TEST REPORT

Engineering recommendation G83/2

Recommendation for the connection of type tested small-scale embedded generators (up to 16 A per phase) in parallel with low-voltage distribution systems.

Report reference number ..... :	**PVUK140508N005**
Date of issue ..... ……..:	2014-07-22
Total number of pages ..... ……..:	176
Testing laboratory name ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
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Applicant's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Address ..... :	3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China.
Test specification	
Standard ..... :	G83/2
Certificate ..... :	**Certificate of compliance**
Test report form number. ..... :	G83/2
Master TRF ..... :	Bureau Veritas Consumer Products Services Germany GmbH
Test item description ..... :	**Grid connected photovoltaic inverter**
Trademark ..... :	
Model / Type ..... :	SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL, SOFAR 2700TL, SOFAR 3000TL

Ratings ..... :	SOFAR 1100TL	SOFAR 1600TL	SOFAR 2200TL	SOFAR 2700TL	SOFAR 3000TL
MPP DC voltage range [V] ..... :	110-380	165-380	170-450	210-450	230-450
Input DC voltage range [V] ..... :	90-400, max. 450		100-480, max. 500		
Input DC current [A] ..... :	Max.10		Max.13		
Output AC voltage [V] ..... :	230, 50Hz				
Output AC current [A] ..... :	Max.4,5	Max.7,0	Max.9,5	Max.11,5	Max.13,0
Output power [W] ..... :	1000	1500	2000	2500	2800

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) ..... :	Corney Zhang 
Manufacturer's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Factory address ..... :	No. 8, Fulong road, Qingxi town, Dongguan city, Guangdong, China.

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2014-07-22	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.. :	IP65 according to EN 60529
Mass of equipment [kg]..... :	SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL: 11kg SOFAR 2700TL, SOFAR 3000TL: 12kg

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..... :	2014-05-08
Date(s) of performance of test..... :	2014-05-08 to 2014-07-16

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 G83/1. This report must not be reproduced in part or in full without the written approval of the issuing testing laboratory.

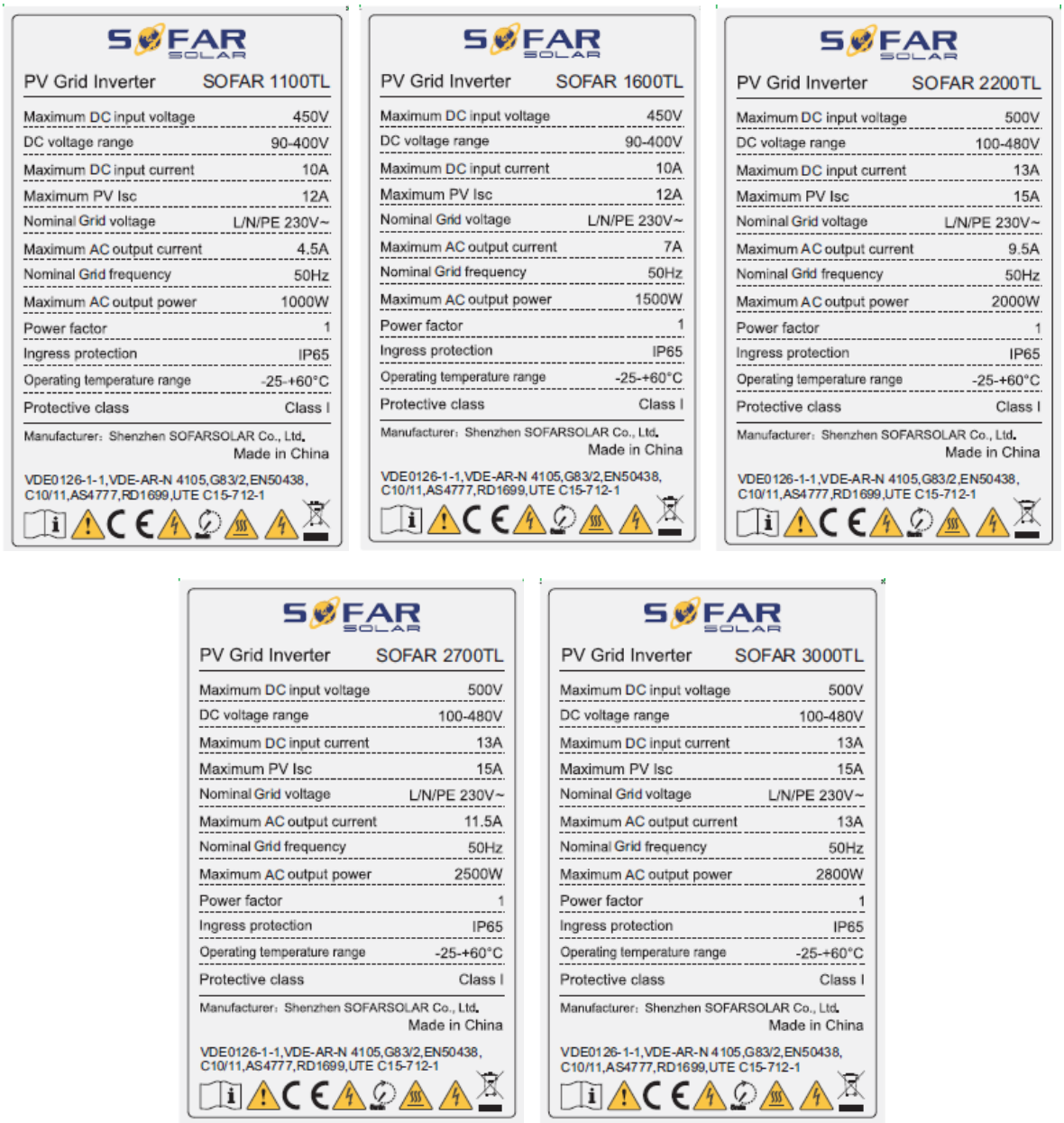
”(see Annex #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

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

This Test Report consists of the following documents:

1. Test Results
2. Annex No. 1 – EMC Test Report
3. Annex No. 2 – Pictures of the unit
4. Annex No. 3 – Test equipment list

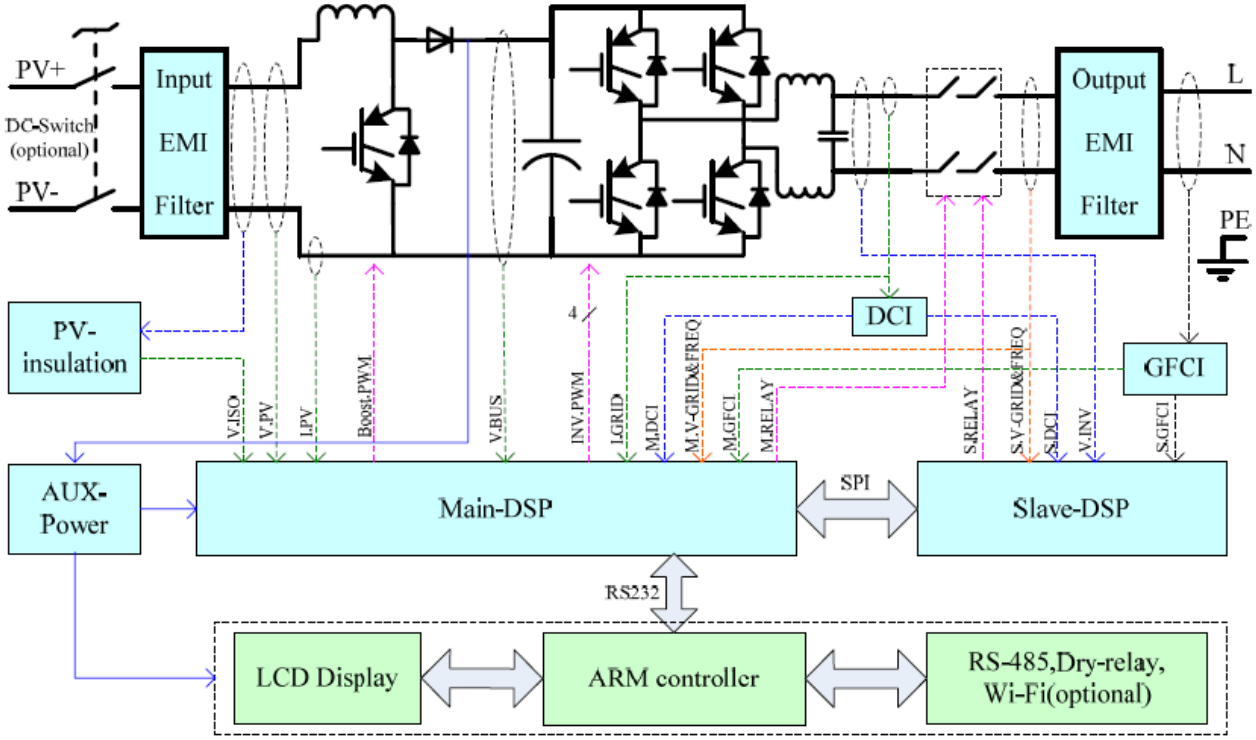
Copy of marking plate:



General product information:

The Solar Inverter converts DC voltage into AC voltage.

The input and output are protected by varistors to Earth. The unit is providing EMC filtering at the PV input and output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundantly by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of a single error.



The internal control is redundant built. It consists of Microcontroller Master DSP (UC34) and Slave DSP (UC35).

The Master DSP control the relays (RYP2-RYP5) by switching signals; measures the PV voltage, PV current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition it tests the current sensors and the RCMU circuit before each start up.

The Slave DSP (UC35) is measures the grid voltage, AC current, grid frequency and residual current, also can switch off the relays (RYP2-RYP5) independently, and communicate with Master DSP (UC34) each other.

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the Master DSP(UC34). The Master DSP(UC34) tests and calibrates before each start up all current sensors.

The unit provides two relays in series in all output 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 each start up.

The product was tested on:
Hardware version: V1.00
Software version: V1.00

Description of the differences of the models within a series:

The models SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL, SOFAR 2700TL and SOFAR 3000TL are same as in hardware except the components are in the different table. Identical in software the output power just adjusted by software.

Difference table					
	SOFAR 1100TL	SOFAR 1600TL	SOFAR 2500TL	SOFAR 2700TL	SOFAR 3000TL
Boost inductor	2,6mH	2,6mH	1,9mH	1,9mH	1,9mH
Resistor (RP105, RP108 /RP189,RP109)	220ohm / 10Kohm	220ohm / 10Kohm	200ohm / 7,5Kohm	200ohm / 7,5Kohm	200ohm / 7,5Kohm
BUS capacitor (ECP1, ECP2, ECP3, ECP4)	2 pcs	2 pcs	3 pcs	3 pcs	3 or 4 pcs
Inverter inductor	3,4mH	2,3mH	2,1mH	1,5mH	1,3mH
Resistor (RP118, RP119, RC18 /RP120, RP121,RC22)	499 Ω, 200 Ω, 200 Ω	1 KΩ, 200 Ω, 100 Ω	1 KΩ, 330 Ω, 330 Ω	2 KΩ, 100 Ω, 100 Ω	2 KΩ, 100 Ω, 100 Ω
DC switch and Wi-Fi module are optional.					

All tests were performed on EUT SOFAR 3000TL. Tests of the SOFAR 3000TL not applicable for the model(s) SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL were performed on the concerned model(s) and a statement is given at the relevant test.

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
5	**Connection, Protection & Testing Requirements**		
5.1	**Connection Procedure**		
5.1.1	**Single Premises Connection Procedure** In most instances the installation of a single SSEG or multiple SSEGs (provided that the aggregate installed capacity is no greater than 16A per phase) within a single Customer's Installation, connected in parallel with the public Distribution System, will have negligible impact on the operation of the Distribution System; as such there will be no need for the DNO to carry out detailed network studies to assess the impact of the connection. As required by the ESQCR Certificate of Exemption (2008) (see Appendix 6) the Installer shall provide the DNO with all necessary information on the installation no later than 28 days after the SSEG(s) have been commissioned; the format and content shall be as shown in Appendix 3. This procedure will not apply where an Installer plans or has already installed other SSEGs in a Close Geographic Region; in this case the procedure in 5.1.2 shall be followed. Failure to comply with this requirement may lead to the disconnection of the Customers Installation under ESQCR (26) or failure of the SSEG to operate as intended.	Rely in the responsibility of the installer.	**N/A**
5.1.2	**Multiple Premises Connection Procedure** In the case of projects where the proposal is to install single or multiple SSEGs in a number of Customers Installations in a Close Geographic Region, the Installer shall discuss the installation project with the local DNO at the earliest opportunity. The DNO will need to assess the impact that these connections may have on the network and specify conditions for connection. The initial application will need to be in a format similar to that shown in Appendix 2. Connection of the SSEG is only allowed after the application for connection has been approved by the DNO and any DNO works facilitating the connection have been completed. Confirmation of the commissioning of each SSEG system will need to be made no later than 28 days after commissioning; the	Rely in the responsibility of the installer.	**N/A**

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Clause	Requirement – Test	Result – Remark	Verdict
	format and content shall be as shown in Appendix 3.		
5.2	**Installation Wiring and Isolation** The installation that connects the SSEG to the Exit Point shall comply with the requirements of BS 7671. All wiring between the Exit Point and the SSEG shall be protected by a suitably rated protective device; and shall be of suitable size and type for the rating of the SSEG. The SSEG(s) shall be connected via an accessible isolation switch that is capable of isolating all phases and neutral. The isolation switch shall be capable of being secured in the 'off' (isolated) position.	The required wiring for the SSEG is stated in the manual. The installation relies in the responsibility of the installer.	**P**
5.3	**Interface Protection** The purpose of the Interface Protection is to ensure that the connection of a SSEG system will not impair the integrity or degrade the safety of the DNO's Distribution System. The interface protection may be located in a separate unit or integrated into the SSEG (the Inverter in the case of technologies which connect via an Inverter). The DNO is responsible under the Distribution Code for ensuring, by design, that the voltage and frequency at the Connection Point remains within statutory limits. The G83/2 Interface Protection settings have been chosen to allow for voltage rise or drop within the Customer's Installation and to allow the SSEG to continue to operate outside of the statutory frequency range as required in the Distribution Code.	Test results see appended table.	**P**
5.3.1	**Interface Protection Settings and Test Requirements** Interface Protection shall be installed which disconnects the SSEG system from the DNO's Distribution System when any parameter is outside of the settings shown in Table 1. Protection Function / Trip Setting / Trip delay Setting (Time) U/V stage 1 / V_{nom}-13% / 2,5s U/V stage 2 / V_{nom}-20% / 0,5s O/V stage 1 / V_{nom}+14% / 1,0s O/V stage 2 / V_{nom}+19%[2] / 0,5s	Test results see appended table. A Disconnection device with mechanical separation in the use of two relays in series in line and neutral are provided in the SSEG. The SSEG provides the followings secure way to display the settings: A display on a PC which can communicate with the device and confirm that it is the correct device by	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	<table><tr><td>U/F stage 1</td><td>47,7Hz</td><td>20s</td></tr><tr><td>U/F stage 2</td><td>47Hz</td><td>0,5s</td></tr><tr><td>O/F stage 1</td><td>51,5Hz</td><td>90s</td></tr><tr><td>O/F stage 2</td><td>52Hz</td><td>0,5s</td></tr><tr><td>Loss of Mains* (Vector Shift)</td><td>12 degrees</td><td>0,0s</td></tr><tr><td>Loss of Mains* (RoCoF)</td><td>0,2Hz per second</td><td>0,0s</td></tr></table> V_{nom} = 230V phase to neutral * Other forms of Loss of Mains techniques may be utilised but the aggregate of the protection operating time, disconnection device operating time and trip delay setting shall not exceed 1.0 second. [2] For grid surge voltages greater than 230V +19% which are present for periods of <0.5s the SSEG is permitted to reduce/cease exporting in order to protect the equipment. The total disconnection time for voltage and frequency protection including the operating time of the disconnection device shall be the trip delay setting with a tolerance of, -0 s + 0.5s. For the avoidance of doubt voltage and frequency excursions lasting less than the trip delay setting shall not result in disconnection. All settings shall be applied as shown in the above table, so that they can be inspected if required by the DNO to confirm that the settings are correct. Only devices that have protection settings set and locked during manufacture can be considered as Type Tested. a) A display on a screen which can be read; b) A display on a PC which can communicate with the device and confirm that it is the correct device by means of a serial number permanently fixed to the device and visible on the PC screen at the same time as the settings; c) Display of all settings including nominal voltage and current outputs, alongside the serial number of the device, permanently fixed to the device.	means of a serial number permanently fixed to the device and visible on the PC screen at the same time as the settings The settings of SSEG are password protected and only changeable by the responsible installer and not by the user.	
5.3.2	**Loss of Mains Protection** Loss of mains protection shall be incorporated and tested as defined in the relevant annex. Active methods which use impedance measuring techniques by	Test results see appended table.	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	drawing current pulses from or injecting AC currents into the DNO's system are not considered to be suitable. For SSEGs which generate on more than one phase, the loss of mains protection should be able to detect the loss of a single phase of the supply network. This should be tested during type testing and recorded on in Appendix 4.		
5.3.3	**Frequency Drift and Step Change Stability Test** Under normal operation of the network the frequency changes over time due to continuous unbalance of load and generation or can see a step change due to the loss of a network component which does not cause a loss of supply. In order to ensure that the phenomena do not cause un-necessary tripping of SSEG, stability Type Tests shall be carried out.	The SSEG provides the Change of Frequency (RoCoF) method. Test results see appended table.	**P**
5.3.4	**Automatic Reconnection** Some Distribution Systems employ automatic Circuit Breakers that trip and re-close when a fault is detected. In order to prevent a SSEG being damaged by a DNO Circuit Breaker automatically closing and consequently energising a SSEG when it is out of synchronism with the rest of the system, the protection system shall ensure that the SSEG remains disconnected from the DNO's Distribution System until the voltage and frequency on the DNO's Distribution System have remained within the limits of Table 1 for a minimum of 20 seconds[3]. [3] Reference in accordance with BS EN 50438 (2007)	Test results see appended table.	**P**
5.4	**Quality of Supply** The connection of the SSEG in parallel with a DNO's Distribution System shall not impair the quality of supply provided by the DNO to the User or any other Customer. In this respect the SSEG shall comply with the requirements of the EMC Directive and in particular the product family emission standards listed in Table 2.	Test results see appended table. See Annex 1 EMC test report.	**P**

Parameter	SSEG rating	Standard	Class
Harmonics	≤ 16 A	EN 61000-3	lass A
Voltage fluctuations	≤ 16 A	EN 61000-3-3	dmax = 4%

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	and Flicker		
5.4.1	**Testing for Harmonic emissions** The SSEG or group shall meet the harmonic emissions of table 1 in BS EN 61000-3-2 with a scaling factor applied as follows for each harmonic current.	Test results see appended table.	**P**
5.4.2	**Testing for flicker** The SSEG or group shall meet the required d_{max}, d_c, $d_{(t)}$, P_{st} , P_{lt} requirements of BS EN 61000-3-3 with a scaling factor applied as follows for each voltage change component.	Test results see appended table.	**P**
5.5	**DC Injection** The effects of, and therefore limits for, DC currents injected in the DNO's Distribution System is an area under current investigation by DNOs. Until these investigations are concluded the upper limit for DC injection is 0.25% of AC current rating per phase. Where a SSEG is designed to be installed singly in an installation, for example a domestic CHP unit, then this DC injection limit can be a maximum value of 20mA for sub 2kW SSEG and can be tested alone. Where necessary the DC emission requirements can also be satisfied by installing an isolating transformer between the Inverter and the connection to the DNO's Distribution System.	Test results see appended table.	**P**
5.6	**Power Factor** When operating at rated power the SSEG shall operate at a power factor within the range 0.95 lagging to 0.95 leading relative to the voltage waveform unless otherwise agreed with the DNO eg for power factor improvement.	Test results see appended table.	**P**
5.7	**Short Circuit Current Contribution**		**P**
5.7.1	**Directly Coupled Generation** The Manufacturer shall establish the maximum short circuit current contribution from the SSEG and the conditions under which this exists. This information shall be provided to the DNO by the Installer as part of the commissioning notification as per Appendix 3. Parameter | Symbol | Method of Determination	Test results see appended table.	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	Peak short-circuit current: ip — Direct measurement Initial value of aperiodic component: A — Direct measurement Initial symmetrical short-circuit current: Ik" — Interpolation of plot Decaying (aperiodic) component of short- circuit current: idc — Interpolation of plot & calculation Reactance / Resistance ratio of source: X/R — Calculation		
5.7.2	**Inverter Connected Generation** Inverter connected SSEGs generally have small short circuit fault contributions.	Test results see appended table.	**P**
5.8	**Voltage Unbalance** There is no requirement to balance phases on installations below or equal to 16A per phase. For multiple installations of SSEGs (eg in new housing developments), balancing the SSEGs evenly against the load on the three phases will need to be considered by the DNO.	Considered The SSEG is rated with 4,34A per phase for SOFAR 1100TL, The SSEG is rated with 6,52A per phase for SOFAR 1600TL, The SSEG is rated with 8,69A per phase for SOFAR 2200TL, The SSEG is rated with 10,86A per phase for SOFAR 2700TL, The SSEG is rated with 12,17A per phase for SOFAR 3000TL,	**P**
5.9	**Certification Requirements**		**P**
5.9.1	**General** Type Tested certification is the responsibility of the SSEG Manufacturer. The requirements are detailed in Appendix 4.	Considered	**P**
5.9.2	**Compliance** The SSEG shall comply with all relevant European Directives and should be labelled with a CE marking.	Considered EMC test results see Annex 1 EMC test report. The CE declaration relies in the responsibility of the manufacturer.	**P**
5.9.3	**Verification Test Report** The Manufacturer shall make available	Considered Rely in the responsibility of	**P**

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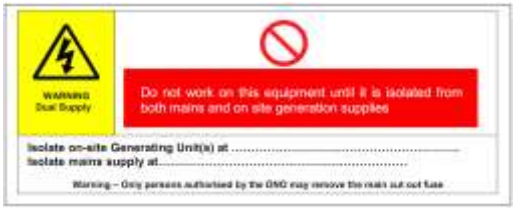
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	upon request a verification test report confirming that the SSEG has been Type Tested to satisfy the requirements of this Engineering Recommendation. The report shall detail the type and model of SSEG tested, the test conditions and results recorded. All of these details shall be included on a test sheet. The required test sheet and declaration is shown in Appendix 4.	the manufacturer.	
6	**Operation and Safety**		
6.1	**Operational Requirements** In all cases the User shall ensure that the SSEG system is so installed, designed and operated to maintain at all times, compliance with the requirements of ESQCR 22(1) (a).	The inverter is tested according the relevant requirements. The operational requirements in all cases rely in the responsibility of the user.	**P**
6.2	**Labelling** The Installer shall provide labelling at the Exit Point (Fused Cut Out), meter position, consumer unit and at all points of isolation between the Exit Point and the SSEG within the User's premises to indicate the presence of a SSEG. The labelling should be sufficiently robust and if necessary fixed in place to ensure that it remains legible and secure for the lifetime of the installation. The following sign shall be used.  Note: The safety sign does not imply a right on the Customer, User, Installer or maintainer to operate (remove / replace) the DNO's cut-out fuse. In addition to the safety labelling, this Engineering Recommendation requires the following, up to date, information to be displayed at the point of interconnection with the DNO's Distribution System. a) A circuit diagram relevant to the installation showing the circuit wiring, including all protective devices, between the SSEG and the DNOs fused cut-out. This diagram should also show by whom all	The required labelling is stated in the manual of the SSEG. The installation relies in the responsibility of the installer.	**P**

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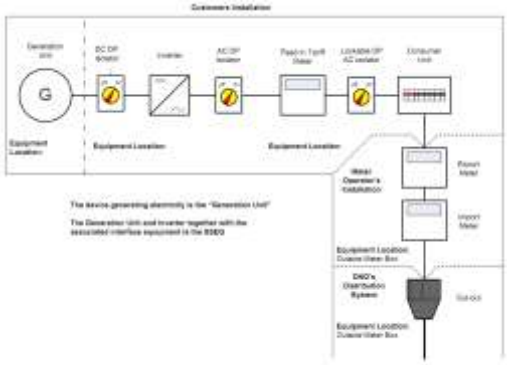
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	apparatus is owned and maintained; b) A summary of the protection settings incorporated within the equipment. Figure 2 shows an outline example of the type of circuit diagram that will need to be displayed. Figure 2 is non-prescriptive and is for illustrative purposes only.  Figure 2 - Example of the type of circuit diagram The Installer shall advise the User that it is the User's responsibility to ensure that this safety information is kept up to date. The installation operating instructions shall contain the Manufacturer's contact details eg name, telephone number and web address.		
6.3	**Maintenance & Routine Testing** Periodic testing of the SSEG is recommended at intervals prescribed by the Manufacturer. This information shall be included in the installation and User Instructions. The method of testing and/or servicing should be included in the servicing instructions.	The periodic testing of the SSEG is stated with 5.5 years in the manual.	**P**
6.4	**Earthing** When a SSEG is operating in parallel with a DNO's Distribution System there shall be no direct connection between the SSEG current carrying conductors and earth with the following exception; For a SSEG which is designed to operate in parallel with a DNO's Distribution System but which is connected via an Inverter (eg a PV array or fuel cell) it is permissible to connect one pole of the DC side of the Inverter to the DNO's earth terminal if the insulation between the AC and the DC sides of the Inverter meets the requirements for at least simple separation. The requirements for simple separation are	The SSEG is a transformerless unit and did not provide an earthing option. The installation of the SSEG relies in the responsibility of the installer.	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	those given in Section 5.3.3 of BS EN 60664-1 for basic insulation. In such cases the Installer and Manufacturer shall take all reasonable precautions to ensure that the SSEG system will not impair the integrity of the DNO's Distribution System and will not suffer unacceptable damage for all credible operating conditions, including faults on the DNO's Distribution System. In all cases the level of DC injection should not exceed that detailed under clause 5.5. Earthing of all exposed conductive parts shall comply with the requirements of BS 7671.		
7	**Commissioning/Decommissioning and Acceptance Testing**		
7.1	**General** The information required by a DNO under an Application for Connection is shown in Appendix 2. The information required by a DNO to confirm commissioning is shown in Appendix 3. It is the responsibility of the Installer to ensure that the relevant information is forwarded to the local DNO in accordance with the requirements of 5.1.1 and/or 5.1.2 as appropriate.	Rely in the responsibility of the installer.	**N/A**
7.2	**Installation and Commissioning** The installation shall be carried out by Installers who are competent and have sufficient skills, and training (complete with recognised and approved qualifications relating to the fuels used and general electrical installations) to apply safe methods of work to install a SSEG in compliance with this Engineering Recommendation.	Rely in the responsibility of the installer.	**N/A**
7.3	**Notification of Commissioning** In accordance with ESQCR and HSE Certificate of Exemption (2008) (see Appendix 6) the Installer shall ensure that the DNO is advised of the intention to use the SSEG in parallel with the network no later than 28 days (inclusive of the day of commissioning), after commissioning the SSEG. Notification that the SSEG has been connected / commissioned is achieved by completing a commissioning form as per Appendix 3, which also includes the relevant details on the SSEG installation required by the DNO	Rely in the responsibility of the installer.	**N/A**

Engineering recommendation G83/2			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
7.4	**Notification of Changes** If during the lifetime of the SSEG it is necessary to replace a major component of the SSEG, it is only necessary to notify the DNO if the operating characteristics of the SSEG or the Interface Protection have been altered when compared against the unit that was originally commissioned.	Rely in the responsibility of the installer.	**N/A**
7.5	**Notification of Decommissioning** In the event that a SSEG system is to be decommissioned and will no longer operate as a source of electrical energy in parallel with the DNO's Distribution System, the User shall notify the DNO by providing the information as detailed under Appendix 5.	Rely in the responsibility of the installer.	**N/A**
Annex A-C	**Guidance on Type Testing Requirements**		
	An SSEG requiring type testing must be Type Tested in relation to its grid connection type and its energy source technology. Annex A relates to any SSEG that uses an Inverter (or Converter) as its means of connecting to the grid. Annex B relates to any SSEG that during normal running operation is connected directly to the grid.		
Annex A1	**Common Inverter Connected SSEG Requirements**		
A1.1	**Certification & Type Testing SSEG Requirements** This Annex describes a methodology for obtaining type certification or type verification for the interface equipment between the Inverter connected SSEG and the distribution network. Typically, all interface functions are contained within the Inverter and in such cases it is only necessary to have the Inverter Type Tested. Alternatively, a package of specific separate parts of equivalent function may also be Type Tested. Other Annexes containing Inverter connected equipment may make reference to the requirements specified in this Annex. This Annex applies for SSEG systems either with or without load management or energy storage systems which connected on the generator side of the Inverter.	Considered	**P**
A1.2	**CE Marking and Certification** The type verification procedure requires	Considered EMC test results see	**P**

Engineering recommendation G83/2			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	that the SSEG interface be certified to the relevant requirements of the applicable Directives before the unit can be labelled with a CE mark. Where the protection control is to be provided as a separate device, this must also be Type Tested and certified to the relevant requirements of the applicable Directives before it can be labelled with a CE mark. Currently there are no harmonised functional standards that apply to the SSEG Interface Protection, therefore the Inverter and any separate Interface Protection unit will require functional Type Tested as described in this Annex, and recorded in format similar to that shown in Appendix 4.	Annex 1 EMC test report. The CE declaration relies in the responsibility of the manufacturer.	
A1.3	**Type Verification Functional Testing of the Interface Protection** Type Testing is the responsibility of the Manufacturer. This test will verify that the operation of the SSEG Interface Protection shall result: a) in the safe disconnection of the SSEG from the DNO's Distribution System in the event that the protection settings specified in table 1 are exceeded; and b) in the SSEG remaining connected to the DNO's Distribution System while network conditions are: a. within the envelope specified by the settings plus and minus the tolerances specified for equipment operation in table 1; and b. within the trip delay settings specified in table 1. The Type Testing can be done by the Manufacturer of an individual component, by an external test house, or by the supplier of the complete system, or any combination of them as appropriate.	Considered Test results see appended table.	**P**
A1.3.1	**Disconnection times** The minimum trip delay settings, for tests in A3.2, A3.3 and A3.4, are presented in table 1. For tests A3.2, A3.3 and A3.4, reconnection shall be checked as detailed in A3.5 below.	Test results see appended table.	**P**
A1.3.2	**Over / Under Voltage**	Test results see appended	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	The Inverter shall be tested by operating the Inverter in parallel with a variable AC test supply, see figure A2. Correct protection and ride-through operation shall be confirmed during operation of the Inverter. The set points for over and under voltage at which the Inverter system disconnects from the supply will be established by varying the AC supply voltage.	table.	
A1.3.3	**Over / Under Frequency** The Inverter shall be tested by operating the Inverter in parallel with a low impedance, variable frequency test supply system, see figure A3. Correct protection and ride-through operation should be confirmed during operation of the Inverter. The set points for over and under frequency at which the Inverter system disconnects from the supply will be established by varying the test supply frequency.	Test results see appended table.	**P**
A1.3.4	**Loss of Mains Protection** The tests should be carried out in accordance with BS EN 62116 and a subset of results should be recorded as indicated in the Protection – Loss of Mains test section of Annex 4 Type Test Verification Report.	Test results see appended table.	**P**
A1.3.5	**Re-connection** Further tests will be carried out with the three test circuits above to check the Inverter time out feature prior to automatic network reconnection. This test will confirm that once the AC supply voltage and frequency have returned to be within the stage 1 settings specified in table 1 following an automatic protection trip operation there is a minimum time delay of 20 seconds before the Inverter output is restored (ie before the Inverter automatically reconnects to the network).	Test results see appended table.	**P**
A1.3.6	**Frequency Drift and Step Change Stability test** The tests will be carried out using the same circuit as specified in A1.3.3 above and following confirmation that the SSEG has passed the under and over frequency trip tests and the under and over frequency stability tests.	The SSEG provides the Change of Frequency (RoCoF) method. Test results see appended table.	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A1.4	**Power Quality**	Test results see appended table.	**P**
A1.4.1	**Harmonics** The tests should be carried out as specified in BS EN 61000-3-2 and can be undertaken with a fixed source of energy at two power levels firstly between 45 and 55% and at 100% of maximum export capacity.	Test results see appended table. See Annex 1 EMC test report.	**P**
A1.4.2	**Power Factor** The test set up shall be such that the Inverter supplies full load to the DNO's Distribution System via the power factor (pf) meter and the variac as shown below in figure A5. The Inverter pf should be within the limits given in 5.6, for three test voltages 230 V –6%, 230V and 230 V +10%.	Test results see appended table.	**P**
A1.4.3	**Voltage Flicker** The voltage fluctuations and flicker emissions from the SSEG shall be measured in accordance with BS EN 61000-3-3 and technology specific annex.	Test results see appended table. See Annex 1 EMC test report.	**P**
A1.4.4	**DC Injection** The level of DC injection from the Inverter-connected PV generator in to the DNO's Distribution System shall not exceed the levels specified in 5.5 when measured during operation at three levels, 10%, 55% and 100% of rating with a tolerance of plus or minus 5%. The DC injection requirements can be satisfied by the installation of an isolation transformer on the AC side of an Inverter-connected SSEG. A declaration that an isolating transformer is fitted can be made in lieu of the tests noted above.	Test results see appended table.	**P**
A1.4.5	**Overcurrent Protection** Where appropriate the protection shall comply with the requirements of BS7671.	Test results see appended table.	**P**
A1.4.6	**Short Circuit Current Contribution** Inverter connected SSEG's generally have small short circuit fault contributions however DNO's need to understand the contribution that they do make to system fault levels in order to determine that they can continue to safely operate without exceeding design fault levels for switchgear	Test results see appended table.	**P**

Engineering recommendation G83/2			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	and other circuit components. The following type tests shall be carried out and the results noted in Appendix 4.		
A1.4.7	**Self-Monitoring - Solid State Disconnection** Some Inverters include solid state switching devices to disconnect from the DNO's Distribution System. In this case 5.3.1 requires the control equipment to monitor the output stage of the Inverter to ensure that in the event of a protection initiated trip the output voltage is either disconnected completely or reduced to a value below 50 volts AC. This shall be verified either by self-certification by the Manufacturer, or additional material shall be presented to the tester sufficient to allow an assessment to be made.	A Disconnection device with mechanical separation in the use of two relays in series in line and neutral are provided in the SSEG.	**P**
A1.4.8	**Electromagnetic Compatibility (EMC)** All equipment shall comply with the generic EMC standards: BS EN61000-6-3: 2007 Electromagnetic Compatibility, Generic Emission Standard; and BS EN61000-6-1: 2007 Electromagnetic Compatibility, Generic Immunity Standard.	See Annex 1 EMC test report.	**P**
Annex B1	**Common Directly Coupled Connected SSEG Requirements**		
B1.1	**Certification & Type Testing General Requirements** This Annex describes a methodology for obtaining type certification or type verification for the interface equipment between a directly coupled SSEG and the distribution network. Interface functions can be provided by either as an integrated part of the controller or by incorporating a Type Tested protection relay. Other Annexes containing directly coupled equipment may make reference to the requirements specified in this Annex. This Annex applies for SSEG systems either with or without load management or energy storage systems which connected on the generator side of the controller.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.2	**CE Marking & Certification** The type verification procedure requires that the SSEG interface be certified to the relevant requirements of the applicable Directives before the unit can be labelled	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**

Engineering recommendation G83/2			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	with a CE mark. Where the protection control is to be provided as a separate device, this must also be Type Tested and certified to the relevant requirements of the applicable Directives before it can be labelled with a CE mark. Currently there are no harmonised functional standards that apply to the SSEG Interface Protection, therefore the Controller and any separate Interface Protection unit will require the functionality to be Type Tested as described in this Annex, and recorded in format similar to that shown in Appendix 4.		
B1.3	**Type Verification Functional Testing of the Interface Protection** Type verification testing is the responsibility of the Manufacturer. This test will verify that the operation of the SSEG Interface Protection shall result: a) in the safe disconnection of the SSEG from the DNO's Distribution System in the event that the protection settings specified in table 1 are exceeded; and b) in the SSEG remaining connected to the DNO's Distribution System while network conditions are: a. within the envelope specified by the settings plus and minus the tolerances specified for equipment operation in table 1; and b. within the trip delay settings specified in table 1 The testing can be done by the Manufacturer of an individual component, by an external test house, or by the supplier of the complete system, or any combination of them as appropriate.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.3.1	**Disconnection times** The minimum trip delay settings, for tests in B3.2, B3.3 and B3.4, are presented in table 1. For tests B3.2, B3.3 and B3.4, reconnection shall be checked as detailed in 5.3.4 as a mechanical based system.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.3.2	**Over / Under Voltage** The Controller shall be tested by operating the Controller in parallel with a variable AC test supply, see figure B2. Correct	The SSEG is a photovoltaic inverter. Therefore the requirements according	**N/A**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	protection and ride-through operation shall be confirmed. The set points for over and under voltage at which the Controller disconnects from the supply, will be established by varying the AC supply voltage. The disconnect sequence should be initiated when the conditions of table 1 are met, otherwise normal operation should continue.	C1.2 are applicable.	
B1.3.3	**Over / Under Frequency** The protection shall be tested by operating the SSEG in parallel with a low impedance, variable frequency test supply system, see figure B3. Correct protection and ride-through operation should be confirmed during operation of the SSEG. The set points for over and under frequency at which the SSEG system disconnects from the supply will be established by varying the test supply frequency.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.3.4	**Loss of Mains Protection** The resonant test circuit specified in this test has been designed to model the interaction of the directly coupled SSEG under test with the local load including multiple directly coupled connected SSEGs in parallel.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.3.5	**Re-connection** Further tests will be carried out with the three test circuits above to check the directly coupled SSEG time- out feature prior to automatic network reconnection. This test will confirm that once the AC supply voltage and frequency have returned to within the stage 1 settings specified in table 1 following an automatic protection trip operation there is a minimum time delay as specified in table 1 before reconnection will be allowed.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.3.6	**Frequency Drift and Step Change Stability test** The tests will be carried out using the same circuit as specified in B1.3.3 above and following confirmation that the SSEG has passed the under and over frequency trip tests and the under and over frequency stability tests.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.4	**Power Quality**		**N/A**
B1.4.1	**Harmonics**	The SSEG is a photovoltaic inverter.	**N/A**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	The tests should be carried out as specified in BS EN 61000-3-2 and can be undertaken with a fixed source of energy at two power levels firstly between 45 and 55% and at 100% of maximum export capacity.	Therefore the requirements according C1.2 are applicable.	
B1.4.2	**Power Factor** The test set up shall be such that the directly coupled SSEG supplies full load to the DNO's Distribution System via the power factor (pf) meter and the variac as shown below in figure B5. The directly coupled SSEG pf should be within the limits given in 5.6, for three test voltages 230 V – 6%, 230V and 230 V +10%.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.4.3	**Voltage Flicker** The voltage fluctuations and flicker emissions from the SSEG shall be measured in accordance with BS EN 61000-3-3 and technology specific annex.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.4.4	**DC Injection** The level of DC injection from the directly coupled SSEG to the DNO's Distribution System shall not exceed the levels specified in 5.5. In a directly coupled SSEG, any harmonics present will be as a result of any electronic components, with in the Controller and can be measured at 0% load.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.4.5	**Overcurrent Protection** Where appropriate the protection shall comply with the requirements of BS7671.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.4.6	**Short Circuit Current Contribution** DNOs need to understand the contribution an SSEG makes to system fault levels in order to determine that they can continue to safely operate without exceeding design fault levels for switchgear and other circuit components. For rotating machines BS EN 60034-4:1995 Methods for determining synchronous machine quantities from tests should be used to establish the parameters required to be recorded in Appendix 4 under the section Fault Level Contribution.	The SSEG is a photovoltaic inverter. Therefore the requirements according C1.2 are applicable.	**N/A**
B1.4.7	**Electromagnetic Compatibility (EMC)** All equipment shall comply with the generic	The SSEG is a photovoltaic inverter.	**N/A**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	EMC standards: BS EN61000-6-3: 2007 Electromagnetic Compatibility, Generic Emission Standard; and BS EN61000-6-1: 2007 Electromagnetic Compatibility, Generic Immunity Standard.	Therefore the requirements according C1.2 are applicable.	
Annex C1	**Separate Specific SSEG Technology Requirements**		
C1.1	**Domestic CHP** For Domestic CHP SSEGs connected to the DNO's Distribution System via an Inverter, the type verification testing and Interface Protection requirements will be as per the requirements defined in Annex A. For Domestic CHP SSEGs directly coupled to the DNO's Distribution System, the type verification testing and Interface Protection requirements will be as per the requirements defined in Annex B.	The SSEG is a photovoltaic inverter.	**N/A**
C1.2	**Photovoltaic** As all current Photovoltaic SSEGs will connect to the DNO's Distribution System via an Inverter, the type verification testing and Interface Protection requirements will be as per the requirements defined in Annex A.	The SSEG is a photovoltaic inverter.	**P**
C1.3	**Fuel Cells** As all current Fuel Cell SSEGs will connect to the DNO's Distribution System via an Inverter, the type verification testing and Interface Protection requirements will be as per the requirements defined in Annex A.	The SSEG is a photovoltaic inverter.	**N/A**
C1.4	**Hydro** Hydro can be connected to the DNO's Distribution System directly using induction or synchronous generators or it can be connected by an Inverter. The common requirements for the generator technologies will apply to micro hydro in addition the following needs to be taken into consideration. SSEGs with manually fixed output or where the output is fixed by controlling the water flow through the turbine to a steady rate, need to comply with the maximum voltage change requirements of BS EN 61000-3-2 but do not need to be tested for P_{st} or P_{lt}. SSEGs where the output is controlled by varying the load on the generator using the	The SSEG is a photovoltaic inverter.	**N/A**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	Inverter and which therefore produces variable output need to comply with the maximum voltage change requirements of BS EN 61000-3-2 and also need to be tested for P_{st} and P_{lt} over a period where the range of flows varies over the design range of the turbine with a period of at least 2 hours at each step with there being 10 steps from min flow to maximum flow. P_{st} and P_{lt} values to recorded and normalised as per the method laid down in Appendix 4.		
C1.5	**Wind** Wind turbines can be connected to the DNO's Distribution System directly, typically using asynchronous induction generators, or using Inverters. For those connected via Inverters, the type verification testing and interface protection requirements shall be as specified in Annex A. For those connected directly to the DNO's Distribution System, the type verification testing and interface protection requirements shall be as specified in Annex B. In addition, in either case, the note regarding wind turbine voltage flicker testing specified in 5.4 shall apply.	The SSEG is a photovoltaic inverter.	**N/A**
C1.6	**Energy Storage Device** Energy Storage Devices can be connected to the DNO's Distribution System directly or using Inverters. For those connected via Inverters, the type verification testing and interface protection requirements shall be as specified in Annex A. For those connected directly to the DNO's Distribution System, the type verification testing and interface protection requirements shall be as specified in Annex B.	The SSEG is a photovoltaic inverter.	**N/A**

G83/2 Test Results:
A1 Common Directly Coupled Connected SSEG Requirements

A1.3 Type Verification Functional Testing of the Interface Protection Functional safety - fault condition tests according DIN V VDE V 0126-1-1	P

	ambient temperature [°C] :	23,8
	model/type of power supply :	DC : 62150H-1000S AC : 61512
	manufacturer of power supply :	Chroma
	rated markings of power supply :	DC: 0-1000V, 15kW AC: 0-300V, 18kW

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
PV voltage detect UC1C Pin 9	Open	230V 12,63 A	450V 6,62A	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID09. (PV voltage over range)
PV current detect UC1B Pin 5	Open	230V 12,63 A	450V 6,6A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID14. (PV current over range)
GFCI detect UC2D Pin 12-13	Short	230V 12,63 A	450V 6,62A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID12. (GFCI fault)
GFCI detect UC2C Pin 10	Short	230V 12,63 A	450V 6,62A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID52. (GFCI fault)
Grid voltage detect UC2A Pin 3	Open	230V 12,64 A	450V 6,67A	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID15. (Grid current or voltage over range)
Grid voltage detect RC17	Open	230V 12,63 A	450V 6,62A	2 Min.	--	230V 0,17A	450V 0,01A	PV inverter disconnected from grid immediately, error message: ID02, ID49, ID70. (Grid current or voltage under range)
Grid voltage detect RC25	Open	230V 12,64 A	450V 6,62A	2 Min.	--	230V 0,18A	450V 0,01A	PV inverter disconnected from grid immediately, error message: ID55. (Relay fault)
Bus voltage detect RP3	Open	230V 12,61 A	450V 6,63A	2 Min.	--	230V 0,6A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID23. (Bus voltage zero fault)

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
Bus voltage detect UC1A Pin2-3	Short	230V 12,56A	450V 6,65A	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID66. (Bus voltage over range)
Bus voltage detect RC82	Short	230V 12,56A	450V 6,69A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID25. (Bus voltage under range)
ISO detect RC105	Open before start	230V 0,17A	450V 0,18A	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter can not start up, error message: ID56. (ISO fault)
AC current detect RC22	Open	230V 12,56	450V 6,68	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID15. (AC current over range), QP2， QP6，QP9，RP26，RP28，RP11 damaged.
AC current detect RC21	Open	230V 12,62A	450V 6,63A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID15. (AC current over range).
DC current detect RC33	Open	230V 12,67A	450V 6,69A	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID28. (DC current over range).
DC current detect RC37	Open	230V 12,54A	450V 6,67A	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID28. (DC current over range).
DC current detect RC42	Open	230V 12,62A	450V 6,66A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID51. (DC current fault).
AC current detect RC61	Open	230V 12,66A	450V 6,7A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID15, ID65. (AC voltage or current over range).
AC current detect RC80	Open	230V 12,67A	450V 6,8A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID15, ID65. (AC voltage or current over range).
GFCI detect RP70	Open	230V 12,63A	450V 6,66A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID12. (GFCI fault).
GFCI detect RP80	Open	230V 12,63A	450V 6,66	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID12. (GFCI fault).

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
GFCI detect UP7A Pin2-3	Short	230V 12,56A	450V 6,67A	2 Min.	--	230V 0,17A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID12. (GFCI fault).
PV voltage detect RP115	Open	230V 12,62A	450V 6,67A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, no display, and reconnect to grid, error message: ID56. (ISO fault).
PV voltage detect RP115	Short	230V 12,63A	450V 6,63A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID09. (PV voltage over range)
ISO detect RP99	Open before start	230V 0,16A	450V 0,02A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter can not start up, error message: ID56. (ISO fault).
Relay detect RYP2 Pin3-4	Short before start	230V 0,16A	450V 0,02A	2 Min.	--	230V 016A	450V 0,02A	PV inverter can not start up, error message: ID55, ID77. (Relay fault).
Relay detect RYP3 Pin3-4	Short before start	230V 0,16A	450V 0,02A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter can not start up, error message: ID55, ID77. (Relay fault).
Relay detect RYP4 Pin3-4	Short before start	230V 0,16A	450V 0,02A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter can not start up, error message: ID55, ID77. (Relay fault).
Relay detect RYP5 Pin3-4	Short before start	230V 0,16A	450V 0,02A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter can not start up, error message: ID55, ID77. (Relay fault).
Grid voltage detect RP150	Open	230V 0,62A	450V 6,67A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID02. (Grid voltage under range)
Grid voltage detect RP150	Short	230V 12,64A	450V 6,66A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID01. (Grid voltage over range)
Grid voltage detect RP135	Short	230V 12,64A	450V 6,67A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID01. (Grid voltage over range)
Grid voltage detect RP135	Open	230V 12,61A	450V 6,66A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: ID02. (Grid voltage under range)
Loss of control CC100	Short	230V 12,61A	450V 6,67A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: DSP communicate fail

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
Loss of control XLC	Short	230V 12,63A	450V 6,65A	2 Min.	--	230V 0,16A	450V 0,02A	PV inverter disconnected from grid immediately, error message: DSP communicate fail
Communication microcontroller defect UC34 Pin 31	Open	230V 12,64A	450V 6,66A	2 Min.	--	230V 0.16A	450V 0.02A	PV inverter disconnected from grid immediately, error message: ID 53 (SPI Communication fault)
Communication microcontroller defect UC34 Pin 37	Open	230V 12,64A	450V 6,66A	2 Min.	--	230V 0.17A	450V 0.02A	PV inverter disconnected from grid immediately, error message: ID 53 (SPI Communication fault)
Communication microcontroller defect UC34 Pin 44	Open	230V 12,63A	450V 6,66A	2 Min.	--	230V 0.17A	450V 0.02A	PV inverter disconnected from grid immediately, error message: ID 53 (SPI Communication fault)
Communication microcontroller defect UC34 Pin 47	Open	230V 12,64A	450V 6,67A	2 Min.	--	230V 0.17A	450V 0.02A	PV inverter disconnected from grid immediately, error message: ID 53 (SPI Communication fault)
The errors in the control circuit simulate that the safety is even ensured during single fault. The tests had been performed on the SOFAR 3000TL is valid for the SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.								

A1.3.2 Over / Under Voltage (230Vac)

The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2

P

Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	201,0V	2,513s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,8V	0,517s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	261,3V	1,014s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,3V	0,516s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

Note:

The total disconnection time for voltage and frequency protection including the operating time of the disconnection device shall be the trip delay setting with a tolerance of, -0s + 0.5s.

For the avoidance of doubt voltage and frequency excursions lasting less than the trip delay setting shall not result in disconnection.

For grid surge voltages greater than 230V +19% which are present for periods of <0.5s the SSEG is permitted to reduce/cease exporting in order to protect the equipment.

The Manufacturer must ensure that the Interface Protection is capable of measuring voltage to an accuracy of ± 1.5% of the nominal value (± 3.45V) and of measuring frequency to ± 0.2% of the nominal value (± 0.1Hz) across its operating range of voltage, frequency and temperature.

To establish a trip voltage, the test voltage should be applied in steps of ± 0.5% or less, of the nominal voltage for a duration that is longer than the trip time delay, for example 1 second in the case of a delay setting of 0.5 second starting at least 4V below or above the setting. The test voltage at which this trip occurred is to be recorded. Additional tests just above and below the trip voltage should be undertaken to show that the test is repeatable and the figure at which a repeatable trip occurs should be recorded on the type verification test report Appendix 4 of this Engineering Recommendation.

To establish the trip time, the test voltage should be applied starting from 4V below or above the recorded trip voltage and should be changed to 4V above or below the recorded trip voltage in a single step. The time taken from the step change to the SSEG tripping is to be recorded on on the type verification test report Appendix 4 of this Engineering Recommendation.

The tests had been performed on the SOFAR 3000TL is valid for the SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

U/V stage 1

U/V stage 2:

O/V stage 1

O/V stage 2:

A1.3.2 Over / Under Voltage (240Vac) The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2	**P**

Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	208,8V	2,5s	210,2V	2,515s	212,8V / 3,5s	No trip
U/V stage 2	192V	0,5s	193,4V	0,523s	196V / 2,48s	No trip
					188V / 0,48s	No trip
O/V stage 1	273,6V	1,0s	273,5V	1,013s	269,6V 2,0s	No trip
O/V stage 2	285,6V	0,5s	285,5V	0,520s	281,6V 0,98s	No trip
					289,6V 0,48s	No trip

Note:
The total disconnection time for voltage and frequency protection including the operating time of the disconnection device shall be the trip delay setting with a tolerance of, -0s + 0.5s.

For the avoidance of doubt voltage and frequency excursions lasting less than the trip delay setting shall not result in disconnection.

For grid surge voltages greater than 230V +19% which are present for periods of <0.5s the SSEG is permitted to reduce/cease exporting in order to protect the equipment.

The Manufacturer must ensure that the Interface Protection is capable of measuring voltage to an accuracy of ± 1.5% of the nominal value (± 3.45V) and of measuring frequency to ± 0.2% of the nominal value (± 0.1Hz) across its operating range of voltage, frequency and temperature.

To establish a trip voltage, the test voltage should be applied in steps of ± 0.5% or less, of the nominal voltage for a duration that is longer than the trip time delay, for example 1 second in the case of a delay setting of 0.5 second starting at least 4V below or above the setting. The test voltage at which this trip occurred is to be recorded. Additional tests just above and below the trip voltage should be undertaken to show that the test is repeatable and the figure at which a repeatable trip occurs should be recorded on the type verification test report Appendix 4 of this Engineering Recommendation.

To establish the trip time, the test voltage should be applied starting from 4V below or above the recorded trip voltage and should be changed to 4V above or below the recorded trip voltage in a single step. The time taken from the step change to the SSEG tripping is to be recorded on on the type verification test report Appendix 4 of this Engineering Recommendation.

The tests had been performed on the SOFAR 3000TL is valid for the SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

U/V stage 1

U/V stage 2:

O/V stage 1

O/V stage 2:

A1.3.2 Over / Under Frequency

The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.3

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Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,50Hz	20,15s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,00Hz	0,673s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,50Hz	90,13s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,00Hz	0,694s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note:

The total disconnection time for voltage and frequency protection including the operating time of the disconnection device shall be the trip delay setting with a tolerance of, -0s + 0.5s.

For the avoidance of doubt voltage and frequency excursions lasting less than the trip delay setting shall not result in disconnection.

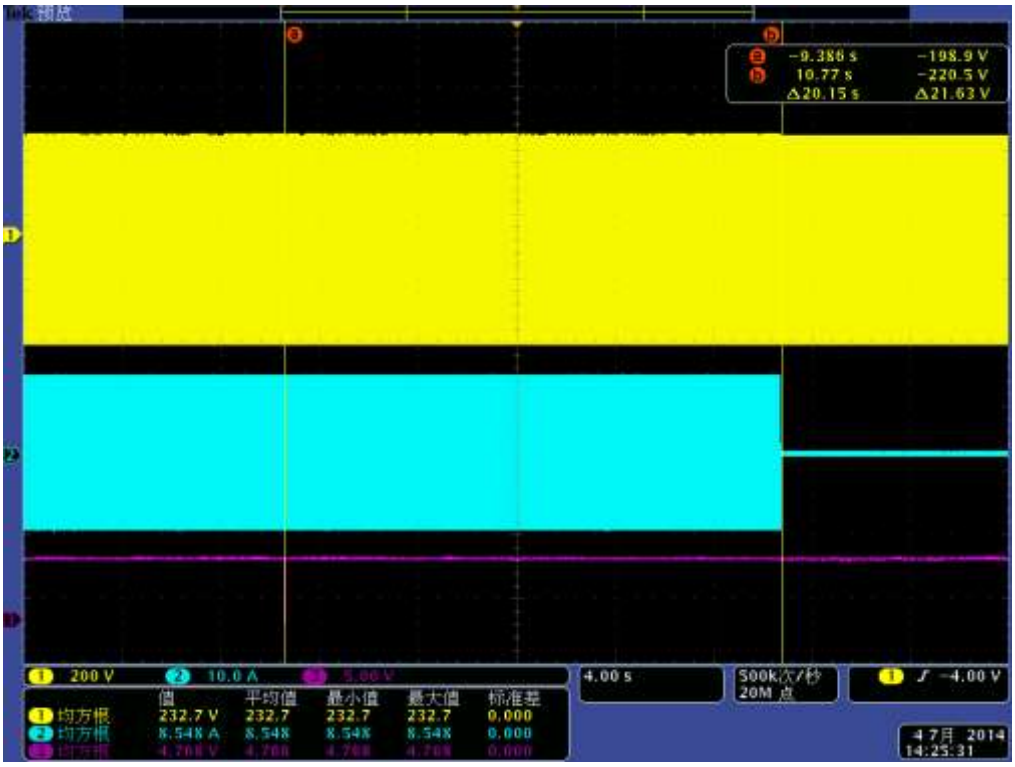
The Manufacturer must ensure that the Interface Protection is capable of measuring voltage to an accuracy of ± 1.5% of the nominal value (± 3.45V) and of measuring frequency to ± 0.2% of the nominal value (± 0.1Hz) across its operating range of voltage, frequency and temperature.

To establish a trip frequency, the test frequency should be applied in a slow ramp rate of less than 0.1Hz/second, or if this is not possible in steps of 0.05Hz for a duration that is longer than the trip time delay, for example 1 second in the case of a delay setting of 0.5 second. The test frequency at which this trip occurred is to be recorded. Additional tests just above and below the trip frequency should be undertaken to show that the test is repeatable and the figure at which a repeatable trip occurs should be recorded on the type verification test report Appendix 4 of this Engineering Recommendation.

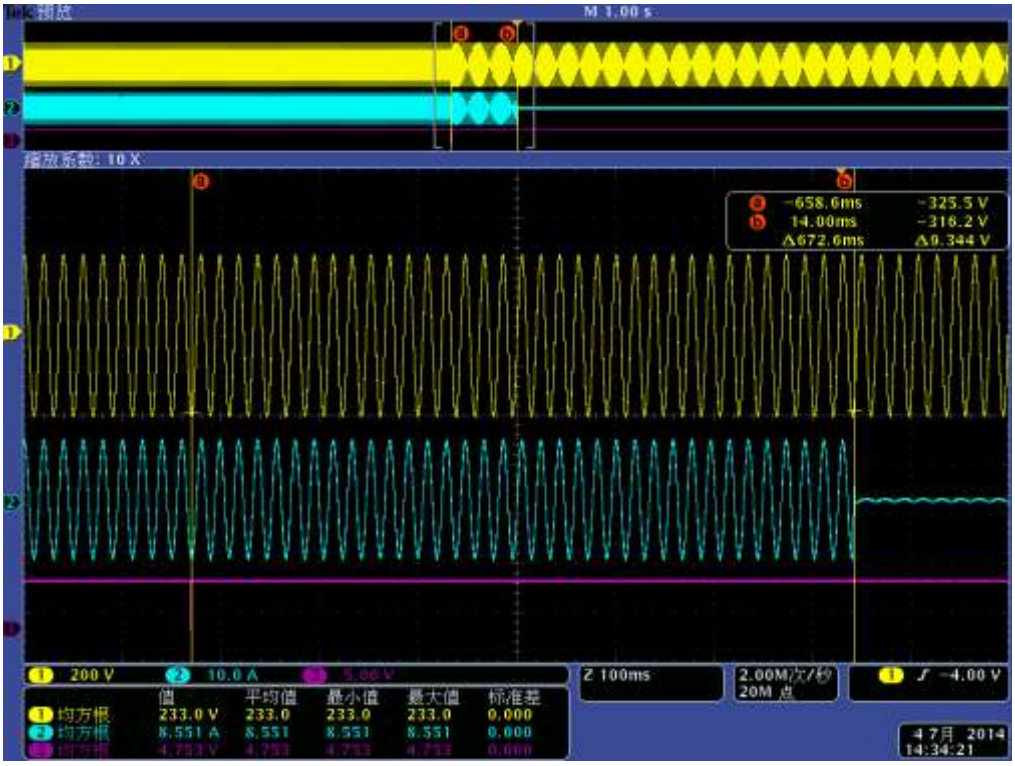
To establish the trip time, the test frequency should be applied starting from 0.3Hz below or above the recorded trip frequency and should be changed to 0.3Hz above or below the recorded trip frequency in a single step. The time taken from the step change to the SSEG tripping is to be recorded on the type verification test report Appendix 4 of this Engineering Recommendation. It should be noted that with some loss of mains detection techniques this test may result in a faster trip due to operation of the loss of mains protection. There are two ways around this. Firstly the loss of mains protection may be able to be turned off in order to carry out this test. Secondly by establishing an accurate frequency for the trip a much smaller.

The tests had been performed on the SOFAR 3000TL is valid for the SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

U/F stage 1

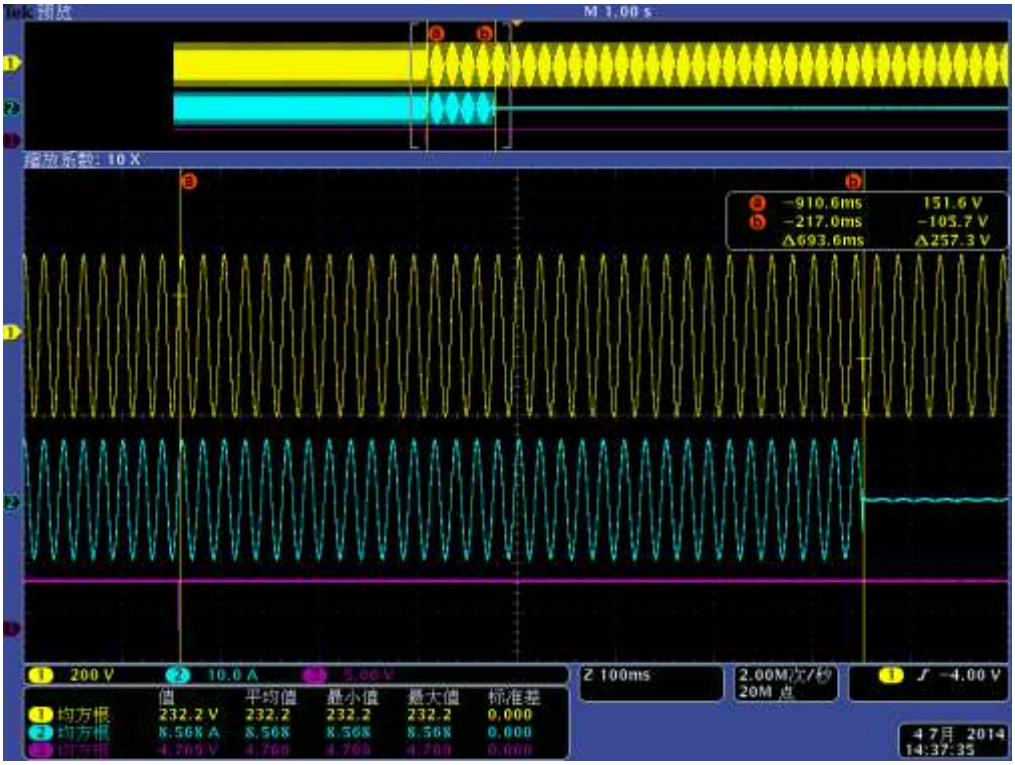


U/F stage 2



O/F stage 1

O/F stage 2



A1.3.4 Loss of mains protection according BS EN 62116

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The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)

SOFAR 1100TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

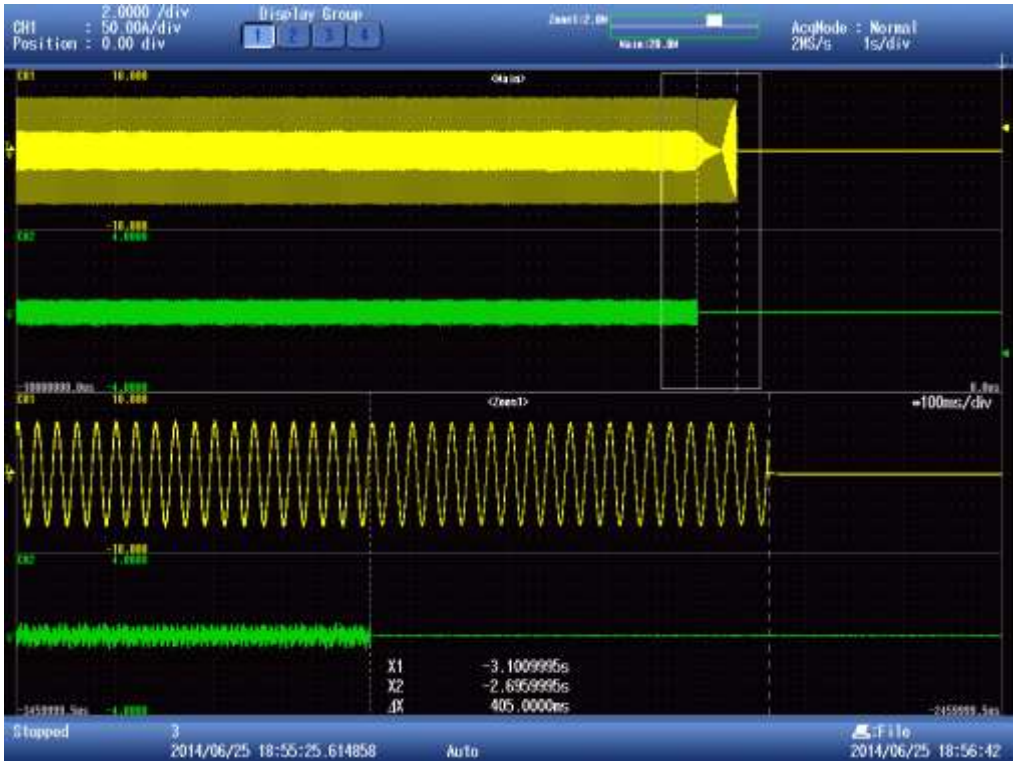
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
1	100	100	0	0	405	1019	1,02	335	Test A at BL
4	100	100	-5	-5	95	1019	0,94	335	Test A at IB
5	100	100	-5	0	376	1019	0,97	335	Test A at IB
6	100	100	-5	+5	126	1019	0,99	335	Test A at IB
7	100	100	0	-5	72	1019	0,99	335	Test A at IB
8	100	100	0	+5	169	1019	1,04	335	Test A at IB
9	100	100	+5	-5	61	1019	1,04	335	Test A at IB
10	100	100	+5	0	223	1019	1,07	335	Test A at IB
11	100	100	+5	+5	170	1019	1,09	335	Test A at IB

Parameter at 0%	L= 161,13 mH	R= 51,91 Ω	C= 61,62 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

Note:
Note for technologies which have a substantial shut down time this can be added to the 0.5 seconds in establishing that the trip occurred in less than 0.5s. Maximum shut down time could therefore be up to 1.0 seconds for these technologies.
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] BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum [5]
EUT input voltage [6] = >90% of rated input voltage range
[5] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 100% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)

P

SOFAR 1100TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

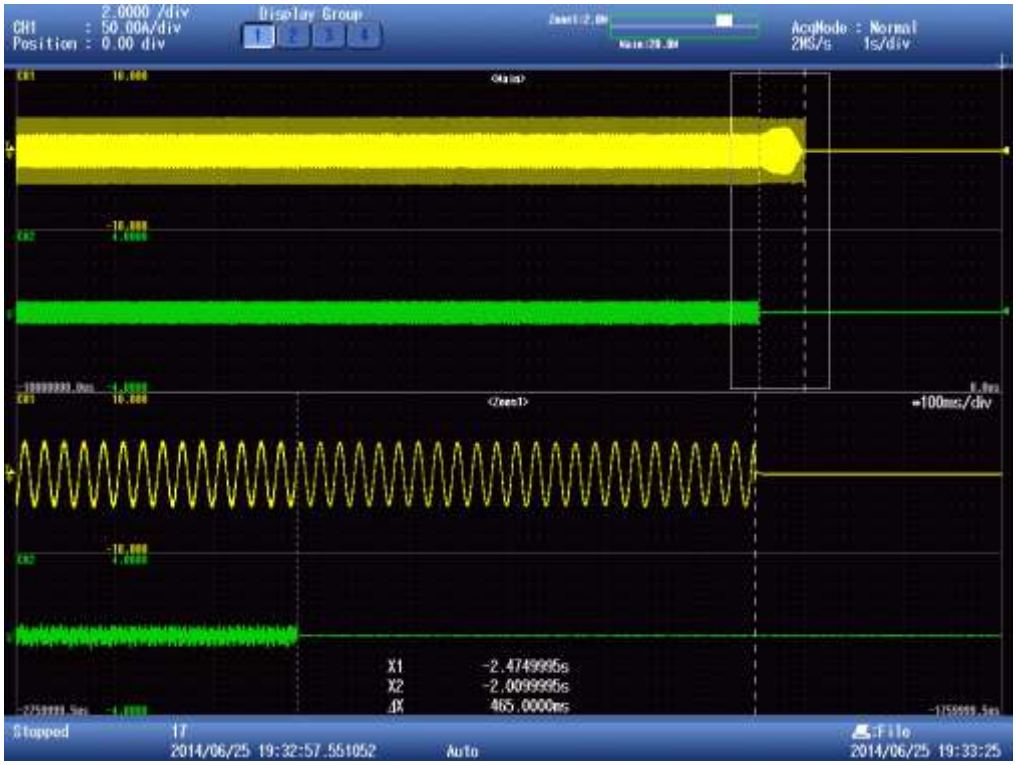
No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks 4)
12	66	66	0	-5	88	629	0,98	235	Test B at IB
13	66	66	0	-4	146	629	0,98	235	Test B at IB
14	66	66	0	-3	201	629	0,99	235	Test B at IB
15	66	66	0	-2	196	629	0,99	235	Test B at IB
16	66	66	0	-1	299	629	1,00	235	Test B at IB
2	66	66	0	0	299	629	1,00	235	Test B at BL
17	66	66	0	1	409	629	1,01	235	Test B at IB
18	66	66	0	2	465	629	1,01	235	Test B at IB
19	66	66	0	3	311	629	1,02	235	Test B at IB
20	66	66	0	4	144	629	1,02	235	Test B at IB
21	66	66	0	5	209	629	1,03	235	Test B at IB

Parameter at 0%	L= 263,10 mH	R= 84,10 Ω	C= 37,55 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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) BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage 5) = 50 % of rated input voltage range, ±10 %
5) 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.

Disconnection at P_{AC} 0% and Q_{AC} 2% reactive load and 66% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)

SOFAR 1100TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

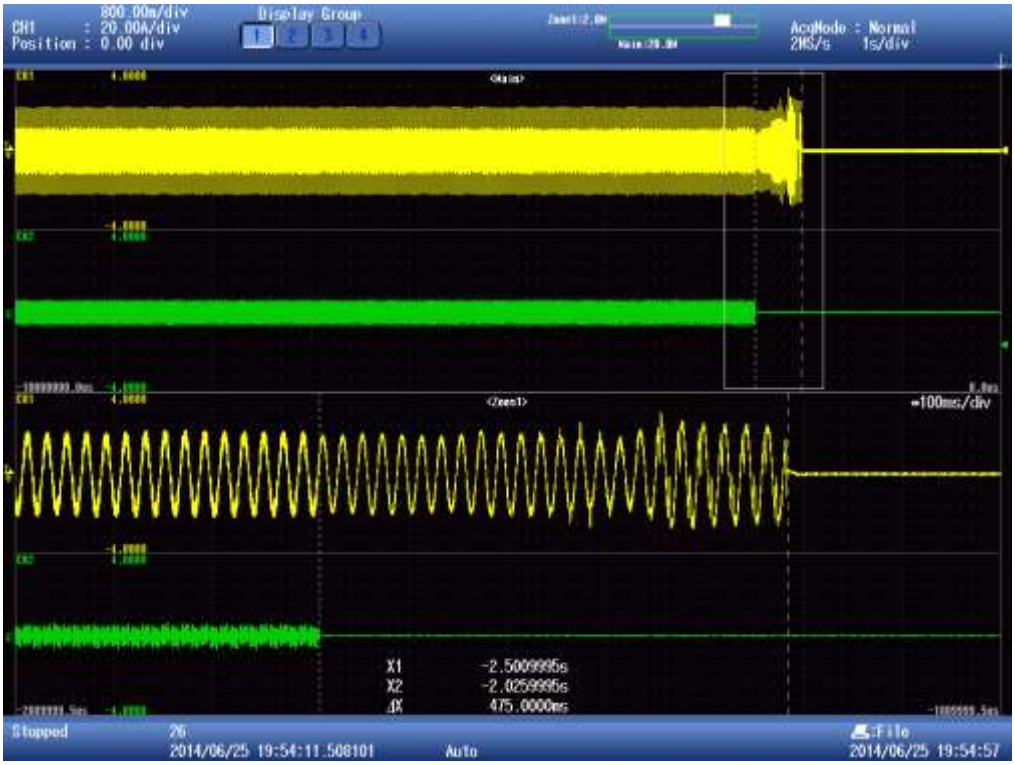
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
22	33	33	0	-5	100	303	0,99	135	Test C at IB
23	33	33	0	-4	45	303	1,00	135	Test C at IB
24	33	33	0	-3	220	303	1,00	135	Test C at IB
25	33	33	0	-2	128	303	1,01	135	Test C at IB
26	33	33	0	-1	236	303	1,01	135	Test C at IB
3	33	33	0	0	475	303	1,02	135	Test C at BL
27	33	33	0	1	359	303	1,02	135	Test C at IB
28	33	33	0	2	243	303	1,03	135	Test C at IB
29	33	33	0	3	146	303	1,03	135	Test C at IB
30	33	33	0	4	204	303	1,04	135	Test C at IB
31	33	33	0	5	131	303	1,04	135	Test C at IB

Parameter at 0%	L= 536,26 mH	R= 174,59 Ω	C= 18,29 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition C:
EUT output power PEUT = 25 % – 33 % [5] of maximum
EUT input voltage [6] = <10 % of rated input voltage range
[5] Or minimum allowable EUT output level if greater than 33 %.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 33% nominal power



A1.3.4 Loss of mains protection according BS EN 62116 The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4 Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)	**P**

SOFAR 1600TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

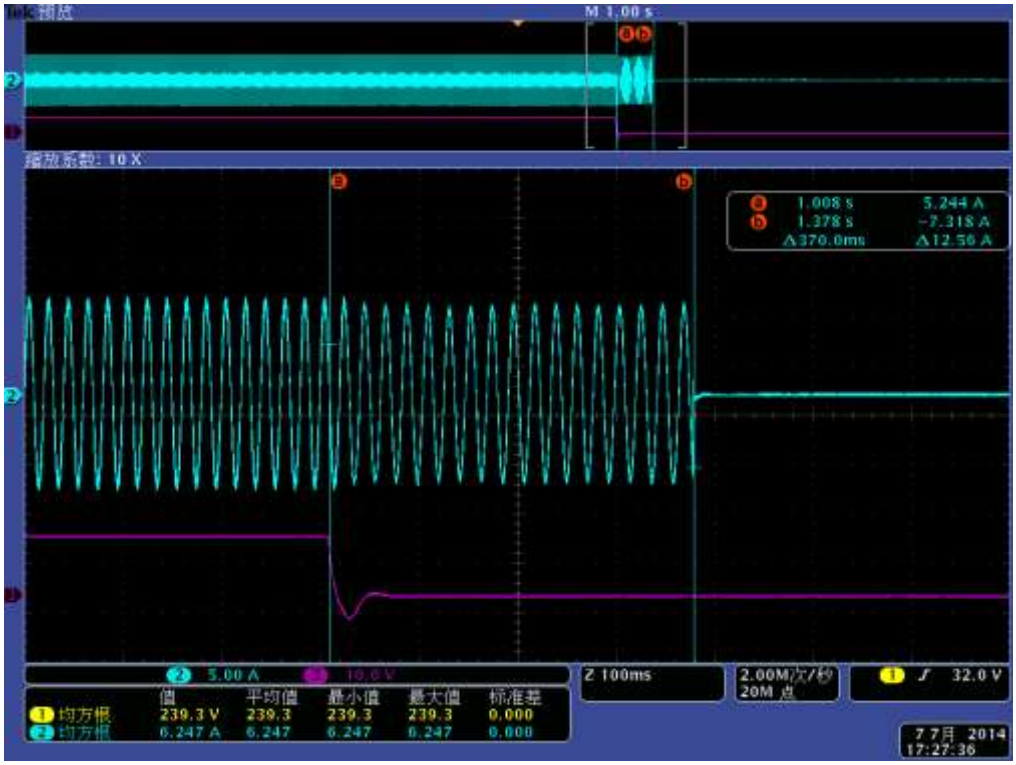
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
1	100	100	0	0	370	1499	1,02	340,5	Test A at BL
4	100	100	-5	-5	353	1499	0,94	340,5	Test A at IB
5	100	100	-5	0	303	1499	0,97	340,5	Test A at IB
6	100	100	-5	+5	286	1499	0,99	340,5	Test A at IB
7	100	100	0	-5	285	1499	0,99	340,5	Test A at IB
8	100	100	0	+5	348	1499	1,04	340,5	Test A at IB
9	100	100	+5	-5	369	1499	1,04	340,5	Test A at IB
10	100	100	+5	0	301	1499	1,07	340,5	Test A at IB
11	100	100	+5	+5	347	1499	1,10	340,5	Test A at IB

Parameter at 0%	L= 108,71 mH	R= 35,29 Ω	C= 90,26 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

Note:
Note for technologies which have a substantial shut down time this can be added to the 0.5 seconds in establishing that the trip occurred in less than 0.5s. Maximum shut down time could therefore be up to 1.0 seconds for these technologies.
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] BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum [5]
EUT input voltage [6] = >90% of rated input voltage range
[5] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 100% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)

SOFAR 1600TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

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)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
12	66	66	0	-5	356	912	1,00	262,5	Test B at IB
13	66	66	0	-4	347	912	1,00	262,5	Test B at IB
14	66	66	0	-3	407	912	1,01	262,5	Test B at IB
15	66	66	0	-2	443	912	1,01	262,5	Test B at IB
16	66	66	0	-1	333	912	1,02	262,5	Test B at IB
2	66	66	0	0	379	912	1,02	262,5	Test B at BL
17	66	66	0	1	426	912	1,03	262,5	Test B at IB
18	66	66	0	2	389	912	1,03	262,5	Test B at IB
19	66	66	0	3	330	912	1,04	262,5	Test B at IB
20	66	66	0	4	448	912	1,04	262,5	Test B at IB
21	66	66	0	5	303	912	1,05	262,5	Test B at IB

Parameter at 0%	L= 177,44 mH	R= 58,00 Ω	C= 55,24 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage [5] = 50 % of rated input voltage range, ±10 %
[5] 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.

Disconnection at P_{AC} 0% and Q_{AC} 4% reactive load and 66% nominal power

A1.3.4 Loss of mains protection according BS EN 62116 The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4 Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	**P**

SOFAR 1600TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

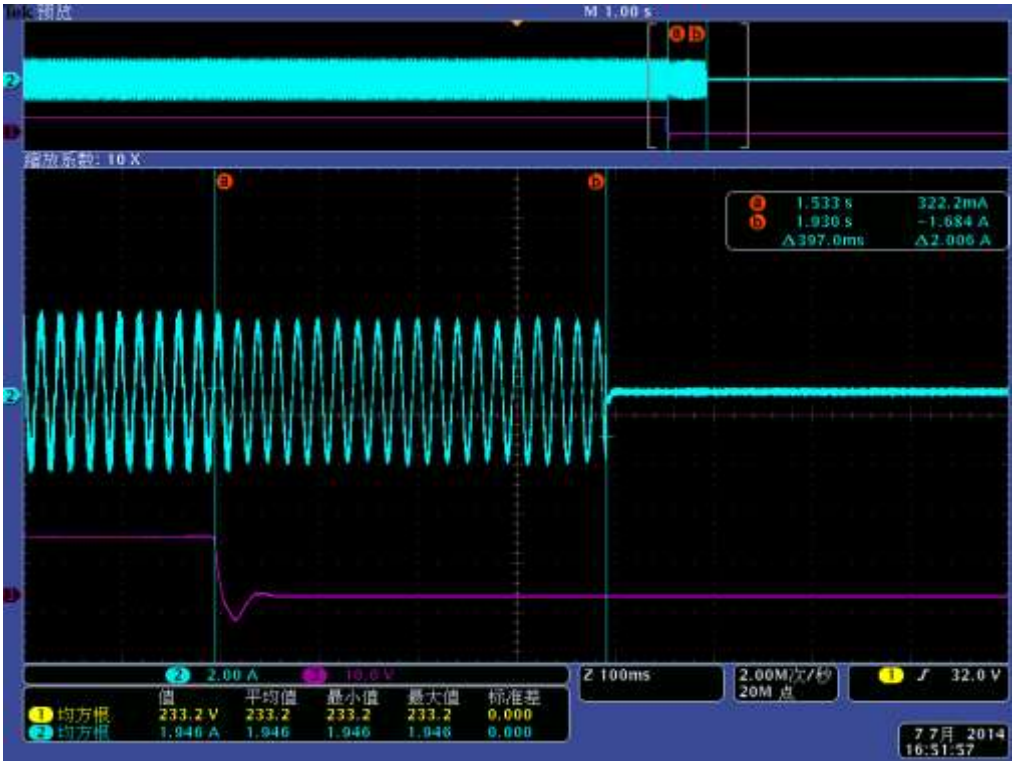
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
22	33	33	0	-5	349	439	0,99	184,5	Test C at IB
23	33	33	0	-4	361	439	1,00	184,5	Test C at IB
24	33	33	0	-3	397	439	1,00	184,5	Test C at IB
25	33	33	0	-2	389	439	1,01	184,5	Test C at IB
26	33	33	0	-1	352	439	1,01	184,5	Test C at IB
3	33	33	0	0	325	439	1,02	184,5	Test C at BL
27	33	33	0	1	357	439	1,02	184,5	Test C at IB
28	33	33	0	2	327	439	1,03	184,5	Test C at IB
29	33	33	0	3	306	439	1,03	184,5	Test C at IB
30	33	33	0	4	349	439	1,04	184,5	Test C at IB
31	33	33	0	5	310	439	1,04	184,5	Test C at IB

Parameter at 0%	L= 370,08 mH	R= 120,50 Ω	C= 26,36 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition C:
EUT output power PEUT = 25 % – 33 % [5] of maximum
EUT input voltage [6] = <10 % of rated input voltage range
[5] Or minimum allowable EUT output level if greater than 33 %.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0%? and Q_{AC} -3% reactive load and 33% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)

SOFAR 2200TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

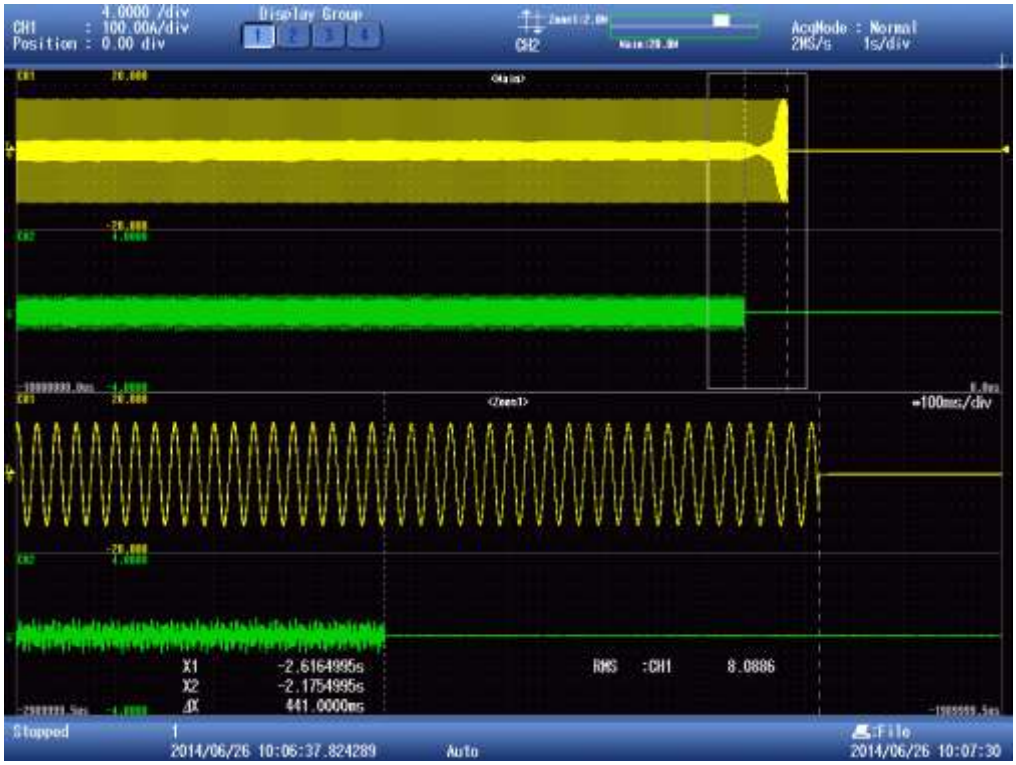
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
1	100	100	0	0	441	2032	1,01	377	Test A at BL
4	100	100	-5	-5	100	2032	0,94	377	Test A at IB
5	100	100	-5	0	433	2032	0,97	377	Test A at IB
6	100	100	-5	+5	164	2032	0,99	377	Test A at IB
7	100	100	0	-5	138	2032	0,99	377	Test A at IB
8	100	100	0	+5	123	2032	1,04	377	Test A at IB
9	100	100	+5	-5	105	2032	1,04	377	Test A at IB
10	100	100	+5	0	408	2032	1,07	377	Test A at IB
11	100	100	+5	+5	121	2032	1,09	377	Test A at IB

Parameter at 0%	L= 80,76 mH	R= 26,03 Ω	C= 122,51 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

Note:
Note for technologies which have a substantial shut down time this can be added to the 0.5 seconds in establishing that the trip occurred in less than 0.5s. Maximum shut down time could therefore be up to 1.0 seconds for these technologies.
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] BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum [5]
EUT input voltage [6] = >90% of rated input voltage range
[5] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 100% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)

SOFAR 2200TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

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)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
12	66	66	0	-5	95	1240	0,98	285	Test B at IB
13	66	66	0	-4	108	1240	0,99	285	Test B at IB
14	66	66	0	-3	212	1240	0,99	285	Test B at IB
15	66	66	0	-2	239	1240	1,00	285	Test B at IB
16	66	66	0	-1	308	1240	1,00	285	Test B at IB
2	66	66	0	0	292	1240	1,01	285	Test B at BL
17	66	66	0	1	419	1240	1,01	285	Test B at IB
18	66	66	0	2	307	1240	1,02	285	Test B at IB
19	66	66	0	3	200	1240	1,02	285	Test B at IB
20	66	66	0	4	217	1240	1,03	285	Test B at IB
21	66	66	0	5	128	1240	1,03	285	Test B at IB

Parameter at 0%	L= 133,53 mH	R= 42,66 Ω	C= 74,43 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage [5] = 50 % of rated input voltage range, ±10 %
[5] 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.

Disconnection at P_{AC} 0% and Q_{AC} 1% reactive load and 66% nominal power

A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)

SOFAR 2200TL

Test conditions	Frequency: 50+/-0,1Hz, U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

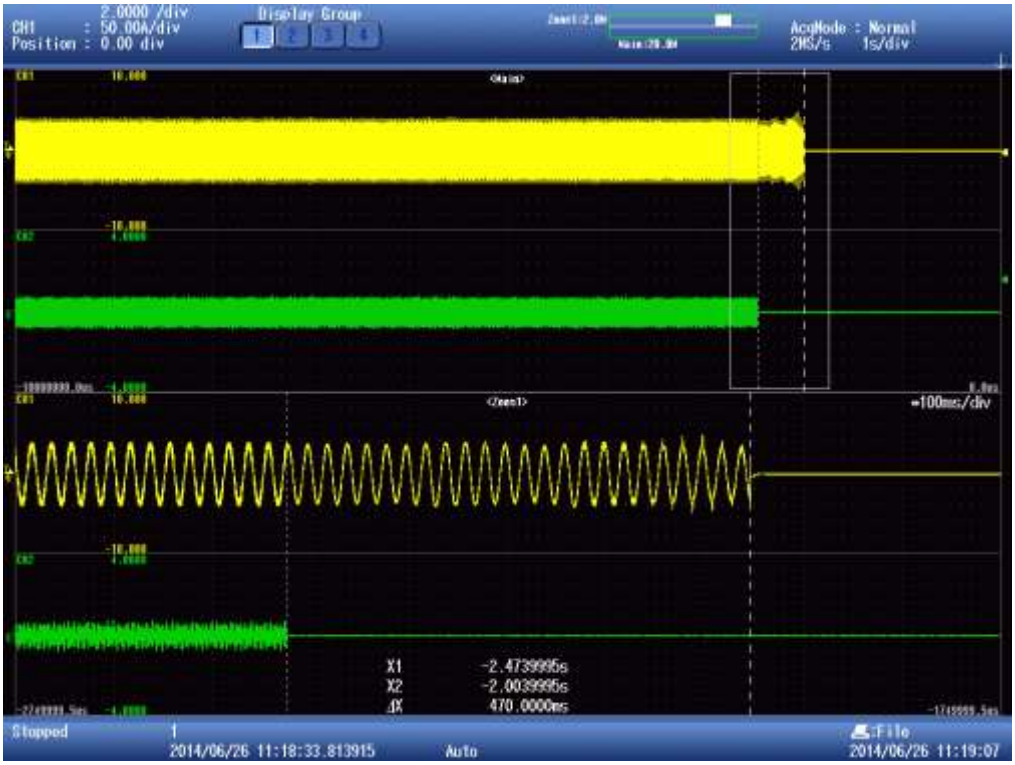
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
32	33	33	0	-6	153	594	0,99	193	Test C at IB
22	33	33	0	-5	172	594	0,99	193	Test C at IB
23	33	33	0	-4	140	594	1,00	193	Test C at IB
24	33	33	0	-3	124	594	1,00	193	Test C at IB
25	33	33	0	-2	211	594	1,01	193	Test C at IB
26	33	33	0	-1	140	594	1,01	193	Test C at IB
3	33	33	0	0	197	594	1,02	193	Test C at BL
27	33	33	0	1	470	594	1,02	193	Test C at IB
28	33	33	0	2	366	594	1,03	193	Test C at IB
29	33	33	0	3	255	594	1,03	193	Test C at IB
30	33	33	0	4	180	594	1,04	193	Test C at IB
31	33	33	0	5	65	594	1,04	193	Test C at IB

Parameter at 0%	L= 275,59 mH	R= 89,06 Ω	C= 35,92 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition C:
EUT output power PEUT = 25 % – 33 % [5] of maximum
EUT input voltage [6] = <10 % of rated input voltage range
[5] Or minimum allowable EUT output level if greater than 33 %.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 1% reactive load and 33% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)

SOFAR 2700TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

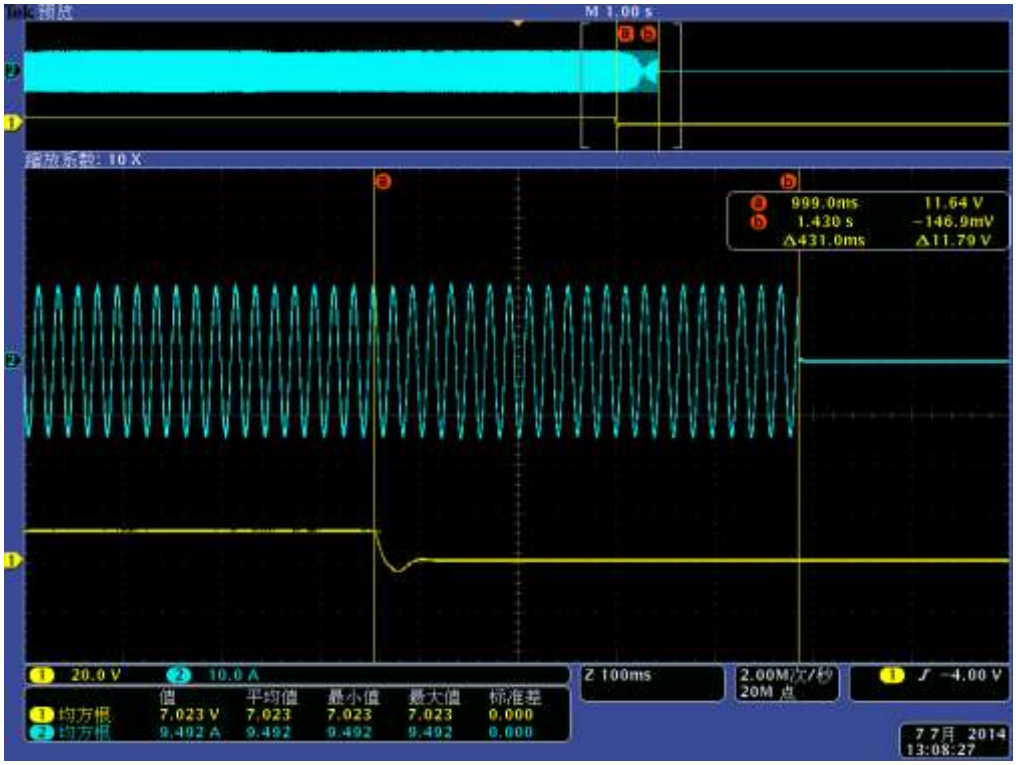
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
1	100	100	0	0	431	2496	1,01	381	Test A at BL
4	100	100	-5	-5	240	2496	0,94	381	Test A at IB
5	100	100	-5	0	326	2496	0,96	381	Test A at IB
6	100	100	-5	+5	268	2496	9,98	381	Test A at IB
7	100	100	0	-5	237	2496	0,98	381	Test A at IB
8	100	100	0	+5	288	2496	1,03	381	Test A at IB
9	100	100	+5	-5	279	2496	1,03	381	Test A at IB
10	100	100	+5	0	258	2496	1,06	381	Test A at IB
11	100	100	+5	+5	397	2496	1,09	381	Test A at IB

Parameter at 0%	L= 66,22 mH	R= 21,19 Ω	C= 149,59 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

Note:
Note for technologies which have a substantial shut down time this can be added to the 0.5 seconds in establishing that the trip occurred in less than 0.5s. Maximum shut down time could therefore be up to 1.0 seconds for these technologies.
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] BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum [5]
EUT input voltage [6] = >90% of rated input voltage range
[5] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 100% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)

SOFAR 2700TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

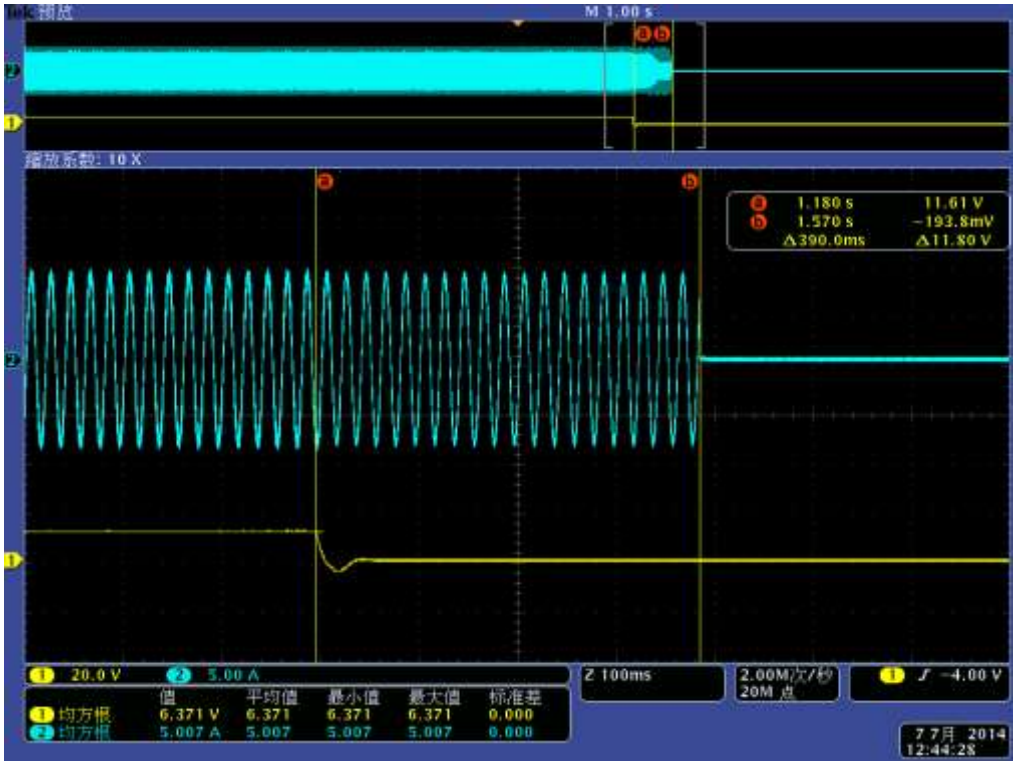
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
12	66	66	0	-5	239	1375	0,97	305	Test B at IB
13	66	66	0	-4	248	1375	0,98	305	Test B at IB
14	66	66	0	-3	201	1375	0,98	305	Test B at IB
15	66	66	0	-2	237	1375	0,99	305	Test B at IB
16	66	66	0	-1	331	1375	0,99	305	Test B at IB
2	66	66	0	0	390	1375	1,00	305	Test B at BL
17	66	66	0	1	293	1375	1,00	305	Test B at IB
18	66	66	0	2	248	1375	1,01	305	Test B at IB
19	66	66	0	3	222	1375	1,01	305	Test B at IB
20	66	66	0	4	355	1375	1,02	305	Test B at IB
21	66	66	0	5	300	1375	1,02	305	Test B at IB

Parameter at 0%	L= 121,32 mH	R= 38,47 Ω	C= 81,41 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage [5] = 50 % of rated input voltage range, ±10 %
[5] 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.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 66% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)

P

SOFAR 2700TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

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)	Run on Time (ms)	P_{EUT}(W)	Qf	V_{DC}	Remarks[4]
22	33	33	0	-5	243	745	1,01	229	Test C at IB
23	33	33	0	-4	264	745	1,01	229	Test C at IB
24	33	33	0	-3	268	745	1,02	229	Test C at IB
25	33	33	0	-2	197	745	1,02	229	Test C at IB
26	33	33	0	-1	176	745	1,03	229	Test C at IB
3	33	33	0	0	296	745	1,03	229	Test C at BL
27	33	33	0	1	219	745	1,04	229	Test C at IB
28	33	33	0	2	231	745	1,05	229	Test C at IB
29	33	33	0	3	342	745	1,05	229	Test C at IB
30	33	33	0	4	351	745	1,06	229	Test C at IB
31	33	33	0	5	287	745	1,06	229	Test C at IB

Parameter at 0%	L= 219,82 mH	R= 71,01 Ω	C= 46,69 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition C:
EUT output power PEUT = 25 % – 33 % [5] of maximum
EUT input voltage [6] = <10 % of rated input voltage range
[5] Or minimum allowable EUT output level if greater than 33 %.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0 %and Q_{AC} 4% reactive load and 33% nominal power

A1.3.4 Loss of mains protection according BS EN 62116

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)

P

SOFAR 3000TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

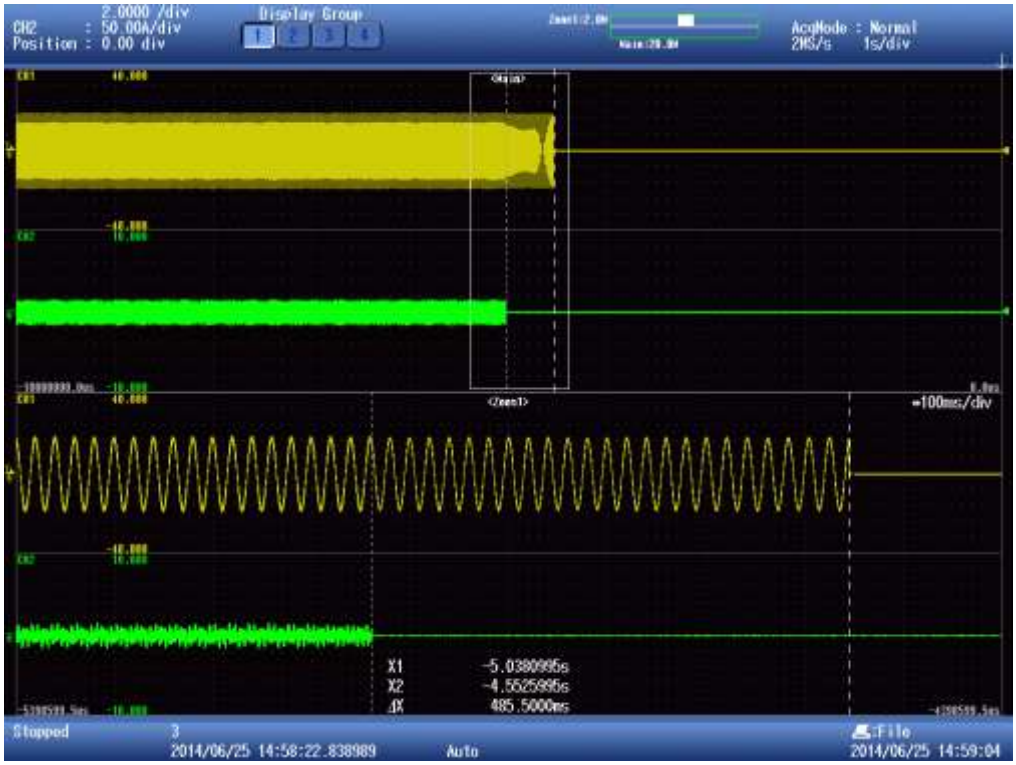
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
1	100	100	0	0	486	2821	1,00	383	Test A at BL
4	100	100	-5	-5	150	2821	0,93	383	Test A at IB
5	100	100	-5	0	404	2821	0,95	383	Test A at IB
6	100	100	-5	+5	86	2821	0,97	383	Test A at IB
7	100	100	0	-5	195	2821	0,97	383	Test A at IB
8	100	100	0	+5	64	2821	1,02	383	Test A at IB
9	100	100	+5	-5	54	2821	1,02	383	Test A at IB
10	100	100	+5	0	234	2821	1,05	383	Test A at IB
11	100	100	+5	+5	122	2821	1,08	383	Test A at IB

Parameter at 0%	L= 59,84 mH	R= 18,75 Ω	C= 169,75 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

Note:
Note for technologies which have a substantial shut down time this can be added to the 0.5 seconds in establishing that the trip occurred in less than 0.5s. Maximum shut down time could therefore be up to 1.0 seconds for these technologies.
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] BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum [5]
EUT input voltage [6] = >90% of rated input voltage range
[5] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 100% nominal power



A1.3.4 Loss of mains protection according BS EN 62116 The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4 Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	**P**

SOFAR 3000TL

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

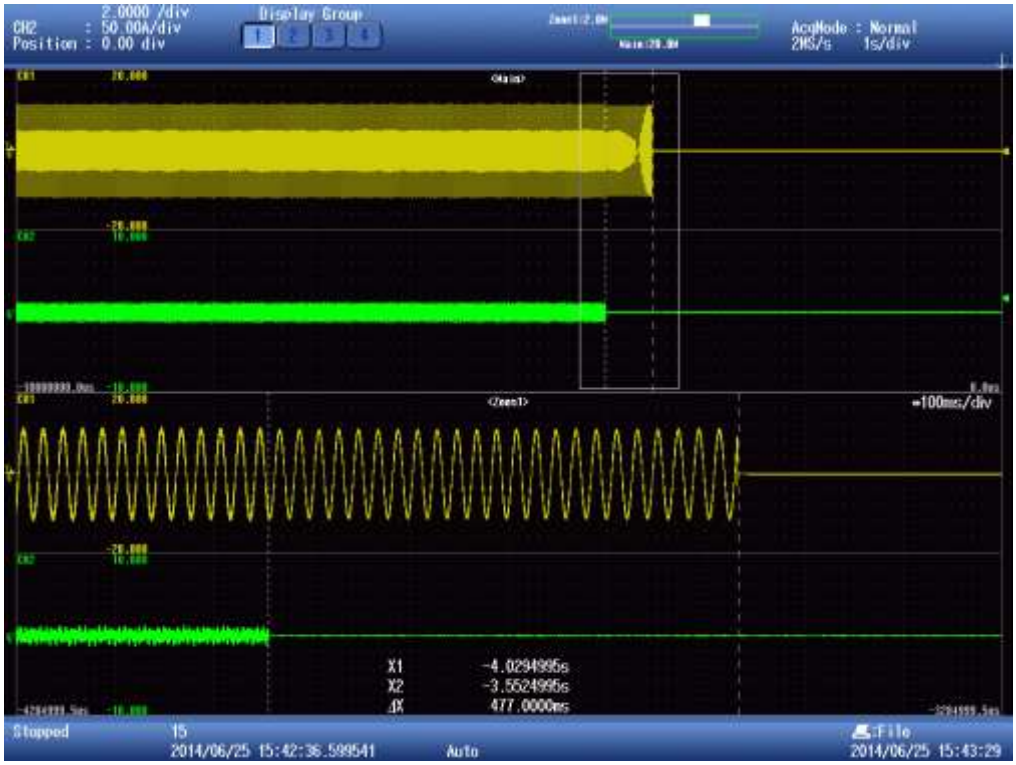
No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	Run on Time (ms)	P_{EUT}(W)	Qf	V_{DC}	Remarks[4]
32	66	66	0	-6	95	1771	0,97	315	Test B at IB
12	66	66	0	-5	116	1771	0,98	315	Test B at IB
13	66	66	0	-4	95	1771	0,98	315	Test B at IB
14	66	66	0	-3	131	1771	0,99	315	Test B at IB
15	66	66	0	-2	150	1771	0,99	315	Test B at IB
16	66	66	0	-1	233	1771	1,00	315	Test B at IB
2	66	66	0	0	477	1771	1,00	315	Test B at BL
17	66	66	0	1	200	1771	1,01	315	Test B at IB
18	66	66	0	2	387	1771	1,01	315	Test B at IB
19	66	66	0	3	165	1771	1,02	315	Test B at IB
20	66	66	0	4	217	1771	1,02	315	Test B at IB
21	66	66	0	5	139	1771	1,03	315	Test B at IB

Parameter at 0%	L= 94,92 mH	R= 29,87 Ω	C= 106,93 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage [5] = 50 % of rated input voltage range, ±10 %
[5] 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.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 66% nominal power



A1.3.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4
Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)

SOFAR 3000TL

Test conditions	Frequency: 50+/-0,1Hz, U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	0,5s

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)	Run on Time (ms)	P_{EUT} (W)	Qf	V_{DC}	Remarks[4]
33	33	33	0	-6	88	828	0,97	247	Test C at IB
22	33	33	0	-5	213	828	0,98	247	Test C at IB
23	33	33	0	-4	72	828	0,98	247	Test C at IB
24	33	33	0	-3	136	828	0,99	247	Test C at IB
25	33	33	0	-2	222	828	0,99	247	Test C at IB
26	33	33	0	-1	408	828	1,00	247	Test C at IB
3	33	33	0	0	499	828	1,00	247	Test C at BL
27	33	33	0	1	304	828	1,01	247	Test C at IB
28	33	33	0	2	184	828	1,01	247	Test C at IB
29	33	33	0	3	218	828	1,02	247	Test C at IB
30	33	33	0	4	100	828	1,02	247	Test C at IB
31	33	33	0	5	69	828	1,03	247	Test C at IB

Parameter at 0%	L= 202,14 mH	R= 63,89 Ω	C= 50,00 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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] BL: Balance condition, IB: Imbalance condition.
Condition C:
EUT output power PEUT = 25 % – 33 % [5] of maximum
EUT input voltage [6] = <10 % of rated input voltage range
[5] Or minimum allowable EUT output level if greater than 33 %.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 33% nominal power

A1.3.5 Re-connection The requirement is specified in section 5.3.4 Automatic Reconnection, test procedure in Annex A or B 1.3.5	**P**

Test should prove that the reconnection sequence starts after a minimum delay of 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 1.

Voltage	
Time delay setting	Measured delay
60s	74s

Frequency	
Time delay setting	Measured delay
60s	74s

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
Confirmation that the SSEG does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Note:
Reference in accordance with BS EN 50438 (2007)

The tests had been performed on the SOFAR 3000TL is valid for the SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

A1.3.6 Frequency Drift and Step change Stability test **P**

The requirement is specified in section 5.3.3, test procedure in Annex A or B 1.3.6

	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+9 degrees		No trip
Negative Vector Shift	50,5Hz	- 9 degrees		No trip
Positive Frequency drift	49,5Hz	+0,19Hz/sec	51,5Hz	No trip
Negative Frequency drift	50,5Hz	-0,19Hz/sec	47,5Hz	No trip

Note:
Manufacturers considering new designs should allow for the RoCoF where stability is required to be increased to, up to 2Hz per second, as proposed in the new European network codes, which are expected to come into force over the period 2014/2015. Under these conditions RoCoF will cease to be an effective loss of mains protection and is unlikely to be permitted in future revisions of this document.

For the step change test the SSEG should be operated with a measureable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 seconds to complete the test. The SSEG should not trip during this test.

For frequency drift tests the SSEG should be operated with a measureable output at the start frequency and then the frequency changed in a ramp function at 0.19Hz per second to the end frequency. On reaching the end frequency it should be maintained for a period of at least10 seconds. The SSEG should not trip during this test.

The tests had been performed on the SOFAR 3000TL is valid for the SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

A1.4 Power quality

A1.4.1 Harmonic Current Emissions

The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1

(SOFAR 1100TL)

P

SSEG rating per phase (rpp)					NV=MV*3,68/rpp	
	At 45-55% of rated ouput 0,5kW		100% of rated output 1,0kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,009	0,032	0,002	0,006	1,080	
3rd	0,050	0,180	0,080	0,293	2,300	
4th	0,005	0,019	0,001	0,005	0,430	
5th	0,014	0,049	0,010	0,036	1,140	
6th	0,004	0,014	0,001	0,005	0,300	
7th	0,013	0,046	0,006	0,023	0,770	
8th	0,003	0,012	0,002	0,006	0,230	
9th	0,008	0,030	0,004	0,015	0,400	
10th	0,004	0,013	0,002	0,007	0,184	
11th	0,005	0,019	0,003	0,010	0,330	
12th	0,003	0,011	0,002	0,007	0,153	
13th	0,004	0,013	0,002	0,007	0,210	
14th	0,003	0,010	0,002	0,007	0,131	
15th	0,003	0,011	0,002	0,007	0,150	
16th	0,002	0,008	0,002	0,006	0,115	
17th	0,003	0,010	0,002	0,006	0,132	
18th	0,002	0,007	0,001	0,005	0,102	
19th	0,002	0,008	0,002	0,006	0,118	
20th	0,002	0,006	0,001	0,005	0,092	
21th	0,003	0,010	0,002	0,008	0,107	0,160
22th	0,002	0,006	0,001	0,004	0,084	
23th	0,002	0,007	0,002	0,006	0,098	0,147
24th	0,001	0,005	0,001	0,004	0,077	
25th	0,002	0,007	0,002	0,007	0,090	0,135
26th	0,001	0,005	0,001	0,003	0,071	
27th	0,002	0,008	0,002	0,006	0,083	0,124
28th	0,001	0,005	0,001	0,004	0,066	
29th	0,002	0,007	0,002	0,007	0,078	0,117
30th	0,001	0,004	0,001	0,002	0,061	
31th	0,002	0,006	0,001	0,005	0,073	0,109
32th	0,002	0,006	0,001	0,003	0,058	
33th	0,002	0,007	0,002	0,006	0,068	0,102
34th	0,001	0,004	0,001	0,002	0,054	
35th	0,001	0,004	0,001	0,005	0,064	0,096
36th	0,001	0,005	0,001	0,002	0,051	
37th	0,002	0,008	0,002	0,006	0,061	0,091
38th	0,001	0,005	0,001	0,003	0,048	
39th	0,001	0,003	0,001	0,005	0,058	0,087
40th	0,001	0,004	0,001	0,002	0,046	

Note:
The higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

A1.4.1 Harmonic Current Emissions

The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1

(SOFAR 3000TL)

P

SSEG rating per phase (rpp)					NV=MV*3,68/rpp	
	At 45-55% of rated ouput 1,4kW		100% of rated output 2,8kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,006	0,008	0,008	0,011	1,080	
3rd	0,080	0,105	0,158	0,208	2,300	
4th	0,002	0,003	0,006	0,008	0,430	
5th	0,035	0,046	0,032	0,042	1,140	
6th	0,003	0,004	0,003	0,004	0,300	
7th	0,014	0,019	0,014	0,018	0,770	
8th	0,003	0,004	0,003	0,004	0,230	
9th	0,007	0,009	0,005	0,007	0,400	
10th	0,003	0,004	0,004	0,006	0,184	
11th	0,006	0,008	0,006	0,008	0,330	
12th	0,003	0,004	0,004	0,005	0,153	
13th	0,008	0,010	0,012	0,016	0,210	
14th	0,003	0,004	0,004	0,005	0,131	
15th	0,008	0,011	0,010	0,013	0,150	
16th	0,003	0,004	0,003	0,004	0,115	
17th	0,010	0,013	0,013	0,017	0,132	
18th	0,002	0,003	0,002	0,003	0,102	
19th	0,011	0,015	0,014	0,018	0,118	
20th	0,002	0,003	0,003	0,003	0,092	
21th	0,012	0,016	0,015	0,019	0,107	0,160
22th	0,002	0,002	0,002	0,002	0,084	
23th	0,014	0,018	0,014	0,018	0,098	0,147
24th	0,002	0,002	0,002	0,002	0,077	
25th	0,013	0,016	0,013	0,017	0,090	0,135
26th	0,002	0,002	0,002	0,002	0,071	
27th	0,012	0,016	0,013	0,017	0,083	0,124
28th	0,002	0,002	0,002	0,002	0,066	
29th	0,012	0,015	0,012	0,016	0,078	0,117
30th	0,001	0,002	0,001	0,002	0,061	
31th	0,012	0,015	0,011	0,014	0,073	0,109
32th	0,001	0,002	0,001	0,002	0,058	
33th	0,012	0,015	0,009	0,012	0,068	0,102
34th	0,001	0,002	0,001	0,002	0,054	
35th	0,011	0,014	0,009	0,012	0,064	0,096
36th	0,002	0,002	0,001	0,001	0,051	
37th	0,010	0,014	0,008	0,010	0,061	0,091
38th	0,001	0,002	0,001	0,002	0,048	
39th	0,009	0,012	0,008	0,010	0,058	0,087
40th	0,001	0,002	0,001	0,002	0,046	

Note:

The higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

The tests had been performed on the SOFAR 1100TL and SOFAR 3000TL are valid for the SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

A1.4.2 Power factor The requirement is specified in section 5.6, test procedure in Annex A or B 1.4.2				**P**
SOFAR 1100TL				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1,5% of the stated level during the test.
Measured value	0,998c	0,999c	0,999c	
Limit	>0,95	>0,95	>0,95	
SOFAR 3000TL				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1,5% of the stated level during the test.
Measured value	0,999c	0,999c	0,999c	
Limit	>0,95	>0,95	>0,95	

Note:
When operating at rated power the SSEG shall operate at a power factor within the range 0.95 lagging to 0.95 leading relative to the voltage waveform unless otherwise agreed with the DNO eg for power factor improvement.

The test set up shall be such that the Inverter supplies full load to the DNO's Distribution System via the power factor (pf) meter and the variac as shown below in figure A5. The Inverter pf should be within the limits given in 5.6, for three test voltages 230 V –6%, 230V and 230 V +10%.

The tests had been performed on the SOFAR 1100TL and SOFAR 3000TL are valid for the SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

A1.4.3 Voltage Flicker

The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3

P

SOFAR 1100TL

	Starting			Stopping			Running	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
Measured values	0,01	0,01	0,01	0,01	0,01	0,01	0,07	0,07
Normalised to standard impedance and 3.68kW for multiple units	0,003	0,003	0,003	0,003	0,003	0,003	0,0209	0,0209
Limits set under BS EN 61000-3-2	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

No.	dc[%]	dmax[%]	d(t)[ms]	Pst
1	0.00	0.00	0.00	0.07
2	0.00	0.00	0.00	0.07
3	0.00	0.00	0.00	0.07
4	0.00	0.00	0.00	0.07
5	0.00	0.00	0.00	0.07
6	0.00	0.00	0.00	0.07
7	0.00	0.00	0.00	0.07
8	0.00	0.00	0.00	0.07
9	0.00	0.00	0.00	0.07
10	0.00	0.00	0.00	0.07
11	0.00	0.00	0.00	0.07
12	0.00	0.00	0.00	0.07

Plt
0.07

SOFAR 3000TL

	Starting			Stopping			Running	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
Measured values	0,01	0,01	0,01	0,01	0,01	0,01	0,07	0,07
Normalised to standard impedance and 3.68kW for multiple units	0,008	0,008	0,008	0,008	0,008	0,008	0,0571	0,0571
Limits set under BS EN 61000-3-2	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

No.	dc[%]	dmax[%]	d(t)[ms]	Pst
1	0.00	0.00	0.00	0.07
2	0.00	0.00	0.00	0.07
3	0.00	0.00	0.00	0.07
4	0.00	0.00	0.00	0.07
5	0.00	0.00	0.00	0.07
6	0.00	0.00	0.00	0.07
7	0.00	0.00	0.00	0.07
8	0.00	0.00	0.00	0.07
9	0.00	0.00	0.00	0.07
10	0.00	0.00	0.00	0.07
11	0.00	0.00	0.00	0.07
12	0.00	0.00	0.00	0.07

Plt
0.07

Note:
For wind turbines, flicker testing should be carried out during the performance tests specified in IEC 61400-12-1. Flicker data should be recorded from wind speeds of 1m/s below cut-in to 1.5 times 85% of the rated power. The wind speed range should be divided into contiguous bins of 1m/s centred on multiples of 1m/s. The dataset shall be considered complete when each bin includes a minimum of 10 minutes of sampled data. The highest value of each parameter measured across the entire range of tests shall be recorded.

Note that as an alternative to Type Testing the supplier of a SSEG incorporating an Inverter may give a guarantee that rates of change of output do not exceed the following ramp rate limits. Output needs to ramp up at a constant rate.
This exception to site testing does not apply to devices where the output changes in steps of over 30ms rather than as a ramp function, a site test is required for these units.

Single phase units and two phase units in a three phase system, maximum ramp up rate 333 watts per second;
Two phase units in a split phase system and three phase units, maximum ramp up rate 860 watts per second.
It should be noted that units complying with this declaration are likely to be less efficient at capturing energy during times when the energy source is changing.

For technologies other than wind turbines, testing should ensure that the controls or automatic programs used produce the most unfavourable sequence of voltage changes.

Mains Impedance according EN61000-3-3: **R_{max} = 0,24Ω; jX_{max}= 0,15Ω @50Hz (|Z_{max}| = 0,283 / 0,472 Ω)**
Bei Einphasigen Invertern Zmax sowie Rn und jxn angeben **R_n = 0,16Ω; jX_n= 0,1Ω**

Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c:
$Z_{max} = Z_{ref} * 3,3\% / d_c(P_n)$
The tests should be based on the limits of the EN61000-3-3 for less than 16A.

The tests had been performed on the SOFAR 1100TL and SOFAR 3000TL are valid for the SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

1.4.4 DC injection The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4			**P**
SOFAR 1100TL			
Test level power	10%	55%	100%
Recorded value	-5,0 mA	-8,0 mA	-6,0 mA
Limit	20 mA	20 mA	20 mA
SOFAR 3000TL			
Test level power	10%	55%	100%
Recorded value	2,9 mA	3,2 mA	3,2 mA
As % of rated AC current	0,02%	0,02%	0,02%
Limit	0,25%	0,25%	0,25%

Diagram of permanent DC-Injection: SOFAR 1100TL

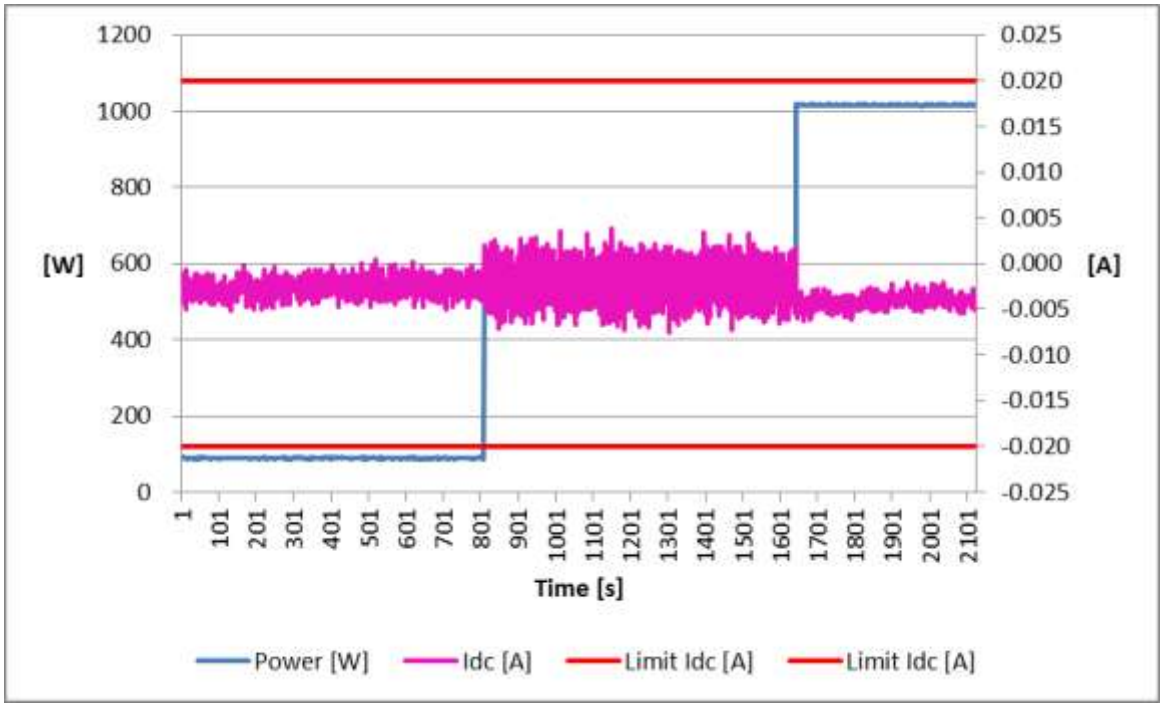
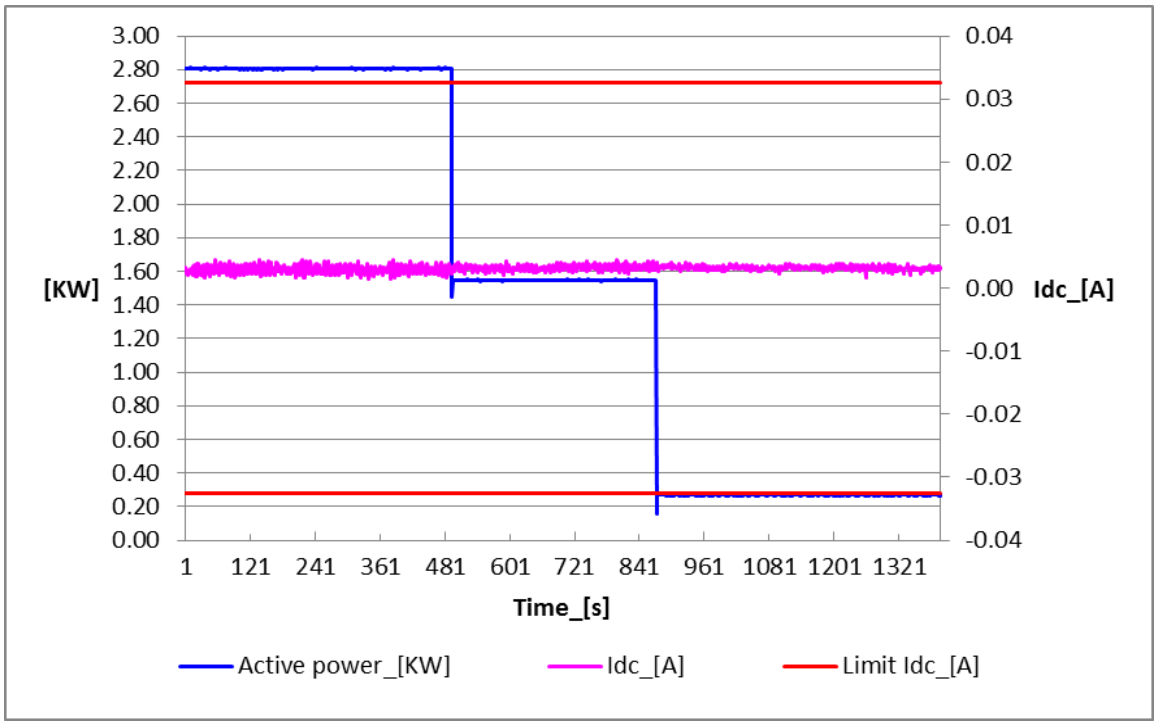


Diagram of permanent DC-Injection: SOFAR 3000TL



Note:
The level of DC injection from the Inverter-connected PV generator in to the DNO's Distribution System shall not exceed the levels specified in 5.5 when measured during operation at three levels, 10%, 55% and 100% of rating with a tolerance of plus or minus 5%.

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.

The tests had been performed on the SOFAR 1100TL and SOFAR 3000TL is valid for the SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

A1.4.4 Overcurrent Protection	**P**
The products have to be installed on a 16 A (IEC) branch circuit in series to provide over-current protection.	
Note: Where appropriate the protection shall comply with the requirements of BS7671. See installation manual	

A1.4.6 Short circuit Current Contribution — **P**

The requirement is specified in section 5.7, test procedure in Annex A or B 1.4.6

For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	N/A	N/A	20ms	49,9	12,77
Initial Value of aperiodic current	N/A	N/A	100ms	33,4	12,71
Initial symmetrical short-circuit current*	N/A	N/A	250ms	30,2	12,73
Decaying (aperiodic) component of short circuit current*	N/A	N/A	500ms	29,1	12,74
Reactance/Resistance Ratio of source*	N/A	N/A	Time to trip	0,516s	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 including the time taken for the Inverter to trip.

The tests had been performed on the SOFAR 3000TL is valid for the SOFAR 1100TL, SOFAR 1600TL, SOFAR 2200TL and SOFAR 2700TL, since it is same as in hardware and just power derated by software.

A1.4.7 Self Monitoring – Solid state Disconnection The requirement is specified in section 5.3.1, No specified test requirements.	**N/A**
It has been verified that in the event of the solid state switching device failing to disconnect the SSEG, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 seconds.	

A1.4.8 Electromagnetic Compatibillity (EMC)	**P**
All equipment shall comply with the generic EMC standards: BS EN61000-6-3: 2007 Electromagnetic Compatibility, Generic Emission Standard; and BS EN61000-6-1: 2007 Electromagnetic Compatibility, Generic Immunity Standard.	
Note: The whole EMC test reports see Annex X EMC test report.	

Annex No. 1

EMC test report

ATTESTATION
of conformity with European Directives

Attestation Number: **1488AB0508N005R1001**
Product: **PV Grid Inverter**
Brand Name: **SOFAR SOLAR**
Model: **SOFAR 3000TL, SOFAR 1100TL, SOFAR 2200TL**
Additional Model: **SOFAR 1600TL, SOFAR 2700TL**
Applicant: **Shenzhen SOFARSOLAR Co., Ltd.**
Address: **3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China.**
Technical Characteristics: **DC Input: DC 110 - 380V Max. 10A For SOFAR 1100TL;**
DC Input: DC 165 - 380V Max. 10A For SOFAR 1600TL ;
DC Input: DC 170 - 450V Max. 13A For SOFAR 2200TL;
DC Input: DC 210 - 450V Max. 13A For SOFAR 2700TL;
DC Input: DC 230 - 450V Max. 13A For SOFAR 3000TL
Output: AC 230V, 50/60Hz, Power: 1000W / 1500W / 2000W / 2500W / 2800W
Output Voltage/Current: SOFAR 1100TL:230V/4.5A; SOFAR 1600TL:230V/7.0A; SOFAR 2200TL:230V/9.5A; SOFAR 2700TL:230V/11.5A; SOFAR 3000TL:230V/13.0A

The submitted sample of the above equipment has been tested for CE marking according to following European Directive and standards:

- Electromagnetic Compatibility **Directive 2004/108/EC**

Standards	Report Number	Report date
EN 61000-6-3:2007 + A1:2011 EN 61000-3-2:2006 + A1 :2009 + A2:2009 EN 61000-3-3:2013 EN 61000-6-2:2005	CE140508N005R1	Jul. 21, 2014

The referred test report(s) show that the product complies with standard(s) recognized as giving presumption of compliance with the essential requirements in the specified European Directive.

This verification does not imply assessment of the production of the product. The CE marking may be affixed if all relevant and effective European Directives with CE are applicable.

CE

Supervisor
EMC Department

Name: Madison Luo
Date: Jul. 21, 2014

Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
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Test Report No.: CE140508N005R1

ACCREDITED
Test Lab
Cert 2951.01

TEST REPORT

Applicant	Shenzhen SOFARSOLAR Co., Ltd.
Address	3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China.

Manufacturer or Supplier	Shenzhen SOFARSOLAR Co., Ltd.
Address	3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China.
Product	PV grid-interactive inverter
Brand Name	SOFAR SOLAR
Model	SOFAR 3000TL, SOFAR 1100TL, SOFAR 2200TL
Additional Model & Model Difference	SOFAR 1600TL, SOFAR 2700TL See item 2.1
Date of tests	May 08, 2014 ~ Jun. 30, 2014

The submitted sample of the above equipment has been tested for according to following European Directive - Electromagnetic directive 2004/108/EC and the tests have been carried out according to the requirements of the following standards:

☒ **EN 61000-6-3:2007 + A1:2011**
☒ **EN 61000-3-2:2006 + A1:2009 + A2:2009**
☒ **EN 61000-3-3:2013**
☒ **EN 61000-6-2:2005**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Tested by Breeze Jiang Project Engineer / EMC Department	Approved by Madison Luo Manager / EMC Department
	Date: Jul. 21, 2014

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Test Report No.: CE140508N005R1

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
CE140508N005	Original release	Jul. 10, 2014
CE140508N005R1	Based on the original report CE140508N005 change power supply information, model and technical characteristics.	Jul. 21, 2014

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1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

EMISSION			
Standard	**Test Type**	**Result**	**Remarks**
EN61000-6-3:2007+ A1:2011	Conducted test	PASS	Meets requirement limit Minimum passing margin is –3.00 dB at 0.36094MHz
	Radiated test (30MHz~1GHz)	PASS	Meets limits minimum passing margin is –5.08 dB at 191.02MHz
EN 61000-3-2:2006 + A1:2009 + A2:2009	Harmonic current emissions	PASS	Meets the requirements.
EN 61000-3-3:2013	Voltage fluctuations & flicker	PASS	Meets the requirements.

IMMUNITY (EN 61000-6-2:2005)			
Standard	**Test Type**	**Result**	**Remarks**
IEC 61000-4-2:2008	Electrostatic discharge immunity test	PASS	Electrostatic Discharge – ESD: 8kV Air discharge, 4kV Contact discharge, Performance Criterion A
IEC 61000-4-3:2005 + A1:2007+A2:2010	Radiated, radio-frequency, electromagnetic field immunity test	PASS	Radio-Frequency Electromagnetic Field Susceptibility Test – RS: 80-1000 MHz, 10V/m, 80% AM (1kHz), 1400-2000 MHz, 3V/m, 80% AM (1kHz) 2000-2700 MHz, 1V/m, 80% AM (1kHz) Performance Criterion A
IEC 61000-4-4:2012	Electrical fast transient / burst immunity test.	PASS	Electrical Fast Transient/Burst - EFT AC Power line: 2kV, DC Power line: 2kV, Performance Criterion A
IEC 61000-4-5:2005	Surge immunity test	PASS	Surge Immunity Test: 1.2/50 us Open Circuit Voltage, 8 /20 us Short Circuit Current, AC Power Line: line to line 1 kV, Line to earth 2kV , DC Power Line: line to line 0.5 kV Performance Criterion B
IEC 61000-4-6:2008	Immunity to conducted disturbances, induced by radio-frequency fields	PASS	Conducted Radio Frequency Disturbances Test – CS: 0.15-80 MHz, 10Vrms, 80% AM, 1kHz, Performance Criterion A
IEC 61000-4-8:2009	Power frequency magnetic field immunity test.	PASS	Power Frequency Magnetic Field Test, 50 Hz / 60Hz, 30A/m, Performance Criterion A

1.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

MEASUREMENT	FREQUENCY	UNCERTAINTY
Mains Terminal Disturbance Voltage Test	0.15MHz ~ 30MHz	+ /-2.67 dB
Radiated Disturbance Test	30MHz ~ 1000MHz	+ /-4.36 dB

2 GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

PRODUCT	PV Grid Inverter
MODEL NO.	SOFAR 3000TL, SOFAR 1100TL, SOFAR 2200TL
ADDITIONAL MODEL	SOFAR 1600TL, SOFAR 2700TL
POWER SUPPLY	DC Input: DC 110 - 380V Max. 10A For SOFAR 1100TL; DC Input: DC 165 - 380V Max. 10A For SOFAR 1600TL ; DC Input: DC 170 - 450V Max. 13A For SOFAR 2200TL; DC Input: DC 210 - 450V Max. 13A For SOFAR 2700TL; DC Input: DC 230 - 450V Max. 13A For SOFAR 3000TL Output: AC 230V, 50/60Hz, Power: 1000W / 1500W / 2000W / 2500W / 2800W Output Voltage/Current: SOFAR 1100TL:230V/4.5A; SOFAR 1600TL:230V/7.0A; SOFAR 2200TL:230V/9.5A; SOFAR 2700TL:230V/11.5A; SOFAR 3000TL:230V/13.0A
SOFTWARE VERSION	V1.00
HARDWARE VERSION	V1.00
THE HIGHEST OPERATING FREQUENCY	Below 108MHz
DATA CABLE SUPPLIED	DC Cable: Shielded; Detachable 1.8m; AC Cable: Shielded; Detachable 1.8m

NOTE:

1. This report CE140508N005R1 supersedes the previous one with the report number CE140508N005 dated on Jul. 10, 2014.

2. For the test results, the EUT had been tested with all conditions. But only the worst case was showed in test report.

3. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

4. RS485 port on the product is for client to collect data, according to client requirements, no need to test.

5. All models shell include red, blue, white and other colors. All models of DC switch and WIFI module is optional accessories, optional installation according to the need of client.

6. This is a series of PV Grid Inverter with the same as in hardware except the amount of BUS capacitor, inverter inductor, Boost and IGBT component and DC switch are different. Identical in software the output power just adjusted by software; models SOFAR 3000TL, SOFAR 1100TL, SOFAR 2200TL are selected to test. full test was performed for the model SOFAR 3000TL, and partial test for the models SOFAR 1100TL, SOFAR 2200TL.

Ratings .....:	SOFAR 1100TL	SOFAR 1600TL	SOFAR 2200TL	SOFAR 2700TL	SOFAR 3000TL
MPP DC voltage range [V] .....:	110-380	165-380	170-450	210-450	230-450
Input DC voltage range [V].....:	90-400, max. 450		100-480, max. 500		
Input DC current [A].....:	10		13		
Output AC voltage [V].....:	230V, 50Hz				
Output AC current [A].....:	4,5	7,0	9,5	11,5	13,0
Output power [W] .....:	1000	1500	2000	2500	2800

7. Model Difference:

Difference:	SOFAR 3000TL	SOFAR 2700TL	SOFAR 2200TL	SOFAR 1600TL	SOFAR 1100TL
Boost inductor	1.9mH	1.9mH	1.9mH	2.6mH	2.6mH
Input sampling resistor (RP105,RP108 /RP189,RP109)	200ohm / 7.5Kohm	200ohm / 7.5Kohm	200ohm / 7.5Kohm	220ohm / 10Kohm	220ohm / 10Kohm
Bus capacitor	3pcs	3pcs	3pcs	2pcs	2pcs
Inverter inductor	1.3mH	1.5mH	2.1mH	2.3mH	3.4mH
Output sampling resistor (RP118, RP119, RC18 /RP120, RP121,RC22)	2Kohm,100ohm,100ohm	2Kohm,100ohm,100ohm	1.0Kohm,330ohm,330ohm	1.0Kohm,200ohm,100ohm	499ohm,200ohm,200ohm

2.2 DESCRIPTION OF TEST MODES

The EUT was tested under the following modes' the final worst mode were marked in boldface and recorded in this report.

◆ For Conducted Emission Test

Test Mode	TEST VOLTAGE	Model
Full Load	DC 380V	SOFAR 2200TL
Full Load	DC 380V	SOFAR 1100TL
Full Load	DC 230V	SOFAR 3000TL
Full Load	**DC 360V**	
Full Load	DC 450V	

◆ For Radiated Emission Test

Test Mode	TEST VOLTAGE	Model
Full Load	DC 380V	SOFAR 2200TL
Full Load	DC 380V	SOFAR 1100TL
Full Load	DC 230V	SOFAR 3000TL
Full Load	**DC 360V**	
Full Load	DC 450V	

◆ For Harmonics and Flicker Tests

Test Mode	TEST VOLTAGE	Model
Full Load	**DC 380V**	**SOFAR 1100TL**
Full Load	**DC 380V**	**SOFAR 3000TL**

◆ For Immunity Test

Test Mode	TEST VOLTAGE	Model
10% Load	**DC 300V**	**SOFAR 3000TL**

2.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT has been tested and complied with the requirements of the following standards:

EN 61000-6-3:2007 + A1:2011
EN 61000-3-2:2006 + A1:2009 + A2:2009
EN 61000-3-3:2013
EN 61000-6-2:2005
IEC 61000-4-2:2008
IEC 61000-4-3:2005 + A1:2007 + A2:2010
IEC 61000-4-4:2012
IEC 61000-4-5:2005
IEC 61000-4-6:2008
IEC 61000-4-8:2009

Notes: The above IEC basic standards are applied with latest version if customer has no special requirement

2.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	DC Source	Chroma	62150H-1000S	62150EF00488	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	AC Line: Unshielded, Detachable 2.0m, DC Line: Unshielded, Detachable 2.0m;

3 EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 - 0.5	79	66	66 - 56	56 - 46
0.50 - 5.0	73	60	56	46
5.0 - 30.0	73	60	60	50

Note: (1) The lower limit shall apply at the transition frequencies.
(2) The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
(3) All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

3.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCS30	100199	May 17,14	May 16,15
Pulse Limiter	Rohde&Schwarz	ESH3-Z2	100168	Oct. 12,13	Oct. 11,14
Artificial Mains Network	Rohde&Schwarz	ESH2-Z5	100071	May 13,14	May 12,15
Test software	ADT	ADT_Cond_ V7.3.7	N/A	N/A	N/A

NOTE: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
2. The test was performed in shielding room 843.

3.1.3 TEST PROCEDURE

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

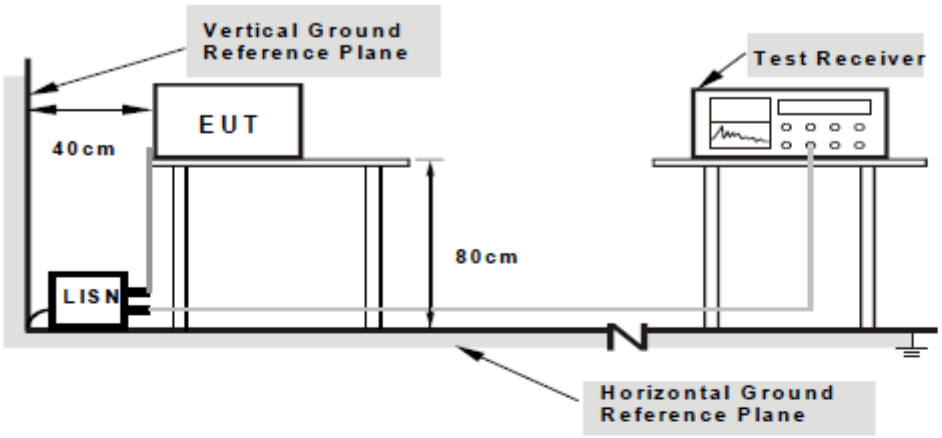
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20dB) were not recorded.

3.1.4 DEVIATION FROM TEST STANDARD

No deviation

3.1.5 TEST SETUP



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

3.1.6 EUT OPERATING CONDITIONS

a. Turned on the power of all equipment.
b. EUT was operated according to the type description in manufacturer's specifications or the User's Manual.

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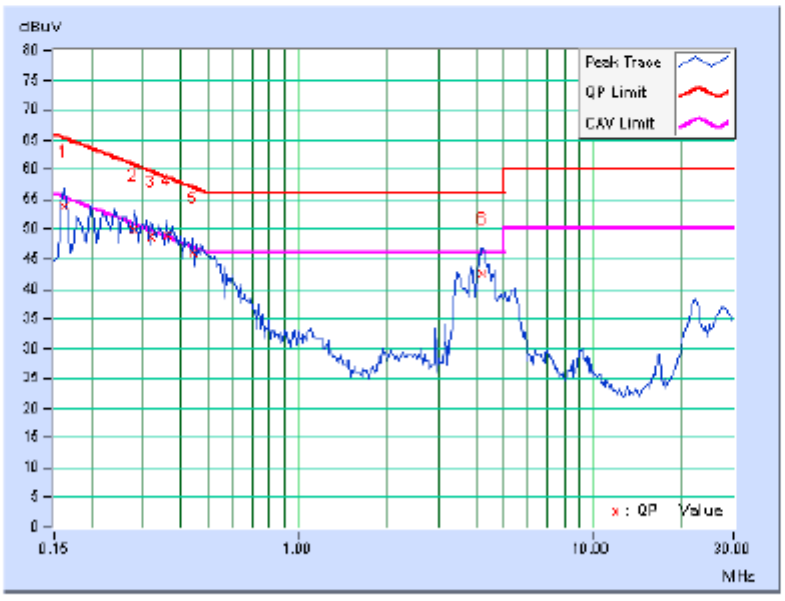
3.1.7 TEST RESULTS

TEST MODE	SOFAR 3000TL Grid Mode	6dB BANDWIDTH	9 kHz
TEST VOLTAGE	DC 360V	PHASE	Line (L)
ENVIRONMENTAL CONDITIONS	23 deg. C, 42% RH	TESTED BY: Heise	

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16172	5.20	48.57	45.49	53.77	50.69	65.38	55.38	-11.60	-4.68
2	0.27891	9.16	40.76	37.52	49.92	46.68	60.85	50.85	-10.93	-4.17
3	0.31797	9.23	39.58	36.34	48.81	45.57	59.76	49.76	-10.95	-4.19
4	0.36094	9.32	39.63	36.39	48.95	45.71	58.71	48.71	-9.76	-3.00
5	0.43906	9.47	36.61	34.20	46.08	43.67	57.08	47.08	-11.00	-3.41
6	4.25000	10.01	32.52	25.58	42.53	35.59	56.00	46.00	-13.47	-10.41

REMARKS: The emission levels of other frequencies were very low against the limit.

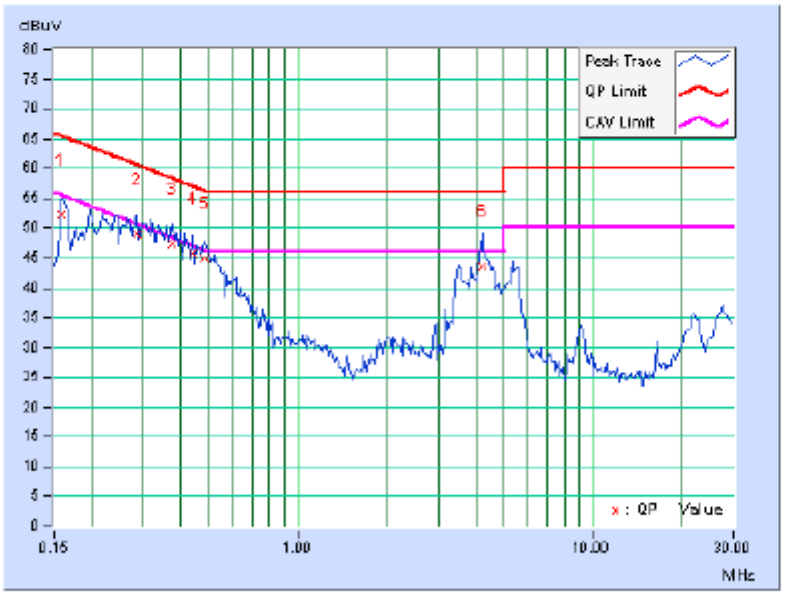


Test Report No.: CE140508N005R1

TEST MODE	SOFAR 3000TL Grid Mode	6dB BANDWIDTH	9 kHz
TEST VOLTAGE	DC 360V	PHASE	Neutral (N)
ENVIRONMENTAL CONDITIONS	23 deg. C, 42% RH	TESTED BY: Heise	

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15781	4.85	47.50	43.90	52.35	48.75	65.58	55.58	-13.22	-6.82
2	0.28281	9.19	39.88	36.67	49.07	45.86	60.73	50.73	-11.67	-4.88
3	0.37656	9.35	38.15	35.11	47.50	44.46	58.35	48.35	-10.85	-3.89
4	0.43906	9.46	36.24	33.89	45.70	43.35	57.08	47.08	-11.38	-3.73
5	0.48203	9.54	35.42	33.03	44.96	42.57	56.30	46.30	-11.35	-3.74
6	4.22266	10.05	33.58	25.62	43.63	35.67	56.00	46.00	-12.37	-10.33

REMARKS: The emission levels of other frequencies were very low against the limit.



3.2 RADIATED EMISSION MEASUREMENT

3.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

TEST STANDARD: EN 61000-6-3

FOR FREQUENCY BELOW 1000 MHz

FREQUENCY (MHz)	Class A (at 10m) dBuV/m	Class B (at 10m) dBuV/m
30 – 230	40	30
230 – 1000	47	37

FREQUENCY RANGE OF RADIATED MEASUREMENT (For unintentional radiators)

Highest frequency generated or Upper frequency of measurement used in the device or on which the device operates or tunes (MHz)	Range (MHz)
Below 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	Up to 5 times of the highest frequency or 6 GHz, whichever is less

FOR FREQUENCY ABOVE 1000 MHz

FREQUENCY (GHz)	Class A (dBuV/m) (at 3m)		Class B (dBuV/m) (at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
1 to 3	76	56	70	50
3 to 6	80	60	74	54

NOTE: (1) The lower limit shall apply at the transition frequencies.
(2) Emission level (dBuV/m) = 20 log Emission level (uV/m).
(3) All emanation from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

3.2.2 TEST INSTRUMENTS

Frequency Range 30MHz-1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	100962	Mar. 06,14	Mar. 05,15
Bilog Antenna	Teseq	CBL 6111D	27089	Jul. 27, 13	Jul. 26, 14
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-554	Dec. 03, 13	Dec. 02, 14
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-555	Dec. 03, 13	Dec. 02, 14
10m Semi-anechoic Chamber	CHANGLING	21.4m*12.1m*8.8m	NSEMC006	Jun. 11, 13	Jun. 10, 14
Amplifier (9kHz-1GHz)	SONOMA	310D	186955	Mar. 05,14	Mar. 04, 15
Test Software	ADT	ADT_Radiated_V7.6.15.9.2	N/A	N/A	N/A

Frequency Range Above1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Horn Antenna	ETS-Lindgren	3117	00062558	Oct. 18,12	Oct. 17,14
EMI Test Receiver	Rohde&Schwarz	ESCI	100962	Mar. 06,14	Mar. 05,15
Spectrum Analyzer	Rohde&Schwarz	FSV40	101003	Apr. 09,14	Apr. 08,15
Pre-Amplifier (100MHz-26.5GHz)	EMCI	EMC 012645	980077	Nov. 07,13	Nov. 06,14
Pre-Amplifier (18GHz-40GHz)	EMCI	EMC 184045	980102	Nov. 04,13	Nov. 03,14
Test Software	ADT	ADT_Radiated_V7.6.15.9.2	N/A	N/A	N/A

NOTE: 1. The calibration interval of the above test instruments is 12 months. And the calibrations are traceable to CEPREI/CHINA and NIM/CHINA.
2. The test was performed in Chamber 10m.

3.2.3 TEST PROCEDURE

<Frequency Range below 1GHz>

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

NOTE:

1. The resolution bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
3. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
4. Margin value = Emission level – Limit value.

<Frequency Range above 1GHz>

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter Semi-anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna can be varied from one meter to four meters, the height of adjustment depends on the EUT height and the antenna 3dB beamwidth both, to detect the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test receiver/spectrum was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

NOTE:

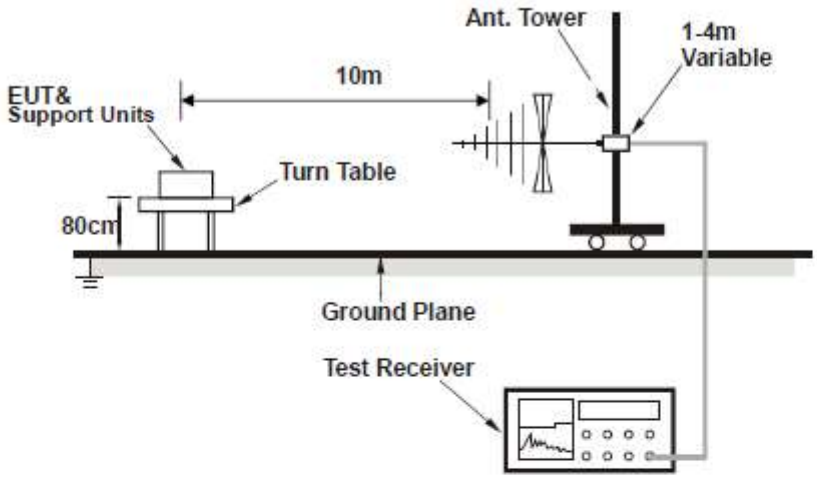
1. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.
2. For measurement of frequency above 1000 MHz, the EUT was set 3 meters away from the receiver antenna.

3.2.4 DEVIATION FROM TEST STANDARD

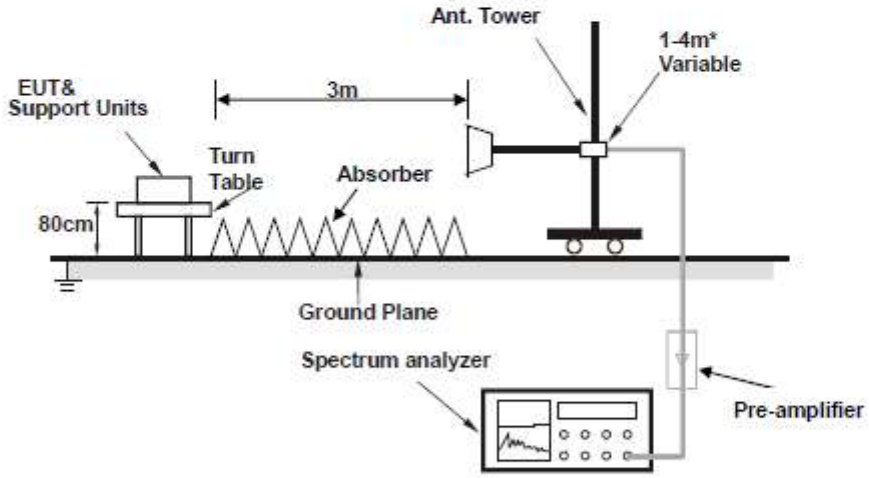
No deviation

3.2.5 TEST SETUP

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



* : depends on the EUT height and the antenna 3dB beamwidth both, refer to section 7.3 of CISPR 16-2-3.

3.2.6 EUT OPERATING CONDITIONS

Same as item 3.1.6

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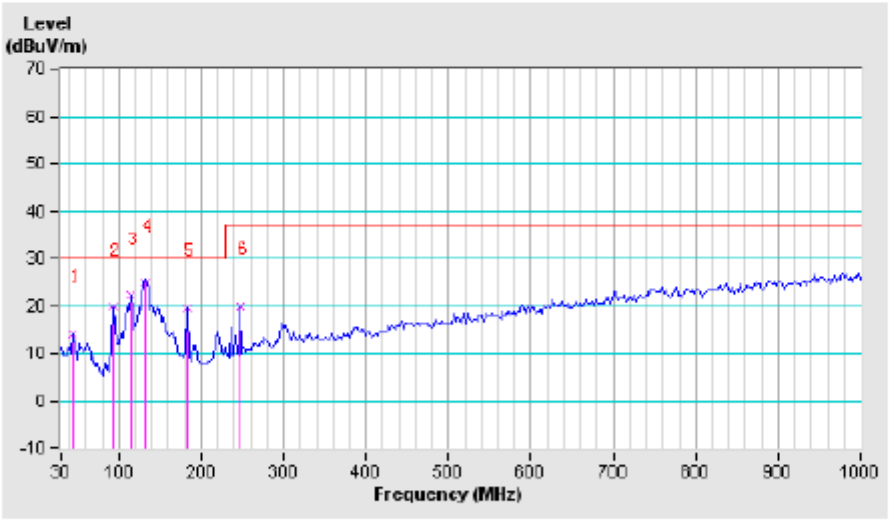
3.2.7 TEST RESULTS

TEST MODE	SOFAR 3000TL Grid Mode	FREQUENCY RANGE	30-1000 MHz
TEST VOLTAGE	DC 360V	DETECTOR FUNCTION & BANDWIDTH	Quasi-Peak, 120kHz
ENVIRONMENTAL CONDITIONS	25 deg. C, 50% RH	TESTED BY: Robert	

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 10 M								
No.	Freq. (MHz)	Correction Factor (dB/m)	Raw Value (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)
1	43.58	14.96	-0.74	14.22	30.00	-15.78	143	12
2	92.08	10.26	9.47	19.73	30.00	-10.27	400	31
3	113.42	12.35	9.75	22.10	30.00	-7.90	400	313
4	130.88	13.26	11.50	24.76	30.00	-5.24	400	122
5	183.26	12.88	6.59	19.47	30.00	-10.53	219	132
6	247.28	14.09	5.71	19.80	37.00	-17.20	100	13

REMARKS: The emission levels of other frequencies were very low against the limit..

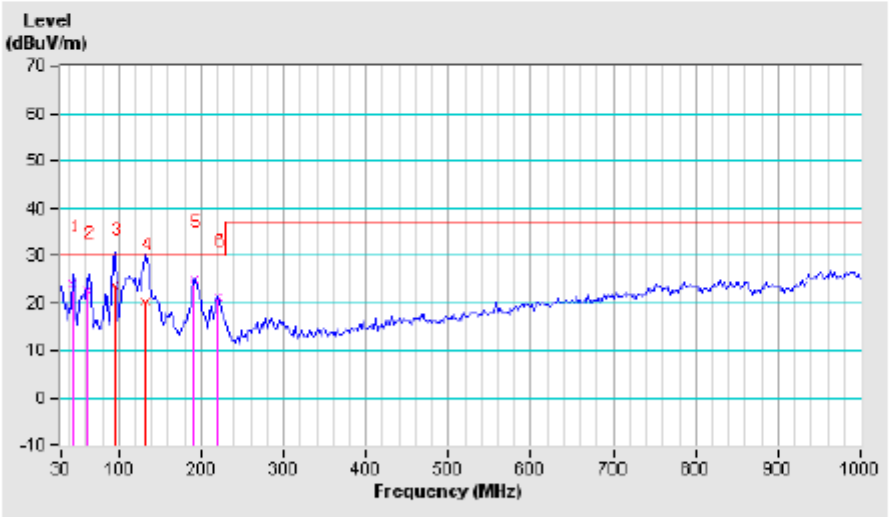


Test Report No.: CE140508N005R1

TEST MODE	SOFAR 3000TL Grid Mode	FREQUENCY RANGE	30-1000 MHz
TEST VOLTAGE	DC 360V	DETECTOR FUNCTION & BANDWIDTH	Quasi-Peak, 120kHz
ENVIRONMENTAL CONDITIONS	25 deg. C, 50% RH	TESTED BY: Robert	

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 10 M								
No.	Freq. (MHz)	Correction Factor (dB/m)	Raw Value (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)
1	43.58	14.96	9.04	24.00	30.00	-6.00	195	129
2	61.04	13.28	9.31	22.59	30.00	-7.41	165	104
3	94.00	10.50	12.90	23.40	30.00	-6.60	100	20
4	130.88	13.26	6.84	20.10	30.00	-9.90	100	20
5	**191.02**	**12.37**	**12.55**	**24.92**	**30.00**	**-5.08**	**128**	**72**
6	220.12	12.64	8.38	21.02	30.00	-8.98	231	160

REMARKS: The emission levels of other frequencies were very low against the limit.



3.3 HARMONICS CURRENT MEASUREMENT (<16A)

3.3.1 LIMITS OF HARMONICS CURRENT MEASUREMENT

TEST STANDARD: EN 61000-3-2

Limits for Class A equipment	
Harmonic Order n	Max. permissible harmonics current A
Odd harmonics	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
15<=n<=39	0.15x15/n
Even harmonics	
2	1.08
4	0.43
6	0.30
8<=n<=40	0.23x8/n

Limits for Class D equipment		
Harmonic Order n	Max. permissible harmonics current per watt mA/W	Max. permissible harmonics current A
Odd Harmonics only		
3	3.4	2.30
5	1.9	1.14
7	1.0	0.77
9	0.5	0.40
11	0.35	0.33
13	0.30	0.21
15<=n<=39	3.85/n	0.15x15/n

NOTE: 1.Class A and Class D are classified according to section 5 of EN 61000-3-2.

2.According to section 7 of EN 61000-3-2, the above limits for all equipment except for lighting equipment having an active power input> 75 W and no limits apply for equipment with an active power input up to and including 75 W.

- **Limits for Class B equipment:**

For class B equipment, the harmonics of the input current shall not exceed the maximum permissible values given for class A equipment multiplied by a factor of 1.5.

Limits for Class C equipment	
Harmonic Order n	Max. permissible harmonics current expressed as a percentage of the input current at the fundamental frequency %
2	2
3	30· λ
5	10
7	7
9	5
11<=n<=39 (odd harmonics only)	3
λ is the circuit power factor	

NOTE: Discharge lighting equipment having an active TEST VOLTAGE smaller than or equal to 25W, the harmonic currents shall not exceed the power related limits of Class D.

3.3.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
PRECISION POWER ANALYZER	YOKOGAWA	WT3000	91M210852	Mar. 12,14	Mar. 11,15
Test Software	YOKOGAWA	IEC61000	N/A	N/A	N/A
PEFERENCE IMPEDANCE NETWORK	Voltech	EUR	3018	N/A	N/A

NOTE: 1. The test was performed in PV Room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

3.3.3 TEST PROCEDURE

a. The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.

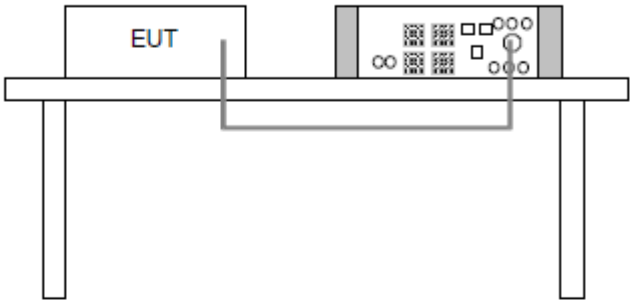
b. The classification of EUT is according to section 5 of EN 61000-3-2:2006 + A1:2009 + A2:2009.
The EUT is classified as follows:
Class A: Balanced three-phase equipment, Household appliances excluding equipment as Class D, Tools excluding portable tools, Dimmers for incandescent lamps, audio equipment, equipment not specified in one of the three other classes.
Class B: Portable tools. ; Arc welding equipment which is not professional equipment
Class C: Lighting equipment.
Class D: Equipment having a specified power less than or equal to 600 W of the following types: Personal computers and personal computer monitors and television receivers.

c. The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the time necessary for the EUT to be exercised.

3.3.4 DEVIATION FROM TEST STANDARD

No deviation

3.3.5 TEST SETUP



3.3.6 EUT OPERATING CONDITIONS

Same as item 3.1.6

Test Report No.: CE140508N005R1

3.3.7 TEST RESULTS

SOFAR 1100TL

******* appliances (Average)**

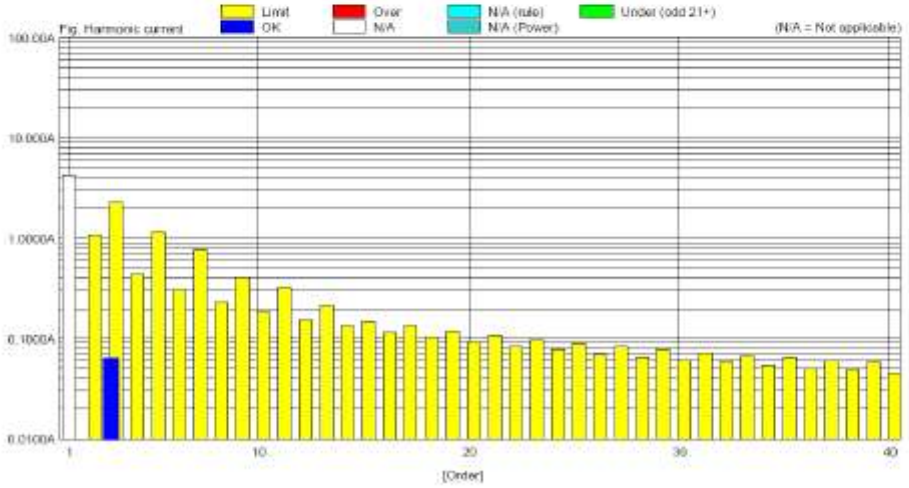
Print Date	:	Mon May 26 14:15:38 2014
MeasureDate	:	Mon May 26 14:15:34 2014
Comment	:	Experimental model Pattern A

Regulation	:	IEC61000-3-2 Ed3.0 am2 IEC61000-4-7 Ed2.0 A1
Class	:	CLASS A
MeasureTime	:	150.00sec
Model	:	YOKOGAWA WT3000
Rating Voltage	:	230.00 V
Wiring	:	single-phase 2-wire
Element	:	1
Range	:	300V/30A
Current(rms)	:	4.2800 A
Voltage(rms)	:	230.42 V
Frequency	:	50.000 Hz
Power Factor	:	0.9957
PCHC Limit	:	0.2514 A
PCHC Max	:	0.0040 A
THC	:	0.0658 A

PASS

Set Fundamental I	:	--------
Set Power Factor	:	--------
Set P	:	--------
Sigma W Max	:	982.9105 W
Sigma PF	:	0.9957
Distortion factor(V)	:	0.05 %
V THDS	:	0.05 %
V THDG	:	0.05 %
Distortion factor(A)	:	1.53 %
A THDS	:	1.53 %
A THDG	:	1.64 %
P THD	:	0.00 %
Power Limit	:	75 W

Order	Measure[A]	Limit[A]	Margin[%]	Order	Measure[A]	Limit[A]	Margin[%]
1	4.2796			2	0.0045	1.0800	99.1
3	0.0632	2.3000	97.3	4	0.0045	0.4300	99.0
5	0.0086	1.1400	99.2	6	0.0031	0.3000	99.0
7	0.0064	0.7700	99.2	8	0.0022	0.2300	99.0
9	0.0036	0.4000	99.1	10	0.0023	0.1840	98.8
11	0.0023	0.3300	99.4	12	0.0023	0.1533	98.5
13	0.0018	0.2100	99.1	14	0.0018	0.1314	98.6
15	0.0016	0.1500	99.0	16	0.0016	0.1150	98.6
17	0.0014	0.1324	99.0	18	0.0018	0.1022	98.3
19	0.0016	0.1184	98.8	20	0.0016	0.0920	98.3
21	0.0017	0.1071	98.4	22	0.0013	0.0836	98.4
23	0.0014	0.0978	98.6	24	0.0012	0.0767	98.4
25	0.0016	0.0900	98.3	26	0.0014	0.0708	98.0
27	0.0012	0.0833	98.6	28	0.0011	0.0657	98.3
29	0.0012	0.0776	98.5	30	0.0010	0.0613	98.4
31	0.0010	0.0726	98.7	32	0.0011	0.0575	98.1
33	0.0011	0.0682	98.4	34	0.0013	0.0541	97.6
35	0.0011	0.0643	98.3	36	0.0012	0.0511	97.7
37	0.0009	0.0608	98.5	38	0.0012	0.0484	97.6
39	0.0009	0.0577	98.5	40	0.0015	0.0460	96.8



Test Report No.: CE140508N005R1

***** appliances (Maximum)

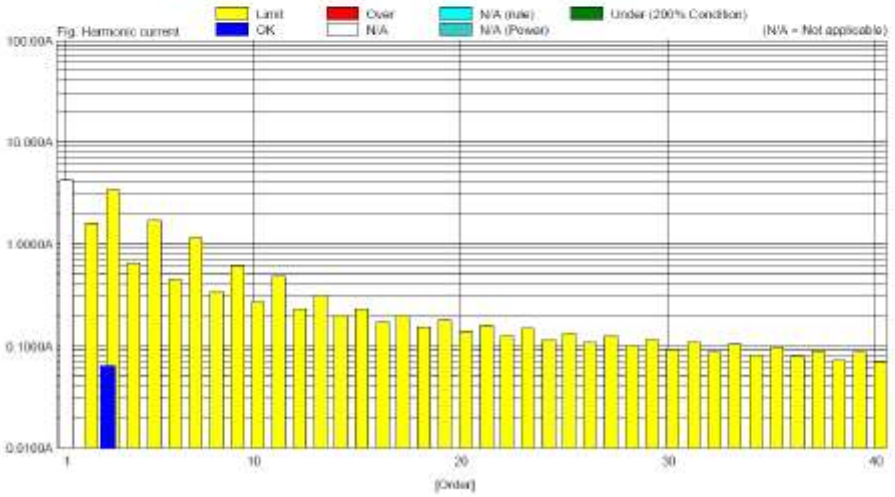
Print Date	:	Mon May 26 14:15:38 2014
MeasureDate	:	Mon May 26 14:15:34 2014
Comment	:	Experimental model Pattern A

Regulation	:	IEC61000-3-2 Ed3.0 am2 IEC61000-4-7 Ed2.0 A1
Class	:	CLASS A
MeasureTime	:	150.00sec
Model	:	YOKOGAWA WT3000
Rating Voltage	:	230.00 V
Wiring	:	single-phase 2-wire
Element	:	1
Range	:	300V/30A
Current(rms)	:	4.2840 A
Voltage(rms)	:	230.42 V
Frequency	:	50.004 Hz
Power Factor	:	0.9957
Beyond Limit Time	:	15.0000 s
Beyond Total Time	:	0.0000 s
THC	:	0.0861 A

PASS

Set Fundamental I	:	---------
Set Power Factor	:	---------
Set P	:	---------
Sigma W Max	:	982.9105 W
Sigma PF	:	0.9957
Distortion factor(V)	:	0.05 %
V THDS	:	0.05 %
V THDG	:	0.05 %
Distortion factor(A)	:	1.55 %
A THDS	:	1.55 %
A THDG	:	1.56 %
P THD	:	0.00 %
Power Limit	:	75 W

Order	Measure[A]	Limit[A]	Margin[%]	Order	Measure[A]	Limit[A]	Margin[%]
1	4.2835			2	0.0100	1.6200	99.4
3	0.0635	3.4500	98.2	4	0.0047	0.6450	99.3
5	0.0099	1.7100	99.4	6	0.0023	0.4500	99.3
7	0.0060	1.1550	99.5	8	0.0024	0.3450	99.3
9	0.0039	0.8000	99.4	10	0.0025	0.2760	99.1
11	0.0022	0.4950	99.5	12	0.0025	0.2300	98.9
13	0.0021	0.3150	99.3	14	0.0020	0.1971	99.0
15	0.0016	0.2250	99.3	16	0.0019	0.1725	99.0
17	0.0015	0.1985	99.2	18	0.0019	0.1533	98.8
19	0.0016	0.1776	99.1	20	0.0017	0.1380	98.7
21	0.0019	0.1607	98.8	22	0.0015	0.1255	98.8
23	0.0016	0.1467	98.9	24	0.0013	0.1150	98.8
25	0.0016	0.1380	98.8	26	0.0015	0.1062	98.6
27	0.0013	0.1250	98.9	28	0.0012	0.0986	98.8
29	0.0013	0.1184	98.9	30	0.0013	0.0920	98.9
31	0.0011	0.1089	99.0	32	0.0012	0.0862	98.6
33	0.0013	0.1023	98.8	34	0.0014	0.0812	98.3
35	0.0012	0.0994	98.7	36	0.0013	0.0767	98.4
37	0.0010	0.0912	98.9	38	0.0013	0.0726	98.3
39	0.0010	0.0885	98.9	40	0.0018	0.0690	97.7



Test Report No.: CE140508N005R1

SOFAR 3000TL

***** appliances (Average)

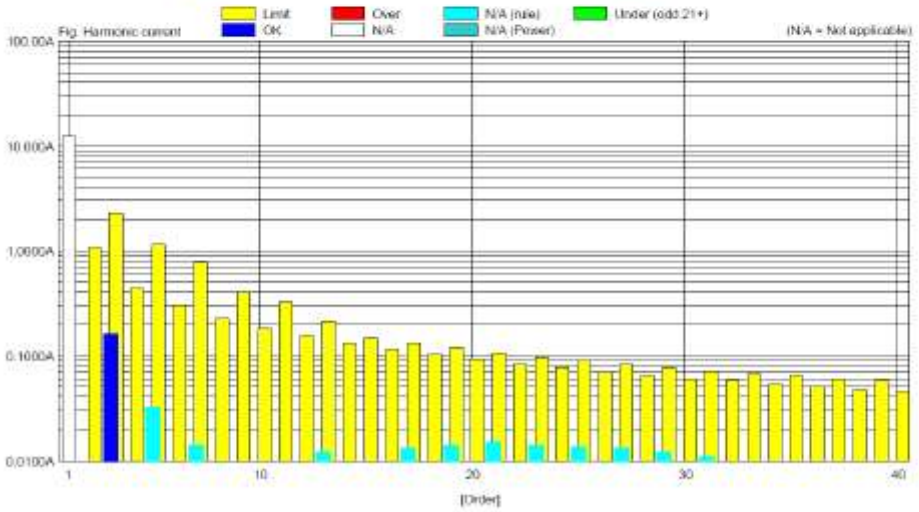
Print Date	Wed Jun 11 11:32:38 2014
MeasureDate	Wed Jun 11 11:31:38 2014
Comment	Experimental model Pattern A

Regulation	IEC61000-3-2 Ed3.0 am2 IEC61000-4-7 Ed2.0 A1
Class	CLASS A
MeasureTime	150.00sec
Model	YOKOGAWA WT3000
Rating Voltage	230.00 V
Wiring	single-phase 2-wire
Element	2
Range	300V/30A
Current(rms)	12.1893 A
Voltage(rms)	229.99 V
Frequency	49.999 Hz
Power Factor	0.9998
POHC Limit	0.2514 A
POHC Max	0.0365 A
THC	0.1683 A

PASS

Set Fundamental I	---------
Set Power Factor	---------
Set P	---------
Sigma W Max	2804.014 W
Sigma PF	0.9998
Distortion factor(V)	0.04 %
V THDS	0.04 %
V THDG	0.04 %
Distortion factor(A)	1.38 %
A THDS	1.38 %
A THDG	1.38 %
P THD	0.00 %
Power Limit	75 W

Order	Measure[A]	Limit[A]	Margin[%]	Order	Measure[A]	Limit[A]	Margin[%]
1	12.1882			2	0.0081	1.0800	99.2
3	0.1680	2.3000	93.1	4	0.0062	0.4300	98.6
5	0.0316	1.1400	97.2	6	0.0031	0.3000	99.0
7	0.0138	0.7700	98.2	8	0.0031	0.2300	98.7
9	0.0054	0.4000	98.6	10	0.0042	0.1840	97.7
11	0.0059	0.3300	98.2	12	0.0037	0.1533	97.6
13	0.0121	0.2100	94.3	14	0.0040	0.1314	96.9
15	0.0102	0.1500	93.2	16	0.0032	0.1150	97.3
17	0.0129	0.1324	90.3	18	0.0034	0.1022	97.7
19	0.0138	0.1184	88.3	20	0.0029	0.0920	97.2
21	0.0149	0.1071	86.3	22	0.0018	0.0836	97.8
23	0.0137	0.0978	86.0	24	0.0016	0.0767	97.9
25	0.0133	0.0900	85.2	26	0.0015	0.0708	97.3
27	0.0130	0.0833	84.4	28	0.0017	0.0657	97.3
29	0.0119	0.0776	84.7	30	0.0013	0.0613	97.8
31	0.0107	0.0726	85.3	32	0.0012	0.0575	98.0
33	0.0094	0.0682	86.1	34	0.0012	0.0541	97.7
35	0.0091	0.0643	85.9	36	0.0011	0.0511	97.8
37	0.0079	0.0608	87.1	38	0.0013	0.0484	97.2
39	0.0077	0.0577	86.6	40	0.0012	0.0460	97.4



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Test Report No.: CE140508N005R1

***** appliances (Maximum)

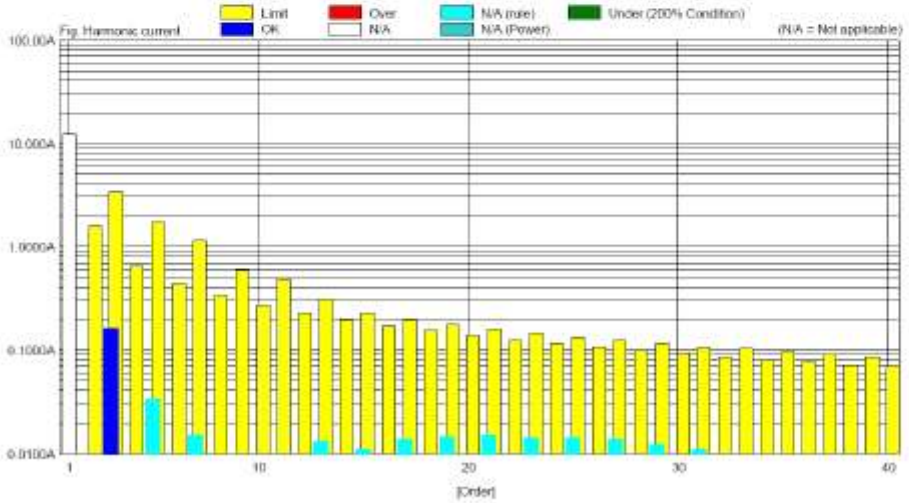
Print Date	:	Wed Jun 11 11:32:39 2014
MeasureDate	:	Wed Jun 11 11:31:38 2014
Comment	:	Experimental model Pattern A

Regulation	:	IEC61000-3-2 Ed3.0 am2
		IEC61000-4-7 Ed2.0 A1
Class	:	CLASS A
MeasureTime	:	150.00sec
Model	:	YOKOGAWA WT3000
Rating Voltage	:	230.00 V
Wiring	:	single-phase 2-wire
Element	:	2
Range	:	300V/30A
Current(rms)	:	12.1941 A
Voltage(rms)	:	228.99 V
Frequency	:	50.018 Hz
Power Factor	:	0.9998
Beyond Limit Time	:	15.0002 s
Beyond Total Time	:	0.0000 s
THC	:	0.1694 A

PASS

Set Fundamental I	:	--------
Set Power Factor	:	--------
Set P	:	--------
Sigma W Max	:	2804.014 W
Sigma PF	:	0.9998
Distortion factor(V)	:	0.04 %
V THDS	:	0.04 %
V THDG	:	0.04 %
Distortion factor(A)	:	1.40 %
A THDS	:	1.40 %
A THDG	:	1.40 %
P THD	:	0.00 %
Power Limit	:	75 W

Order	Measure[A]	Limit[A]	Margin[%]	Order	Measure[A]	Limit[A]	Margin[%]
1	12.1928			2	0.0067	1.6200	99.5
3	0.1691	3.4500	95.4	4	0.0047	0.6480	99.0
5	0.0329	1.7100	98.1	6	0.0035	0.4600	99.2
7	0.0140	1.1550	98.7	8	0.0054	0.3450	99.0
9	0.0068	0.6000	99.0	10	0.0047	0.2760	98.3
11	0.0066	0.4950	98.7	12	0.0042	0.2300	98.2
13	0.0129	0.3150	95.9	14	0.0051	0.1971	97.4
15	0.0109	0.2250	95.2	16	0.0035	0.1725	98.0
17	0.0134	0.1985	93.3	18	0.0027	0.1533	98.2
19	0.0142	0.1776	92.0	20	0.0028	0.1380	97.9
21	0.0150	0.1607	90.7	22	0.0021	0.1255	98.4
23	0.0139	0.1467	90.5	24	0.0019	0.1150	98.4
25	0.0136	0.1350	89.9	26	0.0022	0.1062	98.0
27	0.0132	0.1250	89.4	28	0.0020	0.0986	98.0
29	0.0121	0.1164	89.6	30	0.0016	0.0920	98.4
31	0.0109	0.1089	90.0	32	0.0013	0.0862	98.5
33	0.0097	0.1023	90.6	34	0.0014	0.0812	98.3
35	0.0092	0.0964	90.4	36	0.0012	0.0767	98.4
37	0.0081	0.0912	91.1	38	0.0015	0.0726	97.9
39	0.0078	0.0865	90.8	40	0.0014	0.0690	97.9



3.4 VOLTAGE FLUCTUATION AND FLICKS MEASUREMENT

3.4.1 LIMITS OF VOLTAGE FLUCTUATION AND FLICKS MEASUREMENT

TEST STANDARD: EN 61000-3-3

TEST ITEM	LIMIT	NOTE
P_{st}	1.0	P_{st} means short-term flicker indicator.
P_{lt}	0.65	P_{lt} means long-term flicker indicator.
$T_{d(t)}$ (ms)	500	$T_{d(t)}$ means maximum time that d(t) exceeds 3.3%.
d_{max} (%)	4	dmax means maximum relative voltage change.
dc (%)	3.3	dc means relative steady-state voltage change

3.4.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
PRECISION POWER ANALYZER	YOKOGAWA	WT3000	91M210852	Mar. 12,14	Mar. 11,15
Test Software	YOKOGAWA	IEC61000	N/A	N/A	N/A
PEFERENCE IMPEDANCE NETWORK	Voltech	EUR	3018	N/A	N/A

NOTE: 1. The test was performed in PV Room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

3.4.3 TEST PROCEDURE

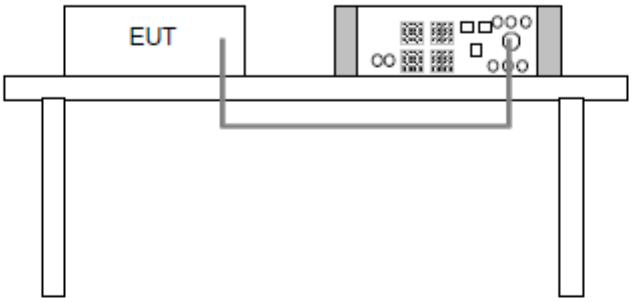
a. The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the most unfavorable sequence of voltage changes under Normal Operating conditions.

b. During the flick measurement, the measure time shall include that part of whole operation cycle in which the EUT produce the most unfavorable sequence of voltage changes. The observation period for short-term flicker indicator is 120 minutes

3.4.4 DEVIATION FROM TEST STANDARD

No deviation

3.4.5 TEST SETUP



3.4.6 EUT OPERATING CONDITIONS

Same as item 3.1.6.

Test Report No.: CE140508N005R1

3.4.7 TEST RESULTS

SOFAR 1100TL

PV Inverter

Print Date : Mon May 26 16:26:18 2014
MeasureDate : Mon May 26 16:26:54 2014
Comment : Experimental model Pattern A

Regulation : IEC61000-3-3 Ed2.0
IEC61000-4-15 Ed1.1
Interval : 10Min0Sec
Model : YOKOGAWA WT3000
Wiring : single-phase 2-wire
Voltage Range : 300.00V
Voltage U1 : 231.61V
Set Frequency : 50Hz
Frequency U1 : 50.000Hz
Element : 1
dmin : 0.10%

PASS(Under dmin)

Element1 : Pass(Under dmin)
dc (3.30%) : Pass
dmax (4.00%) : Pass
d(t) (500ms) : Pass
Pst (1.00) : Pass
Plt (0.65) : Pass

No.	dc[%]	dmax[%]	d(t)[ms]	Pst
1	0.00	0.00	0.00	0.07
2	0.00	0.00	0.00	0.07
3	0.00	0.00	0.00	0.07
4	0.00	0.00	0.00	0.07
5	0.00	0.00	0.00	0.07
6	0.00	0.00	0.00	0.07
7	0.00	0.00	0.00	0.07
8	0.00	0.00	0.00	0.07
9	0.00	0.00	0.00	0.07
10	0.00	0.00	0.00	0.07
11	0.00	0.00	0.00	0.07
12	0.00	0.00	0.00	0.07

Plt
0.07

Test Report No.: CE140508N005R1

SOFAR 3000TL

PV Inverter

Print Date : Fri Jun 13 11:17:38 2014
MeasureDate : Fri Jun 13 11:17:28 2014
Comment : Experimental model Pattern A

Regulation : IEC61000-3-3 Ed2.0
IEC61000-4-15 Ed1.1
Interval : 10Min0Sec
Model : YOKOGAWA WT3000
Wiring : single-phase 2-wire
Voltage Range : 300.00V
Voltage U1 : 234.15V
Set Frequency : 50Hz
Frequency U1 : 50.000Hz
Element : 1
dmin : 0.10%

PASS(Under dmin)

Element1 : Pass(Under dmin)
dc (3.30%) : Pass
dmax (4.00%) : Pass
d(t) (500ms) : Pass
Pst (1.00) : Pass
Plt (0.65) : Pass

No.	dc[%]	dmax[%]	d(t)[ms]	Pst
1	0.00	0.00	0.00	0.07
2	0.00	0.00	0.00	0.07
3	0.00	0.00	0.00	0.07
4	0.00	0.00	0.00	0.07
5	0.00	0.00	0.00	0.07
6	0.00	0.00	0.00	0.07
7	0.00	0.00	0.00	0.07
8	0.00	0.00	0.00	0.07
9	0.00	0.00	0.00	0.07
10	0.00	0.00	0.00	0.07
11	0.00	0.00	0.00	0.07
12	0.00	0.00	0.00	0.07
				Plt
				0.07

4 IMMUNITY TEST

4.1 GENERAL DESCRIPTION

4.1.1 GENERAL DESCRIPTION OF EN 61000-6-2

Product Standard:	EN 61000-6-2:2005	
Basic Standard, specification requirement, and Performance Criteria:	IEC 61000-4-2	Electrostatic Discharge – ESD: 4kV Contact discharge, 8kV air discharge, Performance Criterion B
	IEC 61000-4-3	Radio-Frequency Electromagnetic Field Susceptibility Test – RS: 80-1000 MHz, 10V/m, 80% AM (1kHz), 1400-2000 MHz, 3V/m, 80% AM (1kHz) 2000-2700 MHz, 1V/m, 80% AM (1kHz) Performance Criterion A
	IEC 61000-4-4	Electrical Fast Transient/Burst - EFT AC Power line: 2kV, DC Power line: 2kV Signal line: 1kV Performance Criterion B
	IEC 61000-4-5	Surge Immunity Test: 1.2/50 us Open Circuit Voltage, 8 /20 us Short Circuit Current, AC Power Line: line to line 1 kV, line to earth 2kV DC Power Line: line to line 0.5kV line to earth 0.5kV Signal line: 1kV Performance Criterion B
	IEC 61000-4-6	Conducted Radio Frequency Disturbances Test – CS: 0.15-80 MHz, 10Vrms, 80% AM, 1kHz, Performance Criterion A
	IEC 61000-4-8	Power Frequency Magnetic Field Test, 50 Hz, 30A/m, Performance Criterion A

4.1.2 PERFORMANCE CRITERIA

According to Clause 4 of EN 61000-6-2:2005 standard, the following describes the general performance criteria.

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 reasonably expect from the apparatus if used as intended.
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 operating 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.
CRITERION C	Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

4.1.3 EUT OPERATING CONDITION

Same as item 3.1.6

4.2 ELECTROSTATIC DISCHARGE IMMUNITY TEST (ESD)

4.2.1 TEST SPECIFICATION

Basic Standard:	IEC 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Discharge Voltage:	Air Discharge: 8 kV (Direct) Contact Discharge: 4 kV (Indirect)
Polarity:	Positive & Negative
Number of Discharge:	20 times at each test point
Discharge Mode:	Single Discharge
Discharge Period:	1 second

4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
ESD Generator	TESEQ	NSG 437	279	Oct. 12, 13	Oct. 11, 14
Test Software	TESEQ	V03.03	N/A	N/A	N/A
ESD Generator	EM TEST	Dito	V1211112265	Jun. 19,14	Jun. 18,15
Test Software	EM TEST	V 2.31	N/A	N/A	N/A

NOTE: 1. The test was performed in ESD Room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.2.3 TEST PROCEDURE

The basic test procedure was in accordance with IEC 61000-4-2:

a. Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.

b. The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.

c. The time interval between two successive single discharges was at least 1 second.

d. The ESD generator was held perpendicularly to the surface to which the discharge was applied and the return cable was at least 0.2 meters from the EUT.

e. Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.

f. Air discharges were applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator was removed from the EUT and re-triggered for a new single discharge. The test was repeated until all discharges were complete.

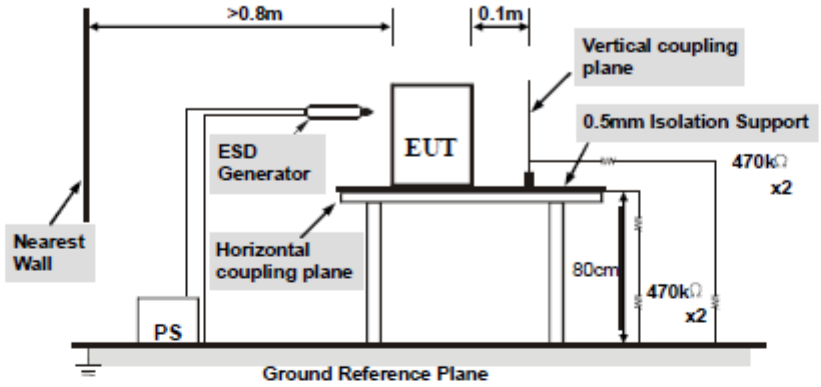
g. At least ten single discharges (in the most sensitive polarity) were applied to the Horizontal Coupling Plane at points on each side of the EUT. The ESD generator was positioned horizontal at a distance of 0.1 meters from the EUT with the discharge electrode touching the HCP.

h. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the Vertical Coupling Plane in sufficiently different positions that the four faces of the EUT were completely illuminated. The VCP (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the EUT.

4.2.4 DEVIATION FROM TEST STANDARD

No Deviation

4.2.5 TEST SETUP



NOTE:

TABLE-TOP EQUIPMENT

The configuration consisted of a wooden table 0.8 meters high standing on the Ground Reference Plane. The GRP consisted of a sheet of aluminum at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system. A Horizontal Coupling Plane (1.6m x 0.8m) was placed on the table and attached to the GRP by means of a cable with 940kΩ total impedance. The equipment under test, was installed in a representative system as described in section 7 of IEC 61000-4-2, and its cables were placed on the HCP and isolated by an insulating support of 0.5mm thickness. A distance of 1-meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

FLOOR-STANDING EQUIPMENT

The equipment under test was installed in a representative system as described in section 7 of IEC 61000-4-2, and its cables were isolated from the Ground Reference Plane by an insulating support of 0.1-meter thickness. The GRP consisted of a sheet of aluminum that is at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system and extended at least 0.5 meters from the EUT on all sides.

4.2.6 TEST RESULTS

TEST MODE	See item 2.2	TEST VOLTAGE	DC 300V
ENVIRONMENTAL CONDITIONS	21.2deg. C, 51% RH 101.3kPa	TESTED BY: Heise	

Direct Discharge Application				
Test Level (kV)	Polarity	Test Point	Test Result of Contact Discharge	Test Result of Air Discharge
4	+/-	All Metal Part	A	N/A
8	+/-	All Non-metal Part	N/A	A

Indirect Discharge Application				
Discharge Level (kV)	Polarity	Test Point	Test Result of HCP	Test Result of VCP
4	+/-	HCP&VCP	A	A

NOTE: A: There was no change compared with initial operation during the test.

4.3 RADIATED, RADIO-FREQUENCY, ELECTROMAGNETIC FIELD IMMUNITY TEST (RS)

4.3.1 TEST SPECIFICATION

Basic Standard:	IEC 61000-4-3
Frequency Range:	80-1000MHz, 1400-2000MHz, 2000-2700MHz
Field Strength:	10V/m, 3V/m, 1V/m
Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of fundamental
Polarity of Antenna:	Horizontal and Vertical
Antenna Height:	1.5m
Dwell Time:	at least 3 seconds

4.3.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Signal Generator	Agilent	N5181A	MY50142530	Nov. 01,13	Oct. 31,14
Antenna Log-Periodic	CORAD	ATR80M6G	0337307	N/A	N/A
Antenna Log-Periodic	CORAD	ATS700M11G	0336821	N/A	N/A
Switch Controller	CORAD	SC1000	0337343	N/A	N/A
RF Power Meter	ESE	4242	13984	Nov. 04,13	Nov. 03,14
Power Sensor	ESE	51011EMC	35716	Nov. 04,13	Nov. 03,14
Power Sensor	ESE	51011EMC	35715	Nov. 04,13	Nov. 03,14
E-Field probe	Narda	NBM-520	2403/01B	May 07,14	May 06,15
Power Amplifier	TESEQ	CBA 1G-150	T44029	N/A	N/A
Power Amplifier	TESEQ	CBA 3G-100	T44030	N/A	N/A
Power Amplifier	TESEQ	CBA 6G-050	1041204	N/A	N/A
Dual Directional Coupler	TESEQ	C5982	95208	Dec. 23,13	Dec. 22,14
Dual Directional Coupler	TESEQ	C6187	95175	Dec. 23,13	Dec. 22,14
Dual Directional Coupler	TESEQ	CPH-274F	M251304-01	Dec. 23,13	Dec. 22,14
Test Software	ADT	BVADT_RS_V7.6.4-DG	N/A	N/A	N/A

NOTE: 1. The test was performed in RS chamber.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.3.3 TEST PROCEDURE

The test procedure was in accordance with IEC 61000-4-3

a. The testing was performed in a fully-anechoic chamber.

b. The frequency range is swept from 80 MHz to 1000 MHz, 1400MHz to 2000MHz, 2000MHz to 2700MHz with the signal 80% amplitude modulated with a 1kHz sine wave.

c. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0,5s.

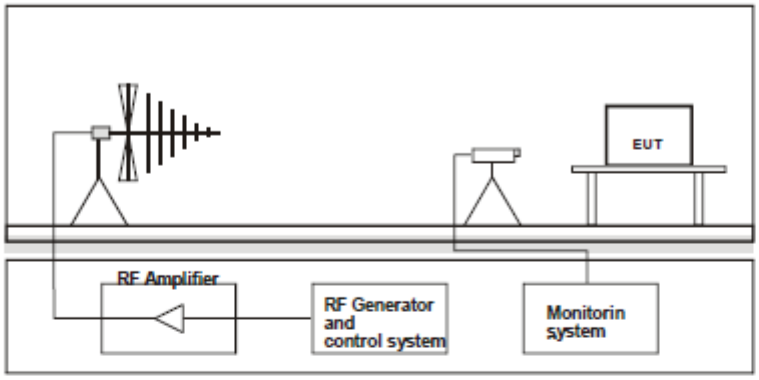
d. The field strength levels were 10V/m, 3V/m, 1V/m.

e. The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

4.3.4 DEVIATION FROM TEST STANDARD

No Deviation

4.3.5 TEST SETUP



NOTE:

TABLETOP EQUIPMENT
The EUT installed in a representative system as described in section 7 of IEC 61000-4-3 was placed on a non-conductive table 0.8 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

FLOOR STANDING EQUIPMENT
The EUT installed in a representative system as described in section 7 of IEC 61000-4-3 was placed on a non-conductive wood support 0.1 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

4.3.6 TEST RESULTS

TEST MODE	See item 2.2	TEST VOLTAGE	DC 300V
ENVIRONMENTAL CONDITIONS	21.6deg. C, 57.5% RH	TESTED BY: Heise	

Field Strength (V/m)	Test Frequency Note#1 (MHz)	Polarization of antenna (Horizontal / Vertical)	Test Distance (m)	Test Result	Remark
10	80 - 1000	H&V	3	A	N/A
3	1400 - 2000	H&V	3	A	N/A
1	2000 - 2700	H&V	3	A	N/A

Note#1:

Tested Israel SII Frequencies 89,100,107,144,163,196,244,315,434,460,600,825,845,880 MHz

NOTE: A: There was no change compared with initial operation during the test.

4.4 ELECTRICAL FAST TRANSIENT/BURST IMMUNITY TEST (EFT)

4.4.1 TEST SPECIFICATION

Basic Standard:	IEC 61000-4-4
Test Voltage:	Power Line: 2kV
Polarity:	Positive & Negative
Impulse Frequency:	5 kHz
Impulse Waveshape :	5/50 ns
Burst Duration:	15 ms
Burst Period:	300 ms
Test Duration:	1 min.

4.4.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EFT Tester	HAEFELY	PEFT4010	150546	May 17,14	May 16,15
EFT Coupling Clamp	HAEFELY	IP4A	150407	May 17,14	May 16,15
Test Software	HAEFELY	SWPE4010 1.22	N/A	N/A	N/A

NOTE: 1. The test was performed in EMS Room 1.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.4.3 TEST PROCEDURE

a. Both positive and negative polarity discharges were applied.

b. The length of the "hot wire" from the coaxial output of the EFT generator to the terminals on the EUT should not exceed 0.5 meter ± 0.05 meter.

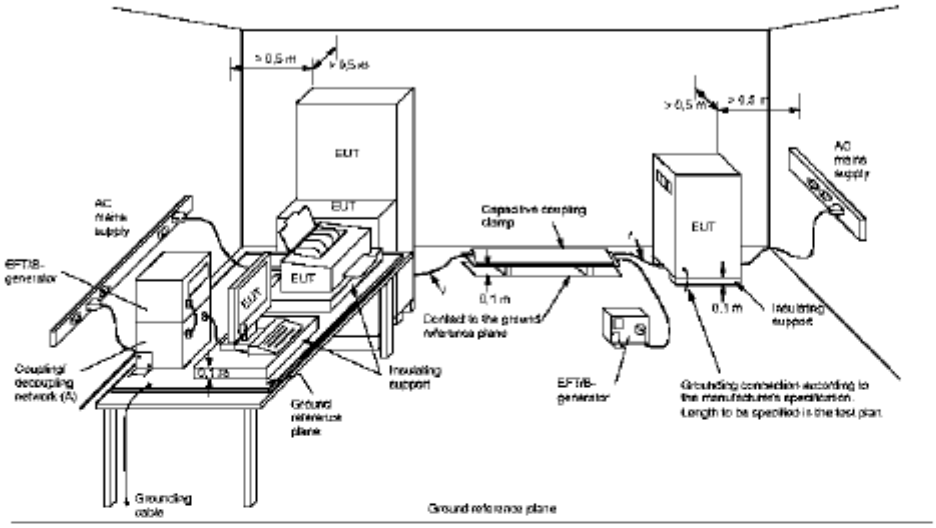
c. The duration time of each test sequential was 1 minute.

d. The transient/burst waveform was in accordance with IEC 61000-4-4, 5/50ns.

4.4.4 DEVIATION FROM TEST STANDARD

No deviation.

4.4.5 TEST SETUP



NOTE:
TABLETOP EQUIPMENT
The configuration consisted of a wooden table standing on the Ground Reference Plane and should be located 0.1m +/- 0.01m above the Ground Reference Plane.
The GRP consisted of a sheet of aluminum (at least 0.25mm thick and 2.5m square) connected to the protective grounding system. A minimum distance of 0.5m was provided between the EUT and the walls of the laboratory or any other metallic structure.

FLOOR STANDING EQUIPMENT
The EUT installed in a representative system as described in section 7 of IEC 61000-4-4 and its cables, were isolated from the Ground Reference Plane by an insulating support that is 0.1-meter thick. The GRP consisted of a sheet of aluminum (at least 0.25mm thick and 2.5m square) connected to the protective grounding system.

Test Report No.: CE140508N005R1

4.4.6 TEST RESULTS

TEST MODE	See item 2.2	TEST VOLTAGE	DC 300V
ENVIRONMENTAL CONDITIONS	21.5 deg. C, 58.2% RH	TESTED BY: Heise	

Pulse Voltage	2 kV		___ kV		___ kV		___ kV	
Pulse Polarity	+	–	+	–	+	–	+	–
L	A	A	/	/	/	/	/	/
N	A	A	/	/	/	/	/	/
PE	A	A	/	/	/	/	/	/
L+N	A	A	/	/	/	/	/	/
L+PE	A	A	/	/	/	/	/	/
N+PE	A	A	/	/	/	/	/	/
L+N+PE	A	A	/	/	/	/	/	/
DC Line	A	A	/	/	/	/	/	/

NOTE: A: There was no change compared with initial operation during the test.

4.5 SURGE IMMUNITY TEST

4.5.1 TEST SPECIFICATION

Basic Standard:	IEC 61000-4-5
Wave-Shape:	Combination Wave 1.2/50 us Open Circuit Voltage 8 /20 us Short Circuit Current
Test Voltage:	AC Power Line: Line to Line:1kV Line to PE:2kV Signal Line: 1kV DC Power Line: Line to Line:0.5kV Line to PE:0.5kV
Surge Input/Output:	L-N&L-PE&N-PE, RJ 45 Line
Generator Source Impedance:	2 ohm between networks 12 ohm between network and ground
Polarity:	Positive/Negative
Phase Angle:	0° /90°/180°/270°
Pulse Repetition Rate:	1 time / 60 sec.
Number of Tests:	5 positive and 5 negative at selected points

4.5.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Combination wave Module	TESEQ AG	CDN 3061	1361	Feb. 17,14	Feb. 16,15
Telecom Surge Module	TESEQ AG	NSG 3060 Mainframe	1404	Feb. 17,14	Feb. 16,15
CDN	TESEQ	CDN HSS-2	34275	Nov.06, 13	Nov.05, 14
CDN	TESEQ	CDN 118	30741	Nov.06, 13	Nov.05, 14
Test Software	TESEQ	CDM 3061_0002.30	1361	N/A	N/A
Test Software	TESEQ	HVM 3060_0002.30	293	N/A	N/A

NOTE: 1. The test was performed in EMS Room 1.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.5.3 TEST PROCEDURE

a. For EUT power supply:

The surge is to be applied to the EUT power supply terminals via the capacitive coupling network. Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines, and to provide sufficient decoupling impedance to the surge wave. The power cord between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

b. For test applied to unshielded unsymmetrically operated interconnection lines of EUT:

The surge is applied to the lines via the capacitive coupling. The coupling / decoupling networks shall not influence the specified functional conditions of the EUT. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

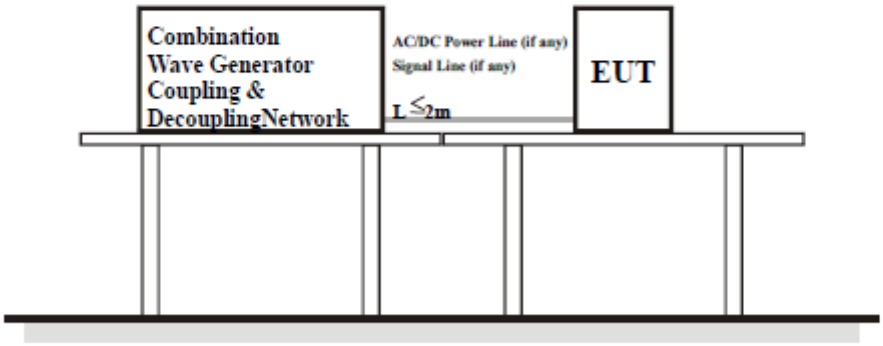
c. For test applied to unshielded symmetrically operated interconnection / telecommunication lines of EUT:

The surge is applied to the lines via gas arrestors coupling. Test levels below the ignition point of the coupling arrestor cannot be specified. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

4.5.4 DEVIATION FROM TEST STANDARD

No deviation.

4.5.5 TEST SETUP



4.5.6 TEST RESULTS

TEST MODE	See item 2.2	TEST VOLTAGE	DC 300V
ENVIRONMENTAL CONDITIONS	21.5deg. C, 59.2% RH	TESTED BY: Heise	

AC/DC Power port:

\Phase angle \ Test result \Voltage (kV) \ Test point\		Polarity	0°	90°	180°	270°	DC Power Port
1	L-N	+	B	B	B	B	N/A
		−	B	B	B	B	N/A
2	L-PE	+	B	B	B	B	N/A
		−	B	B	B	B	N/A
2	N-PE	+	B	B	B	B	N/A
		−	B	B	B	B	N/A

Signal ports and telecommunication ports:

Voltage (kV)	Test Point	Polarity	Test result	Voltage (kV)	Test Point	Polarity	Test result
/	/	+/-	/	/	/	+/-	/

NOTE: A: There was no change compared with initial operation during the test.
B: During test, EUT stopped grid, and could automatically return to normal after test.

4.6 IMMUNITY TO CONDUCTED DISTURBANCES INDUCED BY RF FIELDS (CS)

4.6.1 TEST SPECIFICATION

Basic Standard:	IEC 61000-4-6
Frequency Range:	0.15 MHz - 80 MHz
Field Strength:	$10V_{r.m.s}$
Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of fundamental
Coupled Cable:	Power Mains & DC Power Line
Coupling Device:	CDN-M3(3 wires) & Clamp

4.6.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Signal Generator	Rohde&Schwarz	SME06	829498/006	Oct.15,13	Oct.14, 14
CDN	Luthi	L-801M2/M3	2015	Oct.18,13	Oct. 17,14
CDN(AUX)	TESEQ	CDN M016	27452	Nov. 20,13	Nov. 19,14
CDN	TESEQ	T200A	26944	Apr. 08,14	Apr. 07,15
CDN	TESEQ	T400A	26536	Apr. 08,14	Apr. 07,15
CDN	TESEQ	ST08A	32256	Apr. 08,14	Apr. 07,15
6dB 50Watt Attenuator	HUBER+SUHNER	5906.17.0005	303688	Oct.15,13	Oct.14,14
Signal Amplifier	HAEFELY	PAMP250	149594	NA	NA
Electromagnetic Injection Clamp	Luthi	EM101	35640	Oct.16,13	Oct.15,14
C/S Test System	HAEFELY	WinPAMP	NSEMC002	N/A	N/A
Test Software	ADT	BVADT_CS_V7.5.1	N/A	N/A	N/A

NOTE: 1. The test was performed in CS test room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.6.3 TEST PROCEDURE

a. The EUT shall be tested within its intended operating and climatic conditions.

b. An artificial hand was placed on the hand-held accessory and connected to the ground reference plane.

c. The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn, while the other non-excited RF input ports of the coupling devices are terminated by a 50-ohm load resistor.

d. The frequency range is swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80 % amplitude. The signal is modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. Where the frequency is swept incrementally, the step size shall not exceed 1 % of the preceding frequency value.

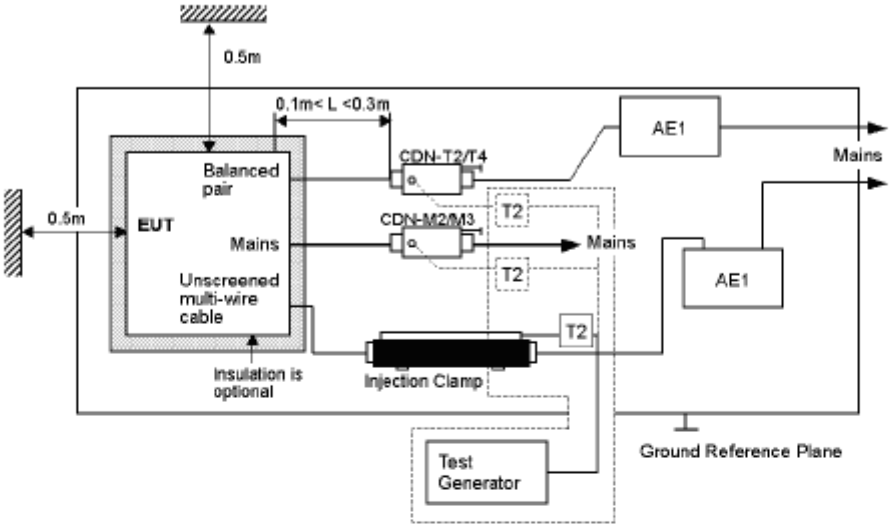
e. The dwell time of the amplitude modulated carrier at each frequency shall not be less than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0,5 s. The sensitive frequencies (e.g. clock frequencies) shall be analyzed separately.

f. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

4.6.4 DEVIATION FROM TEST STANDARD

No deviation.

4.6.5 TEST SETUP



NOTE: The EUT clearance from any metallic obstacles shall be at least 0.5m.
All non-excited input ports of the CDNs shall be terminated by 50Ω loads.

NOTE:

FLOOR-STANDING EQUIPMENT
The equipment to be tested is placed on an insulating support of 0.1 meters height above a ground reference plane. All relevant cables shall be provided with the appropriate coupling and decoupling devices at a distance between 0.1 meters and 0.3 meters from the projected geometry of the EUT on the ground reference plane.

4.6.6 TEST RESULTS

TEST MODE	See Item 2.2	TEST VOLTAGE	DC 300V
ENVIRONMENTAL CONDITIONS	22.5deg. C, 56.6% RH	TESTED BY: Heise	

Voltage (V)	Test Frequency Note#1 (MHz)	Tested Line	Injection Method.	Test Result	Remark
10	0.15 – 80	AC Mains	CDN-M3	A	N/A
10	0.15 – 80	DC line	Clamp	A	N/A

Note#1: Tested Israel SII Frequencies 0.2,0.53,1,1.5,7.1,13.56,21,27.12,40.68,65,68 MHz

NOTE: A: There was no change compared with initial operation during the test.

4.7 POWER FREQUENCY MAGNETIC FIELD IMMUNITY TEST

4.7.1 TEST SPECIFICATION

Basic Standard:	IEC 61000-4-8
Frequency Range:	50Hz, 60Hz
Field Strength:	30A/m
Observation Time:	5 minute
Inductance Coil:	Rectangular type, 1mx1m

4.7.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Magnetic Field Tester	HAEFELY	MAG100.1	150579	Oct.18,13	Oct.17,14
Test Software	N/A	N/A	N/A	N/A	N/A

NOTE: 1. The test was performed in Shielding Room 843.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.7.3 TEST PROCEDURE

a. The equipment is configured and connected to satisfy its functional requirements.

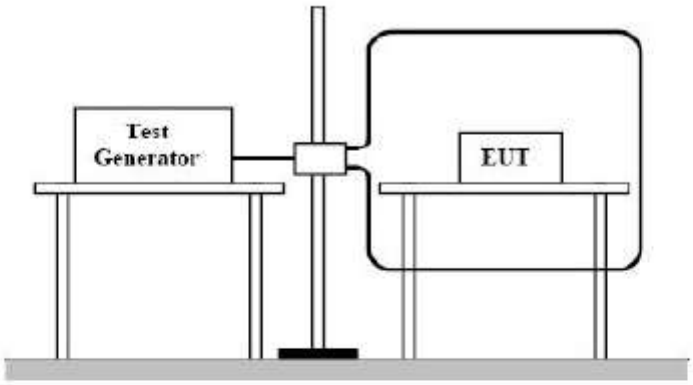
b. The power supply, input and output circuits shall be connected to the sources of power supply, control and signal.

c. The cables supplied or recommended by the equipment manufacturer shall be used. 1 meter of all cables used shall be exposed to the magnetic field.

4.7.4 DEVIATION FROM TEST STANDARD

No Deviation

4.7.5 TEST SETUP



NOTE:

TABLETOP EQUIPMENT
The equipment shall be subjected to the test magnetic field by using the induction coil of standard dimension (1 m x 1 m). The induction coil shall then be rotated by 90 degrees in order to expose the EUT to the test field with different orientations.

FLOOR-STANDING EQUIPMENT
The equipment shall be subjected to the test magnetic field by using induction coils of suitable dimensions. The test shall be repeated by moving and shifting the induction coils, in order to test the whole volume of the EUT for each orthogonal direction. The test shall be repeated with the coil shifted to different positions along the side of the EUT, in steps corresponding to 50 % of the shortest side of the coil. The induction coil shall then be rotated by 90 degrees in order to expose the EUT to the test field with different orientations.

Test Report No.: CE140508N005R1

4.7.6 TEST RESULTS

TEST MODE	See Item 2.2	TEST VOLTAGE	DC 300V
ENVIRONMENTAL CONDITIONS	22deg. C, 59% RH	TESTED BY: Heise	

MAGNETIC FIELD DIRECTION	TESTING RESULT	REMARK
X - Axis	A	30A/ m
Y - Axis	A	30A/ m
Z - Axis	A	30A/ m

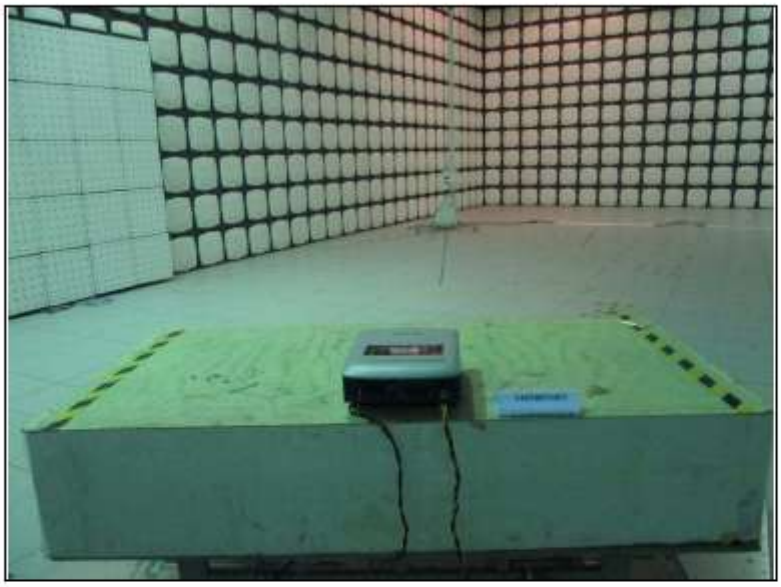
NOTE: A: There is no change compared with the initial operation during the test.

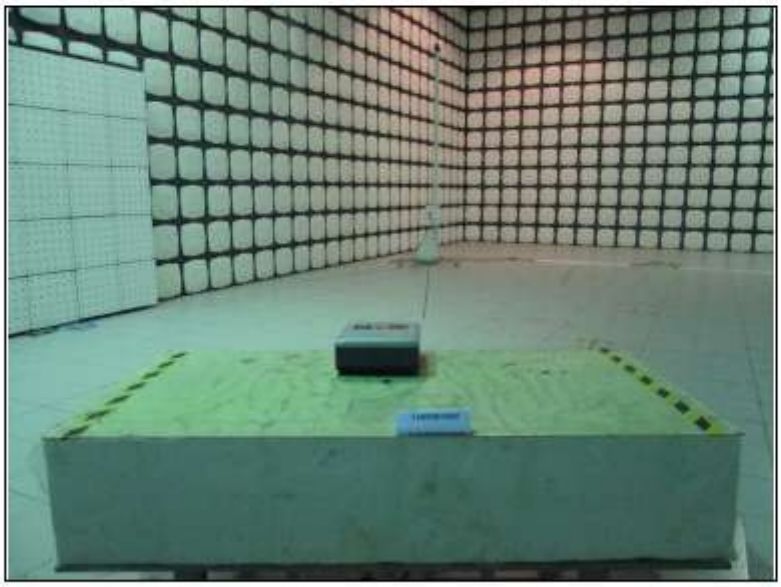
5 PHOTOGRAPHS OF THE TEST CONFIGURATION

CONDUCTED EMISSION TEST

Test Report No.: CE140508N005R1

RADIATED EMISSION TEST





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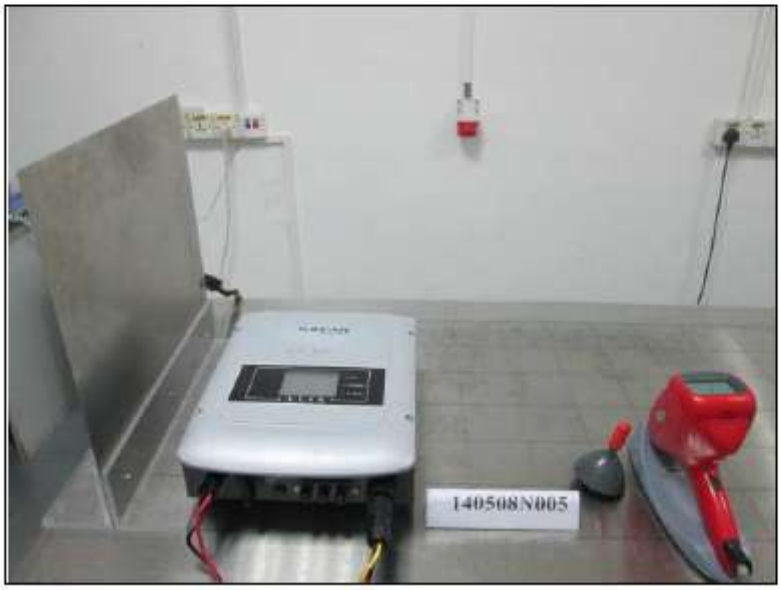
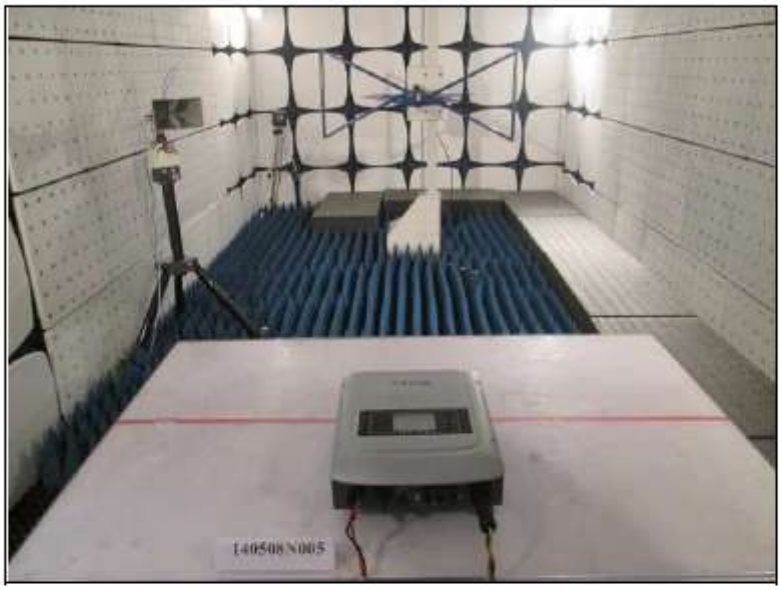
Test Report No.: CE140508N005R1

HARMONICS EMISSION TEST &
VOLTAGE FLUCTUATIONS AND FLICKER TEST

ESD TEST



RS TEST



EFT TEST(AC Mains)

Test Report No.: CE140508N005R1

EFT TEST (DC Port)

SURGE TEST

Test Report No.: CE140508N005R1

CONDUCTED SUSCEPTIBILITY TEST (AC Mains)

CONDUCTED SUSCEPTIBILITY TEST (DC Cable)

Test Report No.: CE140508N005R1

POWER-FREQUENCY MAGNETIC FIELDS TEST

6 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications were made to the EUT by the lab during the test.

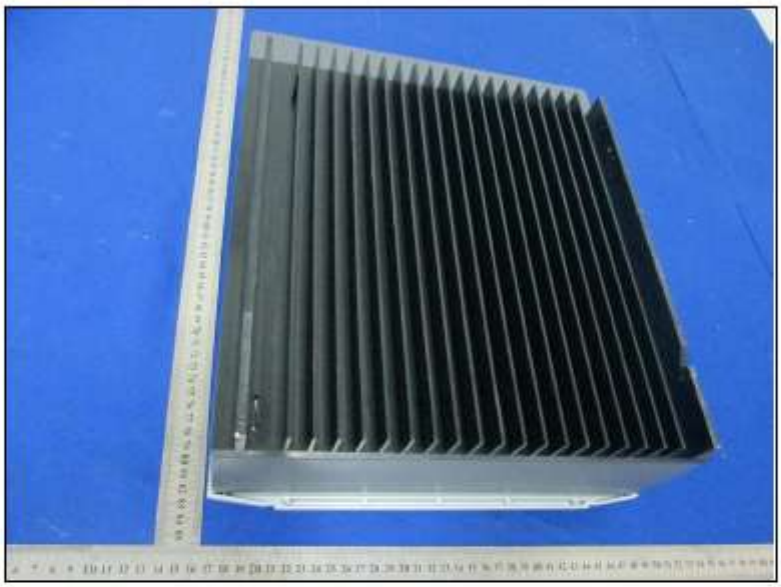
---END---

Reference No.: 140508N005R1

PHOTOGRAPHS OF THE EUT

SOFAR 1100TL:

Reference No.: 140508N005R1



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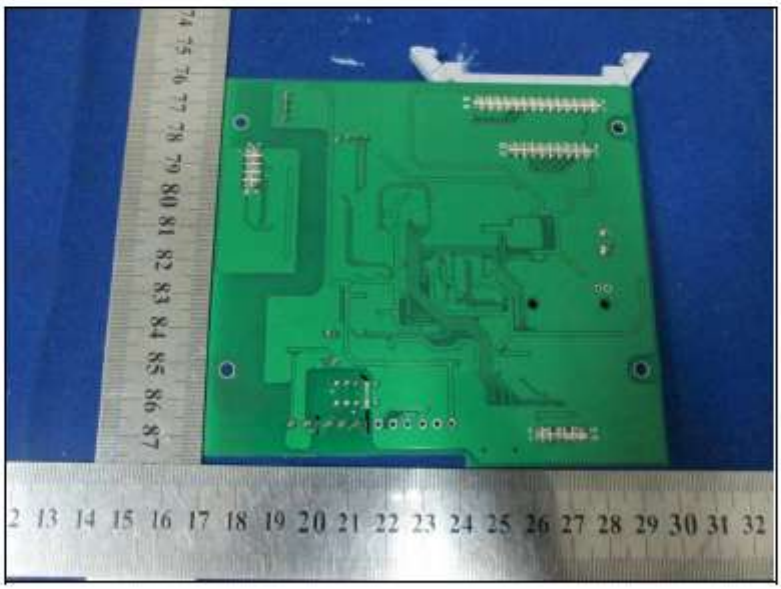

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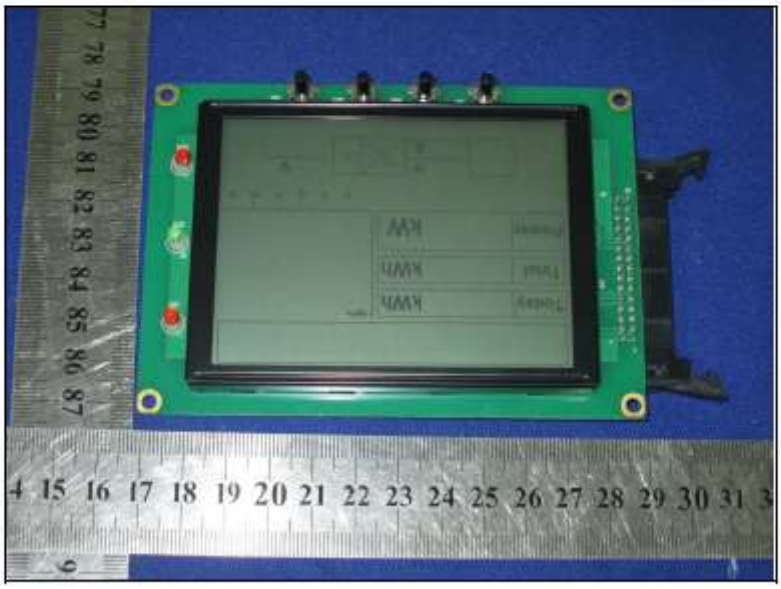

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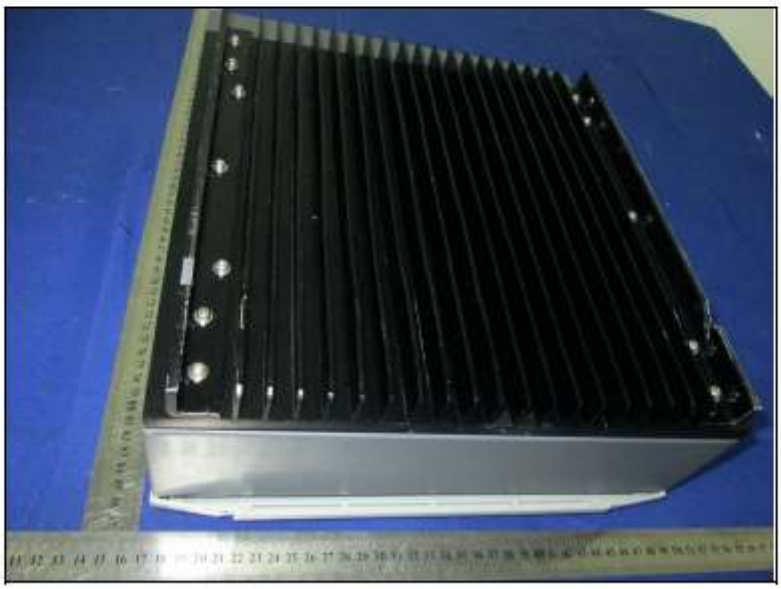

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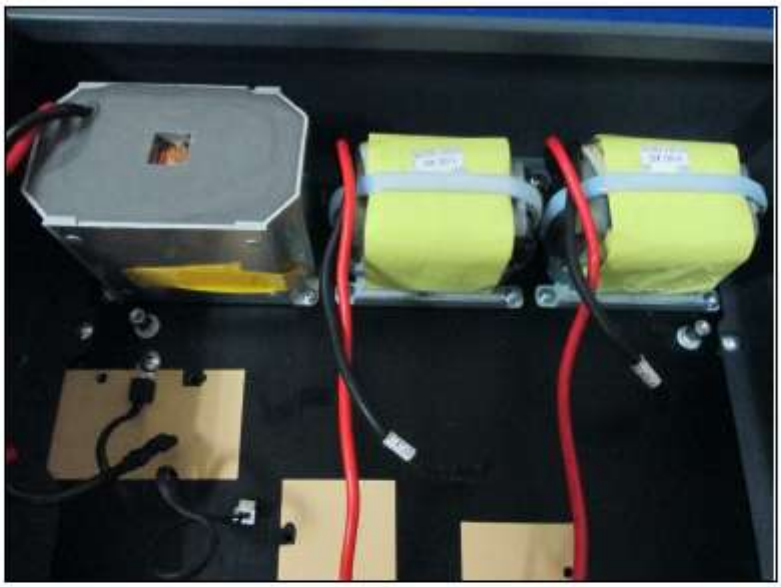

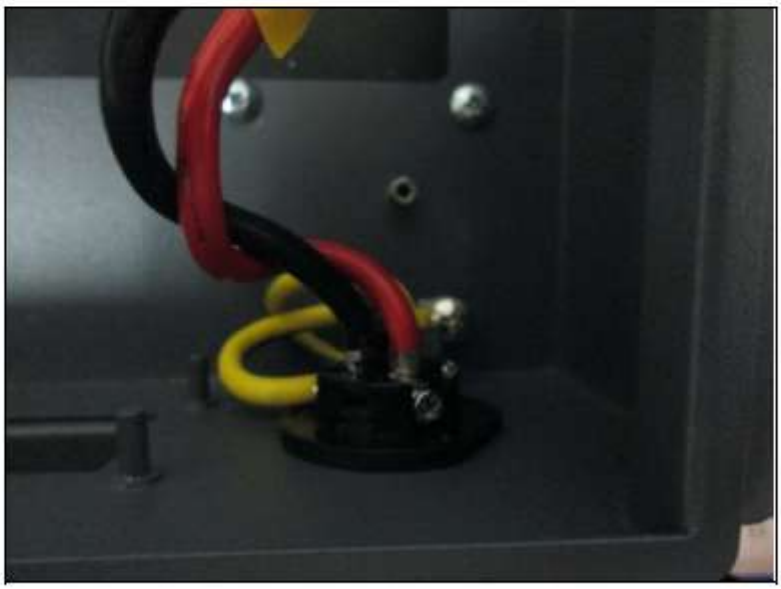

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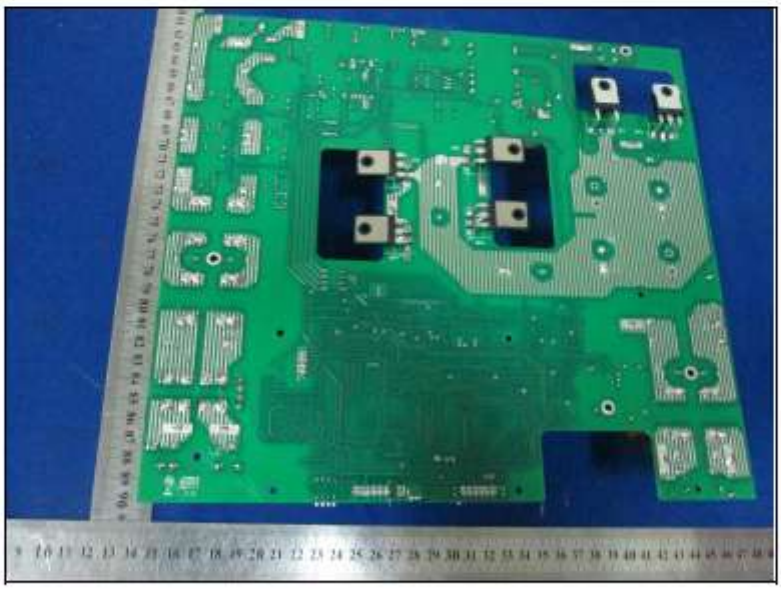

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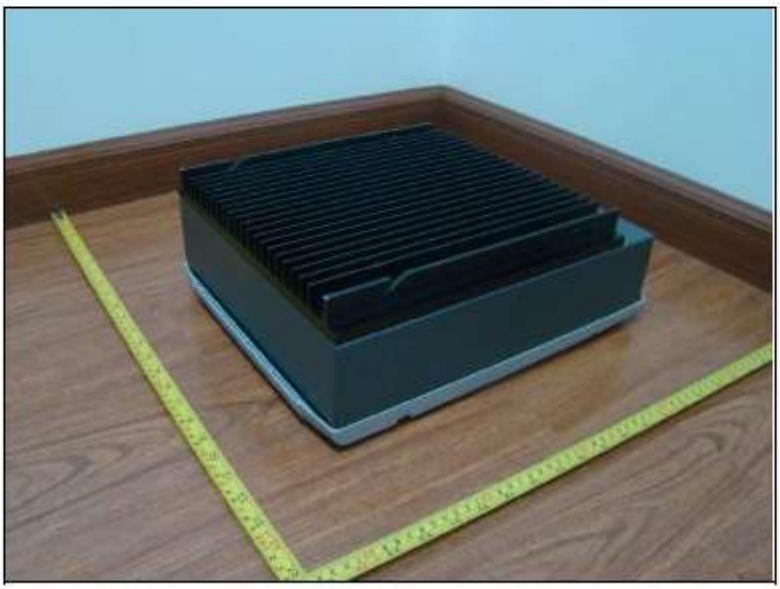

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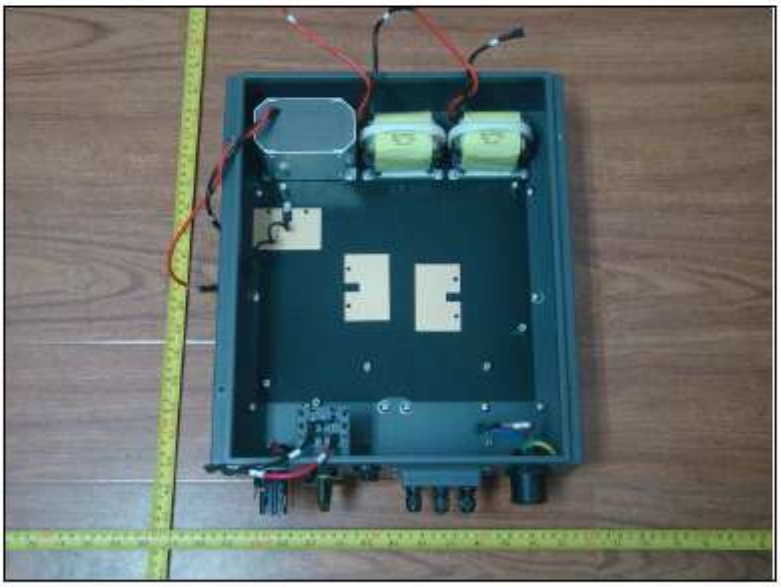

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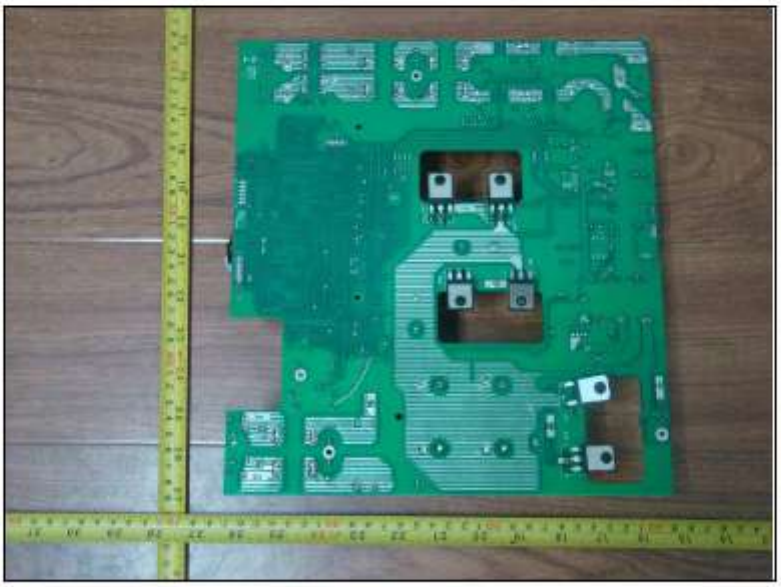
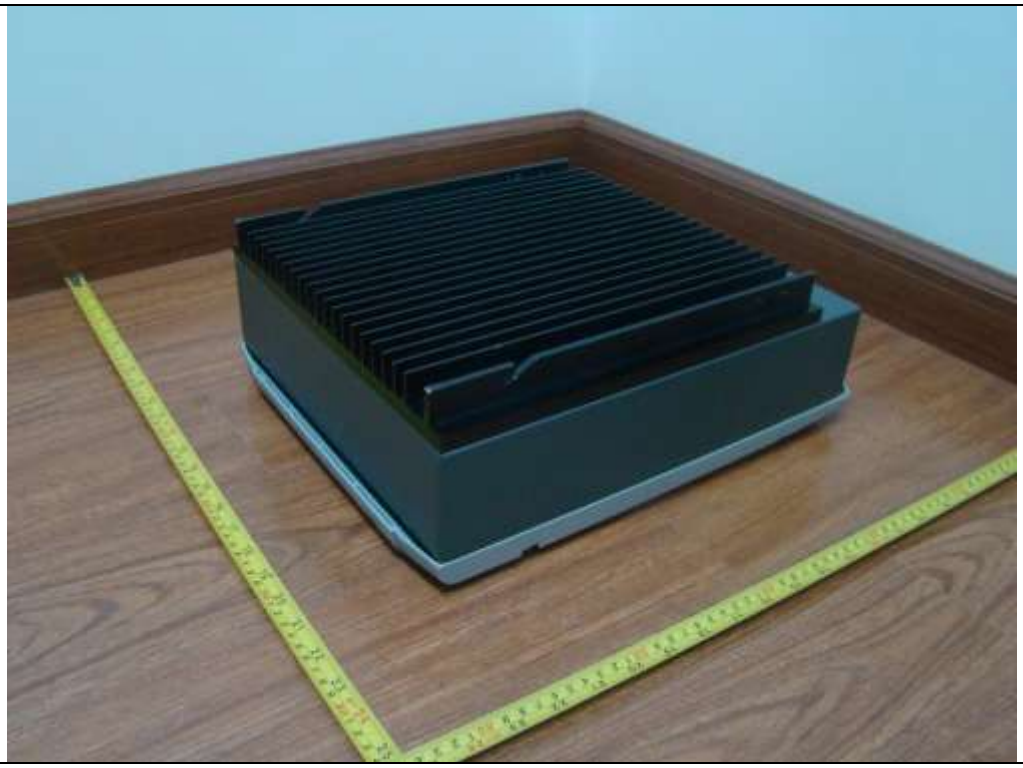


Annex No. 2

Pictures of the unit

Enclosure front view

Enclosure rear view

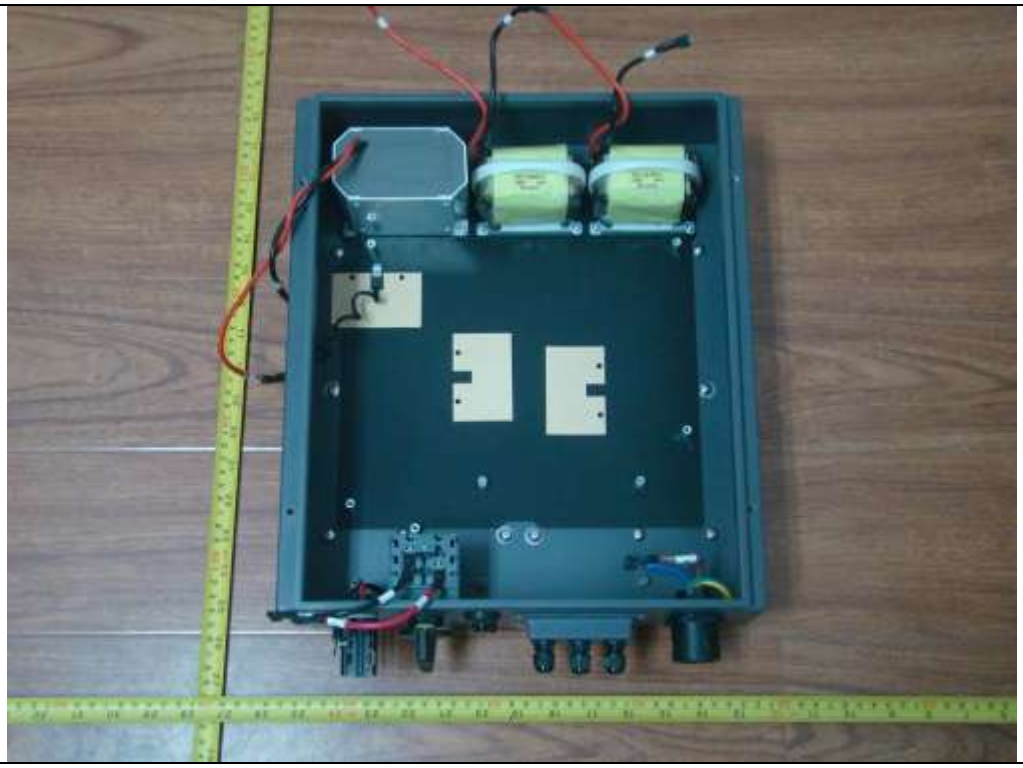


Enclosure bottom view

Internal view-1

Internal view-2

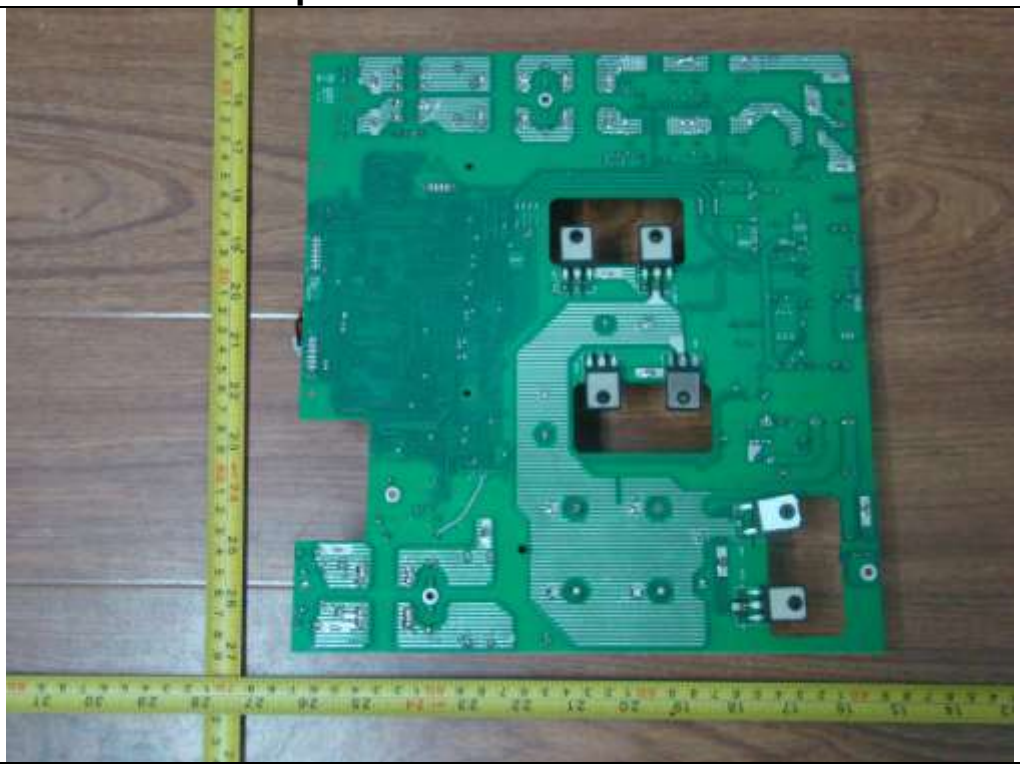
Internal view-3



Internal view-4

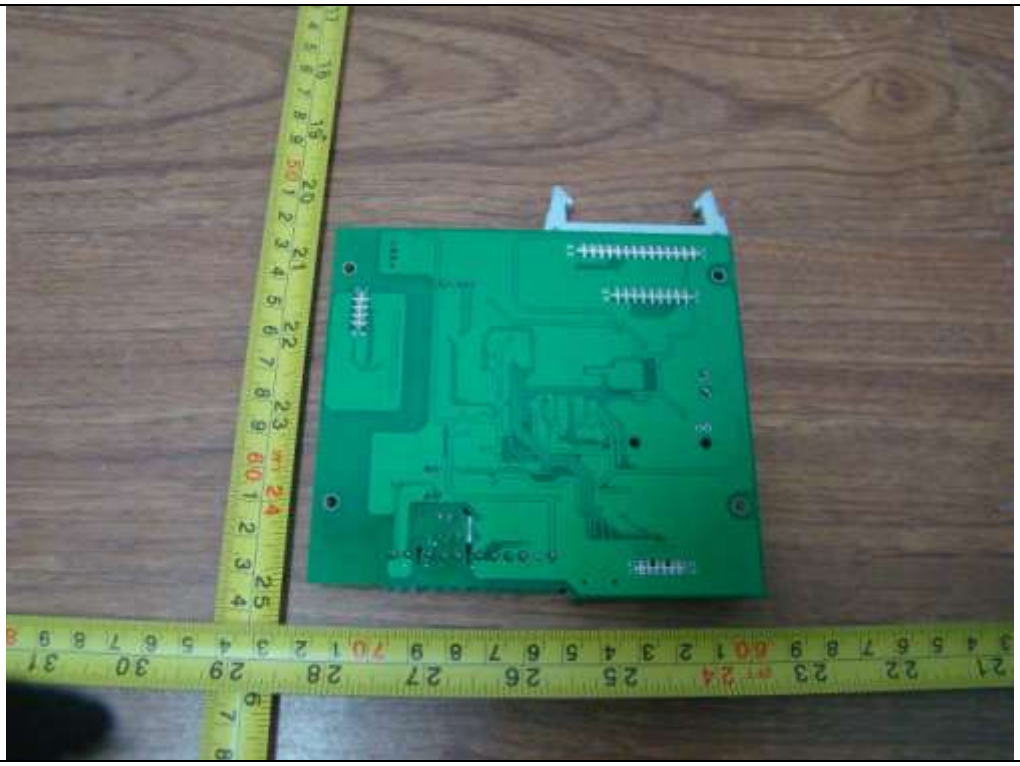
Main power board component side view

Main power board solder side view

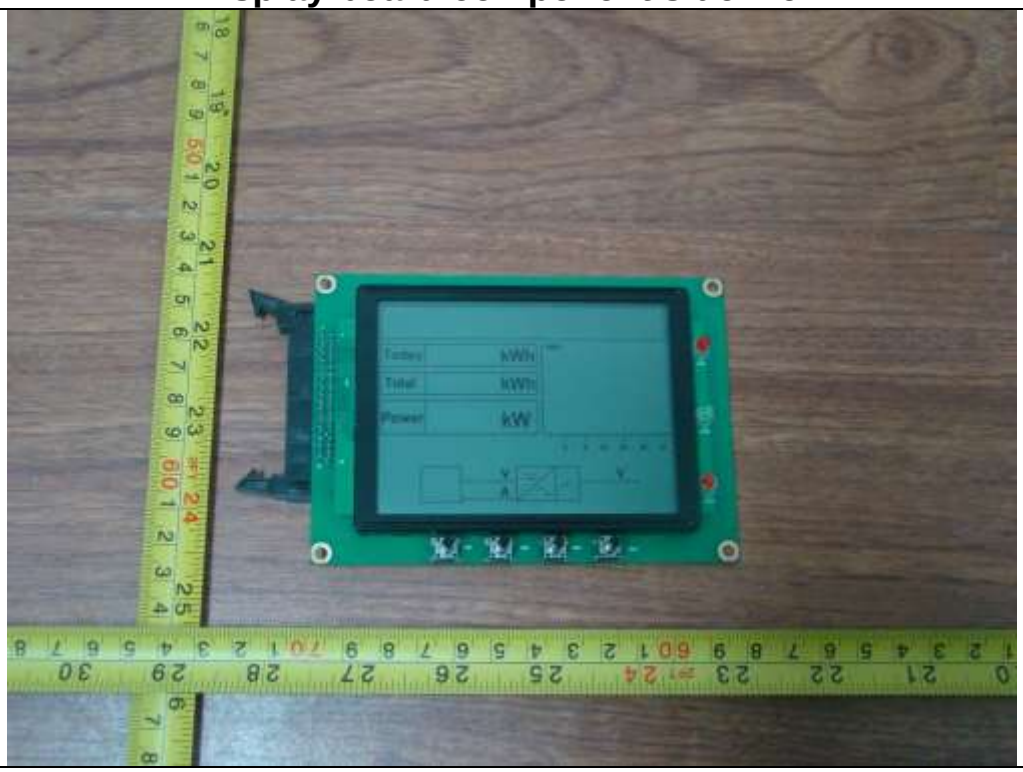


Control board component side view

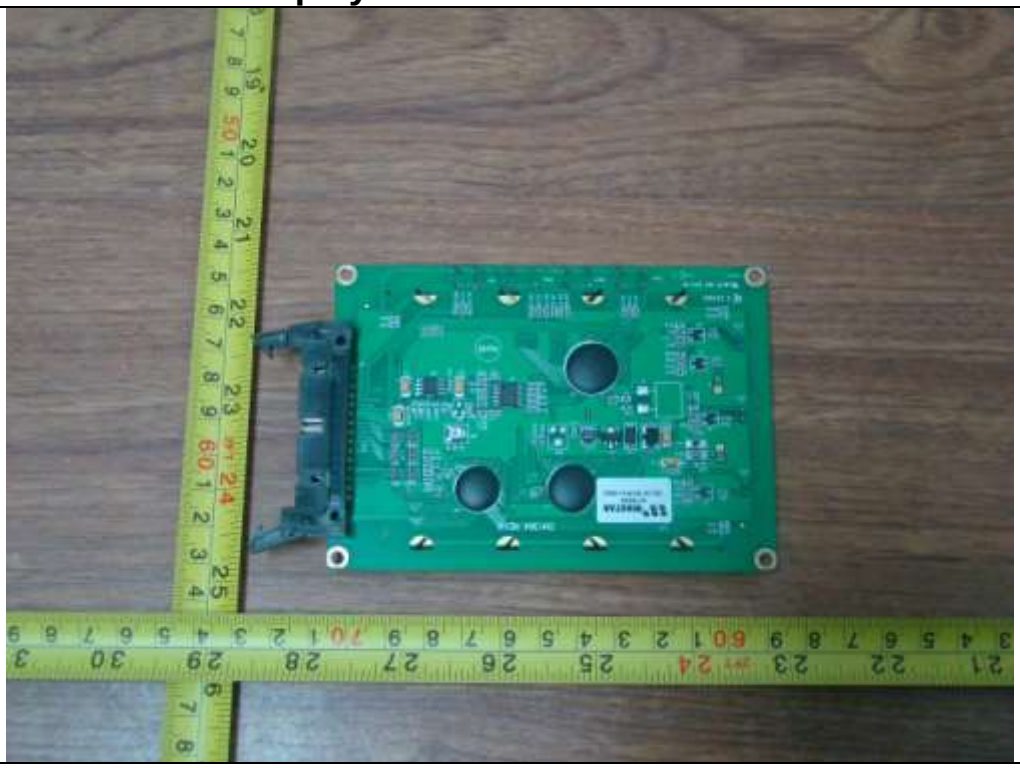
Control board solder side view



Display board component side view



Display board solder side view



Annex No. 3

Test Equipment list

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	Mar. 12, 2014
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
Four Channel Digital Phosphor Oscilloscope	A4089003DG	Tektronix	DPO4104B	C010624	Oct. 17, 2013
Current transducer	A1060007DG	YOKOGAWA	CT200	1130700012	Jan 20, 2014
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	Monitored by Power Analyzer
Oscilloscope probel	A4089010DG	Tektronix	TPP1000	C008228	Dec. 20, 2013
Oscilloscope probel	A4089011DG	Tektronix	TPP1000	C008229	Dec. 20, 2013
LCR Hitester	A1060006DG	HIOKI	3535	120112505	Mar. 06, 2014