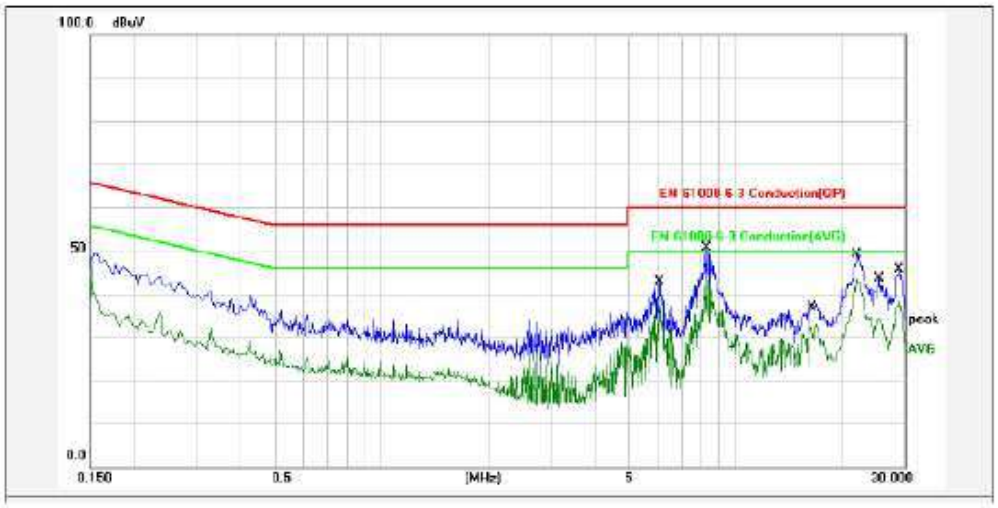
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load	Phase:	Line



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	6.0899	10.34	33.21	43.55	60.00	-16.45	QP	P	
2	6.0899	10.34	27.01	37.35	50.00	-12.65	AVG	P	
3	8.2859	10.35	40.27	50.62	60.00	-9.38	QP	P	
4	8.2859	10.35	32.91	43.26	50.00	-6.74	AVG	P	
5	16.3458	10.41	26.48	36.89	60.00	-23.11	QP	P	
6	16.3458	10.41	21.98	32.39	50.00	-17.61	AVG	P	
7	22.0100	10.59	38.65	49.24	60.00	-10.76	QP	P	
8	22.0100	10.59	33.05	43.64	50.00	-6.36	AVG	P	
9	25.3539	10.62	33.02	43.64	60.00	-16.36	QP	P	
10	25.3539	10.62	23.83	34.45	50.00	-15.55	AVG	P	
11	28.8820	10.69	34.93	45.62	60.00	-14.38	QP	P	
12	28.8820	10.69	27.80	38.49	50.00	-11.51	AVG	P	

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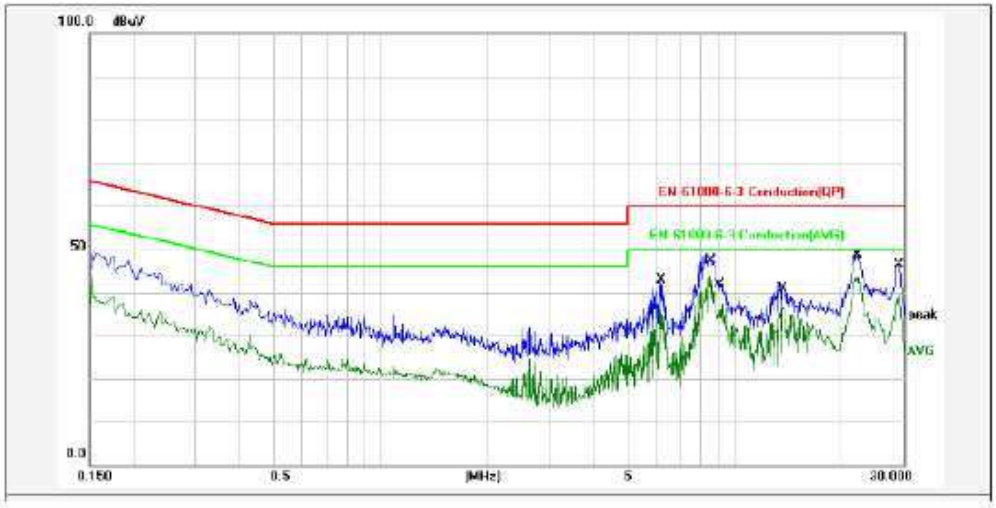
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load	Phase:	Neutral



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	6.1459	10.31	32.51	42.82	60.00	-17.18	QP	P	
2	6.1459	10.31	25.80	36.11	50.00	-13.89	AVG	P	
3	8.5458	10.35	38.38	48.73	60.00	-11.27	QP	P	
4	8.5458	10.35	33.19	43.54	50.00	-6.46	AVG	P	
5	9.1979	10.35	31.52	41.87	60.00	-18.13	QP	P	
6	9.1979	10.35	26.93	37.28	50.00	-12.72	AVG	P	
7	13.6539	10.36	31.55	41.91	60.00	-18.09	QP	P	
8	13.6539	10.36	26.05	36.41	50.00	-13.59	AVG	P	
9	22.1939	10.39	38.30	48.69	60.00	-11.31	QP	P	
10	22.1939	10.39	33.09	43.48	50.00	-6.52	AVG	P	
11	28.8820	10.57	35.87	46.44	60.00	-13.56	QP	P	
12	28.8820	10.57	29.13	39.70	50.00	-10.30	AVG	P	

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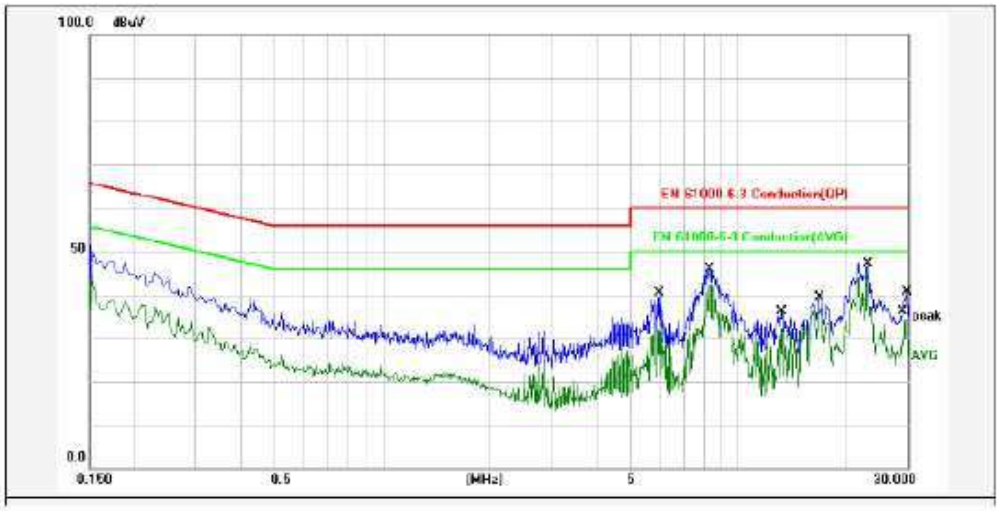
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load+PV	Phase:	Line



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	6.0138	10.34	29.93	40.27	60.00	-19.73	QP	P	
2	6.0138	10.34	22.56	32.90	50.00	-17.10	AVG	P	
3	8.3539	10.35	36.30	46.65	60.00	-13.35	QP	P	
4	8.3539	10.35	32.02	42.37	50.00	-7.63	AVG	P	
5	13.3698	10.35	25.86	36.21	60.00	-23.79	QP	P	
6	13.3698	10.35	21.74	32.09	50.00	-17.91	AVG	P	
7	17.1779	10.45	29.02	39.47	60.00	-20.53	QP	P	
8	17.1779	10.45	26.48	36.93	50.00	-13.07	AVG	P	
9	23.2139	10.60	36.64	47.24	60.00	-12.76	QP	P	
10	23.2139	10.60	34.11	44.71	50.00	-5.29	AVG	P	
11	28.8060	10.69	29.86	40.55	60.00	-19.45	QP	P	
12	29.8060	10.71	23.78	34.49	50.00	-15.51	AVG	P	

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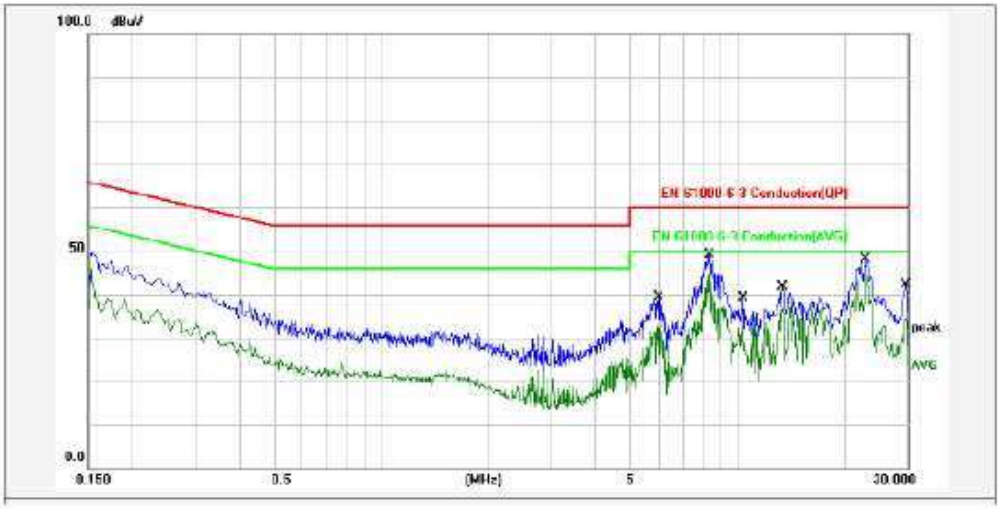
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load+PV	Phase:	Neutral



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	5.9780	10.34	29.09	39.43	60.00	-20.57	QP	P	
2	5.9780	10.34	22.43	32.77	50.00	-17.23	AVG	P	
3	8.3500	10.35	39.27	49.62	60.00	-10.38	QP	P	
4	8.3500	10.35	34.38	44.73	50.00	-5.27	AVG	P	
5	10.2059	10.35	28.81	39.16	60.00	-20.84	QP	P	
6	10.2059	10.35	22.99	33.34	50.00	-16.66	AVG	P	
7	13.3619	10.35	31.25	41.60	60.00	-18.40	QP	P	
8	13.3619	10.35	26.56	36.91	50.00	-13.09	AVG	P	
9	22.9260	10.60	37.58	48.18	60.00	-11.82	QP	P	
10	22.9260	10.60	34.16	44.76	50.00	-5.24	AVG	P	
11	29.7060	10.70	31.41	42.11	60.00	-17.89	QP	P	
12	29.7060	10.70	23.97	34.67	50.00	-15.33	AVG	P	

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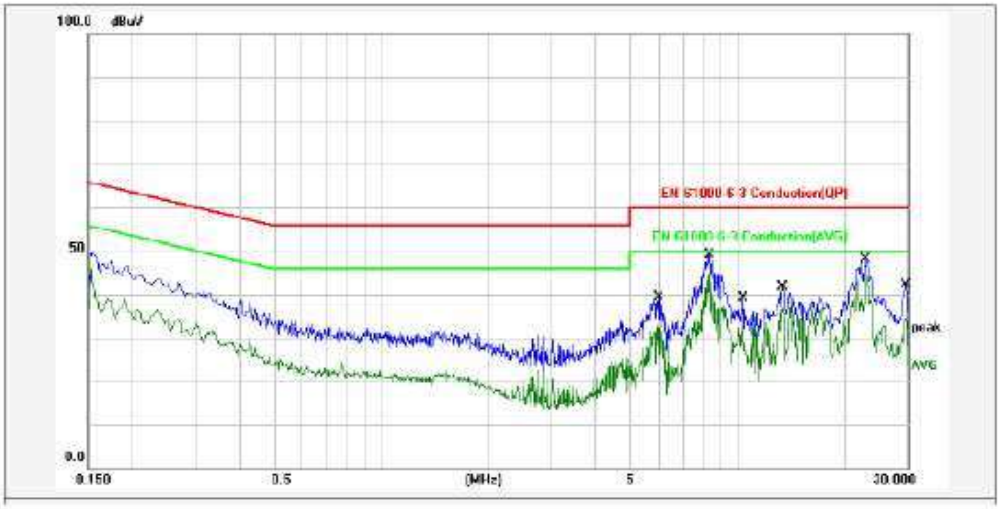
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load+PV	Phase:	Neutral



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	5.9780	10.34	29.09	39.43	60.00	-20.57	QP	P	
2	5.9780	10.34	22.43	32.77	50.00	-17.23	AVG	P	
3	8.3500	10.35	39.27	49.62	60.00	-10.38	QP	P	
4	8.3500	10.35	34.38	44.73	50.00	-5.27	AVG	P	
5	10.2059	10.35	28.81	39.16	60.00	-20.84	QP	P	
6	10.2059	10.35	22.99	33.34	50.00	-16.66	AVG	P	
7	13.3619	10.35	31.25	41.60	60.00	-18.40	QP	P	
8	13.3619	10.35	26.56	36.91	50.00	-13.09	AVG	P	
9	22.9260	10.60	37.58	48.18	60.00	-11.82	QP	P	
10	22.9260	10.60	34.16	44.76	50.00	-5.24	AVG	P	
11	29.7060	10.70	31.41	42.11	60.00	-17.89	QP	P	
12	29.7060	10.70	23.97	34.67	50.00	-15.33	AVG	P	

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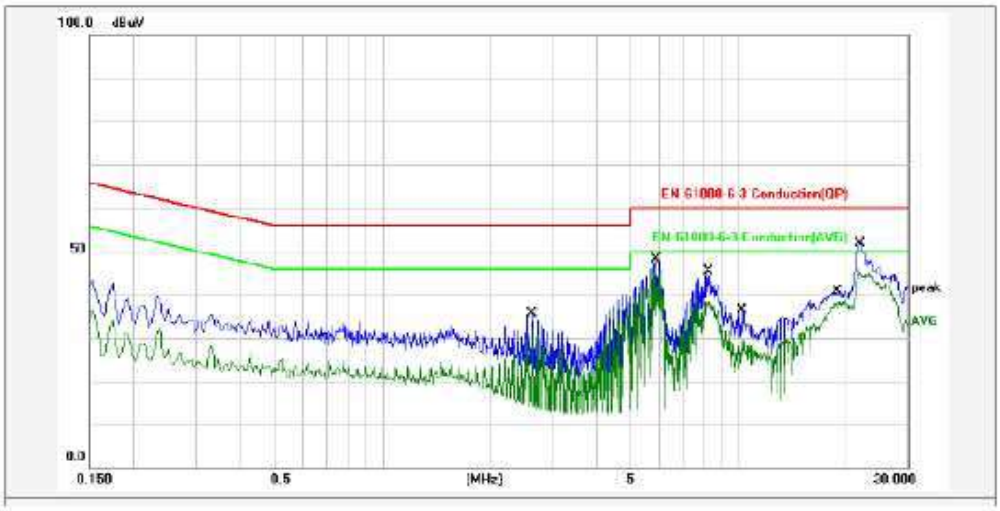
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	26°C	Relative Humidity :	55 %
Pressure :	1006 hPa	Test Voltage :	DC 420V
Test Mode :	Battery+Full Load+PV	Phase:	Line



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	2.6499	10.32	25.28	35.60	56.00	-20.40	QP	P	
2	2.6499	10.32	21.87	32.19	46.00	-13.81	AVG	P	
3	5.9140	10.34	37.84	48.18	60.00	-11.82	QP	P	
4	5.9140	10.34	35.83	46.17	50.00	-3.83	AVG	P	
5	8.2897	10.35	34.96	45.31	60.00	-14.69	QP	P	
6	8.2897	10.35	27.99	38.34	50.00	-11.66	AVG	P	
7	10.2139	10.35	26.10	36.45	60.00	-23.55	QP	P	
8	10.2139	10.35	19.31	29.66	50.00	-20.34	AVG	P	
9	19.0416	10.54	30.45	40.99	60.00	-19.01	QP	P	
10	19.0416	10.54	27.81	38.35	50.00	-11.65	AVG	P	
11	22.0140	10.59	41.32	51.91	60.00	-8.09	QP	P	
12	22.0140	10.59	35.16	45.75	50.00	-4.25	AVG	P	

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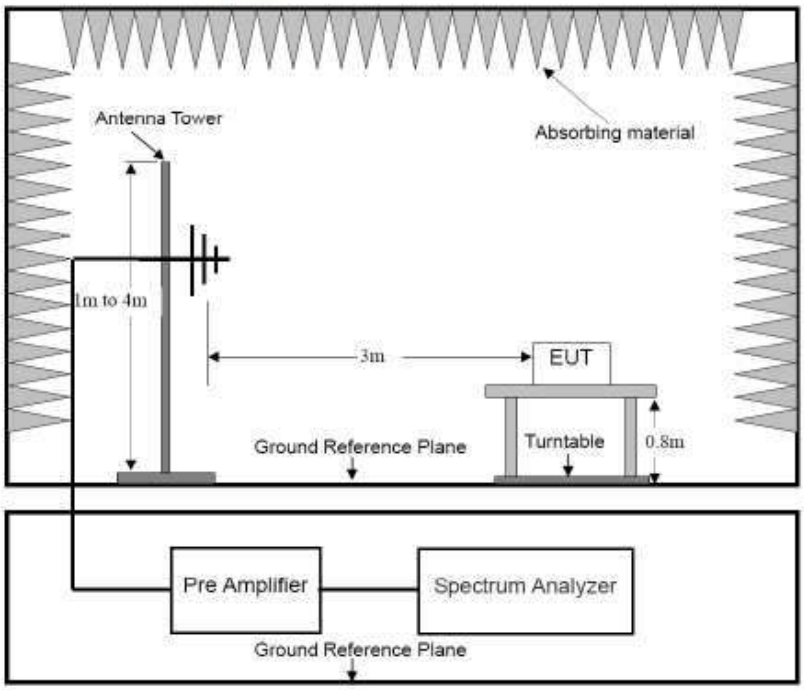
5. RADIATED EMISSION MEASUREMENT

5.1 Block Diagram of Test



5.2 Limit of Radiated Emission Measurement

Test Standard: EN 61000-6-3

Limits for radiated disturbance at a measuring distance of 3m

Frequency range MHz	Quasi-peak limits dB(uV/m)
30 to 230	40
230 to 1000	47
Note 1 The lower limit shall apply at the transition frequency. Note 2 If the internal emission source is operating at a frequency below 9KHz, then measurements need only to be performed up to 230MHz	

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5.3 Test Procedure

E.U.T. and its simulators are placed on a turntable, which is 0.8 meter high above ground. The turntable can rotate 360 degrees to determine the position of the maximum emission level. E.U.T. is set 3.0 meters away from the receiving antenna, which is mounted on a antenna tower. The antenna can be moved up and down between 1.0 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bilog antenna) is used as receiving antenna. Both horizontal and vertical polarization of the antenna is set on measurement. In order to find the maximum emission levels, all of the interface cables must be manipulated according to EN 61000-6-3 on radiated emission measurement.
The bandwidth of the EMI test receiver (R&S ESCI7) is set at 120 KHz.
The frequency range from 30 MHz to 1000 MHz is checked.

5.4 Operating Condition of E.U.T.

5.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

5.4.2 Turn on the power of all equipments.

5.4.3 Let the E.U.T. work in test mode and test it.

5.5 Radiated Emission Measurement Result

PASS.

Please refer to the following pages.

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5.3 Test Procedure

E.U.T. and its simulators are placed on a turntable, which is 0.8 meter high above ground. The turntable can rotate 360 degrees to determine the position of the maximum emission level. E.U.T. is set 3.0 meters away from the receiving antenna, which is mounted on a antenna tower. The antenna can be moved up and down between 1.0 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bilog antenna) is used as receiving antenna. Both horizontal and vertical polarization of the antenna is set on measurement. In order to find the maximum emission levels, all of the interface cables must be manipulated according to EN 61000-6-3 on radiated emission measurement.
The bandwidth of the EMI test receiver (R&S ESCI7) is set at 120 KHz.
The frequency range from 30 MHz to 1000 MHz is checked.

5.4 Operating Condition of E.U.T.

5.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

5.4.2 Turn on the power of all equipments.

5.4.3 Let the E.U.T. work in test mode and test it.

5.5 Radiated Emission Measurement Result

PASS.

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E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	25°C	Relative Humidity :	60 %
Pressure :	1006 hPa	Test Voltage :	DC 48V
Test Mode :	Battery+Full Load	Polarization:	Horizontal

No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	45.5348	-7.79	37.84	30.05	40.00	-9.95	QP			P	
2	53.1313	-11.96	46.10	34.14	40.00	-5.86	QP			P	
3	59.2325	-13.45	44.81	31.36	40.00	-8.64	QP			P	
4	69.8450	-12.08	44.59	32.51	40.00	-7.49	QP			P	
5	112.1305	-5.97	36.44	30.47	40.00	-9.53	QP			P	
6	158.6677	-6.71	37.44	30.73	40.00	-9.27	QP			P	

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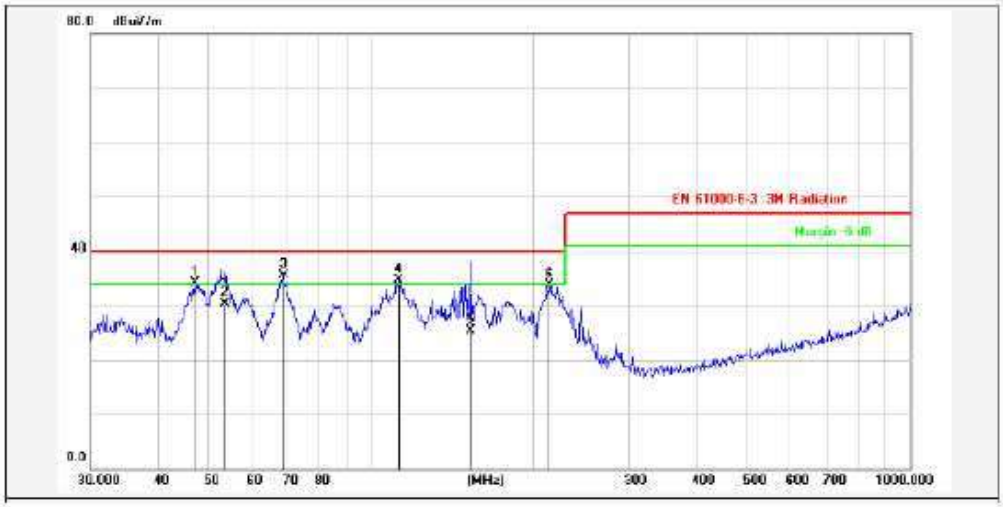
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	25°C	Relative Humidity :	60 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load	Polarization:	Horizontal



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	46.9948	-8.91	42.92	34.01	40.00	-5.99	QP			P	
2	53.4553	-12.03	42.43	30.40	40.00	-9.60	QP			P	
3	68.6310	-12.27	47.74	35.47	40.00	-4.53	QP			P	
4	112.5244	-5.95	40.70	34.75	40.00	-5.25	QP			P	
5	153.7004	-6.51	31.81	25.30	40.00	-14.70	QP			P	
6	214.5143	-7.01	40.76	33.75	40.00	-6.25	QP			P	

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E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	25°C	Relative Humidity :	60 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load	Polarization:	Vertical

No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	33.5624	-4.53	39.54	35.01	40.00	-4.99	QP			P	
2	36.0007	-5.29	39.99	34.70	40.00	-5.30	QP			P	
3	40.1347	-6.62	42.38	35.76	40.00	-4.24	QP			P	
4	44.4308	-8.61	44.03	35.42	40.00	-4.58	QP			P	
5	46.4215	-9.53	45.73	36.20	40.00	-3.80	QP			P	
6	50.2324	-11.26	46.51	35.25	40.00	-4.75	QP			P	

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E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	25°C	Relative Humidity :	60 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load+PV	Polarization:	Vertical

No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	32.2925	-4.12	40.02	35.90	40.00	-4.10	QP			P	
2	40.7552	-6.90	42.30	35.40	40.00	-4.60	QP			P	
3	48.5030	-9.57	45.23	35.66	40.00	-4.34	QP			P	
4	50.5860	-11.34	45.28	33.94	40.00	-6.06	QP			P	
5	53.1313	-11.96	46.62	34.66	40.00	-5.34	QP			P	
6	103.8055	-6.26	42.11	35.85	40.00	-4.15	QP			P	

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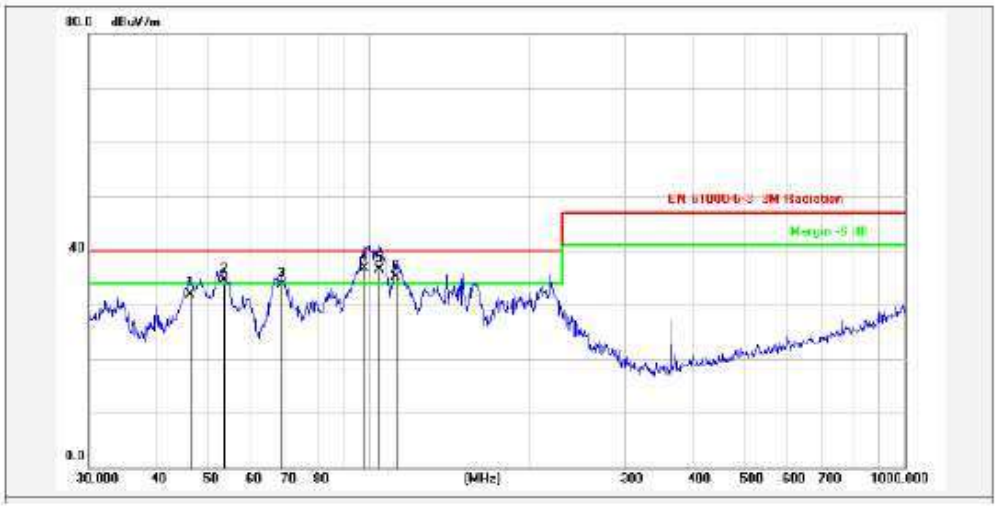
E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	25°C	Relative Humidity :	60 %
Pressure :	1006 hPa	Test Voltage :	AC 230V/50Hz
Test Mode :	Grid+Battery+Full Load+PV	Polarization:	Horizontal



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	46.3402	-8.39	40.32	31.93	40.00	-8.07	QP			P	
2	53.6932	-12.09	46.53	34.44	40.00	-5.56	QP			P	
3	68.8721	-12.23	45.93	33.70	40.00	-6.30	QP			P	
4	98.3086	-6.66	43.36	36.70	40.00	-3.30	QP			P	
5	105.1833	-6.22	42.72	36.50	40.00	-3.50	QP			P	
6	112.1305	-5.97	41.15	35.18	40.00	-4.82	QP			P	

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E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	25°C	Relative Humidity :	60 %
Pressure :	1006 hPa	Test Voltage :	DC 420V
Test Mode :	Battery+Full Load+PV	Polarization:	Vertical

No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	33.0950	-4.37	37.37	33.00	40.00	-7.00	QP			P	
2	36.1272	-5.33	40.64	35.31	40.00	-4.69	QP			P	
3	39.9170	-6.52	42.92	36.40	40.00	-3.60	QP			P	
4	46.5656	-9.60	44.60	35.00	40.00	-5.00	QP			P	
5	49.1865	-10.82	46.96	36.14	40.00	-3.86	QP			P	
6	106.3850	-6.17	41.81	35.64	40.00	-4.36	QP			P	

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Dongguan Nore Testing Center Co., Ltd.
Report No.: NTC1610635E

E.U.T :	Hybrid Solar Inverter	Model Name :	InfiniSolar E 5.5KW
Temperature :	25°C	Relative Humidity :	60 %
Pressure :	1006 hPa	Test Voltage :	DC 420V
Test Mode :	Battery+Full Load+PV	Polarization:	Vertical

No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	33.0950	-4.37	37.37	33.00	40.00	-7.00	QP			P	
2	36.1272	-5.33	40.64	35.31	40.00	-4.69	QP			P	
3	39.9170	-6.52	42.92	36.40	40.00	-3.60	QP			P	
4	46.5656	-9.60	44.60	35.00	40.00	-5.00	QP			P	
5	49.1865	-10.82	46.96	36.14	40.00	-3.86	QP			P	
6	106.3850	-6.17	41.81	35.64	40.00	-4.36	QP			P	

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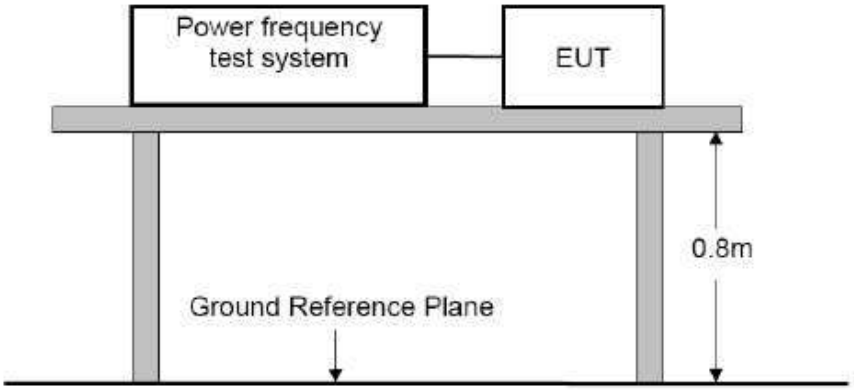
6. HARMONIC CURRENT EMISSION TEST

6.1 Block Diagram of Test Setup



6.2 Limits of Harmonics current measurement

Test Standard: EN 61000-3-12

Current emission limits for equipment other than balanced three-phase equipment

Minimal R_{sce}	Admissible individual harmonic current I_n/I_1 [a] %						Admissible harmonic current distortion factors %	
	I_3	I_5	I_7	I_9	I_{11}	I_{13}	THD	$PWHD$
33	21.6	10.7	7.2	3.8	3.1	2	23	23
66	24	13	8	5	4	3	26	26
120	27	15	10	6	5	4	30	30
250	35	20	13	9	8	6	40	40
≥ 350	41	24	15	12	10	8	47	47

The relative values of even harmonics up to order 12 shall not exceed $16/n$ %. Even harmonics above order 12 are taken into account in THD and $PWHD$ in the same way as odd order harmonics.

NOTE Linear interpolation between successive R_{sce} values is permitted. See also Annex B.

[a] I_1 = reference fundamental current; I_n = harmonic current component.

6.3 Test Procedure

The E.U.T. was put on the top of a wooden table 0.8m above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.

6.4 Operating Condition of E.U.T.

6.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

6.4.2 Turn on the power of all equipments.

6.4.3 Let the E.U.T. work in test mode and test it.

6.5 Test Results

PASS

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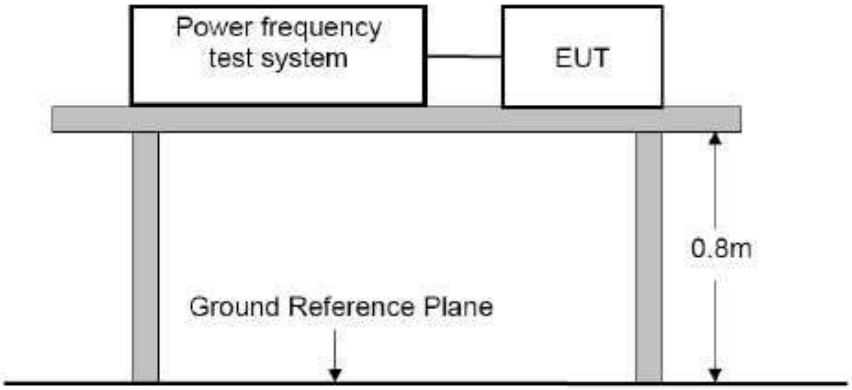
7. VOLTAGE FLUCTUATIONS & FLICKER TEST

7.1 Block Diagram of Test Setup



7.2 Limits of Voltage Fluctuations & Flicker Measurement

Test Standard: EN 61000-3-11

The following limits apply:

- the value of the short-term flicker indicator, Pst shall not be greater than 1,0;
- the value of the long-term flicker indicator, Plt shall not be greater than 0,65;
- the value of d(t) during a voltage change shall not exceed 3,3% for more than 500ms;
- the relative steady-state voltage change, dc, shall not exceed 3,3%;
- the maximum relative voltage change dmax, shall not exceed:
  a) 4% without additional conditions;
  b) 6% for equipment with:
- manual switching, or
- automatic switching more frequently than twice per day and having a delayed restart (the delay being not less than a few tens of seconds) or, manual restart after a power supply interruption.

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c) 7% for equipment which

- is attended whilst in use (for example: hair dryers, vacuum cleaners, kitchen equipment such as mixers, garden equipment such as lawnmowers, portable tools such as electric drills); or
- is switched on automatically, or is intended to be switched on manually, no more than twice per day and has a delayed restart (the delay being not less than a few tens of seconds) or manual restart after a power supply interruption.

In the case of equipment incorporating multiple loads, limits b) and c) shall only apply if there is delayed or manual restart after a power supply interruption; for all equipment with automatic switching which is energized immediately on restoration of supply after a power supply interruption, limits a) shall apply; for all equipment with manual switching, limits b) or c) shall apply, depending on the rate of switching.

Pst and Plt requirements shall not be applicable to voltage changes caused by manual switching.

The limits shall not be applicable to emergency switching or emergency operations.

7.3 Test Procedure

The E.U.T. was put on the top of a wooden table 0.8m above the ground and operated to produce the most unfavorable sequence of voltage changes under normal operating conditions.

7.4 Operating Condition of E.U.T.

7.4.1 Setup the E.U.T. and simulators as shown in Section 2.3.

7.4.2 Turn on the power of all equipments.

7.4.3 Let the E.U.T. work in test mode and test it.

7.5 Test Results

PASS.

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8. PERFORMANCE CRITERIA FOR IMMUNITY

The performance criteria are referred to the test standard: EN 61000-6-2

The variety and the diversity of the apparatus within the scope of this standard makes it difficult to define precise criteria for the evaluation of the immunity test results.
If, as a result of the application of the tests defined in this standard, the apparatus becomes dangerous or unsafe, the apparatus shall be deemed to have failed the test.
A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report.

Performance Criterion A:
The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonable except from the apparatus if used as intended.

Performance Criterion B:
The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operation state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance Criteria C
Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

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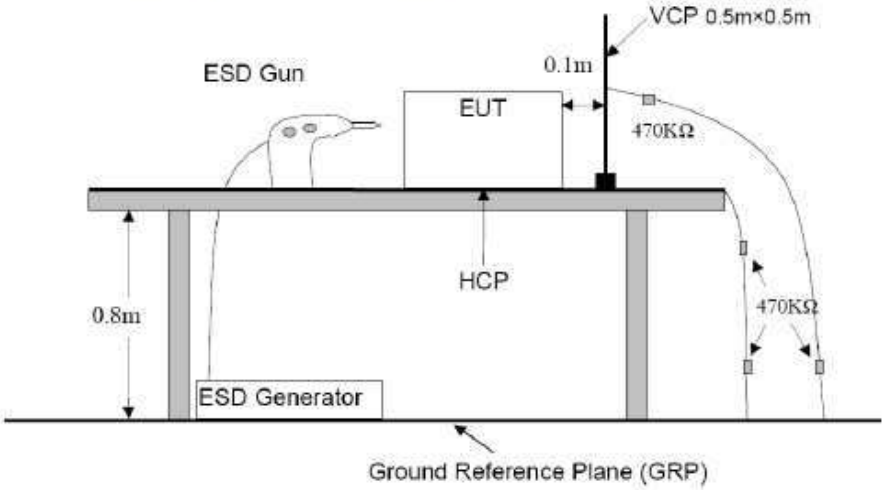
9. ELECTROSTATIC DISCHARGE TEST

9.1 Block Diagram of Test Setup



9.2 Test Standard and Severity Levels

9.2.1 Test Standard:
EN 61000-6-2
(EN 61000-4-2 Air Discharge: Severity Level: 3, ± 8KV;
Contact Discharge: Level: 2, ± 4KV)

9.2.2 Severity Levels:

Level	Test Voltage Contact Discharge (KV)	Test Voltage Air Discharge (KV)
1.	±2	±2
2.	±4	±4
3.	±6	±8
4.	±8	±15
X	Special	Special

9.3 Test Procedure

9.3.1 Air Discharge:

This test is done on a non-conductive surface. The round discharge tip of the discharge electrode shall be approached as fast as possible to touch the E.U.T.. After each discharge, the discharge electrode shall be removed from the E.U.T.. The generator is then re-triggered for a new single discharge and repeated 10 times for each pre-selected test point. This procedure shall be repeated until all the air discharge completed

9.3.2 Contact Discharge:

All the procedure shall be same as Section 9.3.1. except that the tip of the discharge electrode shall touch the E.U.T..

9.3.3 Indirect discharge for horizontal coupling plane

At least 10 single discharges(in the most sensitive polarity) shall be applied at the front edge of each HCP opposite the center point of each unit(if applicable) of the E.U.T. and 0.1m from the front of the E.U.T.. The long axis of the discharge electrode shall be in the plane of the HCP and perpendicular to its front edge during the discharge.

9.3.4 Indirect discharge for vertical coupling plane

At least 10 single discharge (in the most sensitive polarity) shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the E.U.T.. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the E.U.T. are completely illuminated.

9.4 Test Results

PASS.

Please refer to the following page.

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Dongguan Nore Testing Center Co., Ltd.
Report No.: NTC1610635E

Electrostatic Discharge Test Results

Ambient Condition:	Temp.: 25 ℃	R.H.: 51 %	Air Pressure: 101 kPa
Power Supply:	AC 230V/50Hz; DC 48V, DC 420V	Required Performance Criterion:	B
Test Specifications:	±2, 4 kV Contact Discharge; ±2, 4, 8 kV Air Discharge For each point positive 10 times and negative 10 times		
Tested mode:	Grid+Battery+Full Load, Battery+Full Load, Grid+Battery+Full Load+PV, Battery+Full Load+PV		

Test Point	Kind A-Air Discharge C-Contact Discharge	Result (Performance Criterion)
Slot of EUT	A	A
Screen	A	A
Metal	C	A
Button	A	A
Indirect Discharge (HCP)	C	A
Indirect Discharge (VCP)	C	A

Note:

Test Equipment : ESD Tester (TESEQ, NSG 437) Test Engineer : Stan

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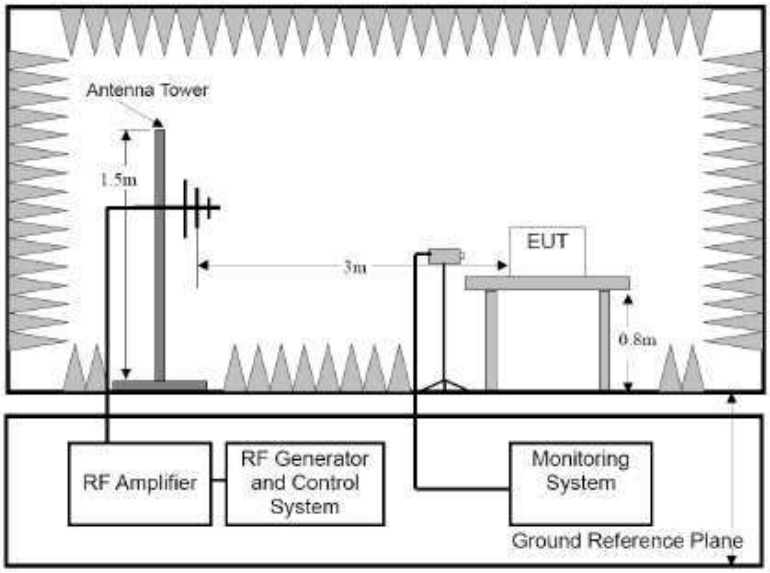
10. RF FIELD STRENGTH SUSCEPTIBILITY TEST

10.1 Block Diagram of Test Setup



10.2 Test Standard and Severity Levels

10.2.1 Test Standard

EN 61000-6-2
(EN 61000-4-3,
80 to 1000MHz Severity Level: 3, 10V/m;
1.4 to 2.0GHz Severity Level: 2, 3V/m;
2.0 to 2.7GHz Severity Level: 1, 1V/m)

10.2.2 Severity Levels

Level	Field Strength V/m
1.	1
2.	3
3.	10
X	Special

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10.3 Test Procedure

The E.U.T. and its simulators are placed on a turn table which is 0.8 meter above ground. E.U.T. is set 3 meter away from the transmitting antenna which is mounted on an antenna tower. Both horizontal and vertical polarization of the antenna are set on test. Each of the four sides of E.U.T. must be faced this transmitting antenna and measured individually.
All the scanning conditions are as follows :

Condition of Test	Remarks
1. Fielded Strength	80 to 1000MHz Severity Level: 3, 10V/m; 1.4 to 2.0GHz Severity Level: 2, 3V/m; 2.0 to 2.7GHz Severity Level: 1, 1V/m
2. Radiated Signal	Modulated
3. Dwell time of radiated	0.0015 decade/s
4. Waiting Time	1 Sec.

10.4 Test Results

PASS.

Please refer to the following page.

RF Field Strength Susceptibility Test Results

Ambient Condition:	Temp.: 25 ℃	R.H.: 51 %	Air Pressure: 101 kPa	
Power Supply:	AC 230V/50Hz; DC 48V, DC 420V	Required Performance Criterion: A		
Test Specifications:	Modulation: 1kHz, 80%AM;	Step Size: 1%;	Dwell Time: 1s	
Tested mode:	Grid+Battery+Full Load, Battery+Full Load, Grid+Battery+Full Load+PV, Battery+Full Load+PV			
Frequency (MHz)	Level (V/m)	Antenna polarity	Side	Result (Performance Criterion)
80-1000	10	Horizontal/ Vertical	Front/ Left/ Right/ Back	A
1400-2000	3			A
2000-2700	1			A
Note:				

Test Equipment :
1. RF Power Meter : 4242 (ESE)
2. Power Amplifier : CBA 1G-150 (TESEQ)
3. Power Sensor: 51011EMC(ESE)
4. Antenna: VULB9162 (Schwarzbeck)

Test Engineer : Stan

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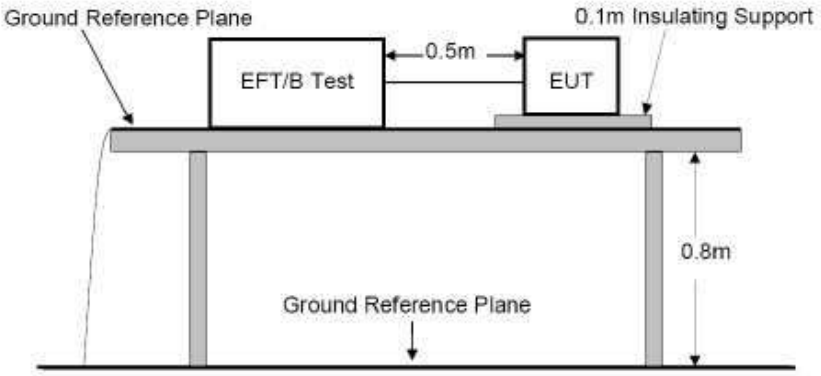
11.ELECTRICAL FAST TRANSIENT/BURST TEST

11.1 Block Diagram of Test Setup



11.2 Test Standard and Severity Levels

11.2.1 Test Standard

EN 61000-6-2
(EN 61000-4-4, Severity Level, Level 3: 2KV)

11.2.2 Severity level

Open circuit output test voltage and repetition rate of the impulses				
Level	On power port, PE		On I/O (Input/Output) Signal data and control ports	
	Voltage peak KV	Repetition rate KHz	Voltage peak KV	Repetition rate KHz
1.	0.5	5 or 100	0.25	5 or 100
2.	1.0	5 or 100	0.5	5 or 100
3.	2.0	5 or 100	1.0	5 or 100
4.	4.0	5 or 100	2.0	5 or 100
X	Special	Special	Special	Special

Note 1 Use of 5 KHz repetition rates is traditional; however, 100 KHz is closer to reality. Product committees should determine which frequencies are relevant for specific products or product types.

Note 2 With some products, there may be no clear distinction, between power ports and I/O ports, in which case it is up to product committees to make this determination for test purposes.

Note 3 "X" is an open level. The level has to be specified in the dedicated equipment specification.

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11.3 Test Procedure

The E.U.T. is put on the table which is 0.8 meter high above the ground. This reference ground plane shall project beyond the E.U.T. by at least 0.1m on all sides and the minimum distance between E.U.T. and all other conductive structure, except the ground plane beneath the E.U.T., shall be more than 0.5m.

11.3.1 For input and output AC power ports:

The E.U.T. is connected to the power mains by using a coupling device which couples the EFT interference signal to AC power lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 2 minutes.

11.3.2 For signal lines ports:

It's unnecessary to test.

11.3.3 For DC ports:

It's unnecessary to test.

11.4 Test Result

PASS.

Please refer to the following page.

Electrical Fast Transient/Burst Test Results

Ambient Condition:	Temp.: 25 ℃	R.H.: 51 %	Air Pressure: 101 kPa
Power Supply:	AC 230V 50Hz	Required Performance Criterion: B	
Test Specifications:	Repetition Frequency: 5kHz; Duration: 15ms; Period: 300ms		
Test mode:	Grid+Battery+Full Load		
Line : ☒ AC Mains ☐ Signal line ☐ DC line Coupling : ☒ Direct ☐ Capacitive			

Line	Test Voltage	Result (Performance Criterion)
L	±2KV	A
N	±2KV	A
PE	±2KV	A
L、N	±2KV	A
L、PE	±2KV	A
N、PE	±2KV	A
L、N、PE	±2KV	A
Signal line		
DC line		

Note :

Test Equipment : Burst Tester(EM TEST, UCS500N) Test Engineer : Stan

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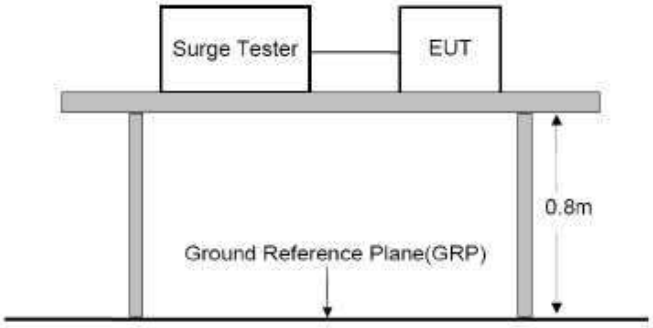
12. SURGE IMMUNITY TEST

12.1 Block Diagram of Test Setup



12.2 Test Standard and Severity Levels

12.2.1 Test Standard

EN 61000-6-2

(EN 61000-4-5, Severity Level: Line To Line, Level 2: 1.0KV
Line To Earth, level 3: 2.0KV)

12.2.2 Severity level

Severity Level	Open-Circuit Test Voltage KV
1	0.5
2	1.0
3	2.0
4	4.0
*	Special

12.3 Test Procedure

1. Set up the E.U.T. and test generator as shown on Section 12.1.
2. For line to line coupling mode, provide a 1.0KV 1.2/50us voltage surge (at open-circuit condition) and 8/20us current surge to E.U.T. selected points. For line to earth coupling mode, provide a 2.0KV 1.2/50us voltage surge (at open-circuit condition) and 8/20us current surge to E.U.T. selected points.

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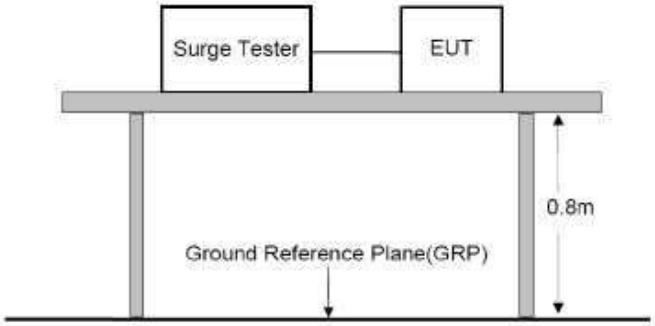
12. SURGE IMMUNITY TEST

12.1 Block Diagram of Test Setup



12.2 Test Standard and Severity Levels

12.2.1 Test Standard

EN 61000-6-2
(EN 61000-4-5, Severity Level: Line To Line, Level 2: 1.0KV
Line To Earth, level 3: 2.0KV)

12.2.2 Severity level

Severity Level	Open-Circuit Test Voltage KV
1	0.5
2	1.0
3	2.0
4	4.0
*	Special

12.3 Test Procedure

1. Set up the E.U.T. and test generator as shown on Section 12.1.
2. For line to line coupling mode, provide a 1.0KV 1.2/50us voltage surge (at open-circuit condition) and 8/20us current surge to E.U.T. selected points. For line to earth coupling mode, provide a 2.0KV 1.2/50us voltage surge (at open-circuit condition) and 8/20us current surge to E.U.T. selected points.

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Dongguan Nore Testing Center Co., Ltd.
Report No.: NTC1610635E

Surge Immunity Test Results

Ambient Condition:	Temp.: 25 ℃	R.H.: 51 %	Air Pressure: 101 kPa
Power Supply:	AC 230V 50Hz	Required Performance Criterion: B	
Test Specifications:	Voltage surge 1.2/50 us ; Current surge 8/20 us .		
Test mode:	Grid+Battery+Full Load		
Line	**Phase Angle**	**Test Voltage**	**Result** (Performance Criterion)
L-N	0°, 90°, 180°, 270°	±1KV	A
L-PE	0°, 90°, 180°, 270°	±2KV	A
N-PE	0°, 90°, 180°, 270°	±2KV	A
Signal line			
DC line			
Note :			
Test Equipment : Burst Tester(EM TEST, UCS500N)			Test Engineer : Stan

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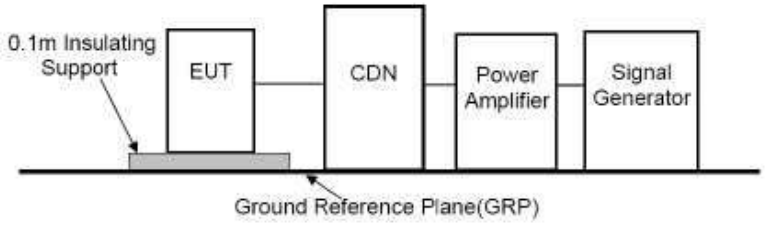
13. INJECTED CURRENTS SUSCEPTIBILITY TEST

13.1 Block Diagram of Test Setup



13.2 Test Standard and Severity Levels

13.2.1 Test Standard

EN 61000-6-2
(EN 61000-4-6, Severity Level 3: 10V (rms),0.15MHz ~ 80MHz)

13.2.2 Severity level

Level	Field Strength V
1.	1
2.	3
3.	10
X	Special

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13.3 Test Procedure

1. Set up the E.U.T., CDN and test generators as shown on Section 13.1.
2. Let the E.U.T. work in test mode and measure it.
3. The E.U.T. are placed on an insulating support 0.1m high above a ground reference plane. CDN (coupling and decoupling device) is placed on the ground plane about 0.3m from E.U.T.. Cables between CDN and E.U.T. are as short as possible, and their height above the ground reference plane shall be between 30 and 50 mm (where possible).
4. The disturbance signal described below is injected to E.U.T. through CDN.
5. The E.U.T. operates within its operational mode(s) under intended climatic conditions after power on.
6. The frequency range is swept from 150 KHz to 80 MHz using 10V signal level, and with the disturbance signal 80% amplitude modulated with a 1KHz sine wave.
7. The rate of sweep shall not exceed $1.5*10^{-3}$decades/s. Where the frequency is swept incrementally, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value.
8. Recording the E.U.T. operating situation during compliance testing and decide the E.U.T. immunity criterion.

13.4 Test Result

PASS.

Please refer to the following page.

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Injected Currents Susceptibility Test Results

Ambient Condition:	Temp.: 25 ℃	R.H.: 51 %	Air Pressure: 101 kPa
Power Supply:	AC 230V 50Hz	Required Performance Criterion: A	
Test Specifications:	Modulation : 1KHz, 80%AM, Step Size : 1%, Dwell Time : 3s		
Test mode:	Grid+Battery+Full Load		
Test Port	Frequency (MHz)	Level(V)	Result (Performance Criterion)
AC Mains	0.15~80	10	A
Note :			
Test Equipment : CDN (Luthi, L-801M2/M3)		Test Engineer : Stan	

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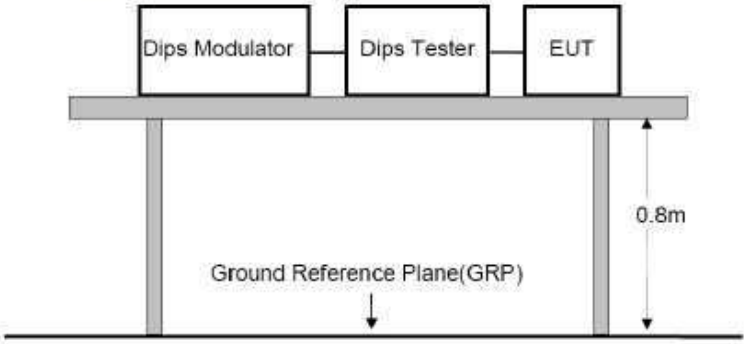
14.VOLTAGE DIPS AND INTERRUPTIONS TEST

14.1 Block Diagram of Test Setup



14.2 Test Standard and Severity Levels

14.2.1 Test Standard

EN 61000-6-2
(EN 61000-4-11)

14.2.2 Severity level

Test Level %UT	Voltage dip and short interruptions %UT	Duration (in period)
0	100	0.5 1 5 10 25 50 *
40	60	
70	30	

14.3 Test Procedure

1. Set up the E.U.T. and test generator as shown on Section 14.1.
2. The interruption is introduced at selected phase angles with specified duration.
3. Record any degradation of performance.

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14.4 Test Result

PASS.

Please refer to the following page.

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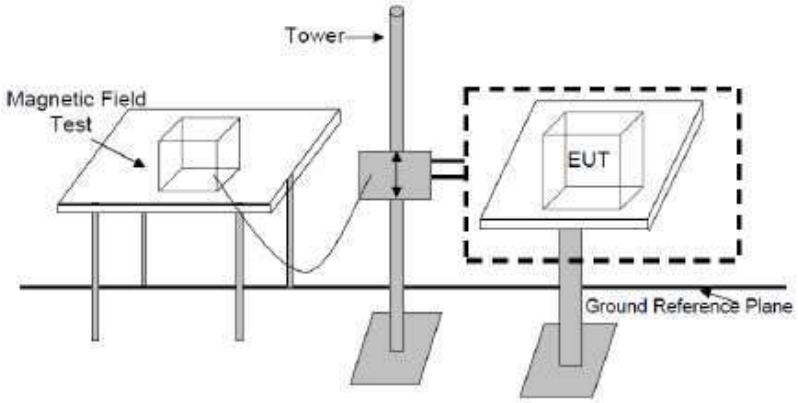
Voltage Dips And Interruptions Test Results

Ambient Condition:	Temp.: 25 ℃		R.H.: 51 %	Air Pressure: 101 kPa
Power Supply:	AC 230V 50Hz		Required Performance Criterion: B & C	
Test Specifications:	0%U_T, 1Cycle; 40%U_T, 10/12Cycles at 50/60Hz ; 70% U_T , 25/30Cycles at 50/60Hz; 0%U_T, 250/300Cycles at 50/60Hz;			
Test mode:	Grid+Battery+Full Load			
Test Level % UT	**Duration (in period)**		**Result** (Performance Criterion)	
	50Hz	**60Hz**		
0	1	–	A	
40	10	–	A	
70	25	–	A	
0	250	–	A	
Note :				
Test Equipment : Dips Tester: EM TEST, UCS 500N			Test Engineer : Stan	

15.MAGNETIC FIELD IMMUNITY TEST

15.1 Block Diagram of Test Setup



15.2 Test Standard and Severity Levels

15.2.1 Test Standard

EN 61000-6-2
(EN 61000-4-8: 2010, Severity level 4: 30A/m)

15.2.2 Severity level

Level	Magnetic Field Strength A/m
1	1
2	3
3	10
4	30
5	100
X	Special

15.3 Test Procedure

The E.U.T. is placed in the middle of a induction coil (1*1m), under which is a 1*1*0.1m (high) table, this small table is also placed on a larger table, 0.8m above the ground. X, Y and Z polarization of the induction coil are set on test, so that each side of the E.U.T. is affected by the magnetic field. Also can reach the same aim by change the position of the E.U.T..

15.4 Test Result

PASS.

Please refer to the following page.

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Magnetic Field Immunity Test Results

Ambient Condition:	Temp.: 25 ℃		R.H.: 51 %	Air Pressure: 101 kPa
Power Supply:	AC 230V/50Hz; DC 48V, DC 420V		Required Performance Criterion: A	
Test Specifications:	30A/m 50/60Hz			
Test mode:	Grid+Battery+Full Load, Battery+Full Load, Grid+Battery+Full Load+PV, Battery+Full Load+PV			
Test Level	**Testing Duration**	**Coil Orientation**	**Result** (Performance Criterion)	
30A/m	5min	X	A	
30A/m	5min	Y	A	
30A/m	5min	Z	A	
Note :				
Test Equipment : Magnetic Field Tester (EMC PARTNER, TRA2000) Test Engineer : Stan				

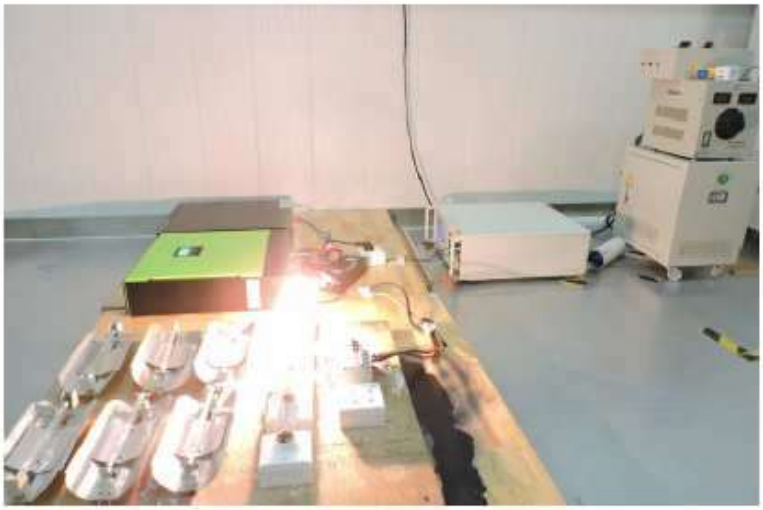
16.PHOTOGRAPH

16.1 Photo of Conducted Emission Measurement

16.2 Photo of Radiation Emission Measurement

16.3 Photo of Electrostatic Discharge Test

16.4 Photo of Electrical Fast Transient /Surge /Voltage Dips Test



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APPENDIX I
(Photos of E.U.T.)

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Figure 1
General Appearance of the E.U.T.

Figure 2
General Appearance of the E.U.T.

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Figure 3
General Appearance of the E.U.T.

Figure 4
General Appearance of the E.U.T.

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Figure 5
General Appearance of the E.U.T.

Figure 6
General Appearance of the E.U.T.

Figure 7
General Appearance of the E.U.T.

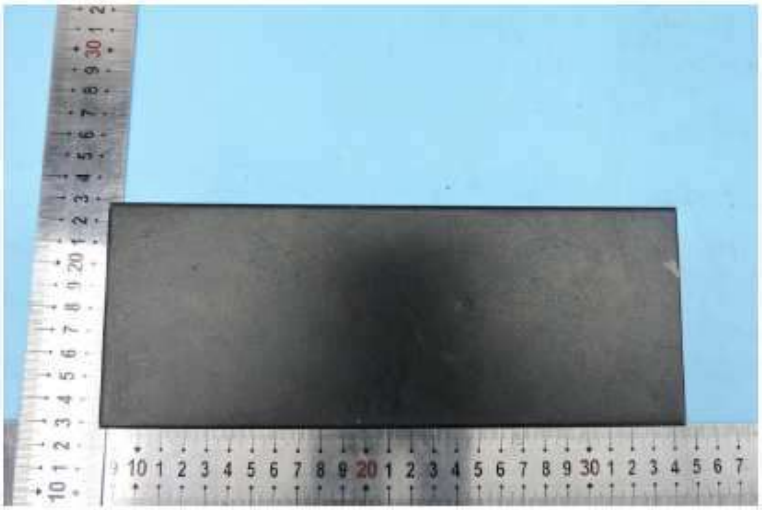

Figure 8
General Internal of the E.U.T.

Figure 9
General Internal of the E.U.T.

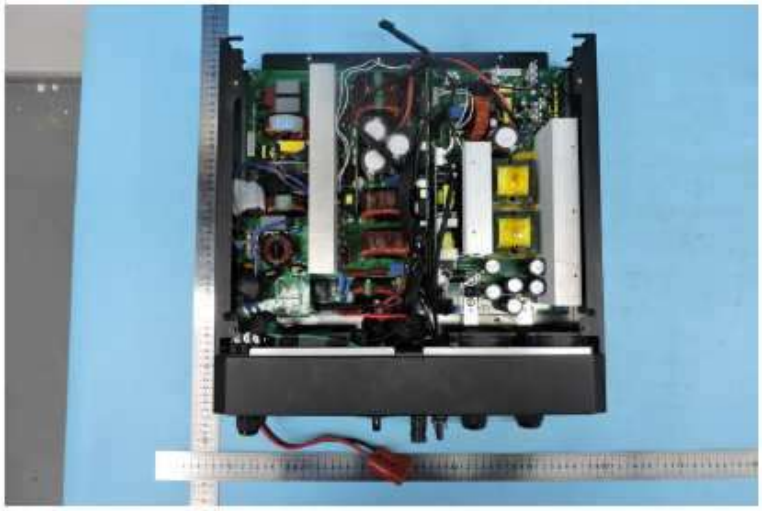

Figure 10
General Appearance of the PCB

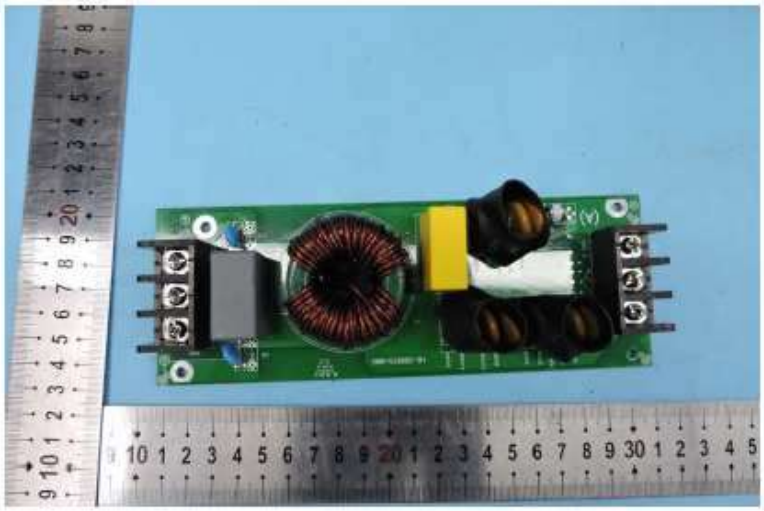

Figure 11
General Appearance of the PCB

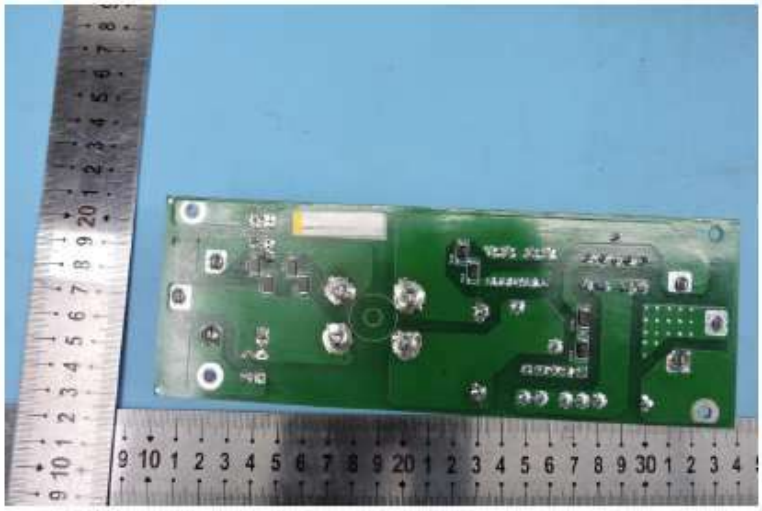

Figure 12
General Appearance of the PCB

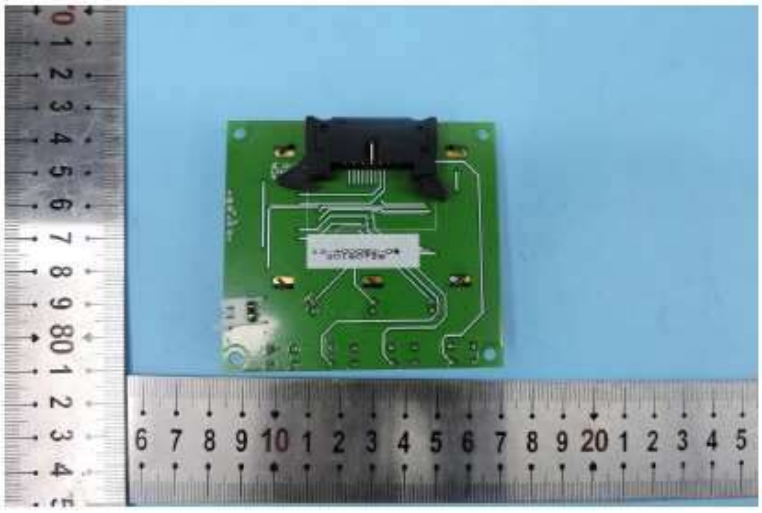

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Figure 13
General Appearance of the PCB

Figure 14
General Appearance of the PCB

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Figure 15
General Appearance of the PCB

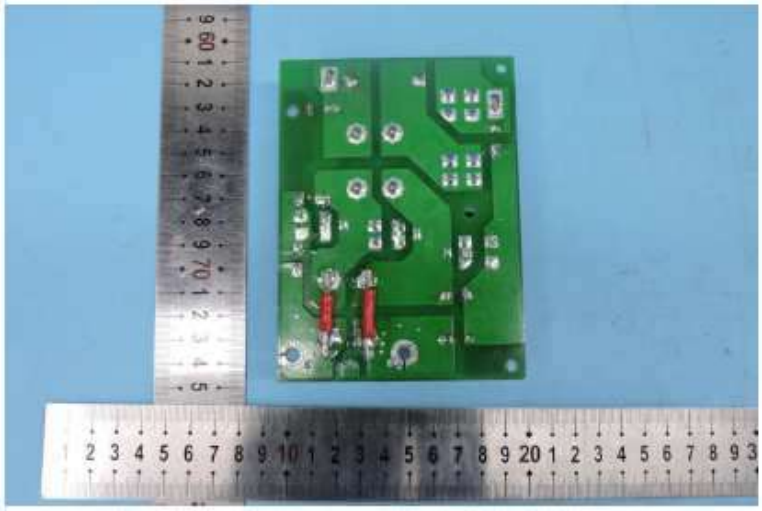

Figure 16
General Appearance of the PCB

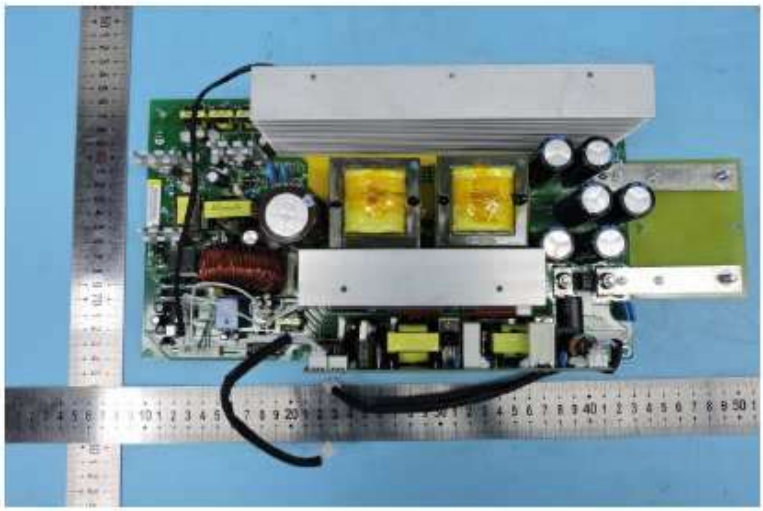

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Figure 17
General Appearance of the PCB

Figure 18
General Appearance of the PCB

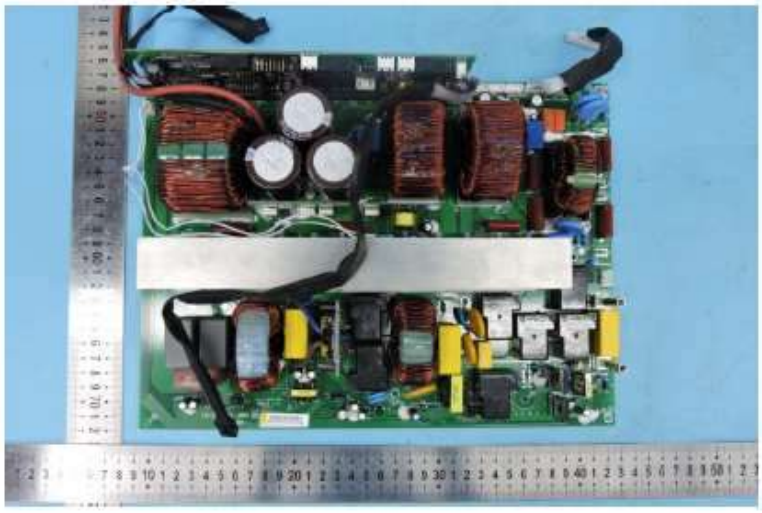

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Figure 19
General Appearance of the PCB

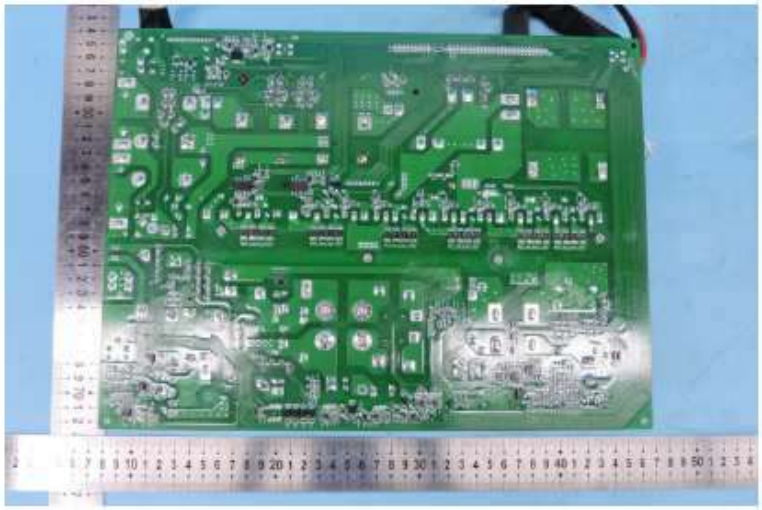

Figure 20
General Appearance of the PCB

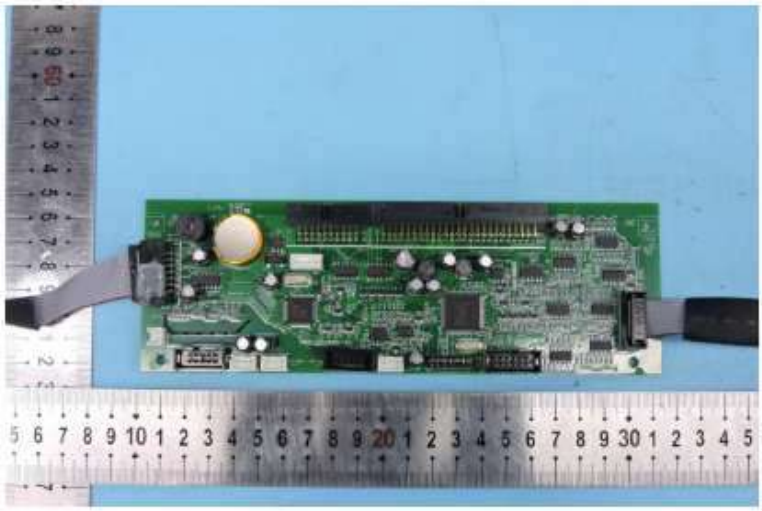

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Figure 21
General Appearance of the PCB

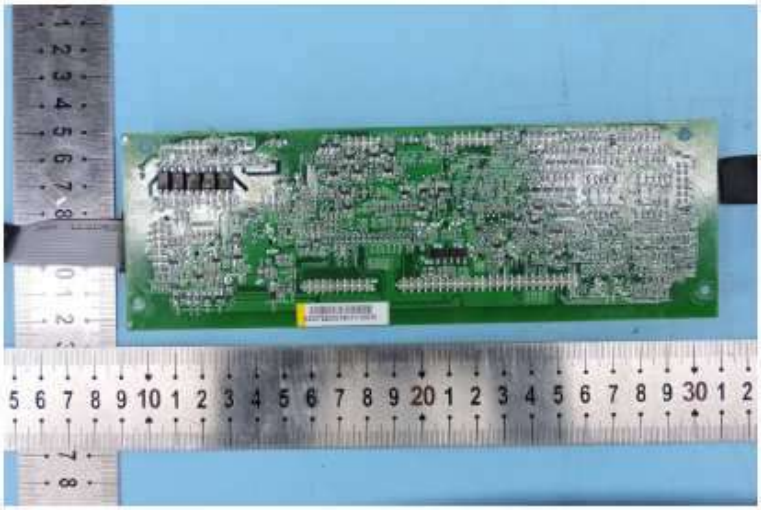

Figure 22
General Appearance of the PCB

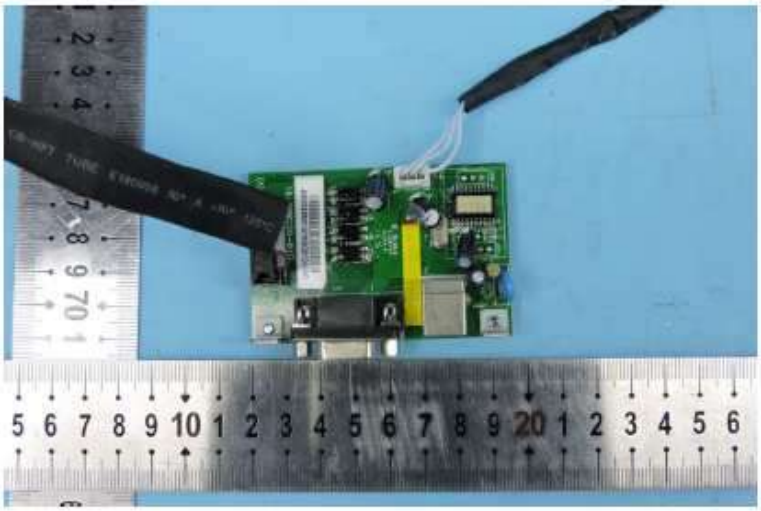

Figure 23
General Appearance of the PCB

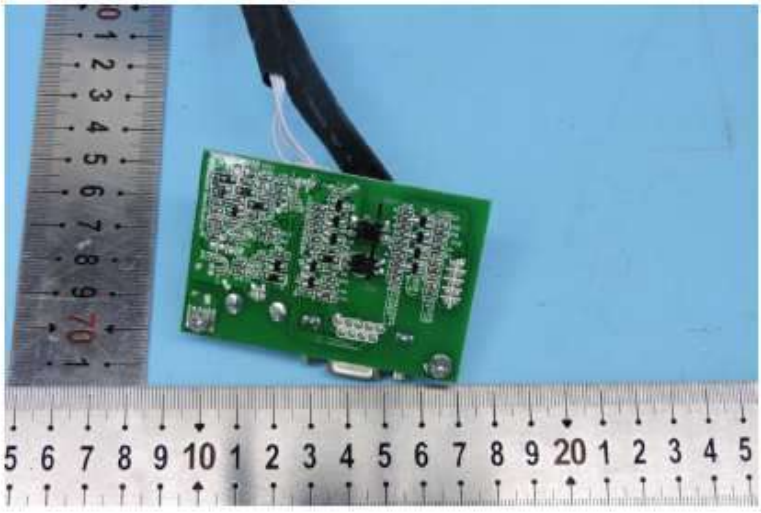

Figure 24
General Appearance of the PCB

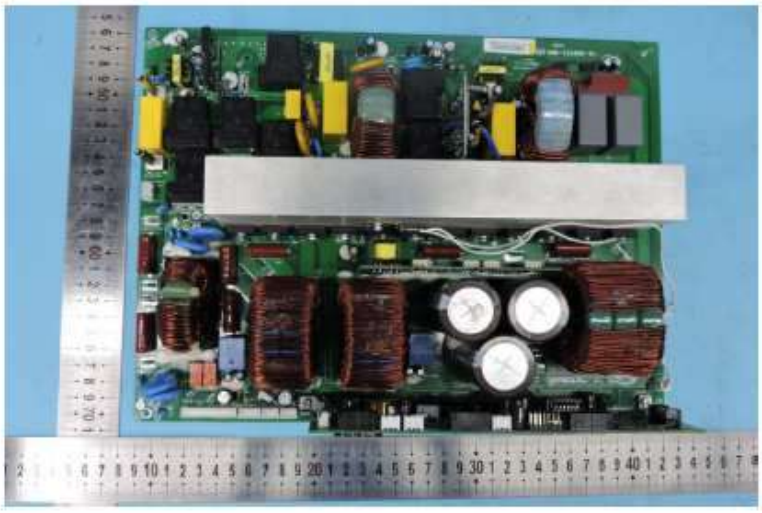

Figure 25
General Appearance of the PCB

Figure 26
General Appearance of the PCB

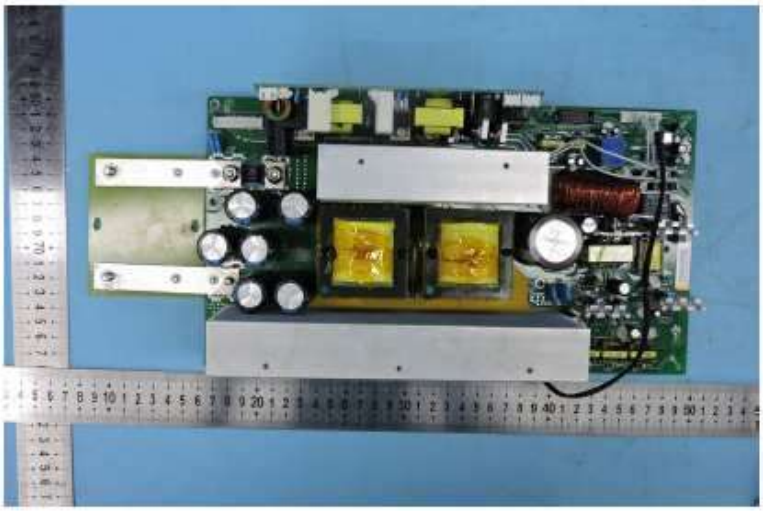

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Figure 27
General Appearance of the PCB

Figure 28
General Appearance of the PCB

---End---

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Annex 2

Pictures of the unit

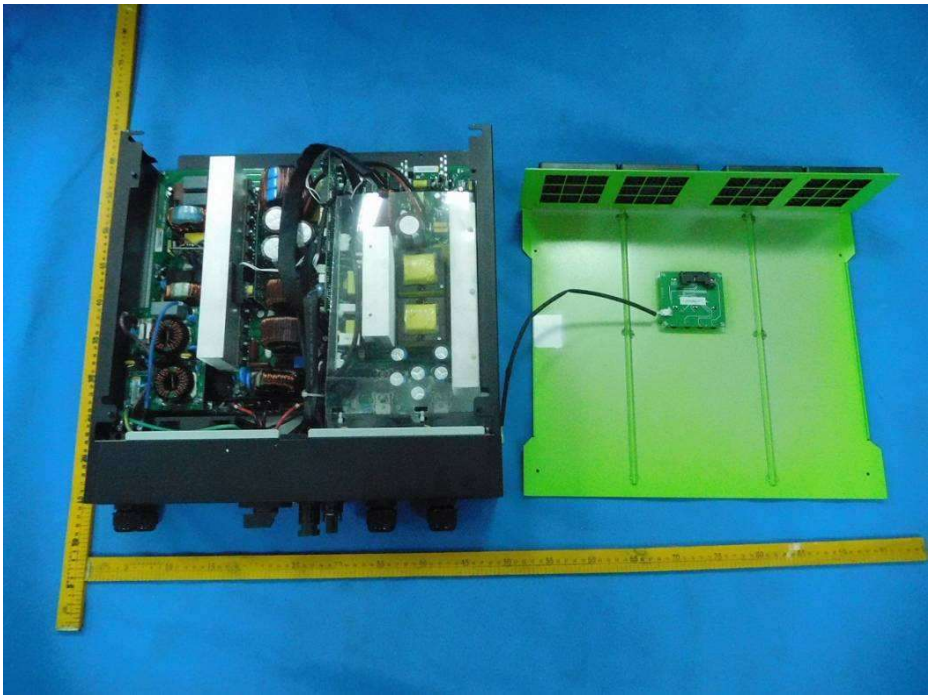
General view - 1

Enclosure front view

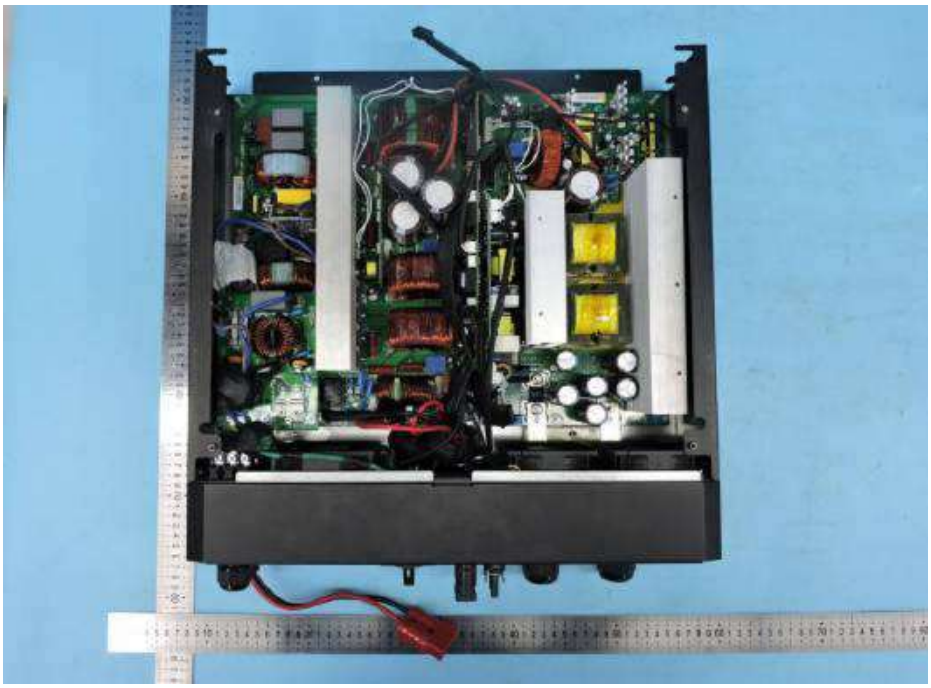
Enclosure back view

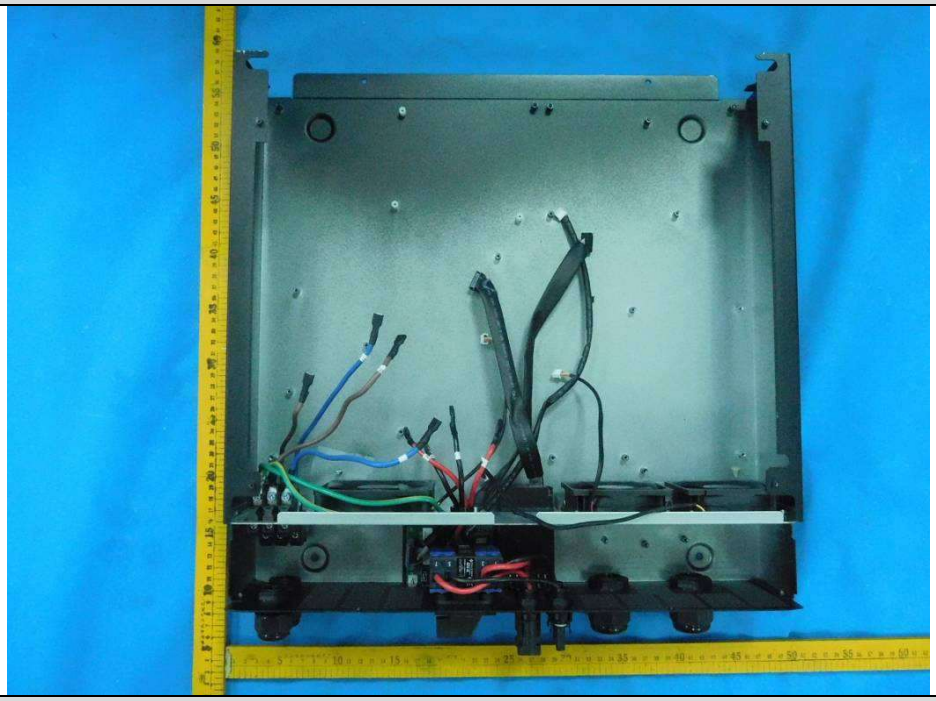
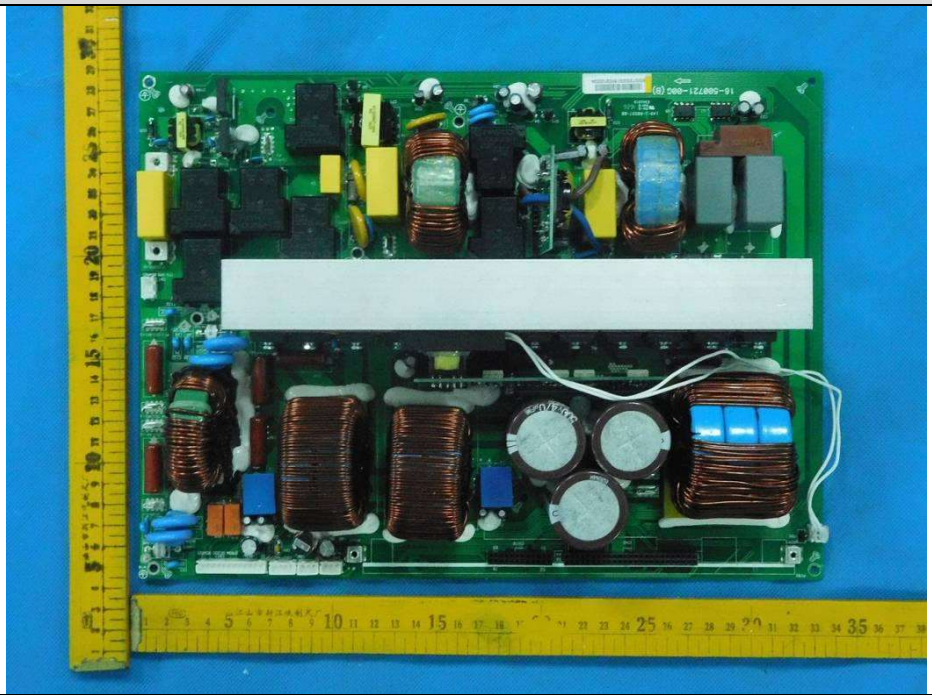
Enclosure terminal view

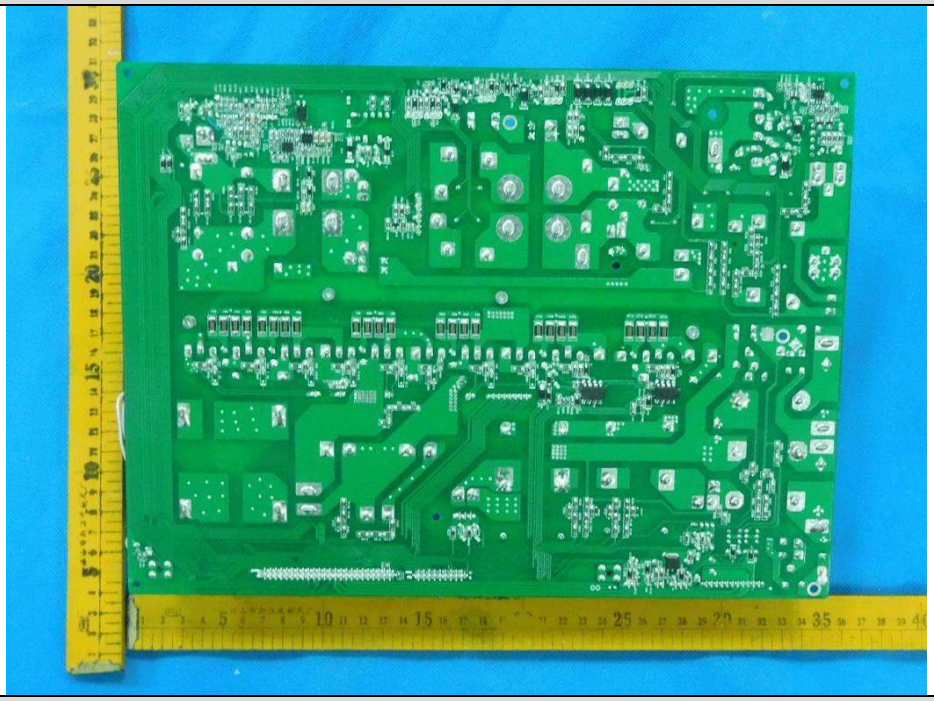
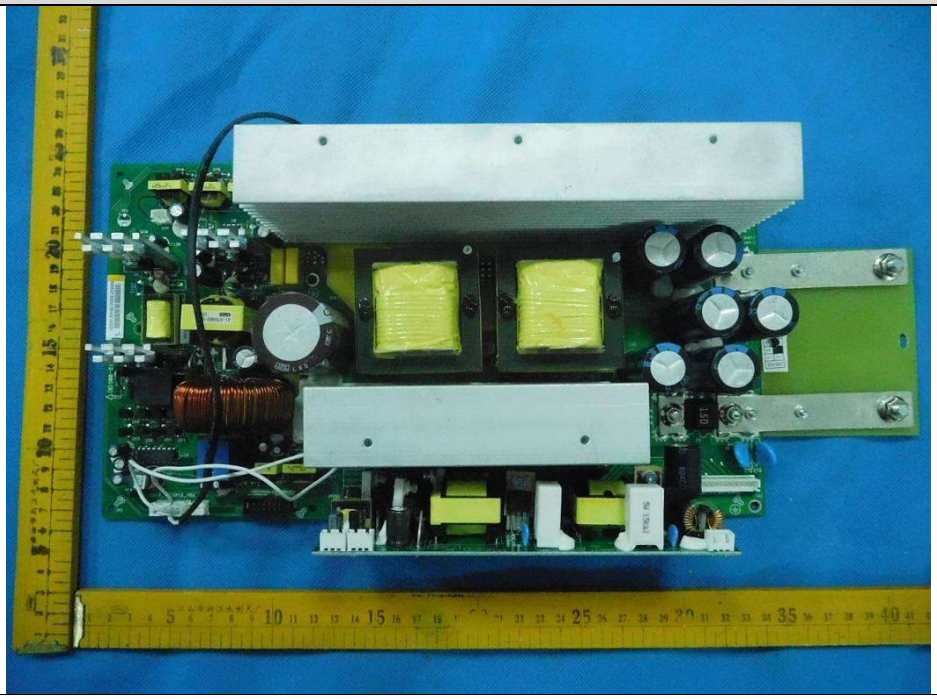
Internal view-1

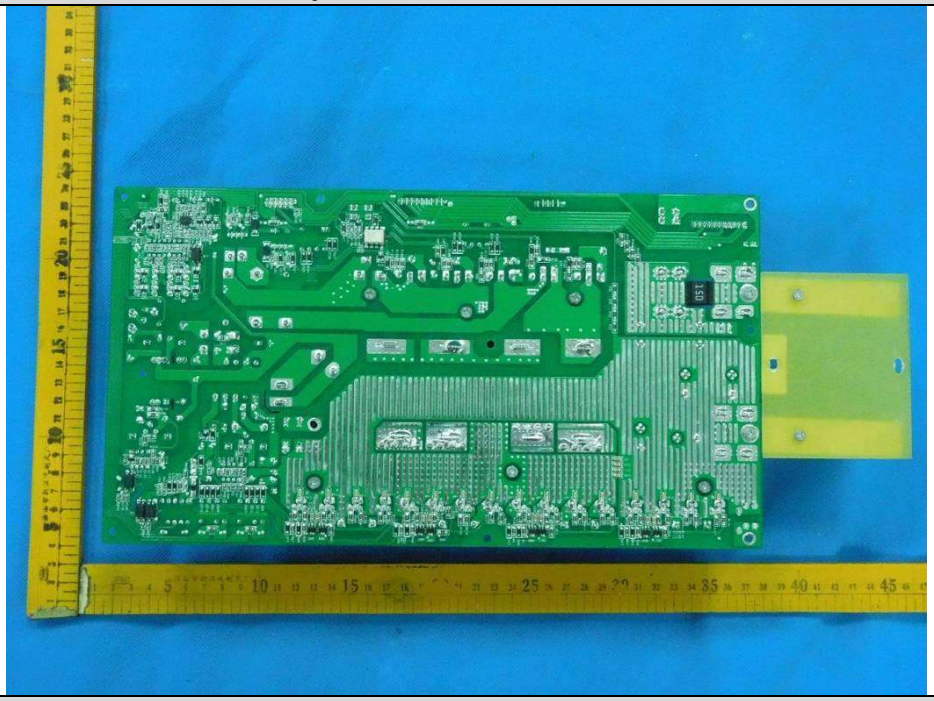
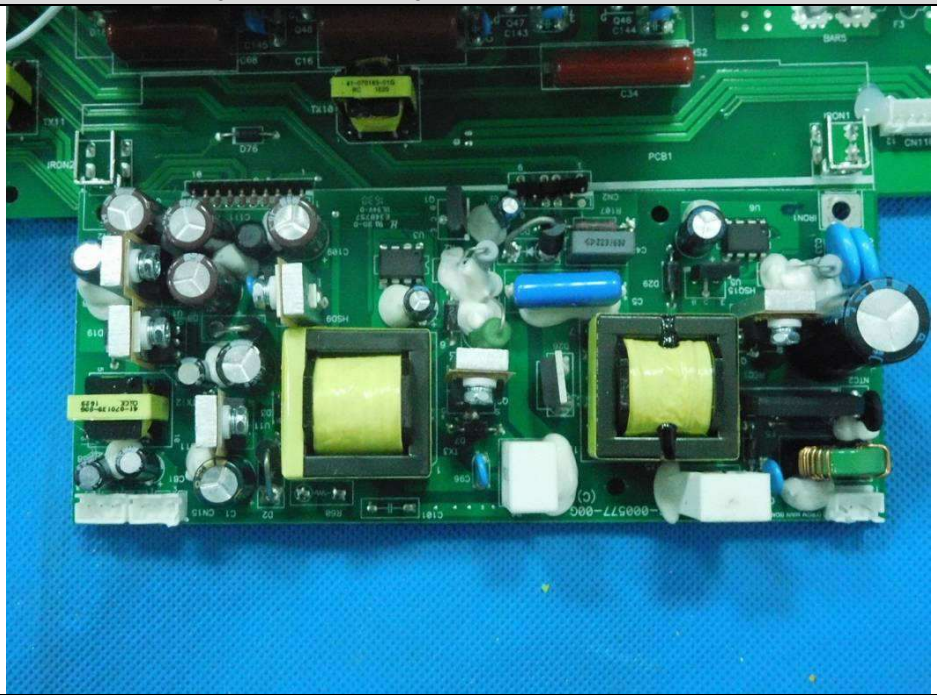


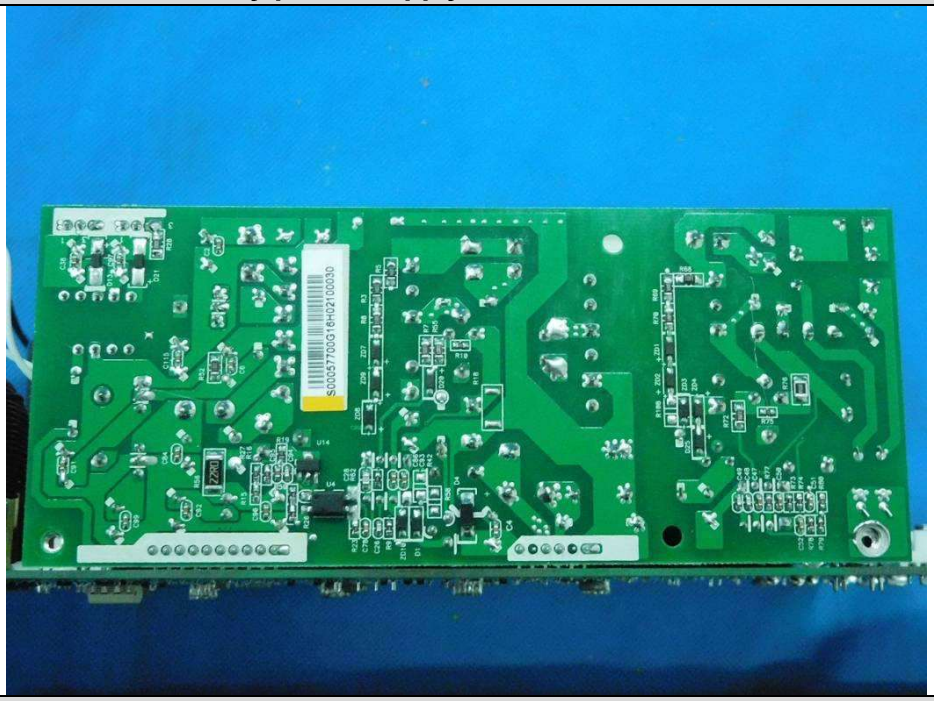
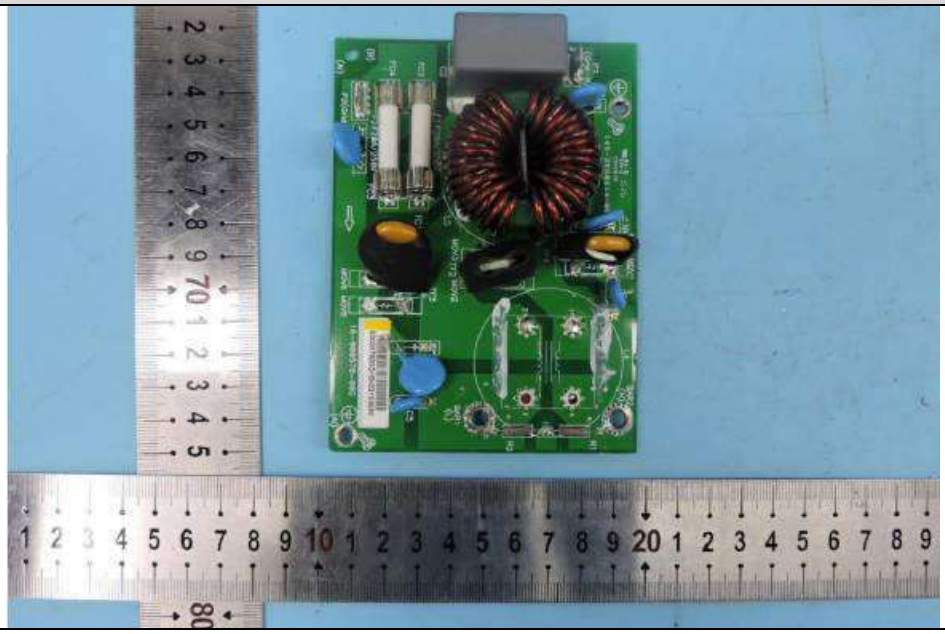
Internal view-2

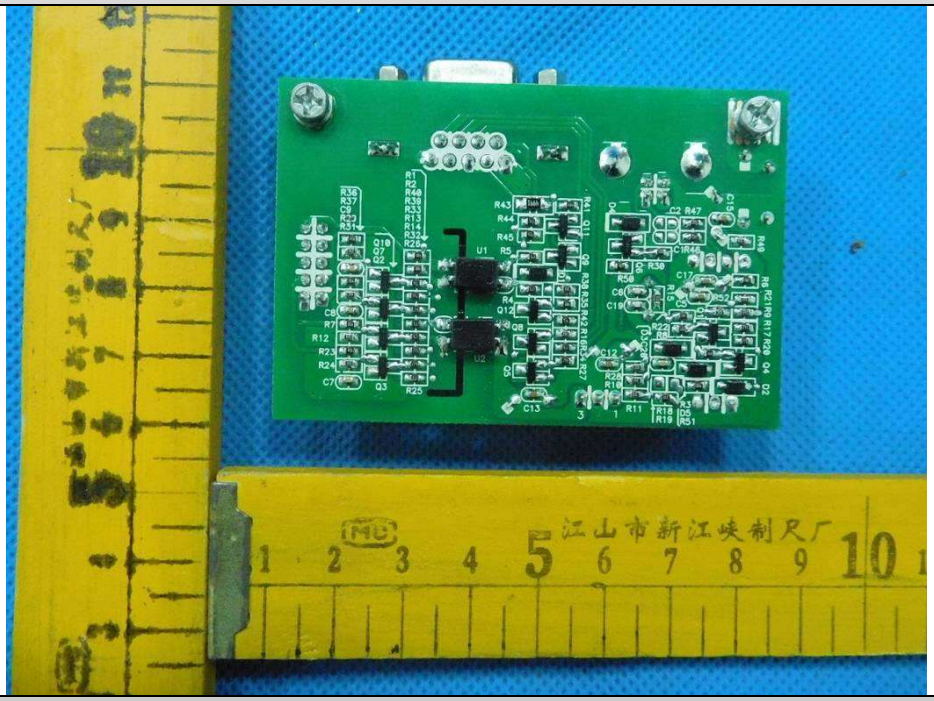
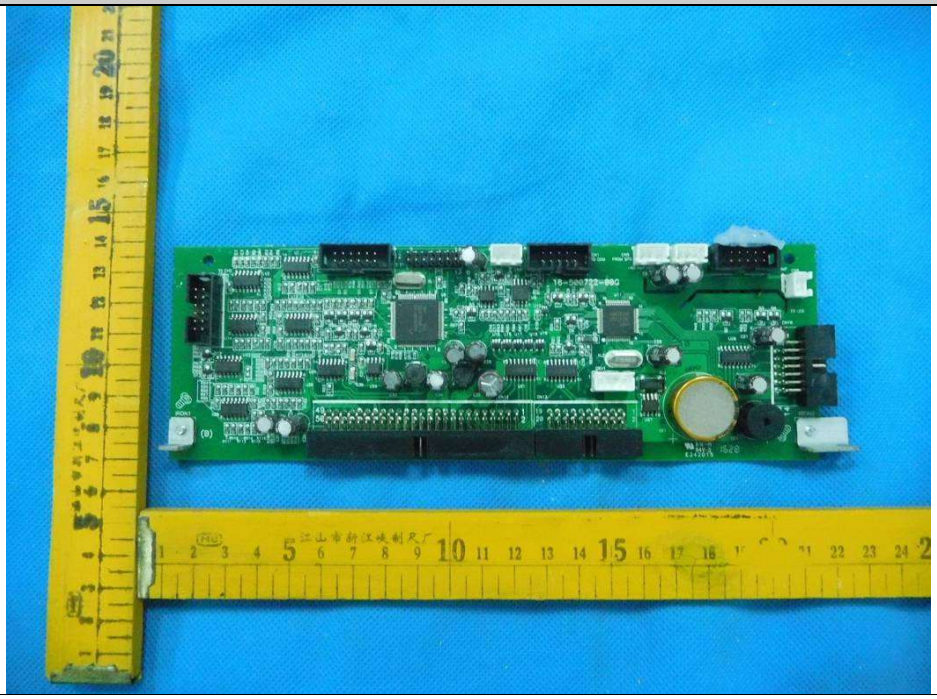


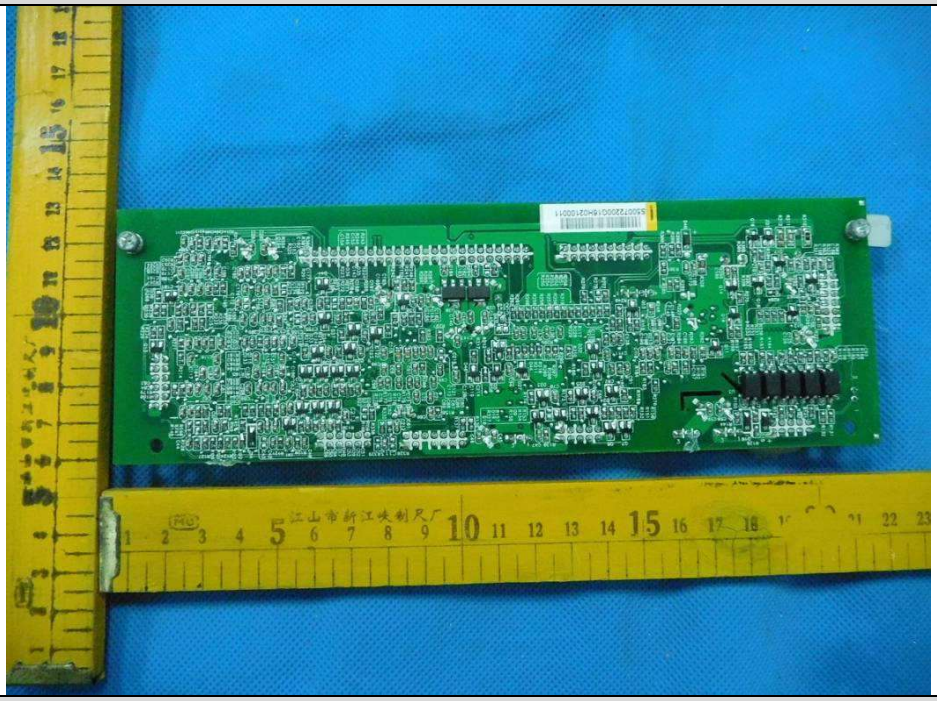
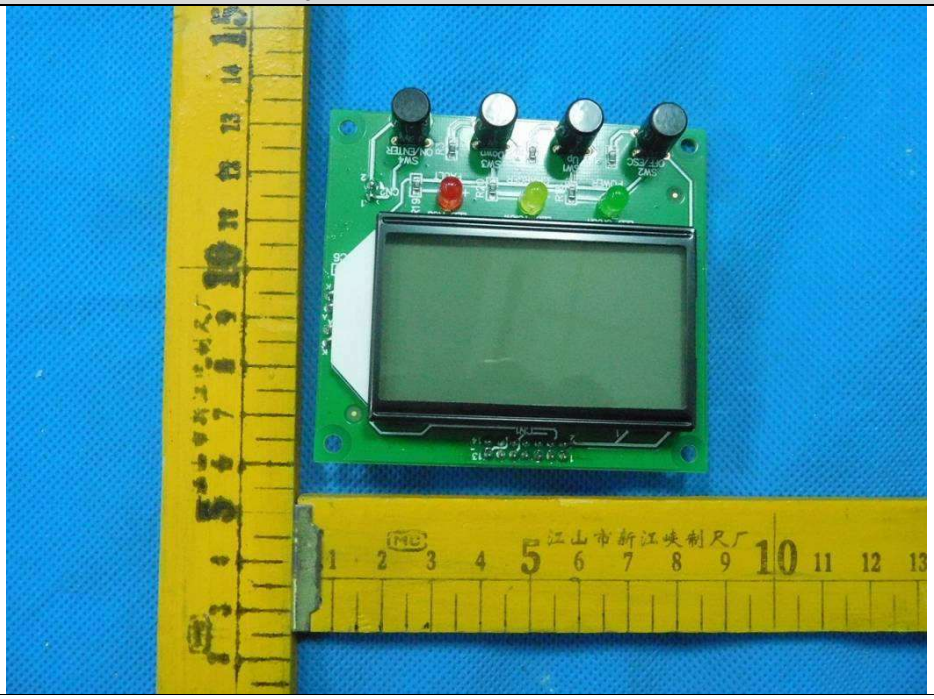
Internal view-3

Main board-component side view


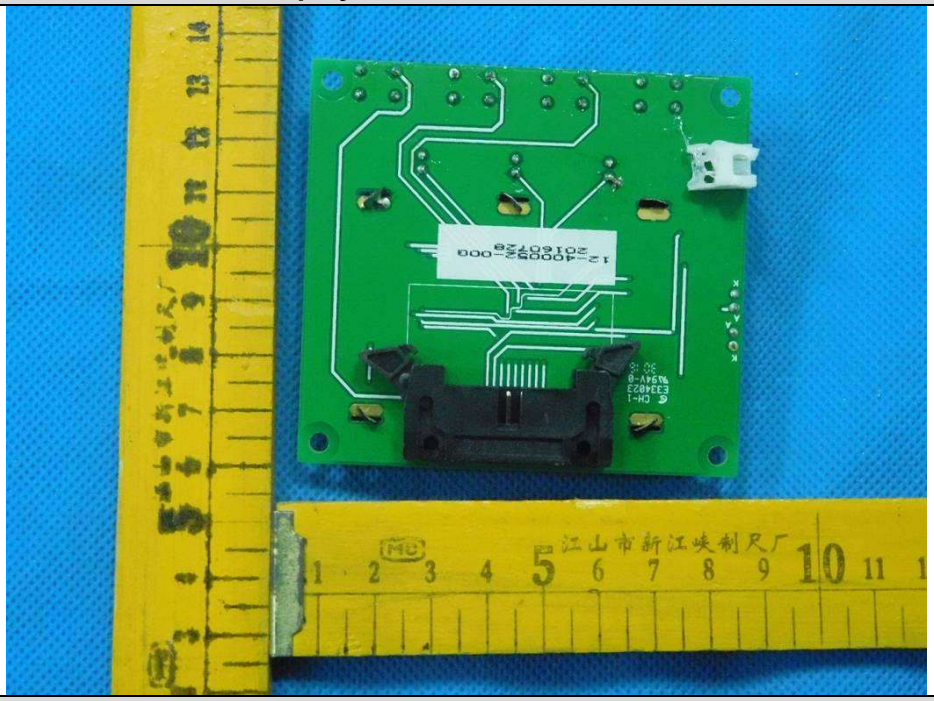
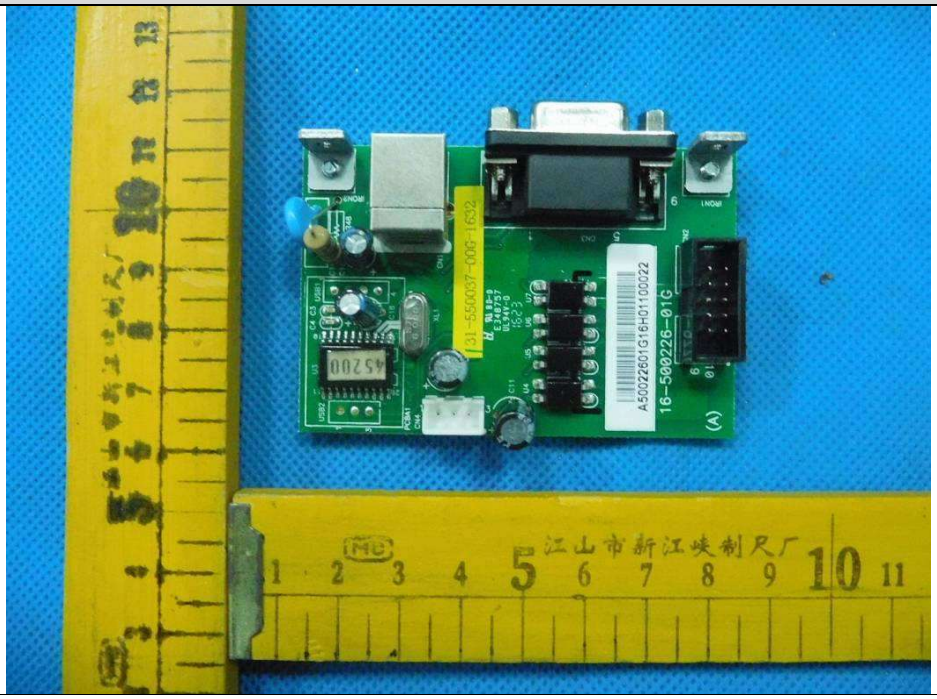
Main board-solder side view

DC-DC power board-component side view


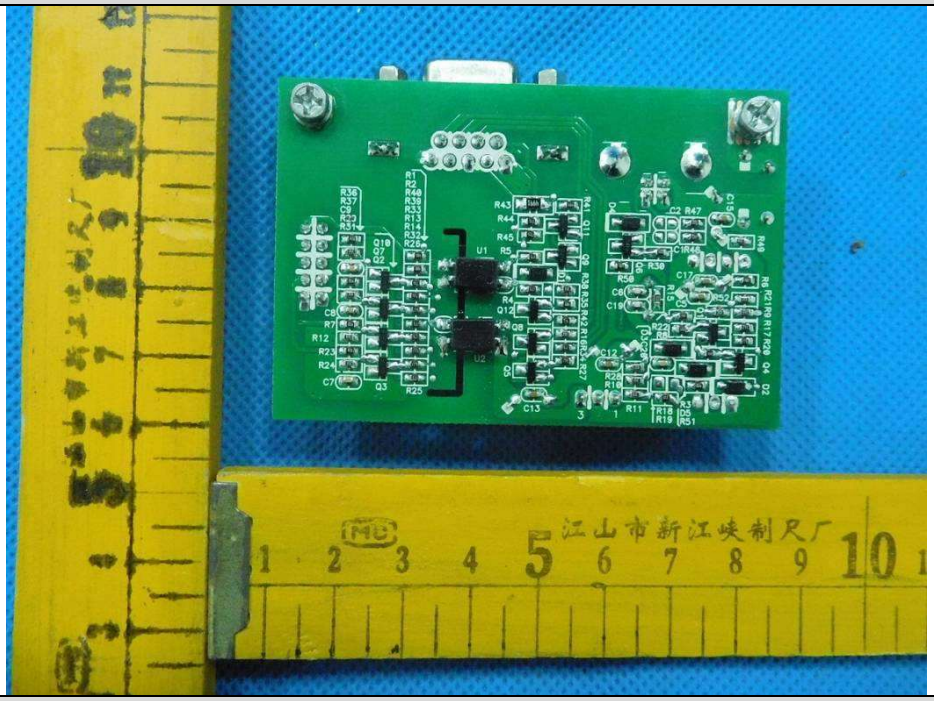
DC-DC power board-solder side view

Auxiliary power supply board-component side view


Auxiliary power supply board-solder side view

EMI board-component side view


EMI board-solder side view

Control board-component side view


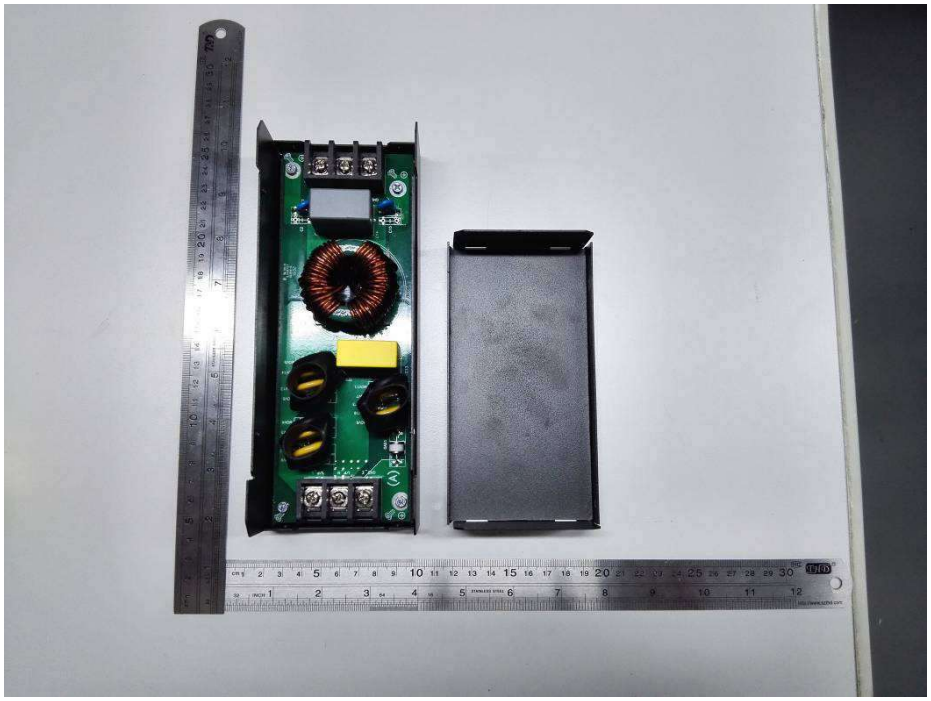
Control board-solder side view

Display board-component side view


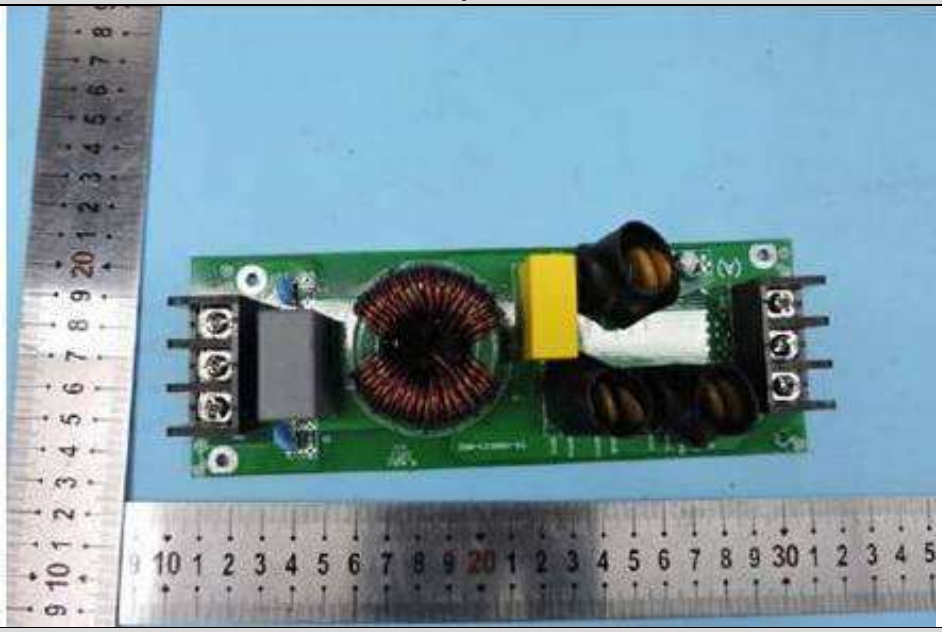
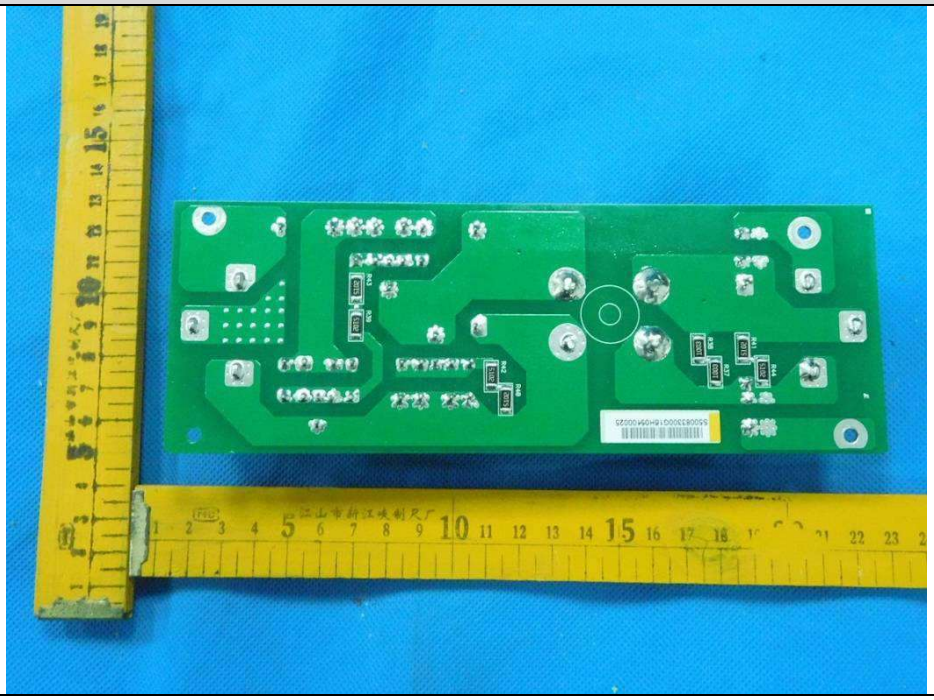
Display board-solder side view

Communication board-component side view


Communication board-solder side view

SPD device view-1


SPD device view-2

SPD device internal view-1



SPD board-component side view

SPD board-solder side view


Annex 3

Test Equipment list

Test location: Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Date of performed test: 2017-01-13 to 2017-03-09

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	Jan. 06, 2017
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyzer
AC Source	A7040020DG	Chroma	61512	61512000438	Monitored by Power Analyzer
DC Simulation Power Supply	A7040015DG	Chroma	62150H-1000S	62150EF00488	Monitored by Power Analyzer
DC Simulation Power Supply	A7040016DG	Chroma	62150H-1000S	62150EF00490	Monitored by Power Analyzer
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	Monitored by Power Analyzer
Four Channel Digital Phosphor Oscilloscope	A4089003DG	Tektronix	DPO4104B	C010624	Oct. 11, 2016
Current transducer	A1060007DG	YOKOGAWA	CT200	1130700012	Nov. 29, 2016
Oscilloscope probel	A4089010DG	Tektronix	TPP1000	C008228	Dec. 15, 2016
Oscilloscope probel	A4089011DG	Tektronix	TPP1000	C008229	Dec. 15, 2016
LCR Hitester	A1060006DG	HIOKI	3535	120112505	Mar. 11, 2016