TEST REPORT

AS/NZS 4777.2

Grid connection of energy systems via inverters
Part 2: Inverter requirements

Report reference number .....:	**PVAU180712N013**
Date of issue .....::	2019-05-16
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Testing laboratory name .....:	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
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Applicant's name.....:	**Shenzhen SOFAR SOLAR Co., Ltd.**
Address .....:	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China.
Test specification	
Standard.....:	AS/NZS 4777.2:2015
Certificate.....:	**Ce**rtificate of compliance
Test report form number .....:	AS4777_C
Master TRF .....:	Bureau Veritas Consumer Products Services Germany GmbH
Test item description .....:	**Solar Grid-tied Inverter**
Trademark.....:	SOFAR SOLAR
Model / Type .....:	SOFAR 20000TL-G2, SOFAR 25000TL-G2, SOFAR 30000TL-G2, SOFAR 33000TL-G2

Ratings ..... :	SOFAR 20000TL-G2	SOFAR 25000TL-G2	SOFAR 30000TL-G2	SOFAR 33000TL-G2
Input DC voltage range [V]..... :	230-1100			
Full load MPPT DC voltage range [V]:	480-850	460-850	520-850	580-850
Input DC current [A] ..... :	24/24	28/28	30/30	30/30
Output AC voltage [V] ..... :	400V, 3/N/PE, 50Hz			
Output AC current [A]..... :	Max. 32	Max. 40	Max. 48	Max. 53
Output power [VA]..... :	22000	27500	33000	36300

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) ..... :	Dora Zhang 
Approved by (name and signature) ..... :	James Huang 
Manufacturer's name ..... :	**Shenzhen SOFAR SOLAR Co., Ltd.**
Manufacturer address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China.
Factory's name ..... :	**Dongguan SOFAR SOLAR Co.,Ltd.**
Factory address	1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2019-05-16	James Huang	Initial report was written	--
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] ..... :	Approx. 37

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 ..... :	2018-07-12
Date(s) of performance of test ..... :	2018-07-12 to 2019-05-09

General remarks*:*

The test result presented in this report relate only to the object(s) tested.
This report shall not be reproduced, except in full, without the written approval of the applicant.

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

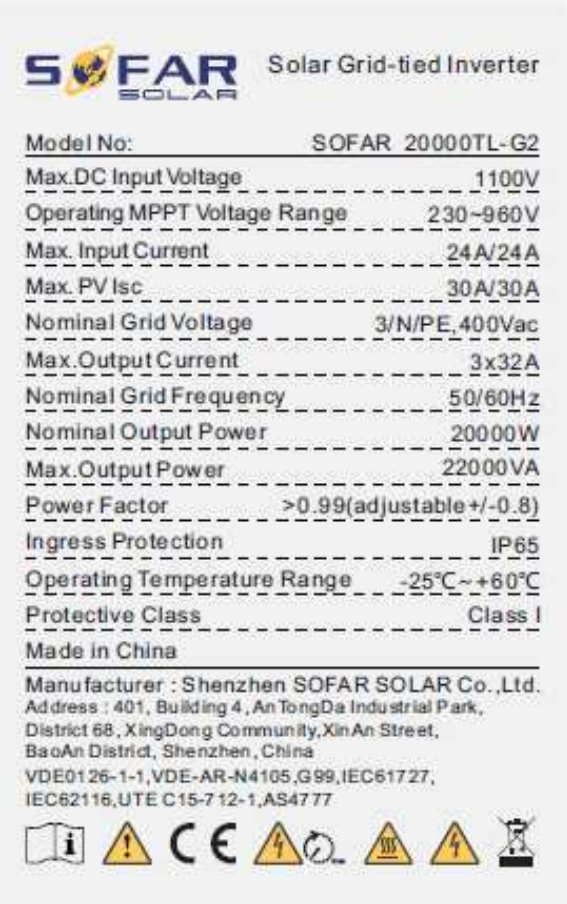
Throughout this report a comma is used as the decimal separator.

The unit was reviewed to
AS 4777.2:2015 Grid connection of energy systems via inverters – Part 2: inverter requirements and the unit fulfils the requirements of the European EMC directive requirements. The EMC requirements of AS 4777.2 (flicker) refer to the same standards as the EMC directive; therefore the EMC report documents show the compliance.

This Test Report consists of the following documents:

- Test Results
- Annex No. 1 – Pictures of the unit
- Annex No. 2 – Test equipment list

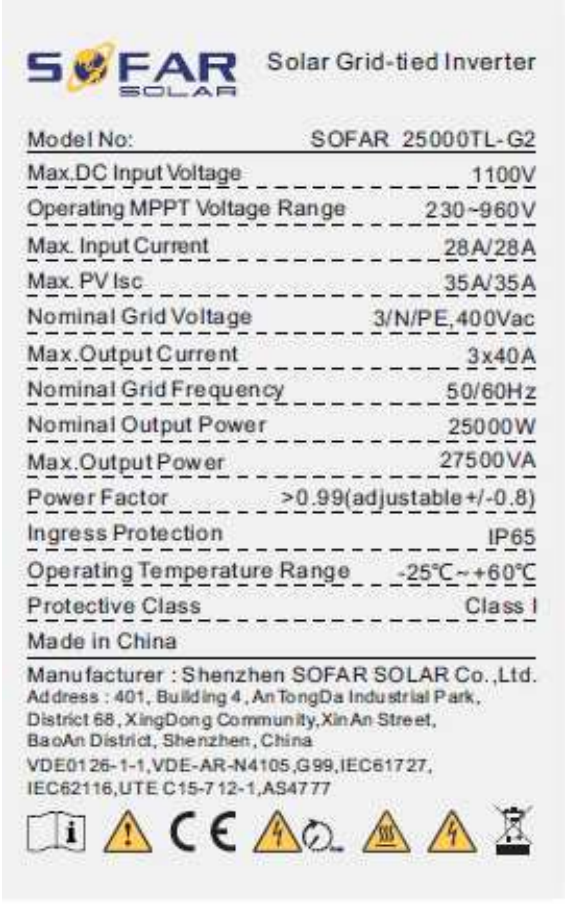
Copy of marking plate



SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 20000TL-G2
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	24A/24A
Max. PV Isc	30A/30A
Nominal Grid Voltage	3/N/PE,400Vac
Max.Output Current	3x32A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	20000W
Max.Output Power	22000VA
Power Factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25℃~+60℃
Protective Class	Class I
Made in China	

Manufacturer : Shenzhen SOFAR SOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727,
IEC62116,UTE C15-712-1,AS4777



SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 25000TL-G2
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	28A/28A
Max. PV Isc	35A/35A
Nominal Grid Voltage	3/N/PE,400Vac
Max.Output Current	3x40A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	25000W
Max.Output Power	27500VA
Power Factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25℃~+60℃
Protective Class	Class I
Made in China	

Manufacturer : Shenzhen SOFAR SOLAR Co.,Ltd.
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VDE0126-1-1,VDE-AR-N4105,G99,IEC61727,
IEC62116,UTE C15-712-1,AS4777

SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 30000TL-G2
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	30A/30A
Max. PV Isc	37.5A/37.5A
Nominal Grid Voltage	3/N/PE,400Vac
Max.Output Current	3x48A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	30000W
Max.Output Power	33000VA
Power Factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25℃~+60℃
Protective Class	Class I

Made in China

Manufacturer : Shenzhen SOFAR SOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727,
IEC62116,UTE C15-712-1,AS4777

SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 33000TL-G2
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	230~960V
Max. Input Current	30A/30A
Max. PV Isc	37.5A/37.5A
Nominal Grid Voltage	3/N/PE,400Vac
Max.Output Current	3x53A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	33000W
Max.Output Power	36300VA
Power Factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25℃~+60℃
Protective Class	Class I

Made in China

Manufacturer : Shenzhen SOFAR SOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
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IEC62116,UTE C15-712-1,AS4777

Non Isolated

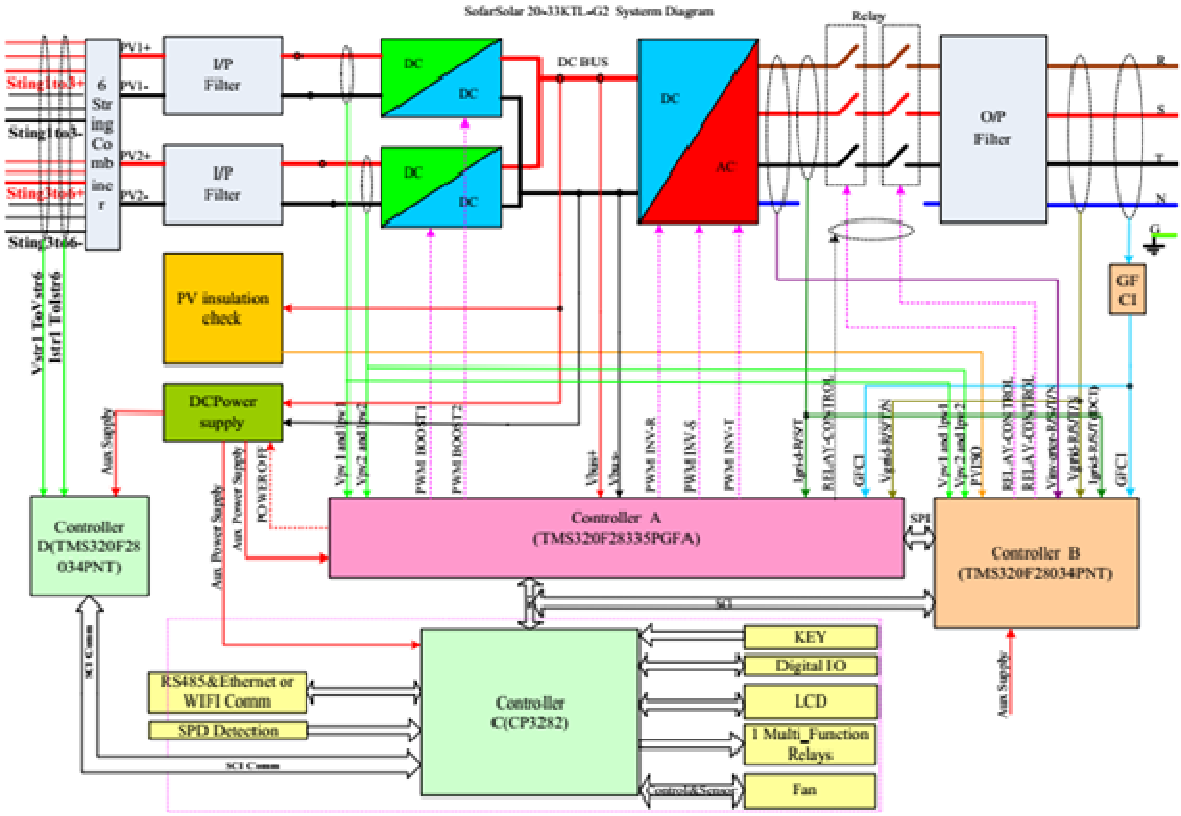
DRM0 ☑	DRM1 ☐	DRM2 ☐
DRM3 ☐	DRM4 ☐	DRM5 ☐
DRM6 ☐	DRM7 ☐	DRM8 ☐

General product information:

The Photovoltaic grid-interactive inverter converts DC voltage, generated by photovoltaic modules, into AC voltage.

The units are three-phases inverter.

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



Block diagram

The internal control is redundant built. It consists of Main DSP(UC20) and slave DSP(UC73).

The Main DSP(UC20) can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, In addition it tests the array insulation resistance and the RCMU circuit before each start up.

The slave DSP(UC73) is using for detect residual current, also can open the relays independently and communicate with Main DSP(UC20).

The unit provides two relays in series on Line conductors. When single-fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before start up. Both controllers(Main DSP(UC20), Slave DSP(UC73) can open the relays.

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.

Differences of the models

The models SOFAR 20000TL-G2, SOFAR 25000TL-G2, SOFAR 30000TL-G2 and SOFAR 33000TL-G2 are almost identical in hardware except the shown in the following table and the output power derated by software.

The difference in hardware			
Item	SOFAR 20000TL-G2	SOFAR 25000TL-G2	SOFAR 30000TL-G2 / SOFAR 33000TL-G2
Number of PV terminal	2+2	3+3	
Number of BUS capacitance	8 capacitors: 550V/110μF 2 capacitors: 1100V/40μF		10 capacitors: 550V/110μF 24 capacitors: 1100V/40μF
INV inductance	785μH	735μH	
BUS board	Not the board	Have the board	
External fan	Not the board	2	3
Relay of output board	6pcs T9VV1K15-12S		3pcs AZSR250-2AE-12D

The product was tested on

Hardware version: V1.00

Software version: V1.40

AS/NZS 4777.2 – 2015			
Clause	**Requirement – Test**	**Result - Remark**	**Verdict**
5	**GENERAL REQUIREMENTS**		**P**
5.1	Electrical safety		P
	Inverters for use in inverter energy systems with photovoltaic (PV) arrays shall comply with the appropriate electrical safety requirements of IEC 62109-1 and IEC 62109-2, and the requirements within this Standard.	An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	P
	Inverters for use in inverter energy systems that have energy storage (batteries) as the only possible energy source shall comply with the electrical safety requirements of AS 62040.1.1, and the requirements within this Standard.	No such the energy storage system.	N/A
	Inverters for use in inverter energy systems that incorporate energy sources other than photovoltaic (PV) arrays or batteries shall comply with the applicable electrical safety requirements of IEC 62109-1 and IEC 62109-2, and the requirements within this Standard.	An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	P
5.2	Provision for external connections	Provided in the installation manual.	P
	Inverters shall be used and installed as fixed equipment only.		P
	Inverter provisions for external connection -	See below.	P
	(a) shall be for fixed equipment only; and	Complied.	P
	(b) shall provide for safe and reliable connection to any d.c. source or load or any a.c. source or load.	Provided in the installation manual.	P
	All inverter ports (except communications ports) shall incorporate connection types for either -	See below.	P
	(i) permanently connected equipment; or		P
	(ii) pluggable type B equipment.	Permanently connected equipment	N/A
	Inverter source or load connections shall not incorporate connection types for pluggable type A equipment.		P
	Permanently connected inverters shall have suitable terminals for connection to fixed installation wiring.	Complied.	P
	Pluggable type B equipment shall have one of the following means of connection:	Permanently connected equipment	N/A
	(A) A non-detachable cord for connection to the supply by means of a connector.	Permanently connected equipment	N/A

	(B) An appliance inlet suitable for connection to a matching connector.	Permanently connected equipment	N/A
	Pluggable type B equipment shall not incorporate -	See below.	N/A
	(1) a connection by a connector or inlet complying with any of the dimensional sheets of AS/NZS 60320.1;		N/A
	(2) a connection by a plug conforming to AS/NZS 3112; or	No such plug used.	N/A
	(3) a connection by a connector or inlet where hazardous voltages are accessible by the standard test finger.	No such devices..	N/A
5.3	Photovoltaic (PV) array earth fault/earth leakage detection		P
	For inverter energy systems used with PV array systems that require earth fault detection and a residual current detection, either internal or external to the inverter, the type of detection used shall be declared in accordance with IEC 62109-1 and IEC 62109-2.	An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	P
	If an external residual current device (RCD) is required, the manufacturer's installation instructions shall state the need for an RCD and shall specify its rating, type and required circuit location in accordance with Clause 9.		N/A
	Where the additional detection for functionally earthed PV arrays, as required by AS/NZS 5033, is present in the inverter, this additional detection shall, before start-up of the system -	See below.	P
	(a) open circuit the functional earth connection to the PV array;		P
	(b) measure the resistance to earth of each conductor of the PV array;	An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	P
	(c) if the earth resistance is above the resistance limit (Riso limit) threshold specified in Table 1, the system shall reconnect the functional earth and shall be allowed to start; and	An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	P
	(d) if the earth resistance is equal to or less than the resistance limit (Riso limit) threshold specified in Table 1, the inverter shall shut down and initiate an earth fault alarm in accordance with the requirements of IEC 62109-2.	An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	P
5.4	Compatibility with electrical installation		P
	The inverter shall be compatible with wiring practices for LV electrical	Considered.	P

	installations of AS/NZS 3000 and variations as required in AS/NZS 4777.1. The inverter a.c. voltage and frequency operation shall comply with the limits specified in AS 60038 (for Australia), or IEC 60038 (for New Zealand).		
5.5	Power factor		P
	The displacement power factor of the inverter, considered as a load from the perspective of the grid, shall, for all current outputs from 25% to 100% of rated current, operate at unity power factor within the range 0.95 leading to 0.95 lagging.	See appendix table.	P
	Operation at power factor other than unity is acceptable where the inverter operates in power quality response modes.	See Clause 6.3.	P
5.6	Harmonic currents		P
	The harmonic currents of the inverter shall not exceed the limits specified in Tables 2 and 3 and the total harmonic current distortion (ITHD) to the 50th harmonic shall be less than 5%.	See appendix table 5.6 Harmonic currents.	P
5.7	Voltage fluctuations and flicker		P
	The inverter shall conform to the voltage fluctuation and flicker limits specified in AS/NZS 61000.3.3 for equipment with rated current less than or equal to 16 A per phase (a.c.).	See appendix table 5.7 Voltage Fluctuations and Flicker.	P
	For equipment with rated current greater than 16 A per phase (a.c.), The impedance shall be determined in accordance with the methods given in AS/NZS 61000.3.11.	See appendix table 5.7 Voltage Fluctuations and Flicker.	P
5.8	Transient voltage limits		P
	To prevent damage to electrical equipment connected to the same circuit as the inverter, disconnection of the inverter from the grid shall not result in transient overvoltages beyond the limits specified in Table 4.	See appendix table 5.8 Transient Voltage Limits (phase to neutral).	P
5.9	D.C. current injection		P
	In the case of a single-phase inverter, the d.c. output current of the inverter at any a.c. port including the grid-interactive and/or stand-alone port shall not exceed 0.5% of the inverter's rated current or 5 mA, whichever is the greater.	See appendix table 5.9 Direct curent injection.	P
	In the case of a three-phase inverter, the d.c. output current of the inverter at any	This is three-phase grid inverter.	P

	a.c. port, including the grid-interactive and/or stand-alone port, measured in each of the phases, shall not exceed 0.5% of the inverter's per-phase rated current or 5 mA, whichever is the greater.		
5.10	Current balance for three-phase inverters		P
	In the case of a three-phase inverter the a.c. output current shall be generated and injected into the three-phase electrical installation as a three-phase balanced current.	See appendix table 5.10.	P

6	**OPERATIONAL MODES AND MULTIPLE MODE INVERTERS**		**P**
6.1	General		P
	Unless otherwise stated, the modes in the following Clauses are for the grid-interactive port of the inverter.		P
6.2	Inverter demand response modes (DRMs)		P
6.2.1	General	See below.	P
	The inverter shall support the demand response mode DRM 0 of Table 5. The inverter should support the other demand response modes of Table 5.	See appendix table 6.2.	P
	The inverter shall detect and initiate a response to all supported demand response commands within 2 s. The inverter shall continue to respond while the mode remains asserted.	See appendix table 6.2.	P
6.2.2	Interaction with demand response enabling device (DRED)	See below.	P
	The inverter shall have a means of connecting to a DRED. This means of connection shall include a terminal block or RJ45 socket.	Considered.	P
	The terminal block or RJ45 socket shall comply with the minimum electrical specifications in Table 6.	Considered.	P
	The DRED asserts demand response modes by shorting together terminals or pins as specified in Table 7.	Considered.	P
6.3	Inverter power quality response modes		P
6.3.1	General	See below.	P
	The inverter may have the capability of operating in modes which will -		P
	(a) contribute to maintaining the power quality at the point of connection with the customer installation; or		P
	(b) provide characteristics which are		P

	outside the typical operation of an inverter for the purpose of providing support to a grid.		
6.3.2	Volt response modes		P
6.3.2.1	General	See below.	P
	The intent of including the volt response modes, which respond to voltage changes at the inverter terminals, is to increase the number of systems which can be connected at a point on the grid without adversely affecting the voltage within an electrical installation.		P
	The volt–watt and volt–var response modes specified in Clause 6.3.2.2 and Clause 6.3.2.3 shall use the volt response reference values specified in Table 9.		P
6.3.2.2	Volt–watt response mode		P
	The inverter should have the volt–watt response mode. If this mode is available, it shall be enabled by default.		P
	The response curve required for the volt–watt response mode is defined by the volt response reference values in Table 9 and corresponding power levels. The default values are listed in Table 10 and example response modes are shown in Figure 2(A) for Australia and Figure 2(B) for New Zealand.	See appendix table 6.3.2.2.	P
6.3.2.3	Volt–var response mode		P
	The inverter should have the volt–var response capability. If this mode is available, it shall be disabled by default.		P
	The response curve required for the volt–var response is defined by the volt response reference values specified in Table 9 and corresponding var levels. The default values are listed in Table 11 and shown in Figure 3.	See appendix table.	P
6.3.2.4	Voltage balance modes		P
	Three-phase inverters, or single-phase inverters used in a three-phase combination may be used for voltage balancing between phases by injecting unbalanced three-phase currents into the electrical installation.	Considered.	P
	If the voltage balance mode is available, the following requirements apply:	see below.	P
	(a) The voltage balance mode shall be disabled by default.	Considered.	P
	(b) For single-phase inverters used in a	The EUT is three-phase type.	N/A

	three-phase combination, the requirements of Clause 8.2 apply.		
	(c) The voltage balancing mode shall be able to -	See below.	P
	(i) operate correctly with a single fault applied;		P
	(ii) detect the fault or loss of operability and cause the inverter to revert to injecting current into the three-phase electrical installation as a three-phase balanced current; or		P
	(iii) detect the fault or loss of operability and disconnect the inverter from the electrical installation.		P
6.3.3	Fixed power factor mode and reactive power mode		P
	These modes shall be disabled by default.		P
	If the inverter is capable of operating with reactive power mode, the maximum ratio of reactive power (vars) to rated apparent power should be 100%.	See appendix table 6.3.3.	P
	If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.	See appendix table 6.3.3.	P
6.3.4	Characteristic power factor curve for cos φ (P) (Power response)		P
	If this mode is available, it shall be disabled by default.		P
	The response curve required for the cos φ (P) response should be defined within displacement power factor range of 0.9 leading to 0.9 lagging. One possible cos φ (P) curve is shown in Figure 4.	See appendix table 6.3.4.	P
6.3.5	Power rate limit		P
6.3.5.1	General	See below.	P
	The power rate limit for an inverter is a power quality response mode.		P
	The inverter shall have the capability to rate limit changes in power generation through the grid-interactive port.		P
	Inverters capable of multiple mode operation should have the capability to rate limit changes in power consumption (for example increasing/decreasing of charging rates of connected energy storage).		N/A
	The power rate limit does not apply when the inverter disconnection device is		P

	required to operate (i.e. to disconnect).		
6.3.5.2	Gradient of power rate limit		P
	The default setting for the power rate limit (WGra) for increase and decrease shall be 16.67% of rated power per minute which is a nominal ramp time of 6 min.	See appendix table 6.3.5.	P
	The power rate limit (WGra) shall be adjustable within the range 5% to 100% of rated power per minute.	See appendix table 6.3.5.	P
	It is acceptable to have two separate power rate limits for increase and decrease in output power, as follows:		N/A
	(a) To rate limit an increase in power (WGra+).	Considered.	P
	(b) To rate limit a decrease in power (WGra–).		N/A
6.3.5.3	Power rate limit modes		P
6.3.5.3.1	General		P
	The inverter power rate limit (WGra) is applicable to operate in the following modes:		P
6.3.5.3.2	Soft ramp up after connect or reconnect		P
	All inverters shall have this mode. This mode shall be enabled as per Clause 7.7 and for the increase in power required by Clause 7.5.3 after frequency decreased to the required limit.	See appendix table.	P
6.3.5.3.3	Changes in a.c. operation and control	No such function.	N/A
	If available, this mode shall be enabled for a change in a demand response mode of Clause 6.2 (except for DRM 0).		N/A
	The power rate limit for changes in a.c. operation and control does not apply to those inverters that are correcting for sags and swells of less than 1 min.		N/A
6.3.5.3.4	Changes in energy source operation	No energy source in the EUT.	N/A
	This mode only applies to multiple mode inverters with energy storage. It operates when there is a change in the energy resource available to the inverter, which causes a change in output through the grid-interactive port.		N/A
	For this mode the power rate limit (WGra) should apply to the increase or decrease in power generation or consumption, and to the transitions between power output levels.		N/A
	For this mode, the power rate limit (WGra)		N/A

	should be able to be enabled or disabled.		
	The power rate limit shall be disabled by default.		N/A
	The increase or decrease for transitions between power output levels is contingent on external situations (such as amount of available solar energy, wind energy or discharge capacity).		N/A
	Only for increases or decreases in the output which are faster than the power rate limit (WGra) does a control action to limit the ramp rate apply.		N/A
6.3.5.4	Nonlinearity of power rate limit changes		P
	The nonlinearity (NL) of the power rate limit (WGra) in response to an increase of the inverter power output, as defined by the characteristic curve depicted in Figure 5, shall be less than 10%.		P
6.4	Multiple mode inverter operation	No multiple mode.	N/A
6.4.1	General	See below.	N/A
	When the multiple mode inverter is disconnected from the grid any stand-alone port shall ensure that all active conductors are also isolated from the grid-interactive port.		N/A
	Multiple mode inverters shall be arranged to ensure that the continuity of the neutral conductor to the load from the electrical installation is not interrupted when the inverter disconnects from the grid and supplies a load via the stand-alone port.		N/A
	When the multiple mode inverter is providing the stand-alone function and is disconnected from the grid, the stand-alone port shall comply with the requirements for d.c. current injection (refer to Clause 5.9) into the connected load circuits. The type of RCD compatible with and for use on the stand-alone function outputs shall be declared.		N/A
6.4.2	Sinusoidal output in stand-alone mode	The EUT is a Grid-tied inverter.	N/A
	The a.c. output voltage waveform of a stand-alone port of a multiple mode inverter operating in stand-alone mode, shall comply with the requirements of this Clause (6.4.2). The a.c. output voltage waveform of a stand-alone mode shall have a voltage total harmonic distortion (THD) not exceeding of 5% and no individual harmonic at a level exceeding 5%.		N/A

6.4.3	Volt–watt response mode for charging of energy storage	No energy storage system in the EUT.	N/A
	A multiple mode inverter with energy storage which can be charged from the grid shall have this volt–watt response mode.		N/A
	This volt–watt response mode is only active when power from the grid is required to charge the energy storage.		N/A
	The response curve required for the volt–watt response is defined by the volt response reference values in Table 9 and corresponding power consumption from the grid through the grid-interactive port for charging energy storage. The default values are listed in Table 12 and shown in Figure 6.		N/A
6.5	Security of operational settings		P
	The internal settings of the demand response or power quality response modes of theinverter shall be secured against inadvertent or unauthorized tampering.	Considered.	P
	Changes to the internal settings shall require the use of a tool and special instructions not provided to unauthorized personnel.	Provide in installation manual.	P

7	**PROTECTIVE FUNCTIONS FOR CONNECTION TO ELECTRICAL INSTALLATIONS AND THE GRID**		**P**
7.1	General	See below.	P
	The automatic disconnection device shall operate -	The automatic disconnection device is integral part of the inverter.	P
	(a) if supply from the grid is disrupted;	Connsidered.	P
	(b) when the grid goes outside preset parameters (e.g. undervoltage/overvoltage, under-frequency/over-frequency); or	Connsidered.	P
	(c) when the demand response mode DRM 0 (see Clause 6.2) is asserted.	Connsidered.	P
	For inverter energy systems connected to multiple phases the automatic disconnection device shall operate if any of the above conditions is met on any phase.	Connsidered.	P
7.2	Automatic disconnection device		P
	The automatic disconnection device shall provide isolation in all live conductors	The unit is switched off redundant by the high power bridge of the inverter and the relays in line and	P

		neutral.	
	The automatic disconnection device shall be capable of interrupting at least the ratedcurrent.	Considered.	P
	The settings of the automatic disconnection device shall not exceed the capability of the inverter.	Considered.	P
	A semiconductor (solid-state) device shall not be used for isolation purposes.	Considered.	P
7.3	Active anti-islanding protection	See below.	P
	The automatic disconnection device shall incorporate at least one method of active anti-islanding protection.	Considered.	P
	The method used to provide active anti-islanding protection shall be declared.	Rate of change of frequency (RoCof) detection method used.	P
	To prevent islanding, the active anti-islanding protection system shall operate the automatic disconnection device (see Clause 7.2) within 2 s of disruption to the power supply from the grid.	See appendix table . 7.3.	P
	Compliance shall be determined by type testing in accordance with the active anti-islanding tests specified in Appendix F or IEC 62116.	Considered.	P
7.4	Voltage and frequency limits (passive anti-islanding protection)	See below.	P
	The automatic disconnection device shall incorporate the following forms of passive anti-islanding protection:	Considered.	P
	(a) Undervoltage and overvoltage protection.	See appendix table7.4	P
	(b) Under-frequency and over-frequency protection.	See appendix table7.4	P
7.5	Limits for sustained operation		P
7.5.1	General	See below.	P
	The inverter or inverter energy system shall remain connected over the range of voltages and frequencies that it is required to be compatible with. Refer to Clause 5.4.	Considered.	P
7.5.2	Sustained operation for voltage variations		P
	The inverter shall operate the automatic disconnection device (see Clause 7.2) within 3 s when the average voltage for a 10 min period exceeds the Vnom_max, where Vnom-max lies in the range 244–258 V.	See appendix table7.5.2	P

	The default set-point for Vnom-max shall be as follows: (a) In Australia: 255 V. (b) In New Zealand: 248 V.	See appendix table7.5.2	P
7.5.3	Sustained operation for frequency variations		P
7.5.3.1	Response to an increase in frequency		P
	The inverter shall be capable of supplying rated power between 47 Hz and 50.25 Hz for Australia.	Considered.	P
	The inverter shall be capable of supplying rated power between 45 Hz and 50.25 Hz for New Zealand.		N/A
	The power level present at the time the frequency reaches or exceeds 50.25 Hz shall be held as the reference power level used to calculate the required response to the increasing frequency.	Considered.	P
	This is expressed in the equation below: $P_{out} = P_{ref}\left[1-\frac{(f-50.25)}{(f_{stop}-50.25)}\right]$ where P_{out} = required output for a frequency between 50.25 Hz and f_{stop} P_{ref} = reference power level when the frequency reaches or exceeds 50.25 Hz f = frequency between 50.25 Hz and f_{stop} When the frequency exceeds f_{stop} the inverter power output shall be ceased (i.e. 0 W). The default set-point for f_{stop} shall be 52 Hz.	See appendix table 7.5.3.1	P
	Unconstrained power operation may recommence 6 min after the frequency returns to and remains at less than 50.15 Hz.	See appendix table 7.5.3.1	P
7.5.3.2	Response to a decrease in grid frequency	The EUT without energy storage.	N/A
	This requirement applies only to inverters with energy storage.		N/A
	The inverter shall be capable of charging the energy storage between 49.75 Hz and 52.0 Hz.		N/A
	The power input level for charging present at the time the frequency reaches or falls below 49.75 Hz shall be held as the reference charge rate used to calculate the required response to the decreasing		N/A

	frequency.		
	This is expressed in the equation below: $P_{charge} = P_{ref}\left[1-\frac{(49.75-f)}{(49.75-f_{stop-CH})}\right]$ where P_{charge} = charge rate of the storage element for a frequency between 49.75 Hz and $f_{stop-CH}$ P_{ref-CH} = charge rate of the storage element when the frequency reaches or falls below 49.75 Hz f = frequency between 49.75 Hz and $f_{stop-CH}$ When the frequency falls below $f_{stop-CH}$, the inverter should have ceased charging the storage element (i.e. 0 W). The default set-point for fstop-CH should be 49 Hz.		N/A
	Unconstrained charging of the storage element may recommence 6 min after the frequency returns to and remains above than 49.85 Hz.		N/A
7.6	Disconnection on external signal	See below	P
	The automatic disconnection device shall incorporate the ability to disconnect on an external signal.	The automatic disconnection device is integral part of the inverter.	P
	If an external signal or demand response 'DRM 0' condition is asserted, the automatic disconnection device shall operate within 2 s.	Considered.	P
7.7	Connection and reconnection procedure	See below	P
	Only after all of the following conditions have been met shall the automatic disconnection device operate to connect or reconnect the inverter to the grid -	The unit provides monitoring of the voltage, frequency and synchronisation. If one of these conditions is not met, then the unit is not switching on.	P
	(a) the voltage of the grid has been maintained within the limits of AS 60038 (for Australia) or IEC 60038 (for New Zealand) for at least 60 s;	Considered.	P
	(b) the frequency of the grid has been maintained within the range 47.5 Hz to 50.15 Hz for at least 60 s;	Considered.	P
	(c) the inverter and the grid are synchronized and in-phase with each other; and	Considered.	P
	(d) no external signal is present or DRM 0 asserted requiring the system to be disconnected.	Considered.	P

7.8	Security of protection settings		P
	The internal settings of the automatic disconnection device shall be secured against inadvertent or unauthorized tampering. Changes to the internal settings shall require the use of a tool and special instructions not provided to unauthorized personnel.	Changes to the internal settings shall require the use of a tool and special instructions provided to authorized personnel.	P

8	**MULTIPLE INVERTER COMBINATIONS**		**N/A**
8.1	General	See below.	N/A
	If a combination is not tested, it should not be used or external devices should be used in accordance with the requirements of AS/NZS 4777.1.	This is a three-phase grid inverter, and it's not used for parallel installations.	N/A
	Possible combinations are single-phase inverters used in parallel, single-phase inverters used in multiple phase installations and three-phase inverters used in parallel.	This is a three-phase grid inverter, and it's not used for parallel installations.	N/A
8.2	Inverter current balance across multiple phases	This is a three-phase grid inverter, and it's not used for parallel installations.	N/A
	The maximum current imbalance in a three-phase inverter system comprised of individual single-phase inverters shall be no more than 21.7 A.	This is a three-phase grid inverter, and it's not used for parallel installations.	N/A
8.3	Grid disconnection		N/A
	When any inverter within the inverter energy system disconnects as required by Clause 7, all inverters within the inverter energy system shall disconnect within 2 s of the first inverter disconnecting.	No energy system in the EUT.	N/A
	This applies to all inverters used in combination for single-phase or multiple phases.	This is a three-phase grid inverter.	N/A
8.4	Grid connection and reconnection	No such installation.	N/A
	When multiple inverters are used together in a multiple phase combination, only after all the conditions of Clause 7.7 have been met on all connected phases shall the automatic disconnection device operate to connect or reconnect any inverter of the multiple phase combination to the grid.		N/A
	Where any inverter used in a multiple phase combination has a rated current exceeding 21.7 A per phase, the requirement of Clause 8.2 shall be met when connecting or reconnecting.		N/A

8.5	Testing combinations		N/A
8.5.1	Single-phase combinations	This is a three-phase grid inverter.	N/A
	Single-phase parallel combinations of inverters shall be tested for combinations with total rated current (I_{rated}) equal to or up to the maximum of 6 A per phase.	This is a three-phase grid inverter.	N/A
	To determine the number of inverters to be tested, the following equation shall be used: $N = \frac{6}{I_{rated}}$ where N = number to be tested, rounded up to next whole number I_{rated} = rating of the inverter in amperes If N ≥ 2, the minimum number of inverters to be tested shall be N. If N > 6, the maximum number of inverters to be tested in a combination shall be 6.	This is a three-phase grid inverter.	N/A
8.5.2	Single-phase inverters used in three-phase combinations	This is a three-phase grid inverter.	N/A
	For single-phase inverters with rated current (I_{rated}) greater than or equal to 5 A used in three-phase combinations, three inverters shall be tested in a three-phase arrangement [refer to Figure 8(a)].	This is a three-phase grid inverter.	N/A
	Single-phase inverters with rated current less than 5 A and to be used in three-phase combinations shall be tested in combination with at least two inverters per phase [refer to Figure 8(b).	This is a three-phase grid inverter.	N/A
8.5.3	Required tests for multiple inverter combinations	This is a three-phase grid inverter.	N/A
	Any single-phase inverter used in a multiple inverter combination shall be tested individually and meet all the requirements of this Standard. Any single-phase inverter which is to be used as part of a multiple inverter combination shall be tested in combination as specified in Clauses 8.5.1 and 8.5.2.	This is a three-phase grid inverter.	N/A
8.5.4	Multiple inverters with one automatic disconnection device	This is a three-phase grid inverter, and it's not used for parallel installations.	N/A
	Where the inverter does not have an internal automatic disconnection device, or requires an external automatic disconnection device to provide the required disconnection function, or both,	This is a three-phase grid inverter, and it's not used for parallel installations.	N/A

	testing shall be conducted with the automatic disconnection device and with either the number of inverters required by Clause 8.5.1 and 8.5.2 or with the automatic disconnection device configured with the number of inverters specified by the manufacturer's instructions.		

9	**INVERTER MARKING AND DOCUMENTATION**		**P**
9.1	General		P
	All markings and documentation shall be in the English language.	Considered.	P
9.2	Marking		P
9.2.1	General		P
9.2.2	Equipment ratings		P
	Photovoltaic		-
	Vmax PV (absolute maximum)	1100 d.c. V	P
	Isc PV (absolute maximum)	SOFAR 20000TL-G2: 30/30 d.c. A SOFAR 25000TL-G2: 35/35 d.c. A SOFAR 30000TL-G2, SOFAR 33000TL-G2: 37,5/37,5 d.c. A	P
	Wind (a.c. or d.c.)		-
	Voltage (nominal or range)		N/A
	Rated current (maximum continuous)		N/A
	Frequency (nominal or range) (a.c. wind only)		N/A
	Energy storage ports		-
	Voltage (nominal)		N/A
	Voltage (range)		N/A
	Rated current (maximum continuous)		N/A
	Storage type		N/A
	Other energy sources or inputs (a.c. or d.c.)		-
	Voltage (nominal or range)		N/A
	Rated current (maximum continuous)		N/A
	Power factor (range)		N/A
	Frequency (nominal or range) (a.c. sources only)		N/A
	a.c. output ratings (for each port)		P
	Voltage (nominal or range)	400a.c. V	P
	Rated current	SOFAR 20000TL-G2: 3×32 a.c. A	P

		SOFAR 25000TL-G2: 3×40 a.c. A SOFAR 30000TL-G2: 3×48 a.c. A SOFAR 33000TL-G2: 3×53 a.c. A	
	Frequency (nominal or range)	50Hz	P
	Rated apparent power	SOFAR 20000TL-G2: 20000W SOFAR 25000TL-G2: 25000W SOFAR 30000TL-G2: 30000W SOFAR 33000TL-G2: 33000W	P
	Power factor range	Adjustable (0,8lead-0,8 lag)	P
	d.c. output ratings		-
	Voltage (nominal or range)		N/A
	Rated current		N/A
	Inverter topology	Non-isolated.	P
	Protective class (I, II or III)	Class I	P
	Ingress protection (IP) rating	IP65	P
9.2.3	Ports		P
	Each port shall be marked with its classification and indicate whether a.c or d.c. voltage asappropriate.	The classification marking were provided adjacent to the terminals of each port.	P
9.2.4	External and ancillary equipment	Ref to installation manual.	P
9.2.5	Residual current devices (RCDs)		N/A
	Where an external RCD is required, the inverter shall be marked with a warning along with the rating and type of RCD required. The warning shall be located in a prominent position and written in lettering at least 5 mm high. It shall contain the following or an equivalent statement: **WARNING: AN RCD IS REQUIRED ON THE [*NAME*] PORTS OF THE INVERTER**	The Residual current devices (RCDs) are integral part of inverter. An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	N/A
	If the inverter energy system requires a Type B RCD, the inverter shall be marked with a warning. The warning shall be located in a prominent position and written in lettering at least 5 mm high. It shall contain the following: **WARNING: A TYPE B RCD IS REQUIRED ON THE [*NAME*] PORTS OF THE INVERTER**	The Residual current devices (RCDs) are integral part of inverter. An applicable test report according to IEC 62109-1, IEC 62109-2 must be provided by the manufacturer.	N/A
9.2.6	Demand response modes		P
	The demand response modes supported by the inverter should be permanently marked on the name plate or on a durable sticker located on or near the demand	The demand response modes supported by the inverter has permanently marked on the name plate closed the communication	P

	response interface port to indicate the demand response modes of which the unit is capable.	terminals for DRED.	
9.3	Documentation		P
9.3.1	General		P
9.3.2	Equipment ratings		P
	Photovoltaic		P
	Vmax PV (absolute maximum)	1100 d.c. V	P
	PV input operating voltage range	250-1100 d.c. V	P
	Maximum operating PV input current	SOFAR 20000TL-G2: 24/24 d.c. A SOFAR 25000TL-G2: 28/28 d.c. A SOFAR 30000TL-G2: 30/30 d.c. A SOFAR 33000TL-G2: 30/30 d.c. A	P
	Isc PV (absolute maximum)	SOFAR 20000TL-G2: 30/30 d.c. A SOFAR 25000TL-G2: 35/35 d.c. A SOFAR 30000TL-G2, SOFAR 33000TL-G2: 37,5/37,5 d.c. A	P
	Maximum inverter backfeed current to array	<6mA	P
	Wind (a.c. or d.c.)		-
	Voltage (nominal or range)		N/A
	Rated current (maximum continuous)		N/A
	Current (inrush)		N/A
	Frequency (nominal or range) (a.c. wind only)		N/A
	Energy storage ports		-
	Voltage (nominal or range)		N/A
	Nominal battery voltage		N/A
	Rated current (maximum continuous) input and output		N/A
	Storage type		N/A
	Other energy sources or inputs (a.c. or d.c.)		-
	Voltage (nominal or range)		N/A
	Rated current (maximum continuous)		N/A
	Power factor (range)		N/A
	Frequency (nominal or range) (a.c. sources only)		N/A
	a.c. output ratings (for each port)	See below	P
	Voltage (nominal or range)	400a.c. V	P
	Rated current	SOFAR 20000TL-G2: 3×32 a.c. A SOFAR 25000TL-G2: 3×40 a.c. A	P

		SOFAR 30000TL-G2: 3×48 a.c. A SOFAR 33000TL-G2: 3×53 a.c. A	
	Current (inrush)	See manual.	P
	Frequency (nominal or range)	50Hz	P
	Rated apparent power	SOFAR 20000TL-G2: 20000W SOFAR 25000TL-G2: 25000W SOFAR 30000TL-G2: 30000W SOFAR 33000TL-G2: 33000W	P
	Power factor range	Adjustable (0.8lead-0.8 lag)	P
	Maximum output fault current	SOFAR 20000TL-G2, SOFAR 25000TL-G2: 85A SOFAR 30000TL-G2, SOFAR 33000TL-G2: 105A	P
	Maximum output overcurrent protection	SOFAR 20000TL-G2, SOFAR 25000TL-G2: 93A SOFAR 30000TL-G2, SOFAR 33000TL-G2: 119A	P
	d.c. output ratings		-
	Voltage (nominal or range)		N/A
	Rated current		N/A
	Inverter topology	Non-isolated.	P
	Active anti-islanding method		P
	Protective class (I, II or III)	Class I	P
	Over voltage category	DC side: OVC II; AC side: OVC III	P
	Ingress protection (IP) rating	IP65	P
	Temperature operating range	-25° C ~ +60° C(above 45° C derating)	P
9.3.3	Ports		P
9.3.4	External and ancillary equipment	Provided in installation manual.	P
9.3.5	RCDs		P
9.3.6	Multiple mode inverters	No such mode.	N/A
9.3.7	Multiple inverter combinations	No such combinations.	N/A

APPENDIX A	**GENERAL TEST AND REPORTING REQUIREMENTS (Normative)**	**P**

APPENDIX B	**POWER FACTOR TEST (Normative)**	**P**

APPENDIX C	**HARMONIC CURRENT LIMIT TEST (Normative)**	**P**

APPENDIX D	**TRANSIENT VOLTAGE LIMIT TEST (Normative)**	**P**

APPENDIX E	**D.C. INJECTION TEST (Normative)**	**P**

APPENDIX F	**ACTIVE ANTI-ISLANDING TEST (Normative)**	**P**

APPENDIX G	**VOLTAGE AND FREQUENCY LIMITS (PASSIVE ANTI-ISLANDING PROTECTION) TESTS (Normative)**	**P**

APPENDIX H	**LIMITS FOR SUSTAINED OPERATION (Normative)**	**P**

APPENDIX I	**DEMAND AND POWER QUALITY RESPONSE MODE TESTING INCLUDING DISCONNECTION ON EXTERNAL SIGNAL (Normative)**	**P**

APPENDIX J	**MULTIPLE INVERTER TESTING (Normative)**	**N/A**

APPENDIX K	**RELATED DOCUMENTS (Informative)**	**P**

Test Results

5.5 Power factor **Appendix B Power factor test**						**P**
SOFAR 33000TL-G2						
Mode	Meausrement	Rated Output Current				
		15+/-5%	25+/-5%	50+/-5%	75+/-5%	100+/-5%
Unity	Vrms (V)	229,85	229,81	229,71	229,57	229,53
	Arms (A)	9,588	14,431	23,957	33,627	47,873
	Apparent Power (kVA)	6,610	9,948	16,508	23,157	32,964
	Power (kW)	6,609	9,947	16,507	23,157	32,963
	Recative power (kVar)	-0,112	-0,103	-0,124	-0,163	-0,195
	PF cos (phi)	0,9999	0,9999	0,9999	0,9999	0,9999
Lag limit	Vrms (V)	230,04	230,03	229,93	229,94	230,08
	Arms (A)	12,003	18,024	30,035	41,843	53,195
	Apparent Power (kVA)	8,282	12,404	20,700	28,837	36,700
	Power (kW)	6,605	9,940	16,583	23,096	29,377
	Recative power (kVar)	4,996	7,474	12,400	17,300	21,999
	PF cos (phi)	0,7976	0,7993	0,8006	0,8007	0,8008
Lead limit	Vrms (V)	230,03	230,06	230,05	230,12	230,11
	Arms (A)	11,984	17,935	29,828	41,703	53,121
	Apparent Power (kVA)	8,270	12,378	20,586	28,789	36,670
	Power (kW)	6,592	9,039	16,495	23,034	29,444
	Recative power (kVar)	-4,993	-6,819	-12,314	-17,268	-21,851
	PF cos (phi)	0,7971	0,7982	0,8013	0,8001	0,8029
Modes	Vrms (V)	N/A	N/A	N/A	N/A	N/A
	Arms (A)	N/A	N/A	N/A	N/A	N/A
	Apparent Power (kVA)	N/A	N/A	N/A	N/A	N/A
	Power (kW)	N/A	N/A	N/A	N/A	N/A
	Recative power (kVar)	N/A	N/A	N/A	N/A	N/A
	PF cos (phi)	N/A	N/A	N/A	N/A	N/A

Note:

Inverter shall be connected to test circuit Figure B1 (AS/NZS 4777.2),

The required accuracy for the measurement and reporting of results is ±0.01 PF. The vars at the 15% test point are required to be the same or less than the vars at the 25% test point when operating at unity power factor.

c: capacitive / leading

i: inductive / lagging

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

5.6 Harmonic currents Appendix C Harmonic Current Limit Test	P

SOFAR 33000TL-G2

L1 phase

Generating Unit rating per phase (rpp)				
	At 50% of rated ouput current		**100% of rated output currentA**	
	Watts	5,496	Watts	11033
	VA	5,499	VA	11033
	Vrms	230,08	Vrms	230,15
	Arms	23,913	Arms	47,940
	PF	0,9995	PF	0,9999
	Frequency	50,00	Frequency	50,00

Harmonic	Value A	Angle degrees	% of fundamental	Value A	Angle degrees	% of fundamental	Limit in % of fundamental
0	N/A	N/A	N/A	N/A	N/A	N/A	--
1st	23,8947	N/A	--	47,9397	N/A	--	--
2nd	0,2888	N/A	0,6040	0,1027	N/A	0,2142	1%
3rd	0,2676	N/A	0,5596	0,0207	N/A	0,0432	4%
4th	0,2280	N/A	0,4768	0,0695	N/A	0,1450	1%
5th	0,2280	N/A	0,4767	0,0433	N/A	0,0903	4%
6th	0,1754	N/A	0,3668	0,0247	N/A	0,0515	1%
7th	0,1649	N/A	0,3448	0,1212	N/A	0,2528	4%
8th	0,1235	N/A	0,2582	0,0403	N/A	0,0842	1%
9th	0,0989	N/A	0,2067	0,0755	N/A	0,1575	2%
10th	0,0969	N/A	0,2027	0,0288	N/A	0,0601	0,5%
11th	0,0587	N/A	0,1228	0,0472	N/A	0,0984	2%
12th	0,0713	N/A	0,1490	0,0162	N/A	0,0337	0,5%
13th	0,0567	N/A	0,1187	0,0603	N/A	0,1258	2%
14th	0,0562	N/A	0,1175	0,0186	N/A	0,0389	0,5%
15th	0,0478	N/A	0,1000	0,0177	N/A	0,0368	1%
16th	0,0480	N/A	0,1003	0,0134	N/A	0,0280	0,5%
17th	0,0502	N/A	0,1050	0,0198	N/A	0,0413	1%
18th	0,0470	N/A	0,0983	0,0141	N/A	0,0293	0,5%
19th	0,0530	N/A	0,1108	0,0384	N/A	0,0800	1%
20th	0,0493	N/A	0,1031	0,0081	N/A	0,0170	0,5%
21th	0,0500	N/A	0,1046	0,0206	N/A	0,0430	0,6%
22th	0,0482	N/A	0,1008	0,0066	N/A	0,0138	0,5%
23th	0,0477	N/A	0,0998	0,0254	N/A	0,0530	0,6%
24th	0,0462	N/A	0,0967	0,0024	N/A	0,0051	0,5%
25th	0,0490	N/A	0,1025	0,0216	N/A	0,0451	0,6%
26th	0,0497	N/A	0,1038	0,0031	N/A	0,0065	0,5%
27th	0,0493	N/A	0,1030	0,0092	N/A	0,0191	0,6%
28th	0,0481	N/A	0,1006	0,0026	N/A	0,0055	0,5%
29th	0,0463	N/A	0,0969	0,0116	N/A	0,0241	0,6%
30th	0,0469	N/A	0,0980	0,0030	N/A	0,0062	0,5%
31th	0,0499	N/A	0,1043	0,0177	N/A	0,0368	0,6%
32th	0,0513	N/A	0,1072	0,0023	N/A	0,0049	0,5%
33th	0,0506	N/A	0,1058	0,0053	N/A	0,0111	0,6%
34th	0,0473	N/A	0,0989	0,0024	N/A	0,0049	--
35th	0,0475	N/A	0,0993	0,0130	N/A	0,0272	--
36th	0,0482	N/A	0,1008	0,0020	N/A	0,0042	--
37th	0,0496	N/A	0,1037	0,0138	N/A	0,0287	--
38th	0,0534	N/A	0,1116	0,0019	N/A	0,0040	--

39th	0,0502	N/A	0,1051	0,0036	N/A	0,0076	--
40th	0,0477	N/A	0,0997	0,0020	N/A	0,0041	--
THD (to 50th)	N/A	N/A	1,269	N/A	N/A	0,479	5%

L2 phase

Generating Unit rating per phase (rpp)				
	At 50% of rated ouput current		**100% of rated output currentA**	
	Watts	5,536	Watts	11003
	VA	5,540	VA	11003
	Vrms	230,08	Vrms	230,13
	Arms	24,084	Arms	47,814
	PF	0,9993	PF	0,9999
	Frequency	50,00	Frequency	50,00

Harmonic	Value A	Angle degrees	% of fundamental	Value A	Angle degrees	% of fundamental	Limit in % of fundamental
0	N/A	N/A	N/A	N/A	N/A	N/A	--
1st	24,0331	N/A	--	47,8130	N/A	--	--
2nd	0,0912	N/A	0,1906	0,0733	N/A	0,1532	1%
3rd	0,0799	N/A	0,1671	0,0364	N/A	0,0761	4%
4th	0,0617	N/A	0,1290	0,0415	N/A	0,0867	1%
5th	0,0629	N/A	0,1316	0,0333	N/A	0,0696	4%
6th	0,0550	N/A	0,1149	0,0114	N/A	0,0238	1%
7th	0,0644	N/A	0,1346	0,1386	N/A	0,2898	4%
8th	0,0515	N/A	0,1077	0,0189	N/A	0,0395	1%
9th	0,0530	N/A	0,1108	0,0605	N/A	0,1266	2%
10th	0,0511	N/A	0,1068	0,0157	N/A	0,0329	0,5%
11th	0,0535	N/A	0,1119	0,0893	N/A	0,1867	2%
12th	0,0473	N/A	0,0990	0,0093	N/A	0,0195	0,5%
13th	0,0486	N/A	0,1017	0,0304	N/A	0,0635	2%
14th	0,0493	N/A	0,1031	0,0169	N/A	0,0354	0,5%
15th	0,0472	N/A	0,0988	0,0285	N/A	0,0595	1%
16th	0,0469	N/A	0,0980	0,0135	N/A	0,0282	0,5%
17th	0,0489	N/A	0,1023	0,0254	N/A	0,0531	1%
18th	0,0451	N/A	0,0944	0,0124	N/A	0,0260	0,5%
19th	0,0459	N/A	0,0960	0,0314	N/A	0,0657	1%
20th	0,0478	N/A	0,1000	0,0061	N/A	0,0127	0,5%
21th	0,0488	N/A	0,1020	0,0083	N/A	0,0174	0,6%
22th	0,0476	N/A	0,0996	0,0042	N/A	0,0089	0,5%
23th	0,0480	N/A	0,1004	0,0404	N/A	0,0844	0,6%
24th	0,0476	N/A	0,0996	0,0040	N/A	0,0084	0,5%
25th	0,0484	N/A	0,1012	0,0178	N/A	0,0372	0,6%
26th	0,0497	N/A	0,1039	0,0028	N/A	0,0058	0,5%
27th	0,0495	N/A	0,1035	0,0039	N/A	0,0083	0,6%
28th	0,0471	N/A	0,0984	0,0032	N/A	0,0066	0,5%
29th	0,0474	N/A	0,0992	0,0169	N/A	0,0354	0,6%
30th	0,0484	N/A	0,1012	0,0036	N/A	0,0075	0,5%
31th	0,0502	N/A	0,1049	0,0136	N/A	0,0284	0,6%
32th	0,0521	N/A	0,1089	0,0027	N/A	0,0057	0,5%
33th	0,0519	N/A	0,1085	0,0028	N/A	0,0059	0,6%
34th	0,0492	N/A	0,1028	0,0025	N/A	0,0052	--
35th	0,0476	N/A	0,0996	0,0194	N/A	0,0405	--
36th	0,0492	N/A	0,1029	0,0030	N/A	0,0063	--
37th	0,0509	N/A	0,1065	0,0091	N/A	0,0191	--
38th	0,0529	N/A	0,1107	0,0026	N/A	0,0054	--
39th	0,0508	N/A	0,1062	0,0041	N/A	0,0086	--
40th	0,0477	N/A	0,0998	0,0024	N/A	0,0050	--

THD (to 50th)	N/A	N/A	0,739	N/A	N/A	0,460	5%
L3 phase							
Generating Unit rating per phase (rpp)							
	At 50% of rated ouput current			**100% of rated output currentA**			
	Watts	5,537		Watts	10983		
	VA	5,539		VA	11003		
	Vrms	230,06		Vrms	230,11		
	Arms	24,089		Arms	47,731		
	PF	0,9996		PF	0,9999		
	Frequency	50,00		Frequency	50,00		
Harmonic	Value A	Angle degrees	% of fundamental	Value A	Angle degrees	% of fundamental	Limit in % of fundamental
0	N/A	N/A	N/A	N/A	N/A	N/A	0,5%
1st	24,0446	N/A	--	47,7302	N/A	--	100%
2nd	0,2414	N/A	0,5048	0,0672	N/A	0,1408	1%
3rd	0,2269	N/A	0,4745	0,0468	N/A	0,0980	4%
4th	0,2004	N/A	0,4189	0,0465	N/A	0,0975	1%
5th	0,2051	N/A	0,4289	0,0326	N/A	0,0682	4%
6th	0,1611	N/A	0,3368	0,0151	N/A	0,0315	1%
7th	0,1533	N/A	0,3204	0,0733	N/A	0,1536	4%
8th	0,1154	N/A	0,2412	0,0304	N/A	0,0637	1%
9th	0,0906	N/A	0,1893	0,0186	N/A	0,0389	2%
10th	0,0816	N/A	0,1707	0,0285	N/A	0,0597	0,5%
11th	0,0716	N/A	0,1497	0,1011	N/A	0,2118	2%
12th	0,0631	N/A	0,1318	0,0093	N/A	0,0194	0,5%
13th	0,0514	N/A	0,1075	0,0489	N/A	0,1025	2%
14th	0,0514	N/A	0,1074	0,0048	N/A	0,0100	0,5%
15th	0,0466	N/A	0,0975	0,0191	N/A	0,0399	1%
16th	0,0457	N/A	0,0955	0,0040	N/A	0,0084	0,5%
17th	0,0491	N/A	0,1026	0,0398	N/A	0,0833	1%
18th	0,0449	N/A	0,0940	0,0032	N/A	0,0068	0,5%
19th	0,0492	N/A	0,1030	0,0483	N/A	0,1012	1%
20th	0,0488	N/A	0,1021	0,0047	N/A	0,0098	0,5%
21th	0,0483	N/A	0,1010	0,0124	N/A	0,0260	0,6%
22th	0,0474	N/A	0,0991	0,0068	N/A	0,0143	0,5%
23th	0,0438	N/A	0,0917	0,0346	N/A	0,0726	0,6%
24th	0,0451	N/A	0,0942	0,0041	N/A	0,0086	0,5%
25th	0,0464	N/A	0,0970	0,0251	N/A	0,0526	0,6%
26th	0,0463	N/A	0,0968	0,0036	N/A	0,0075	0,5%
27th	0,0474	N/A	0,0992	0,0124	N/A	0,0260	0,6%
28th	0,0456	N/A	0,0953	0,0021	N/A	0,0044	0,5%
29th	0,0444	N/A	0,0929	0,0191	N/A	0,0401	0,6%
30th	0,0454	N/A	0,0950	0,0027	N/A	0,0057	0,5%
31th	0,0467	N/A	0,0977	0,0211	N/A	0,0442	0,6%
32th	0,0479	N/A	0,1001	0,0021	N/A	0,0043	0,5%
33th	0,0487	N/A	0,1018	0,0064	N/A	0,0133	0,6%
34th	0,0458	N/A	0,0958	0,0018	N/A	0,0038	--
35th	0,0456	N/A	0,0954	0,0181	N/A	0,0379	--
36th	0,0453	N/A	0,0947	0,0021	N/A	0,0043	--
37th	0,0469	N/A	0,0981	0,0147	N/A	0,0308	--
38th	0,0489	N/A	0,1022	0,0019	N/A	0,0039	--
39th	0,0479	N/A	0,1001	0,0074	N/A	0,0155	--
40th	0,0447	N/A	0,0935	0,0019	N/A	0,0039	
THD (to 50th)	N/A	N/A	1,151	N/A	N/A	0,410	5%

Note:
Inverter shall be connected to test circuit Figure C1 (AS4777.2), Grid nominal voltage within +/-5%, AC-Frequency 50+/-1Hz and Phase angle between 3 phases shall be 120+/-1.5°. Via DC-input set AC-output power (VA) so that it equals to 100+/-5% of rated output. Harmonic ratios of the test voltage shall be measured. Limits based on percentage of fundamental! Total harmonic distortion to the 50th harmonic 5%.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

5.6 Harmonic currents **Appendix C3 Harmonic Voltage Limit Test**					**P**
Generating Unit rating per phase (rpp)					
	At 50% of rated ouput current A		100% of rated output current A		
Harmonic	Value V	% of fundamental	Value V	% of fundamental	Limit in % of fundamental
L1 phase					
2nd	0,0183	0,0080	0,0291	0,0126	0,2%
3rd	0,2308	0,1003	0,5081	0,2205	4%
4th	0,0193	0,0084	0,0643	0,0279	0,2%
5th	0,0755	0,0328	0,2490	0,1081	4%
6th	0,0245	0,0107	0,0225	0,0098	0,2%
7th	0,1576	0,0685	0,0642	0,0279	4%
8th	0,0192	0,0083	0,0936	0,0406	0,2%
9th	0,0205	0,0089	0,0322	0,0140	2%
10th	0,0125	0,0054	0,0373	0,0162	0,2%
11th	0,0575	0,0250	0,1284	0,0557	0,1%
12th	0,0124	0,0054	0,0357	0,0155	0,1%
13th	0,0905	0,0393	0,1118	0,0485	0,1%
14th	0,0104	0,0045	0,0188	0,0081	0,1%
15th	0,0281	0,0122	0,0254	0,0110	0,1%
16th	0,0111	0,0048	0,0100	0,0044	0,1%
17th	0,0558	0,0243	0,0746	0,0324	0,1%
18th	0,0121	0,0053	0,0125	0,0054	0,1%
19th	0,0625	0,0272	0,0575	0,0250	0,1%
20th	0,0107	0,0047	0,0122	0,0053	0,1%
21th	0,0291	0,0126	0,0155	0,0067	0,1%
22th	0,0141	0,0061	0,0135	0,0058	0,1%
23th	0,0304	0,0132	0,0307	0,0133	0,1%
24th	0,0092	0,0040	0,0046	0,0020	0,1%
25th	0,0434	0,0189	0,0448	0,0195	0,1%
26th	0,0123	0,0054	0,0151	0,0066	0,1%
27th	0,0114	0,0050	0,0231	0,0100	0,1%
28th	0,0125	0,0054	0,0104	0,0045	0,1%
29th	0,0206	0,0090	0,0460	0,0200	0,1%
30th	0,0127	0,0055	0,0089	0,0038	0,1%
31th	0,0260	0,0113	0,0425	0,0185	0,1%
32th	0,0104	0,0045	0,0038	0,0017	0,1%
33th	0,0178	0,0077	0,0270	0,0117	0,1%
34th	0,0159	0,0069	0,0091	0,0039	0,1%
35th	0,0150	0,0065	0,0509	0,0221	0,1%
36th	0,0128	0,0055	0,0044	0,0019	0,1%
37th	0,0292	0,0127	0,0265	0,0115	0,1%
38th	0,0084	0,0036	0,0073	0,0032	0,1%
39th	0,0089	0,0039	0,0201	0,0087	0,1%
40th	0,0091	0,0040	0,0169	0,0073	0,1%
41th	0,0215	0,0094	0,0412	0,0179	0,1%
42th	0,0087	0,0038	0,0177	0,0077	0,1%
43th	0,0270	0,0117	0,0331	0,0144	0,1%
44th	0,0085	0,0037	0,0067	0,0029	0,1%
45th	0,0098	0,0043	0,0160	0,0070	0,1%
46th	0,0487	0,0212	0,0182	0,0079	0,1%

47th	0,0207	0,0090	0,0507	0,0220	0,1%
48th	0,0472	0,0205	0,0135	0,0058	0,1%
49th	0,0353	0,0154	0,0383	0,0166	0,1%
50th	0,0088	0,0038	0,0111	0,0048	0,1%
THD	N/A	0,152	N/A	0,9893	5%
L2 phase					
2nd	0,0162	0,0070	0,0491	0,0213	0,2%
3rd	0,2215	0,0963	0,5739	0,2490	4%
4th	0,0166	0,0072	0,0424	0,0184	0,2%
5th	0,0576	0,0251	0,2739	0,1188	4%
6th	0,0156	0,0068	0,0244	0,0106	0,2%
7th	0,1417	0,0616	0,0707	0,0307	4%
8th	0,0128	0,0056	0,0399	0,0173	0,2%
9th	0,0413	0,0180	0,0234	0,0102	2%
10th	0,0160	0,0070	0,0160	0,0070	0,2%
11th	0,0897	0,0390	0,1451	0,0629	0,1%
12th	0,0116	0,0050	0,0321	0,0139	0,1%
13th	0,0557	0,0242	0,1253	0,0544	0,1%
14th	0,0144	0,0062	0,0317	0,0138	0,1%
15th	0,0357	0,0155	0,0775	0,0336	0,1%
16th	0,0142	0,0062	0,0201	0,0087	0,1%
17th	0,0458	0,0199	0,0939	0,0407	0,1%
18th	0,0119	0,0052	0,0211	0,0092	0,1%
19th	0,0413	0,0180	0,0766	0,0332	0,1%
20th	0,0123	0,0053	0,0144	0,0063	0,1%
21th	0,0394	0,0171	0,0221	0,0096	0,1%
22th	0,0151	0,0066	0,0153	0,0066	0,1%
23th	0,0368	0,0160	0,0479	0,0208	0,1%
24th	0,0107	0,0046	0,0172	0,0075	0,1%
25th	0,0257	0,0112	0,0347	0,0151	0,1%
26th	0,0125	0,0054	0,0062	0,0027	0,1%
27th	0,0214	0,0093	0,0287	0,0125	0,1%
28th	0,0140	0,0061	0,0125	0,0054	0,1%
29th	0,0236	0,0103	0,0422	0,0183	0,1%
30th	0,0136	0,0059	0,0141	0,0061	0,1%
31th	0,0133	0,0058	0,0482	0,0209	0,1%
32th	0,0140	0,0061	0,0106	0,0046	0,1%
33th	0,0238	0,0103	0,0202	0,0088	0,1%
34th	0,0121	0,0053	0,0155	0,0067	0,1%
35th	0,0186	0,0081	0,0531	0,0230	0,1%
36th	0,0147	0,0064	0,0089	0,0038	0,1%
37th	0,0168	0,0073	0,0395	0,0172	0,1%
38th	0,0101	0,0044	0,0085	0,0037	0,1%
39th	0,0147	0,0064	0,0140	0,0061	0,1%
40th	0,0093	0,0041	0,0170	0,0074	0,1%
41th	0,0270	0,0117	0,0312	0,0136	0,1%
42th	0,0097	0,0042	0,0173	0,0075	0,1%
43th	0,0157	0,0068	0,0407	0,0177	0,1%
44th	0,0091	0,0040	0,0138	0,0060	0,1%
45th	0,0117	0,0051	0,0111	0,0048	0,1%
46th	0,0483	0,0210	0,0080	0,0035	0,1%
47th	0,0257	0,0112	0,0457	0,0198	0,1%
48th	0,0493	0,0214	0,0059	0,0026	0,1%
49th	0,0261	0,0113	0,0457	0,0198	0,1%
50th	0,0090	0,0039	0,0046	0,0020	0,1%
THD	N/A	0,143	N/A	1,0314	5%
L3 phase					

2nd	0,0151	0,0066	0,0362	0,0157	0,2%
3rd	0,2201	0,0957	0,5929	0,2572	4%
4th	0,0169	0,0073	0,0649	0,0282	0,2%
5th	0,0839	0,0365	0,2955	0,1282	4%
6th	0,0171	0,0074	0,0306	0,0133	0,2%
7th	0,1690	0,0735	0,0800	0,0347	4%
8th	0,0181	0,0079	0,0761	0,0330	0,2%
9th	0,0505	0,0219	0,0291	0,0126	2%
10th	0,0168	0,0073	0,0304	0,0132	0,2%
11th	0,1011	0,0440	0,1345	0,0584	0,1%
12th	0,0108	0,0047	0,0192	0,0083	0,1%
13th	0,0795	0,0345	0,1343	0,0582	0,1%
14th	0,0112	0,0049	0,0204	0,0088	0,1%
15th	0,0327	0,0142	0,0680	0,0295	0,1%
16th	0,0098	0,0043	0,0293	0,0127	0,1%
17th	0,0703	0,0306	0,0939	0,0408	0,1%
18th	0,0111	0,0048	0,0150	0,0065	0,1%
19th	0,0509	0,0221	0,0527	0,0229	0,1%
20th	0,0107	0,0047	0,0252	0,0110	0,1%
21th	0,0174	0,0076	0,0427	0,0185	0,1%
22th	0,0128	0,0055	0,0101	0,0044	0,1%
23th	0,0485	0,0211	0,0216	0,0094	0,1%
24th	0,0097	0,0042	0,0129	0,0056	0,1%
25th	0,0465	0,0202	0,0355	0,0154	0,1%
26th	0,0089	0,0039	0,0041	0,0018	0,1%
27th	0,0210	0,0091	0,0275	0,0119	0,1%
28th	0,0103	0,0045	0,0168	0,0073	0,1%
29th	0,0327	0,0142	0,0455	0,0197	0,1%
30th	0,0137	0,0060	0,0100	0,0043	0,1%
31th	0,0255	0,0111	0,0496	0,0215	0,1%
32th	0,0138	0,0060	0,0040	0,0017	0,1%
33th	0,0192	0,0084	0,0388	0,0168	0,1%
34th	0,0118	0,0051	0,0232	0,0101	0,1%
35th	0,0278	0,0121	0,0440	0,0191	0,1%
36th	0,0147	0,0064	0,0054	0,0023	0,1%
37th	0,0325	0,0141	0,0409	0,0177	0,1%
38th	0,0088	0,0038	0,0039	0,0017	0,1%
39th	0,0173	0,0075	0,0298	0,0129	0,1%
40th	0,0081	0,0035	0,0104	0,0045	0,1%
41th	0,0345	0,0150	0,0215	0,0093	0,1%
42th	0,0095	0,0041	0,0151	0,0065	0,1%
43th	0,0287	0,0125	0,0425	0,0185	0,1%
44th	0,0083	0,0036	0,0098	0,0043	0,1%
45th	0,0260	0,0113	0,0141	0,0061	0,1%
46th	0,0482	0,0209	0,0092	0,0040	0,1%
47th	0,0340	0,0148	0,0380	0,0165	0,1%
48th	0,0484	0,0211	0,0127	0,0055	0,1%
49th	0,0379	0,0165	0,0464	0,0201	0,1%
50th	0,0083	0,0036	0,0139	0,0060	0,1%
THD	N/A	0,160	N/A	1,0472	5%

Note:
Inverter shall be connected to test circuit Figure C1 (AS4777.2), Grid nominal voltage within +/-5%, AC-Frequency 50+/-1Hz and Phase angle between 3 phases shall be 120+/-1.5°. Via DC-input set AC-output power (VA) so that it equals to 100+/-5% of rated output. Harmonic ratios of the test voltage shall be measured. Limits based on percentage of fundamental! Total harmonic distortion to the 50th harmonic 5%.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

5.7 Voltage Fluctuations and Flicker		**P**
Phase 1		
Limit	Pst = 1,0	Plt = 0,65
Test value	0,30	0,39
Phase 2		
Limit	Pst = 1,0	Plt = 0,65
Test value	0,33	0,34
Phase 3		
Limit	Pst = 1,0	Plt = 0,65
Test value	0,30	0,31

Note:

The inverter shall conform to the voltage fluctuation and flicker limits specified in AS/NZS 61000.3.3 for equipment with rated current less than or equal to 16 A per phase (a.c.).
For equipment with rated current greater than 16 A per phase (a.c.), if the inverter cannot meet the requirements of AS/NZS 61000.3.3, the maximum permissible connection point impedance (Zmax) shall be determined such that the voltage fluctuation and flicker limits specified in AS/NZS 61000.3.3 can be met. The impedance shall be determined in

accordance with the methods given in AS/NZS 61000.3.11.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

5.8 Transient Voltage Limits (phase to neutral) **Appendix D Transient Voltage Limit Test**						**P**
L1 phase						
	10+/-5% Output Power (VA)		50+/-5% Output Power (VA)		100+/-5% Output Power (VA)	
	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)
Limit	0,002	580	0,002	580	0,002	580
Test value	0,002	3	0,002	1	0,002	88
Limit	0,006	470	0,006	470	0,006	470
Test value	0,006	4	0,006	1	0,006	88
Limit	0,02	420	0,02	420	0,02	420
Test value	0,02	4	0,02	7	0,02	88
Limit	>0,06	390	>0,06	390	>0,06	390
Test value	>0,06	4	>0,06	8	>0,06	88
L2 phase						
	10+/-5% Output Power (VA)		50+/-5% Output Power (VA)		100+/-5% Output Power (VA)	
	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)
Limit	0,002	580	0,002	580	0,002	580
Test value	0,002	1	0,002	5	0,002	113
Limit	0,006	470	0,006	470	0,006	470
Test value	0,006	2	0,006	3	0,006	106
Limit	0,02	420	0,02	420	0,02	420
Test value	0,02	1	0,02	9	0,02	106
Limit	>0,06	390	>0,06	390	>0,06	390
Test value	>0,06	1	>0,06	6	>0,06	106

L3 phase						
	10+/-5% Output Power (VA)		50+/-5% Output Power (VA)		100+/-5% Output Power (VA)	
	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)
Limit	0,002	580	0,002	580	0,002	580
Test value	0,002	1	0,002	4	0,002	288
Limit	0,006	470	0,006	470	0,006	470
Test value	0,006	1	0,006	5	0,006	288
Limit	0,02	420	0,02	420	0,02	420
Test value	0,02	4	0,02	3	0,02	288
Limit	>0,06	390	>0,06	390	>0,06	390
Test value	>0,06	4	>0,06	1	>0,06	275

Note:
Results shall not exceed limits in Table 4 of AS/NZS 4777.2. Test Specifications: Inverter shall be connected to test circuit AS/NZS 4777.2 Figure D1. Grid nominal voltage within +/-5%, Via DC-input set AC- output power so that it equals to 10+/-5% of rated output (VA). Switch S shall be opened and the output voltage duration (Sample frequency of at least 10kHz) of the inverter shall be recorded. Test shall be repeated at 50+/-5% and 100+/-5% of rated output power.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

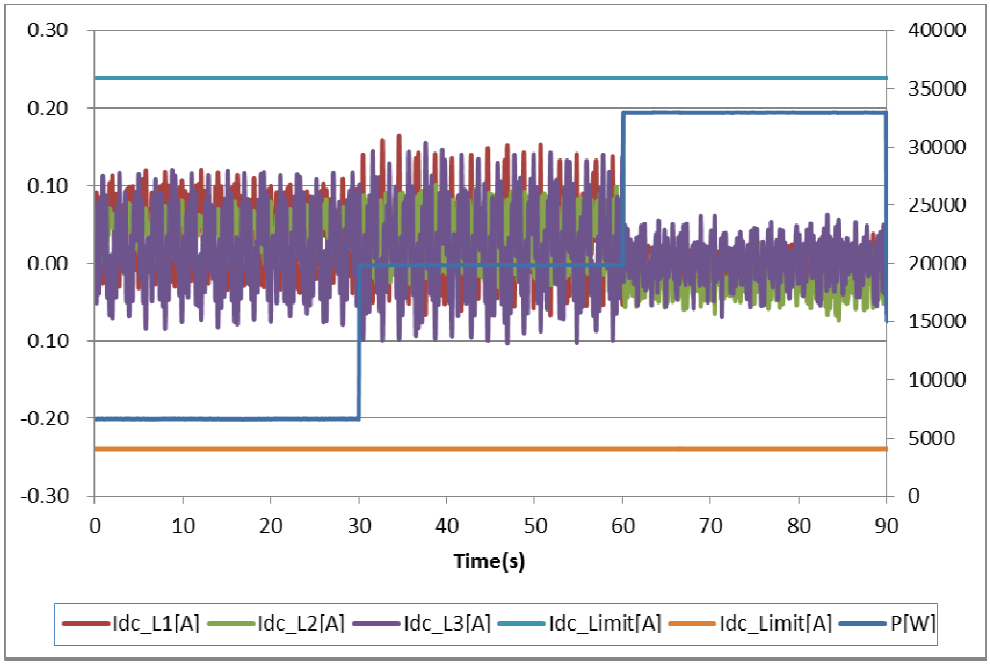
5.8 Transient Voltage Limits (phase to phase) **Appendix D Transient Voltage Limit Test**						**P**
	10+/-5% Output Power (VA)		50+/-5% Output Power (VA)		100+/-5% Output Power (VA)	
	Duration (s)	Line to line (V)	Duration (s)	Line to line (V)	Duration (s)	Line to line (V)
Phase L1 to L2						
Limit	0,002	1010	0,002	1010	0,002	1010
Test value	0,002	6	0,002	3	0,002	688
Limit	0,006	810	0,006	810	0,006	810
Test value	0,006	2	0,006	3	0,006	688
Limit	0,02	720	0,02	720	0,02	720
Test value	0,02	1	0,02	15	0,02	675
Limit	>0,06	670	>0,06	670	>0,06	670
Test value	0,06	1	0,06	15	0,06	663
Phase L2 to L3						
Limit	0,002	1010	0,002	1010	0,002	1010
Test value	0,002	1	0,002	5	0,002	500
Limit	0,006	810	0,006	810	0,006	810
Test value	0,006	6	0,006	11	0,006	488
Limit	0,02	720	0,02	720	0,02	720
Test value	0,02	8	0,02	6	0,02	475
Limit	>0,06	670	>0,06	670	>0,06	670
Test value	0,06	4	0,06	6	0,06	475
Phase L1 to L3						
Limit	0,002	1010	0,002	1010	0,002	1010
Test value	0,002	6	0,002	8	0,002	188
Limit	0,006	810	0,006	810	0,006	810
Test value	0,006	4	0,006	8	0,006	188
Limit	0,02	720	0,02	720	0,02	720
Test value	0,02	8	0,02	9	0,02	175
Limit	>0,06	670	>0,06	670	>0,06	670

Test value	0,06	4	0,06	9	0,06	163

Note:
Results shall not exceed limits in Table 3 of AS/NZS 4777.2. Test Specifications: Inverter shall be connected to test circuit AS/NZS 4777.2 Figure C1, Appendix C. Grid nominal voltage within +/-5%, Via DC-input set AC-output power so that it equals to 10+/-5% of rated output (VA). Switch S shall be opened and the output voltage duration (Sample frequency of at least 10kHz) of the inverter shall be recorded. Test shall be repeated at 50+/-5% and 100+/-5% of rated output power.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

5.9 Direct current injection **Appendix E D.C. injection test**						**P**
SOFAR 33000TL-G2						
	Testing at 20+/-5% Output Power					
Phases	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Abs. Max. Test Value:L1	--	--	--	121	83	121
Abs. Ave. Test Value:L1	--	--	--	46	38	20
	Testing at 60+/-5% Output Power					
Phases	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Abs. Max. Test Value:L2	--	--	--	164	101	155
Abs. Ave. Test Value:L2	--	--	--	45	33	20
	Testing at 100+/-5% Output Power					
Phases	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Abs. Max. Test Value:L3	--	--	--	38	74	69
Abs. Ave. Test Value:L3	--	--	--	3	23	3



Note:
In the case of a single-phase inverter: not exceed 0.5% of the inverter's rated current or 5 mA, whichever is the greater.
In the case of a three-phase inverter: shall not exceed 0.5% of the inverter's per-phase rated current or 5 mA, whichever is the greater.

The test had been performed on the models SOFAR 33000TL-G2, the test results are valid for the SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2 except current sampling circuit and the output power derated by software.

5.10 Current balance for three-phase inverters						P
Setting values	PF cos φ = 1			Rated output current: 47,8 A		
Test value	L1	L2	L3	L1 – L2	L2 – L3	L3 – L1
100% of rated current	47,511	47,677	47,644	-0,166	0,033	0,133
	47,513	47,677	47,648	-0,165	0,030	0,135
	47,505	47,671	47,643	-0,166	0,028	0,138
	47,501	47,664	47,638	-0,163	0,026	0,136
	47,500	47,662	47,636	-0,162	0,026	0,136
Limit [A]: 5% of rated current	2,391A					

Note:

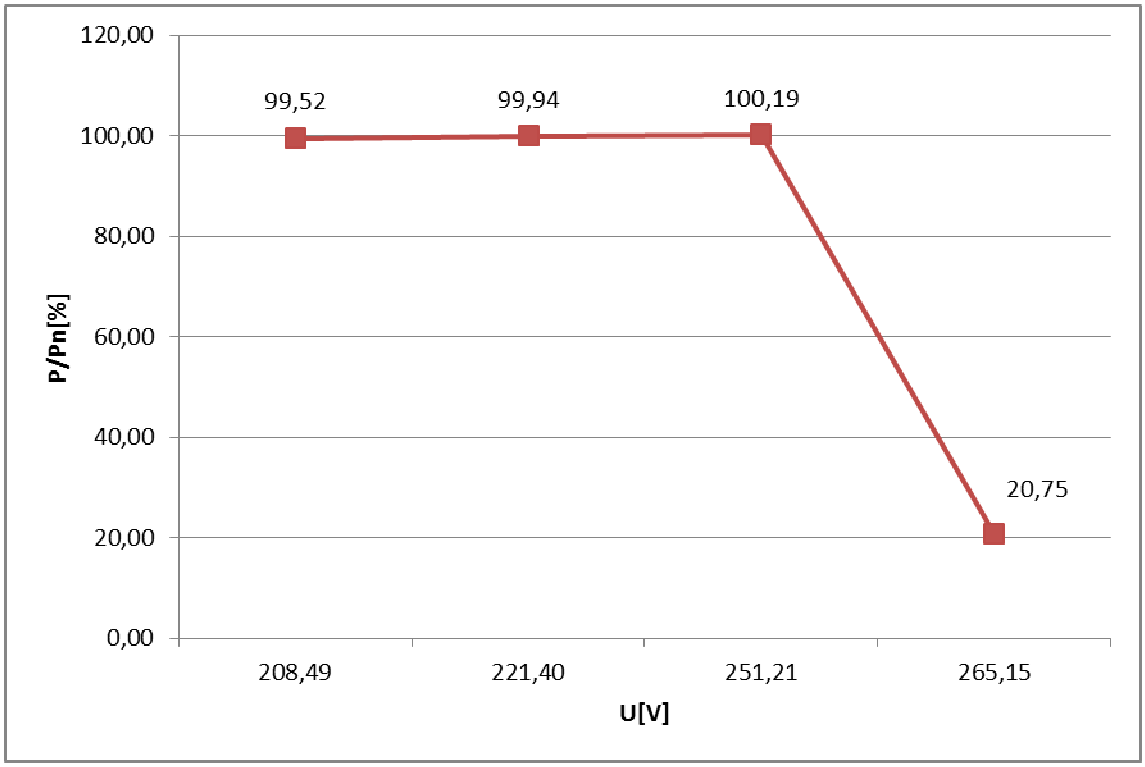
The a.c. output current for each phase for three-phase balanced current shall be within 5% of the measured value of the other phases at rated current when injected into a balanced three phase voltage.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

6.2 Inverter demand response modes (DRMs) **Appendix I Demand and power quality response**					**P**
Mode	Requirement	Measurement			Result
		Real current (A)	Reactive current (A)	Switching Time (s)	
DRM 0	Operate the disconnection device	48,13	3,22	0,111	P
DRM 1	Do not consume power	N/A	N/A	N/A	N/A
DRM 2	Do not consume at more than 50% of rated power	N/A	N/A	N/A	N/A
DRM 1 and DRM 2		N/A	N/A	N/A	N/A
DRM 3	Do not consume at more than 75% of rated power AND Source reactive power if capable	N/A	N/A	N/A	N/A
DRM 2 and DRM 3		N/A	N/A	N/A	N/A
DRM 4	Increase power consumption (subject to constraints from other active DRMs)	N/A	N/A	N/A	N/A
DRM 5	Do not generate power	N/A	N/A	N/A	N/A
DRM 6	Do not generate at more than 50% of rated power	N/A	N/A	N/A	N/A
DRM 5 and DRM 6		N/A	N/A	N/A	N/A
DRM 7	Do not generate at more than 75% of rated power AND Sink reactive power if capable	N/A	N/A	N/A	N/A
DRM 6 and DRM 7		N/A	N/A	N/A	N/A
DRM 8	Increase power generation (subject to constraints from other active DRMs)	N/A	N/A	N/A	N/A
Note: Switching time limit : 2s The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.					

6.3.2.2 Volt-watt response mode (Australia Default Setting)	P

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	208,49	221,40	251,21	265,15
P (kW)	32,841	32,982	33,064	6,847
P/P_{rated} (%)	99,52	99,94	100,19	20,75

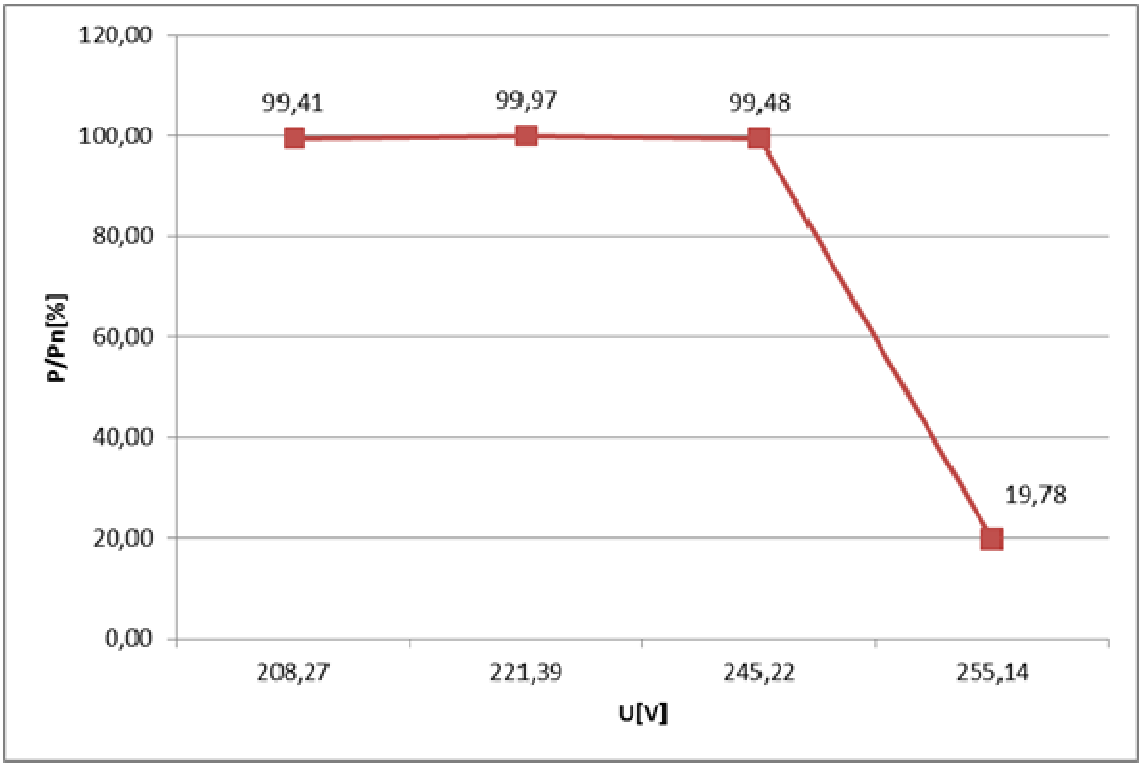


Note:

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

6.3.2.2 Volt-watt response mode (New Zealand Default Setting)	P

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	208,27	221,39	245,22	255,14
P (kW)	32,806	32,991	32,828	6,527
P/P_{rated} (%)	99,41	99,97	99,48	19,78

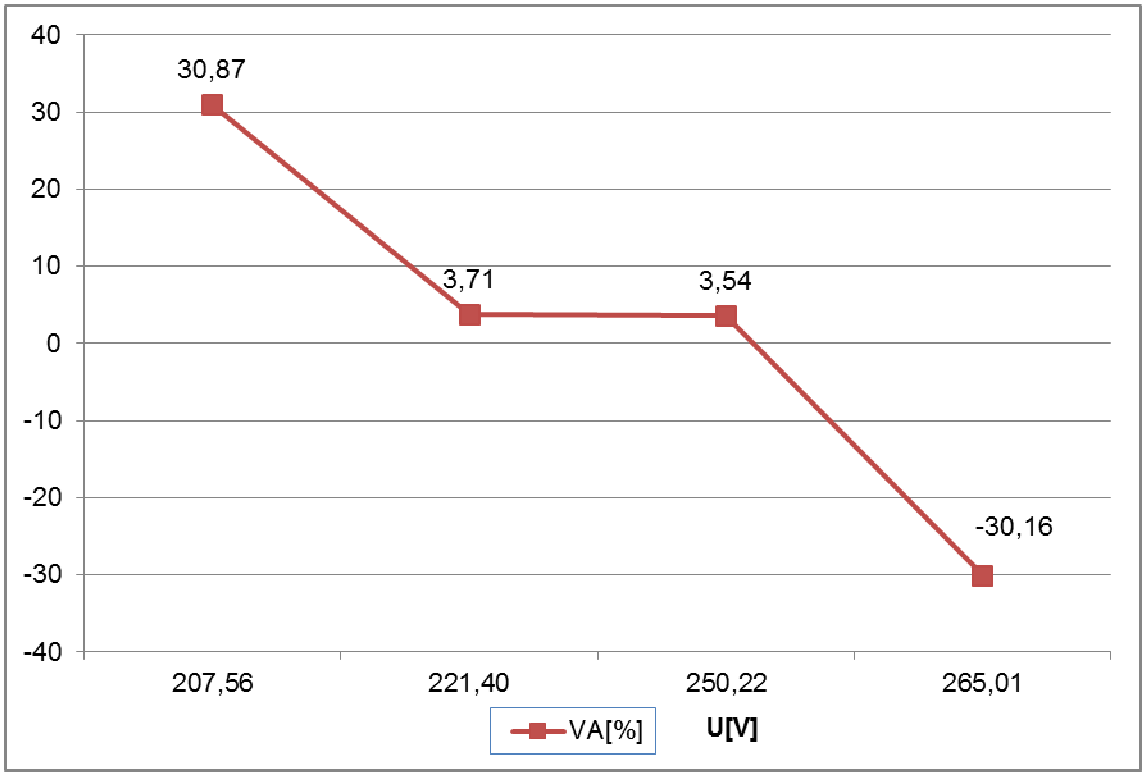


Note:

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

6.3.2.3 Volt-var response mode (Australia Default Setting)	P

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,56	221,40	250,22	265,01
Q (kVar)	10,189	0,653	0,568	-9,884
var / rated VA (%)	30,88	1,98	1,72	-29,95

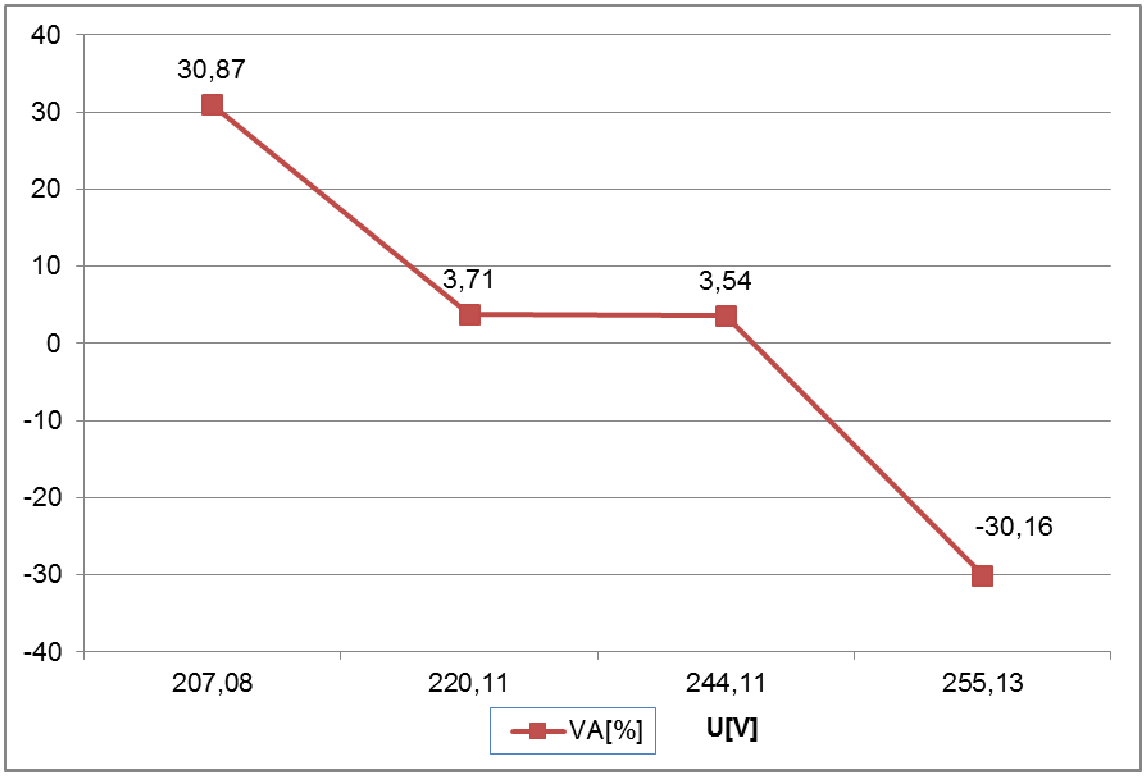


Note:
1. The percentage var/VA level leading is the inverter sourcing vars to the grid, whereas the percentage var/VA level lagging is the inverter sinking vars from the grid.
2. Inverters may provide a range up to 100% leading or lagging.
3. % of rated apparent power use for test.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

6.3.2.3 Volt-var response mode (New Zealand Default Setting)	P

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,08	220,11	244,11	255,13
Q (kVar)	10,186	1,225	1,170	-9,952
var / rated VA (%)	30,87	3,71	3,54	-30,16



Note:
1. The percentage var/VA level leading is the inverter sourcing vars to the grid, whereas the percentage var/VA level lagging is the inverter sinking vars from the grid.
2. Inverters may provide a range up to 100% leading or lagging.
3. % of rated apparent power use for test.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

6.3.3 Fixed power factor mode and reactive power mode										P
P/P_{rated} in %	10	20	30	40	50	60	70	80	90	100
Setting PF cosφ = 1										
U (V)	230,05	230,19	230,34	230,48	230,62	230,77	230,91	231,05	231,19	231,33
Power (W)	3,276	6,618	9,967	13,272	16,567	19,850	23,119	26,378	29,612	32,834
Reactive power (var)	0,187	0,206	0,246	0,287	0,311	0,327	0,356	0,386	0,439	0,504
Power factor	0,9983	0,9995	0,9997	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998
PF = 0,8 leading										
U (V)	230,00	230,10	230,21	230,32	230,33	230,56	230,69	230,80	230,91	230,90
Power (kW)	4,111	8,245	12,410	16,522	13,210	24,697	28,764	32,941	35,836	35,854
Reactive power (kVar)	2,504	4,952	7,448	9,923	9,922	14,844	17,311	19,991	21,520	21,500
Power factor	0,7931	0,7996	0,7998	0,7995	0,7996	0,7992	0,7986	0,7948	0,7996	0,8002
PF = 0,8 lagging										
U (V)	230,10	230,27	230,46	230,63	230,64	230,99	231,14	231,31	231,43	231,44
Power (kW)	4,010	8,136	12,275	16,343	13,188	24,432	28,441	32,430	35,897	35,952
Reactive power (kVar)	-2,349	-4,790	-7,245	-9,651	-9,649	-14,440	-16,818	-19,184	-21,232	-21,268
Power factor	0,8104	0,8083	0,8072	0,8070	0,8070	0,8066	0,8064	0,8063	0,8063	0,8062

Note:
The gird-connected inverter of power plant type shall be evaluated.
Each power-bin must be kept for at least 3 minute.
If the inverter is capable of operating with reactive power mode, the maximum ratio of reactive power (vars) to rated apparent power should be 100%.
If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

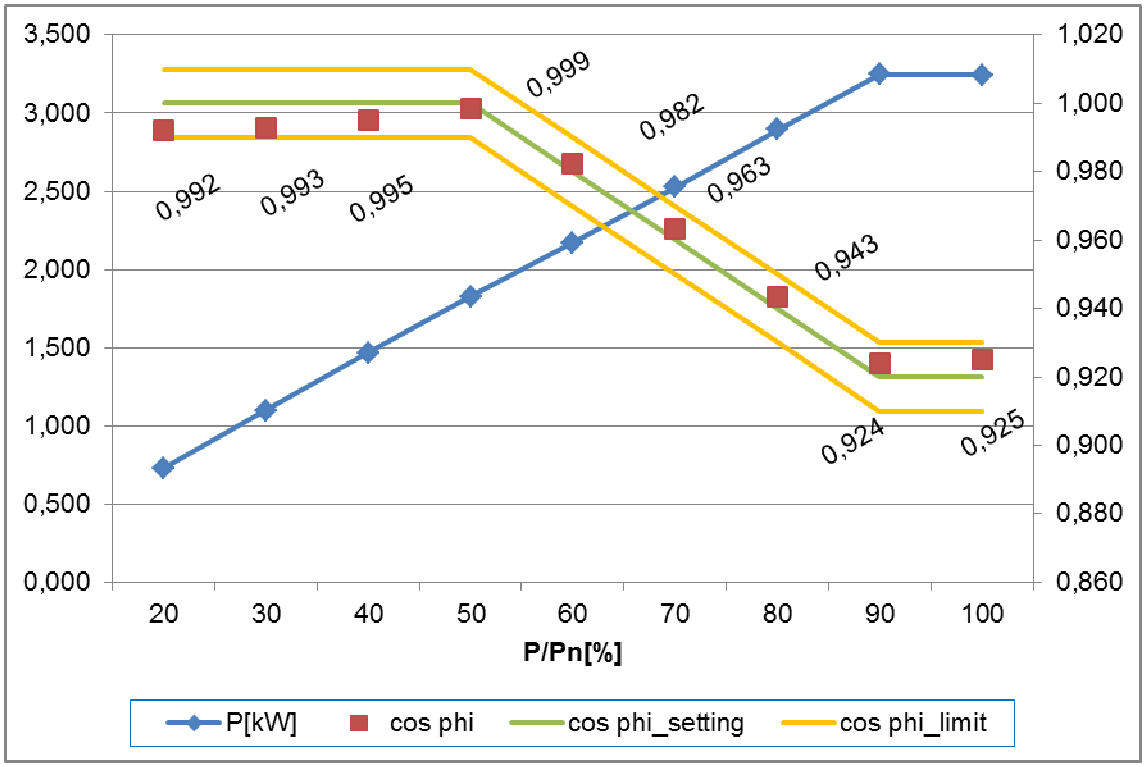
Reactive power mode										
Var/rated VA in %	10	25	30	40	50	60	70	80	90	100
Q=0										
Power (kW)	3,299	6,640	9,939	13,233	16,545	19,847	23,141	26,425	29,693	33,031
Reactive power (kVar)	0,071	0,236	0,252	0,286	0,332	0,381	0,439	0,504	0,572	0,652
Power factor	0,9976	0,9994	0,9997	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998
Reactive power in leading										
Power (kW)	3,283	6,610	9,903	13,188	16,532	19,825	23,143	26,454	29,421	32,597
Reactive power (kVar)	16,836	16,563	16,513	16,506	16,506	16,494	16,475	16,483	16,496	16,493
Power factor	0,1914	0,3706	0,5143	0,6242	0,7076	0,7687	0,8146	0,8487	0,8719	0,8923
Reactive power in lagging										
Power (kW)	3,060	6,598	9,924	13,219	16,497	19,839	23,093	26,429	29,713	32,826
Reactive power (kVar)	-16,263	-16,645	-16,807	-16,876	-16,903	-16,907	-16,925	-16,567	-16,589	-16,645
Power factor	0,1849	0,3685	0,5085	0,6166	0,6985	0,7611	0,8066	0,8473	0,8731	0,8919

Note:
The gird-connected inverter of power plant type shall be evaluated.
Each power-bin must be kept for at least 3 minute.
If the inverter is capable of operating with reactive power mode, the maximum ratio of reactive power (vars) to rated apparent power should be 100%.
If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

6.3.4 characteristic power factor curve for cos φ (P) (Power response)	P

cos φ (P):										
P/P_{rated} (%)	10	25	30	40	50	60	70	80	90	100
30 s mean value	10% to 100% P_{rated}									
U (V):	--	230,03	230,08	230,14	230,19	230,23	230,29	230,34	230,38	230,44
P (kW):	--	6,571	9,912	13,226	16,526	19,778	23,003	26,207	29,404	32,572
P / P_{rated} (%):	--	19,91	30,04	40,08	50,08	59,93	69,71	79,41	89,10	98,70
Q (kVar):	--	0,319	0,368	0,438	0,534	-3,230	-6,285	-9,260	-12,378	-15,614
cos φ:	--	0,999	0,999	0,999	0,999	0,987	0,965	0,943	0,922	0,902
$\cos \varphi_{setpoint}$ of P:	--	1,00	1,00	1,00	1,00	0,98	0,96	0,94	0,92	0,92
Limit cos φ :	$\cos \varphi_{setpoint} \pm 0,01$									



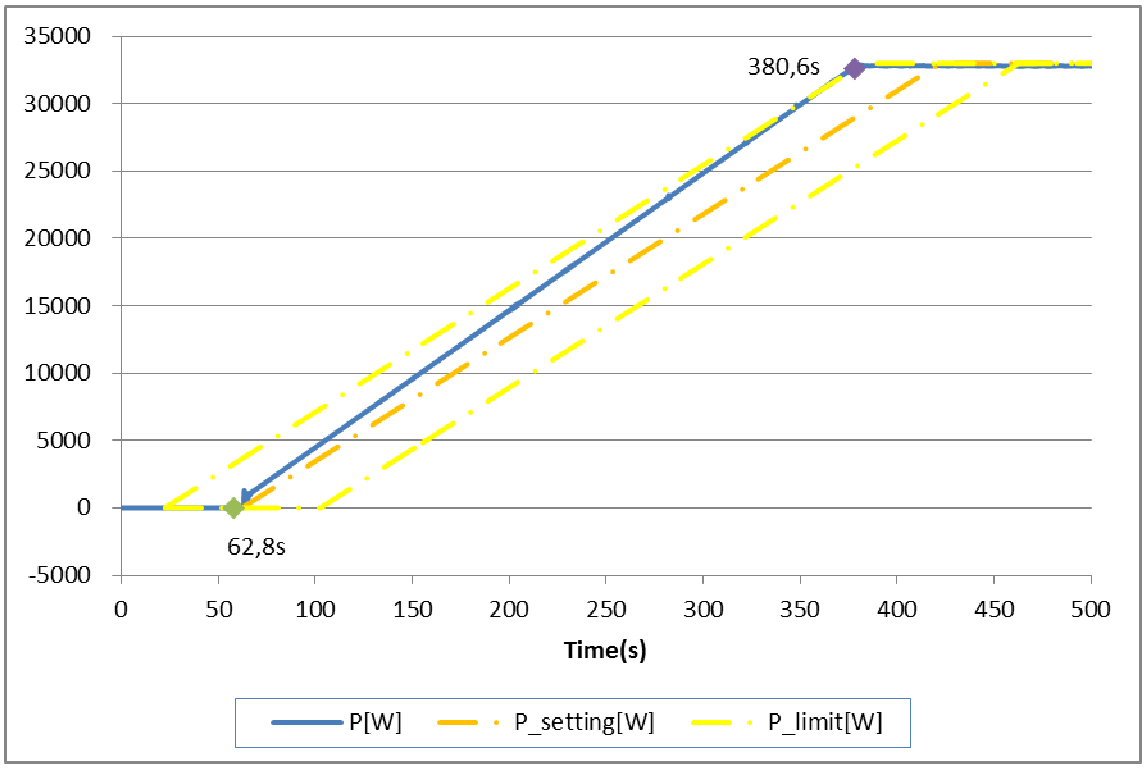
Note:

The response curve required for the cos φ (P) response should be defined within displacement power factor range of 0.9 leading to 0.9 lagging.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

6.3.5 Power rate limit	P

6.3.5.3.2 Test (a): Soft ramp up after connect or reconnect	
Time measurement from 0% to 100% P_{rated} (min)	317,2 s
W_{Gra}	18,72%
Limit W_{Gra} : (Default : 16,67%)	16,67%



6.3.5.3.3 Test (b): Change in a.c. operation and control (DRM control only)		
DRM mode	N/A	N/A
Power change (%)	N/A	N/A
Time measurement	N/A	N/A
W_{Gra}	N/A	N/A
Limit W_{Gra} : (Default : 16,67%)	N/A	N/A
N/A		

6.3.5.3.4 Test ©: Change in energy source operation (only for multiple mode inverters with energy storage)		
DRM mode	N/A	N/A
Power change	N/A	N/A
Time measurement	N/A	N/A
W_{Gra}	N/A	N/A

Limit W_{Gra} : (Default : 16,67%)	N/A	N/A
N/A		
6.3.5.4 Nonlinearity of power rate limit changes		
DRM mode	DRM 0	N/A
Power change	Increase: __0__% to _100__%	N/A
Time measurement	317,2 s	N/A
W_{Gra}	18,72%	N/A
Limit W_{Gra} : (Default : 16,67%)	16,67%	N/A
See table 6.3.5.3.2		
Note: The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.		

7.3 Active anti-islanding protection **IEC 62116 Active anti-islanding test** Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)	**P**

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	2s

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 per phase]	Qf	V_{DC}	Remarks4)
1	**100**	**100**	**0**	**0**	**1192**	**11320**	**1,004**	**718**	**Test A at BL**
4	100	100	-5	-5	590	11320	1,030	718	Test A at IB
5	100	100	-5	0	1021	11320	1,056	718	Test A at IB
6	100	100	-5	+5	115	11320	1,082	718	Test A at IB
7	100	100	0	-5	383	11320	0,978	718	Test A at IB
8	100	100	0	+5	95	11320	1,028	718	Test A at IB
9	100	100	+5	-5	545	11320	0,932	718	Test A at IB
10	100	100	+5	0	1074	11320	0,956	718	Test A at IB
11	100	100	+5	+5	103	11320	0,979	718	Test A at IB

Parameter at 0%	L= 14,81 mH	R= 4,67 Ω	C= 683,13 µF

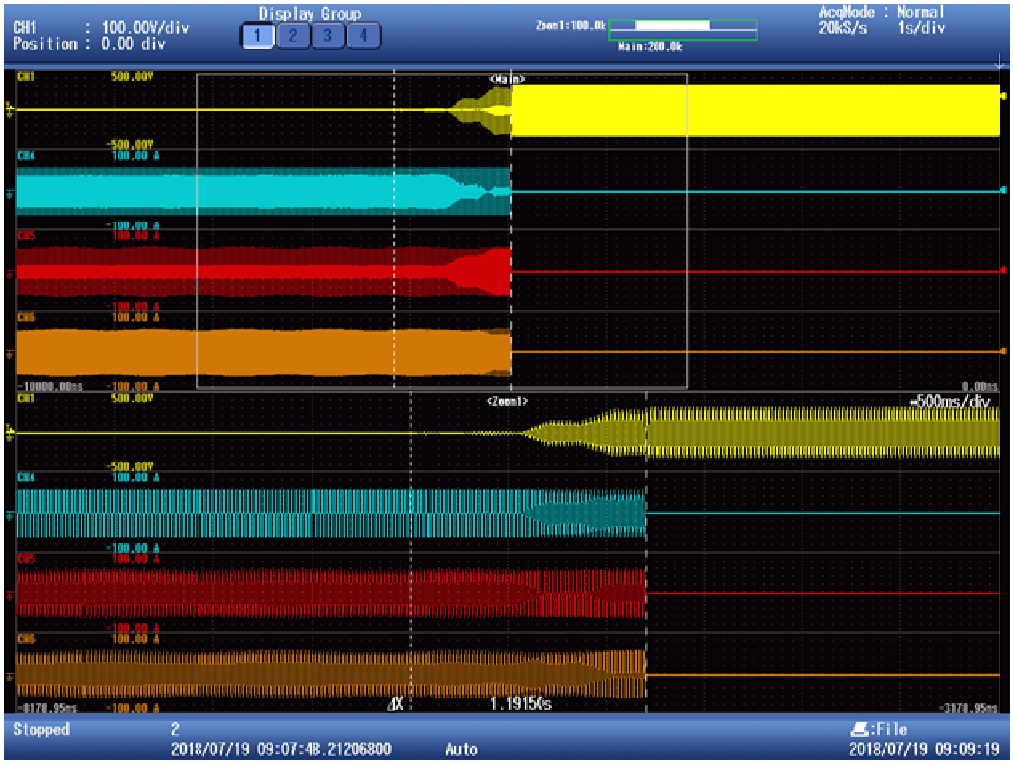
Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

The test results refer to the test report " PV180712N013-1" issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on 2018.08.03

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



7.3 Active anti-islanding protection **IEC 62116 Active anti-islanding test** Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	**P**

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	2s

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 per phase]	Qf	V_{DC} [V]	Remarks4)
12	66	66	0	-5	395	6700	0,977	555	Test B at IB
13	66	66	0	-4	971	6700	0,982	555	Test B at IB
14	66	66	0	-3	994	6700	0,987	555	Test B at IB
15	66	66	0	-2	554	6700	0,992	555	Test B at IB
16	66	66	0	-1	962	6700	0,997	555	Test B at IB
2	**66**	**66**	**0**	**0**	**1149**	**6700**	**1,002**	**555**	**Test B at BL**
17	66	66	0	1	952	6700	1,007	555	Test B at IB
18	66	66	0	2	174	6700	1,012	555	Test B at IB
19	66	66	0	3	140	6700	1,017	555	Test B at IB
20	66	66	0	4	128	6700	1,022	555	Test B at IB
21	66	66	0	5	126	6700	1,027	555	Test B at IB

Parameter at 0%	L= 25,09 mH	R= 7,90 Ω	C= 404,36 µF

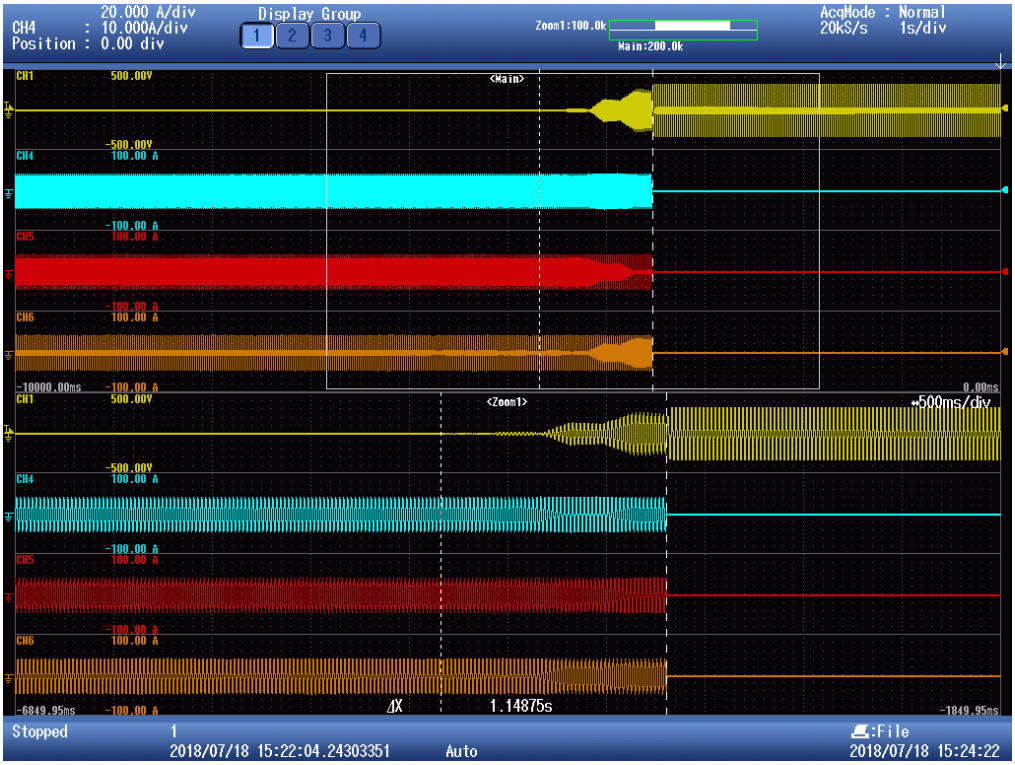
Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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 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.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

The test results refer to the test report " PV180712N013-1" issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on 2018.08.03

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



7.3 Active anti-islanding protection **IEC 62116 Active anti-islanding test** Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	**P**

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	2s

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 per phase]	Qf	V_{DC} [V]	Remarks4)
22	33	33	0	-5	361	3700	0,980	360	Test C at IB
23	33	33	0	-4	582	3700	0,985	360	Test C at IB
24	33	33	0	-3	1053	3700	0,990	360	Test C at IB
25	33	33	0	-2	959	3700	0,995	360	Test C at IB
26	33	33	0	-1	940	3700	1,000	360	Test C at IB
3	**33**	**33**	**0**	**0**	**1717**	**3700**	**1,005**	**360**	**Test C at BL**
27	33	33	0	1	924	3700	1,010	360	Test C at IB
28	33	33	0	2	154	3700	1,015	360	Test C at IB
29	33	33	0	3	114	3700	1,020	360	Test C at IB
30	33	33	0	4	119	3700	1,025	360	Test C at IB
31	33	33	0	5	108	3700	1,030	360	Test C at IB

Parameter at 0%	L= 43,18 mH	R= 13,56 Ω	C= 237,08 µF

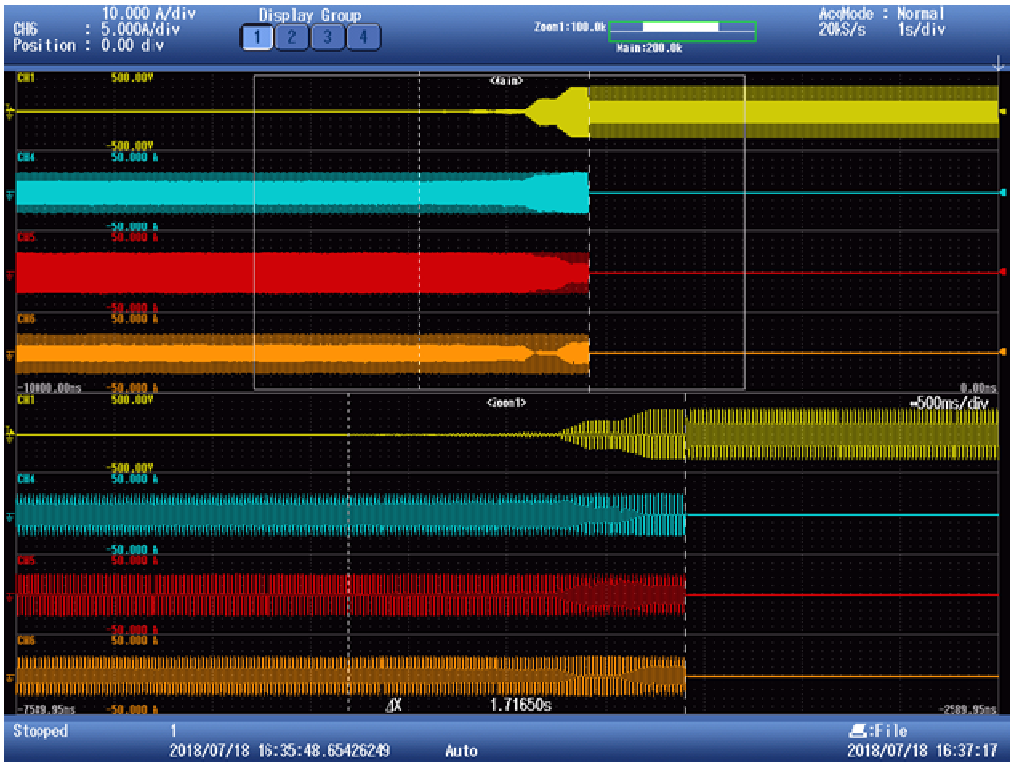
Indicate additional shut down time included in above results. (Disconnection device operation time)	20ms

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.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

The test results refer to the test report " PV180712N013-1" issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch, dated on 2018.08.03

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



7.4 Voltage and frequency limits (passive anti-islanding protection) Appendix G2 Under- and over-voltage trip settings and reconnection test							P
L1 phase							
	Output Current level: 50+/-5% rated current						
Test	**Under Voltage (V)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**
Limit	< 180 V			<=2s			>=60s
Actual setting	180,0			2,0			60,0
Trip value	179,7	179,7	179,7	1,233	1,223	1,223	67
Test	**Over Voltage 1 (V)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**
Limit	> 260 V			<=2s			>=60s
Actual setting	260,0			2,0			60,0
Trip value	260,6	260,6	260,6	1,955	1,932	1,810	67
Test	**Over Voltage 2 (V)**			**Time to disconnect (s)**			**Time to reconnect (s)**
Limit	> 265 V			<=0,2s			>=60s
Actual setting	265,0			0,2			60,0
Trip value	264,9	264,9	264,9	0,122	0,126	0,125	67
L2 phase							
	Output Current level: 50+/-5% rated current						
Test	**Under Voltage (V)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**
Limit	< 180 V			<=2s			>=60s
Actual setting	180,0			2,0			60,0
Trip value	179,9	179,9	179,9	1,232	1,237	1,224	67
Test	**Over Voltage 1 (V)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**
Limit	> 260 V			<=2s			>=60s
Actual setting	260,0			2,0			60,0
Trip value	260,3	260,3	260,3	1,242	1,392	1,215	67
Test	**Over Voltage 2 (V)**			**Time to disconnect (s)**			**Time to reconnect (s)**
Limit	> 265 V			<=0,2s			>=60s
Actual setting	265,0			0,2			60,0
Trip value	264,9	264,9	264,9	0,136	0,168	0,164	67

L3 phase							
	Output Current level: 50+/-5% rated current						
Test	**Under Voltage (V)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**
Limit	< 180 V			<=2s			>=60s
Actual setting	180,0			2,0			60,0
Trip value	179,9	179,9	179,9	1,238	1,238	1,236	68
Test	**Over Voltage 1 (V)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**
Limit	> 260 V			<=2s			>=60s
Actual setting	260,0			2,0			60,0
Trip value	260,5	260,5	260,5	1,810	1,237	1,234	67
Test	**Over Voltage 2 (V)**			**Time to disconnect (s)**			**Time to reconnect (s)**
Limit	> 265 V			<=0,2s			>=60s
Actual setting	265,0			0,2			60,0
Trip value	265,0	265,0	265,0	0,137	0,124	0,113	67

Note:
Actual settings are the settings of the inverter. The Trip value the measured value. It has to be in the range of +/- 2V of the actual setting.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

Diagram of under-voltage protection:L1 phase

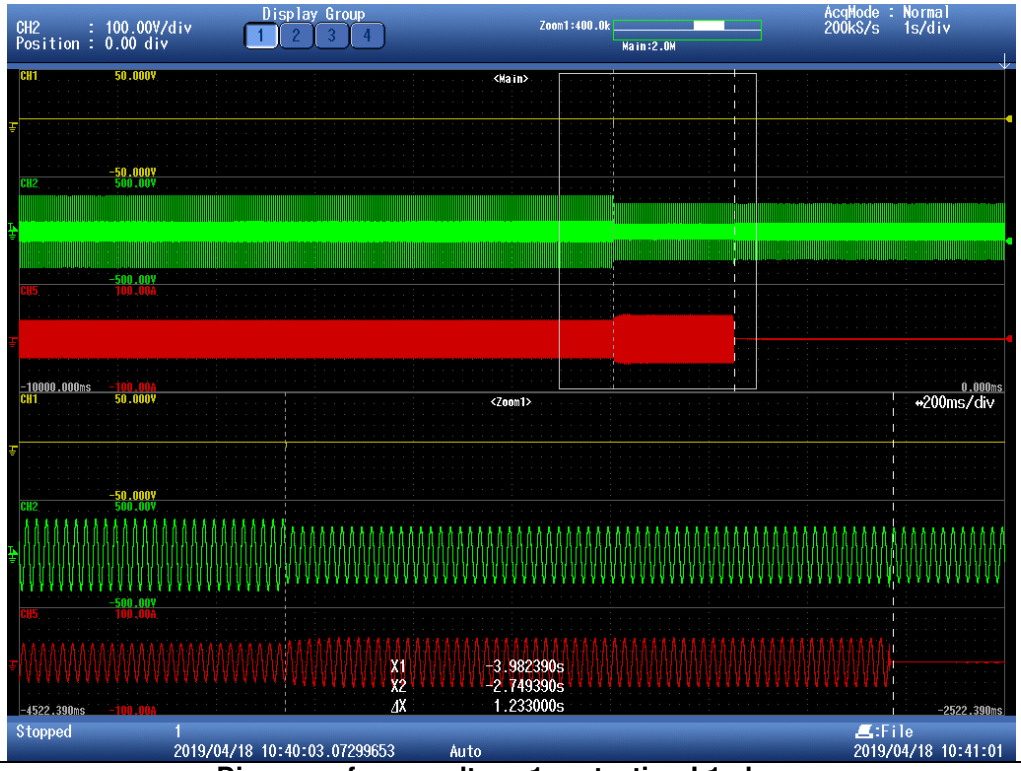


Diagram of over-voltage 1 protection:L1 phase

Diagram of over-voltage 2 protection:L1 phase

Diagram of under-voltage protection:L2 phase

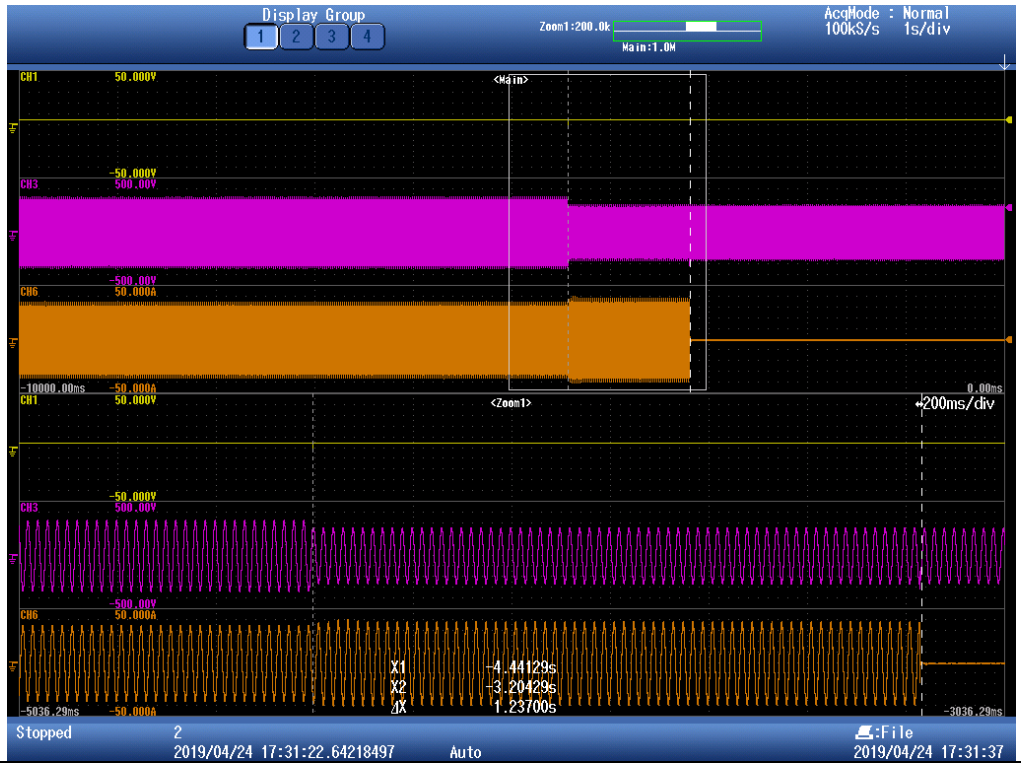


Diagram of over-voltage 1 protection:L2 phase

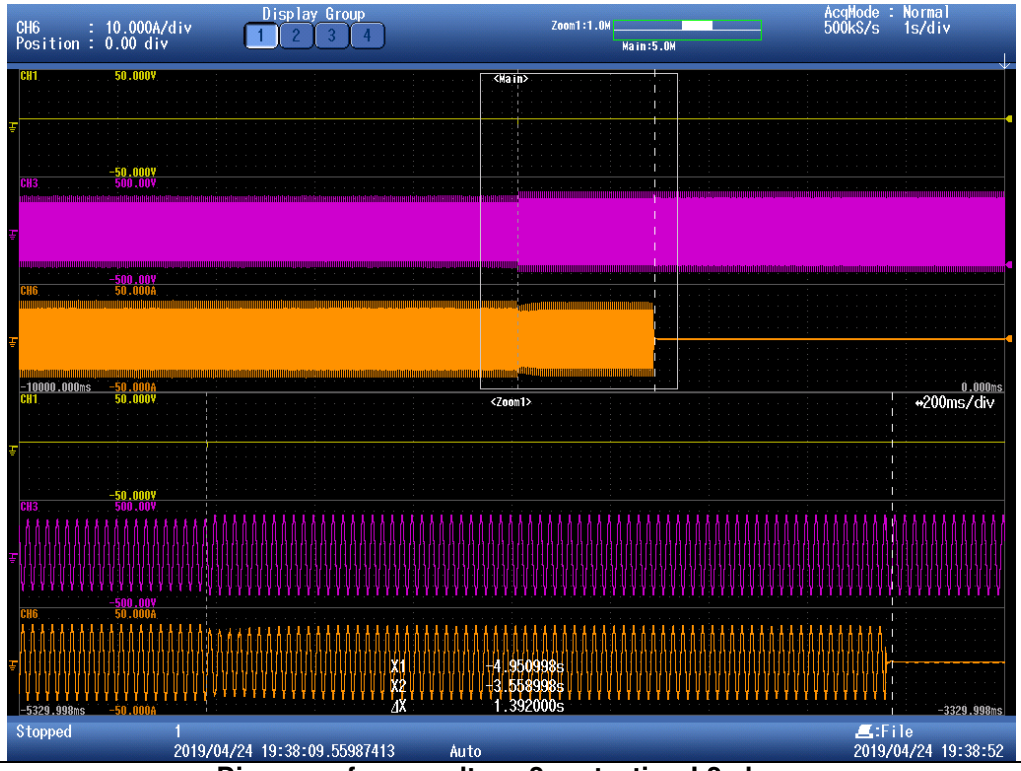


Diagram of over-voltage 2 protection:L2 phase

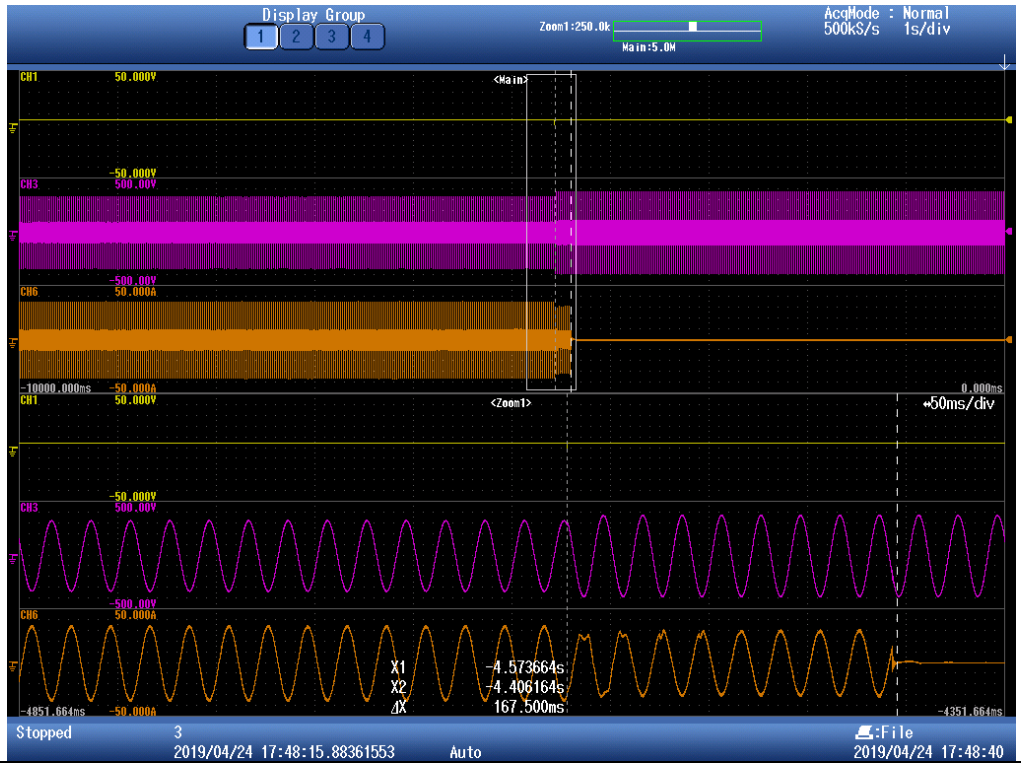


Diagram of under-voltage protection:L3 phase

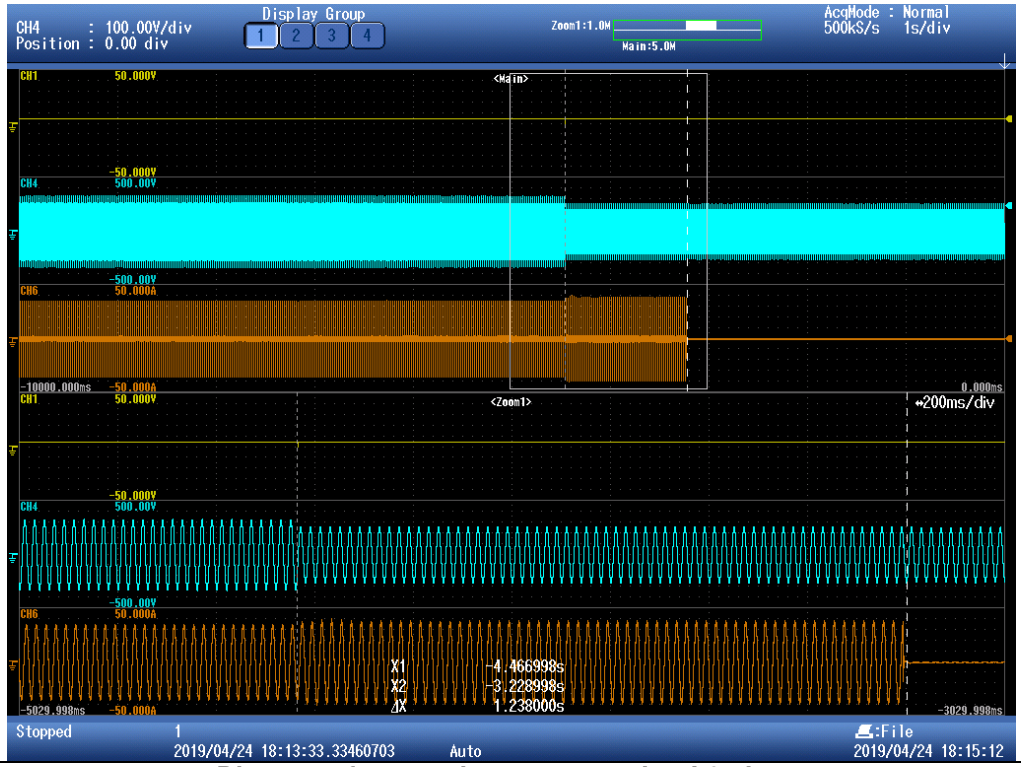


Diagram of over-voltage 1 protection:L3 phase

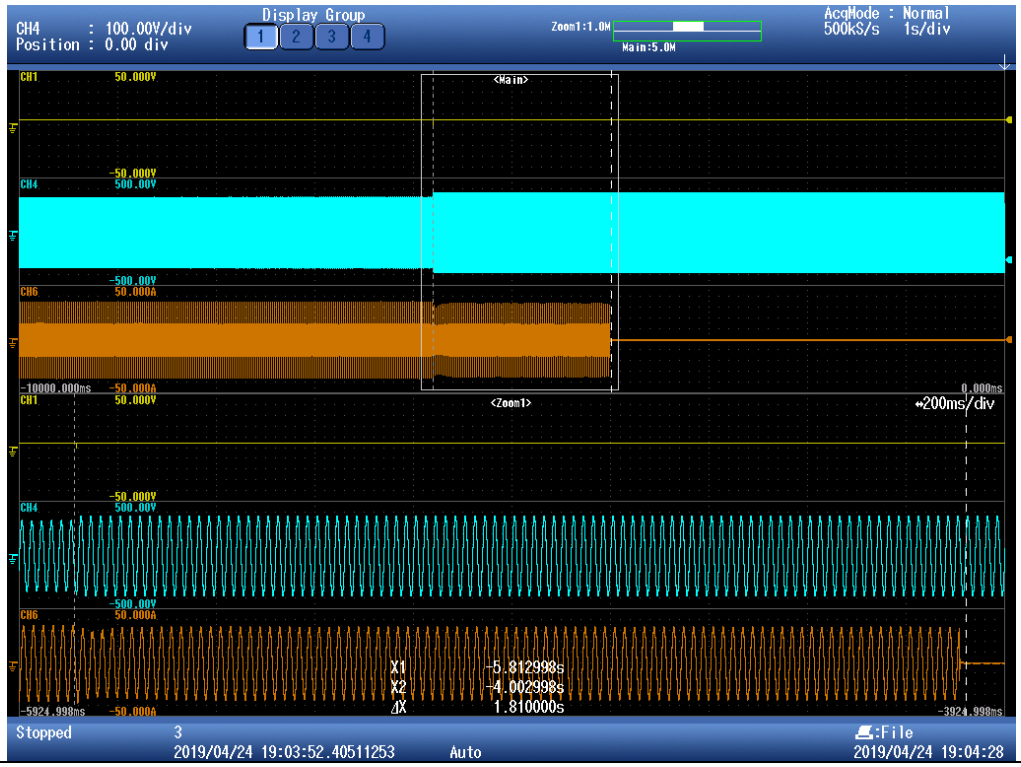
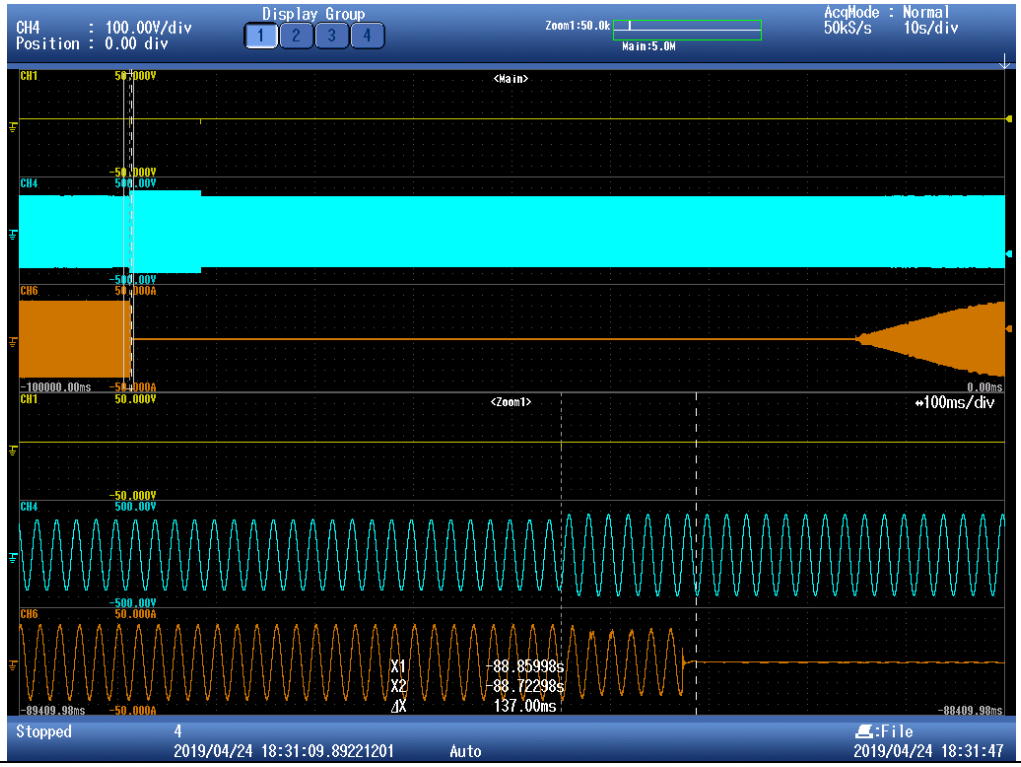


Diagram of over-voltage 2 protection:L3 phase



7.4 Voltage and frequency limits (passive anti-islanding protection) **Appendix G3 Under- and over-frequency trip settings and reconnection test**								**P**
	Output Current level: 50+/-5% rated current or 10A (whichever is the lesser)							
Test	**Under Frequency (Hz)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**	
Australia Limit	>=47Hz			<=2s			>=60s	
Actual setting	47,0			2,0			60,0	
Trip value	47,00	47,00	47,00	1,232	1,225	1,251	67	
Test	**Under Frequency (Hz)**			**Time to disconnect (s) (Trip delay 1s)**			**Time to reconnect (s)**	
New Zealand Limit	>=45Hz			<=2s			>=60s	
Actual setting	45,0			2,0			60,0	
Trip value	45,00	45,00	45,00	1,905	1,280	1,540	67	
Test	**Over Frequency (Hz)**			**Time to disconnect (s)**			**Time to reconnect (s)**	
Limit	<=52Hz			<=0,2s			>=60s	
Actual setting	52,0			0,2			60,0	
Trip value	51,99	51,99	51,99	0,125	0,119	0,179	67	

Note:
Actual settings are the settings of the inverter. The trip value is the measured value. It has to be in the range of +/- 0.1Hz of the actual setting.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

Diagram of under-frequency protection (for Australia)

Diagram of under-frequency protection (for New Zealand)

Diagram of over-frequency protection

7.5.2 Limits for sustainedoeration Appendix H2 Sustained operation for voltage variations Australia	**P**

	Output power level: 50+/-5% Apparent Power	
Setting values	Setting Vnom_max [V]	255,0
	Setting $T_{disconnection}$ [s]	/

Test:

a)

Step 1. The voltage is set to Vnom_max – 1 V. Maintained for 5 min.
Step 2. The voltage increase to Vnom_max + 1 V and proceeding 10 min.
Step 3. The 10 min average voltage shall be recorded.

		Average Voltage (V)	Limit
Phase 1	1st time	255,21	1. Disconnection should take place. 2. Voltage within +/1 % of the set-point.
	2nd time	255,24	
	3rd time	255,26	
Phase 2	1st time	255,26	
	2nd time	254,94	
	3rd time	255,02	
Phase 3	1st time	255,38	
	2nd time	255,48	
	3rd time	255,39	

b)

Step 1. The voltage is set to Vnom_max and maintained for 10 min.
Step 2. Increase 2 V to trig the protection.
Step 3. Record the disconnection time.

	Disconnection time (s)	Limit
Phase 1	19	Disconnection time < 30s
Phase 2	6	
Phase 3	28	

c)

Step 1. The output voltage of variable a.c. supply decrease the voltage to gird test voltage.
Step 2. Record the reconnection time.

	Reconnection time (s)	Limit
Phase 1	87	Reconnection time > 60s
Phase 2	127	
Phase 3	106	

Note:
1. The default set-point for Vnom-max shall be as follows:
   (a) In Australia: 255 V.
   (b) In New Zealand: 248 V.
2. The 10 min average value shall be compared against the limit Vnom_max at least every 3 s to determine when to disconnect.
3. The inverter shall operate the automatic disconnection device (see Clause 7.2) within 3 s when the average voltage for a 10 min period exceeds the Vnom_max.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

7.5.2 Limits for sustainedoeration **Appendix H2 Sustained operation for voltage variations** **New Zealand**	**P**

	Output power level: 50+/-5% Apparent Power	
Setting values	Setting Vnom_max [V]	248,0
	Setting $T_{disconnection}$ [s]	/

Test:

a)

Step 1. The voltage is set to Vnom_max – 1 V. Maintained for 5 min.
Step 2. The voltage increase to Vnom_max + 1 V and proceeding 10 min.
Step 3. The 10 min average voltage shall be recorded.

		Average Voltage (V)	Limit
Phase 1	1st time	247,88	1. Disconnection should take place. 2. Voltage within +/1 % of the set-point.
	2nd time	248,23	
	3rd time	248,29	
Phase 2	1st time	248,02	
	2nd time	248,16	
	3rd time	248,16	
Phase 3	1st time		
	2nd time		
	3rd time		

b)

Step 1. The voltage is set to Vnom_max and maintained for 10 min.
Step 2. Increase 2 V to trig the protection.
Step 3. Record the disconnection time.

	Disconnection time (s)	Limit
Phase 1	9	Disconnection time < 30s
Phase 2	8	
Phase 3	7	

c)

Step 1. The output voltage of variable a.c. supply decrease the voltage to gird test voltage.
Step 2. Record the reconnection time.

	Reconnection time (s)	Limit
Phase 1	62	Reconnection time > 60s
Phase 2	75	
Phase 3	61	

Note:
1. The default set-point for Vnom-max shall be as follows:
   (a) In Australia: 255 V.
   (b) In New Zealand: 248 V.
2. The 10 min average value shall be compared against the limit Vnom_max at least every 3 s to determine when to disconnect.
3. The inverter shall operate the automatic disconnection device (see Clause 7.2) within 3 s when the average voltage for a 10 min period exceeds the Vnom_max.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

7.5.3.1 Response to an increase in frequency **Appendix H3.2 Test procedure**							**P**
1. Measurement a) to w): Power output: 50+/-5% of rated apparent power							
30s mean value	a) 50,00Hz	b) 50,25Hz	c) 50,35Hz	d) 50,45Hz	e) 50,55Hz	f) 50,65Hz	g) 50,75Hz
Frequency [Hz]:	50,00	50,25	50,35	50,45	50,55	50,65	50,75
$P_{setpoint}$ [kW]:	5,500	5,500	5,233	4,914	4,597	4,280	3,962
P [kW]:	5,567	5,555	5,236	4,918	4,600	4,282	3,969
$\Delta P/P_{Setpoint}$ [%]:	-0,61	-0,50	-0,02	-0,04	-0,03	-0,02	-0,07
30s mean value	h) 50,85Hz	i) 50,95Hz	j) 51,05Hz	k) 51,15Hz	l) 51,25Hz	m)51,35Hz	n) 51,45Hz
Frequency [Hz]:	50,85	50,95	51,05	51,15	51,25	51,35	51,45
$P_{setpoint}$ [kW]:	3,647	3,328	3,010	2,694	2,376	2,059	1,740
P [kW]:	3,654	3,334	3,013	2,696	2,377	2,059	1,740
$\Delta P/P_{Setpoint}$ [%]:	-0,07	-0,05	-0,03	-0,03	0,00	0,00	0,00
30s mean value	o) 51,55Hz	p) 51,65Hz	q) 51,75Hz	r) 51,85Hz	s) 51,95Hz	t)52,05Hz	u) 52,15Hz
Frequency [Hz]:	51,55	51,65	51,75	51,85	51,95	52,05	52,15
$P_{setpoint}$ [kW]:	1,425	1,107	0,789	0,461	0,154	0,000	0,000
P [kW]:	1,421	1,103	0,784	0,457	0,147	0,000	0,000
$\Delta P/P_{Setpoint}$ [%]:	0,03	0,04	0,04	0,03	0,06	0,00	0,00
The frequency shall be decreased every 30 s in 0,2 Hz decrements from 52,25Hz until less than 50,15Hz. Maintained for 10 min or until the inverter reaches the maximum output power available. After frequency decreased to less than 50,15Hz, adjust output power to 100% rated power.							
30s mean value	v) 52,25Hz	->	w) 50,05Hz	N/A	N/A	N/A	N/A
Frequency [Hz]:	52,25	N/A	50,05	N/A	N/A	N/A	N/A
$P_{setpoint}$ [kW]:	0,000	N/A	0,000	N/A	N/A	N/A	N/A
P [kW]:	0,000	N/A	0,000	N/A	N/A	N/A	N/A
$\Delta P/P_{Setpoint}$ [%]:	0,00	N/A	0,00	N/A	N/A	N/A	N/A
Limit W_{Gra}:	+ 17 %						
Note: 1. The output power at grid test voltage/50,00Hz shall be maintained for 5 min and the average power shall be used as the frozen value of power (Pref) 2. The frequency increase rate: 0.1Hz/step/30s. 3. The frequency decrease rate: 0.2Hz/step/30s. 4. While the frequency decrease less than 50,15Hz, the voltage and frequency shall be maintained for 10 min or until the inverter reaches the maximum output power available. 5 After frequency decrease less than 50,15Hz, adjust output power to 100% rated power. The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.							

Diagram of overfrequency

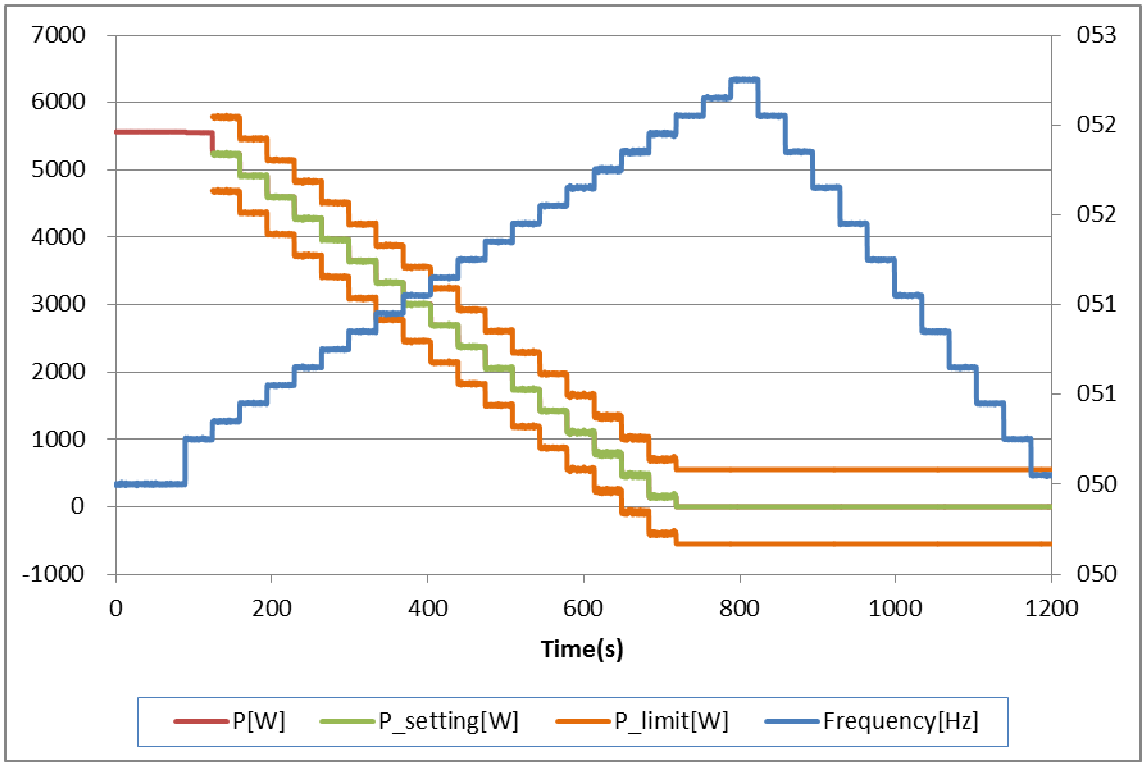
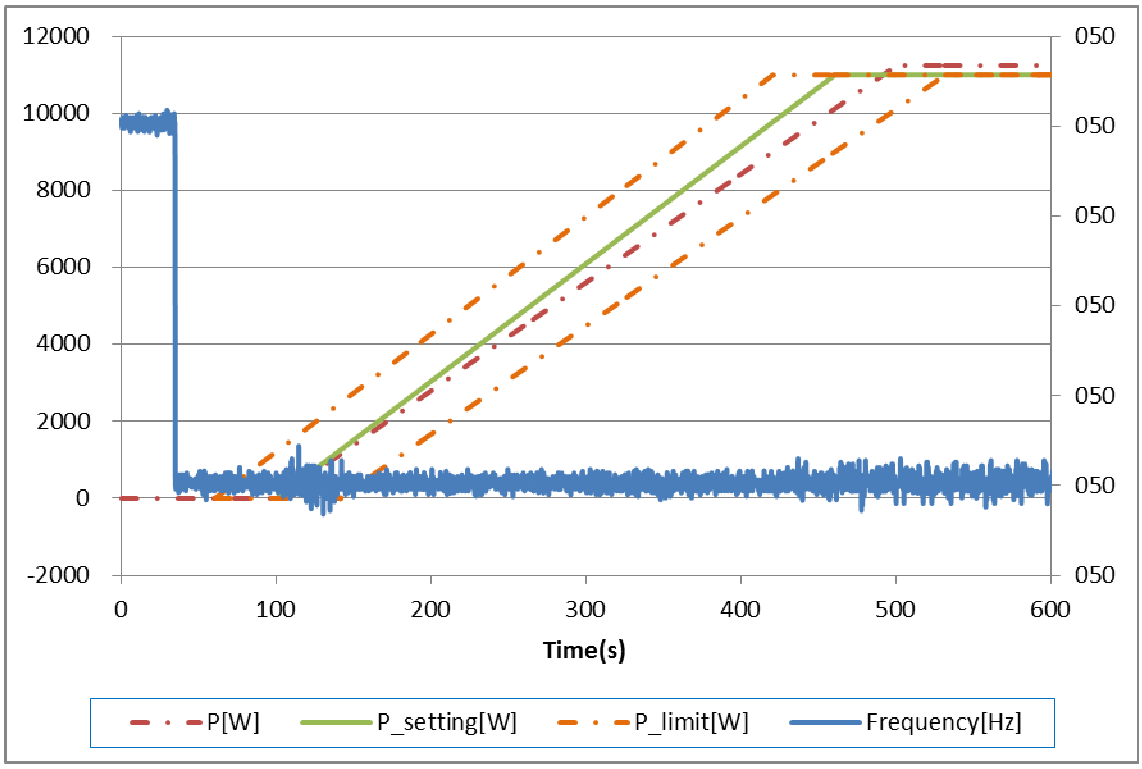


Diagram of power restore gradient line



7.5.3.1 Response to an increase in frequency (continued) **Appendix H3.2 Test procedure (continued)**							**P**
2. Measurement a) to o): Power output: 50+/-5% of rated apparent power							
30s mean value	a) 50,00Hz	b) 50,25Hz	c) 50,35Hz	d) 50,45Hz	e) 50,55Hz	f) 50,65Hz	g) 50,75Hz
Frequency [Hz]:	50,00	50,25	50,35	50,45	50,55	50,65	50,75
$P_{setpoint}$ [kW]:	5,500	5,500	5,182	4,869	4,552	4,237	3,924
P [kW]:	5,567	5,554	5,234	4,916	4,601	4,283	3,968
$\Delta P/P_{Setpoint}$ [%]:	-1,335	-1,072	-1,045	-0,956	-0,979	-0,919	-0,880
30s mean value	h) 50,85Hz	i) 50,95Hz	j) 51,05Hz	N/A	N/A	N/A	N/A
Frequency [Hz]:	50,85	50,95	51,05	N/A	N/A	N/A	N/A
$P_{setpoint}$ [kW]:	3,609	3,294	2,982	N/A	N/A	N/A	N/A
P [kW]:	3,655	3,335	3,016	N/A	N/A	N/A	N/A
$\Delta P/P_{Setpoint}$ [%]:	-0,901	-0,824	-0,687	N/A	N/A	N/A	N/A
The frequency shall be decreased every 30 s in 0,2 Hz decrements from 51,05Hz until less than 50,15Hz. Maintained for 10 min or until the inverter reaches the maximum output power available. After frequency decreased to less than 50,15Hz, adjust output power to 100% rated power.							
30s mean value	k) 50,85Hz	l) 50,65Hz	m)50,45Hz	n) 50,25Hz	o) 50,05Hz	N/A	N/A
Frequency [Hz]:	50,85	50,65	50,45	50,25	50,05	N/A	N/A
$P_{setpoint}$ [kW]:	2,982	2,982	2,982	2,982	2,982	N/A	N/A
P [kW]:	3,016	3,015	3,015	3,015	3,015	N/A	N/A
$\Delta P/P_{Setpoint}$ [%]:	-0,673	-0,670	-0,670	-0,669	-0,669	N/A	N/A
Limit W_{Gra}:	+ 17 %						

Note:
1. The output power at grid test voltage/50,00Hz shall be maintained for 5 min and the average power shall be used as the frozen value of power (Pref)
2. The frequency increase rate: 0.1Hz/step/30s.
3. The frequency decrease rate: 0.2Hz/step/30s.
4. While the frequency decrease less than 50,15Hz, the voltage and frequency shall be maintained for 10 min or until the inverter reaches the maximum output power available.
5 After frequency decrease less than 50,15Hz, adjust output power to 100% rated power.

The tests had been performed on the SOFAR 33000TL-G2 is valid for the and SOFAR 20000TL-G2, SOFAR 25000TL-G2 and SOFAR 30000TL-G2, since it is similar in hardware and just power derated by software.

Diagram of overfrequency

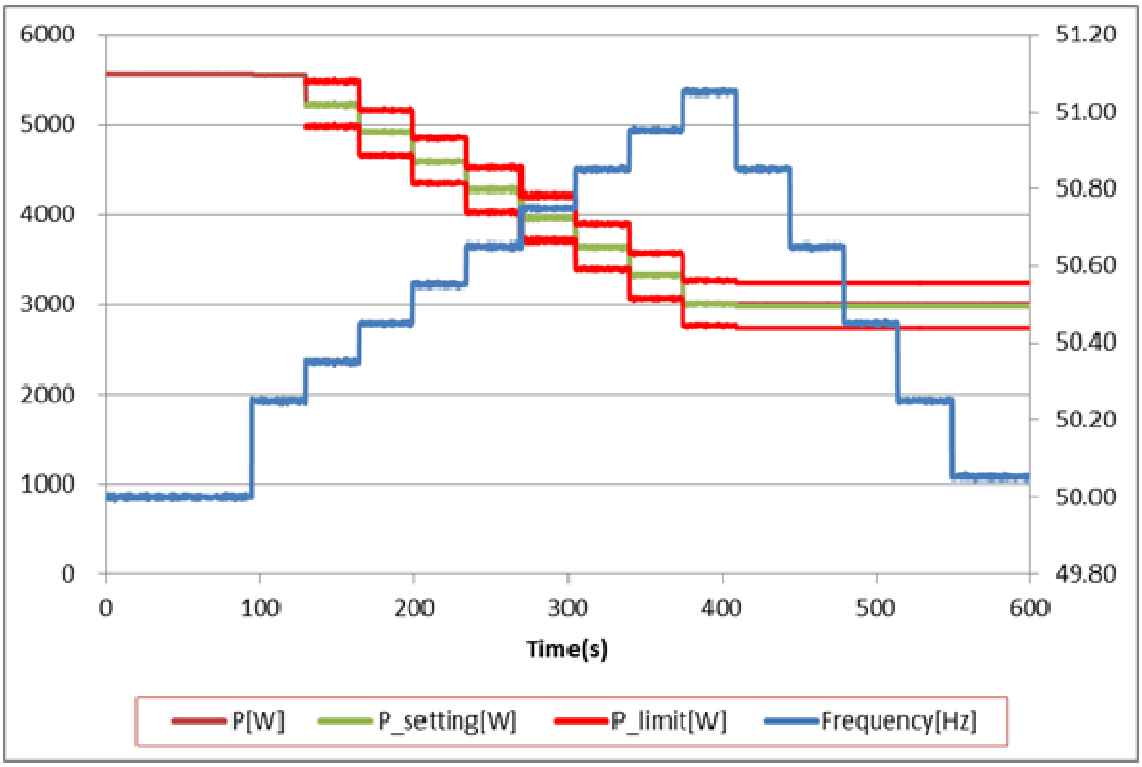
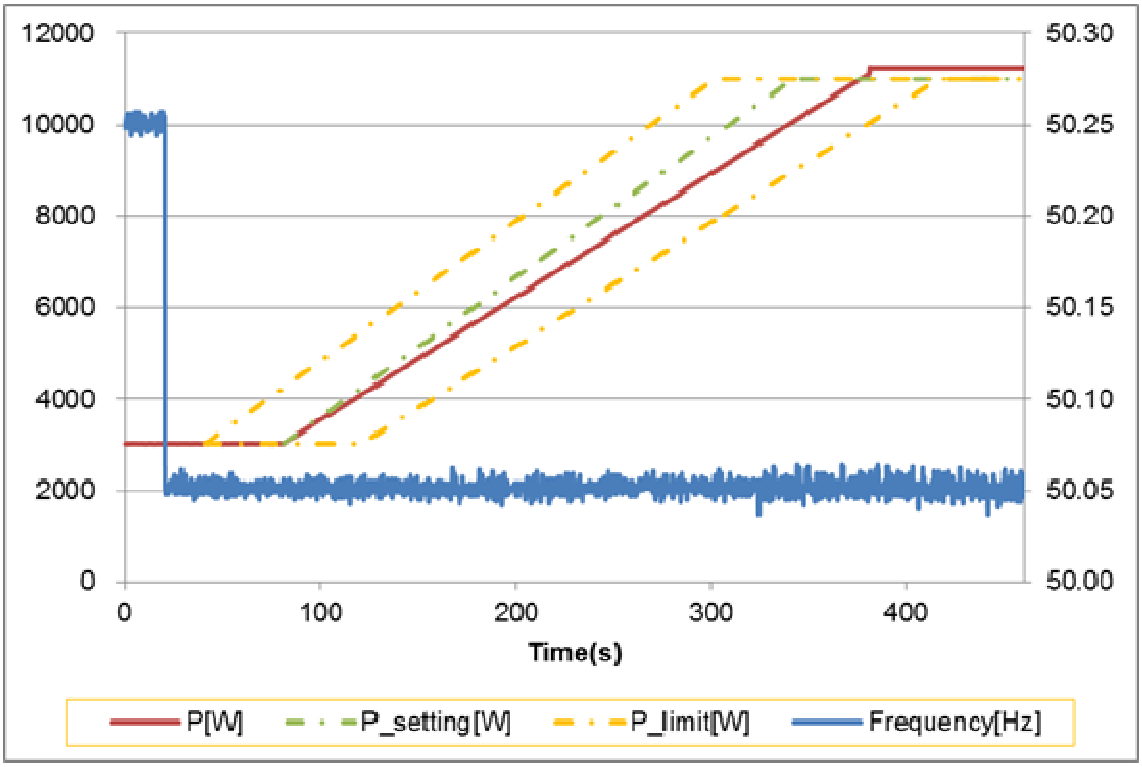


Diagram of power restore gradient line



Annex 1

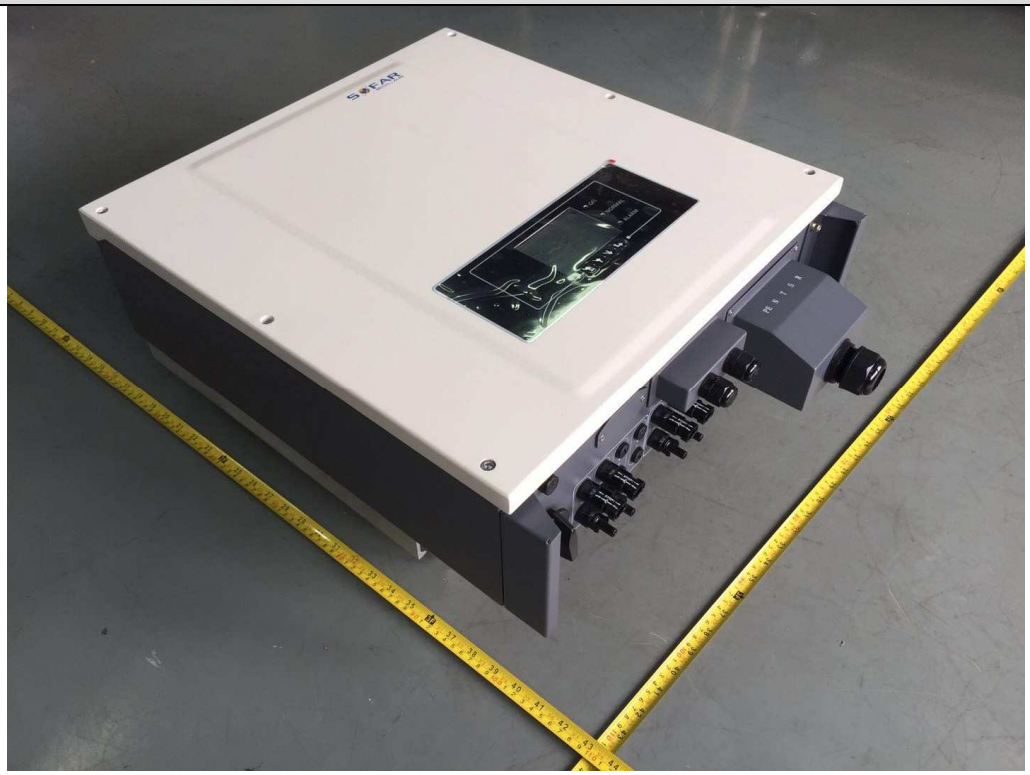
Pictures of the unit

The full pictures refer to PHOTO DOCUMENT

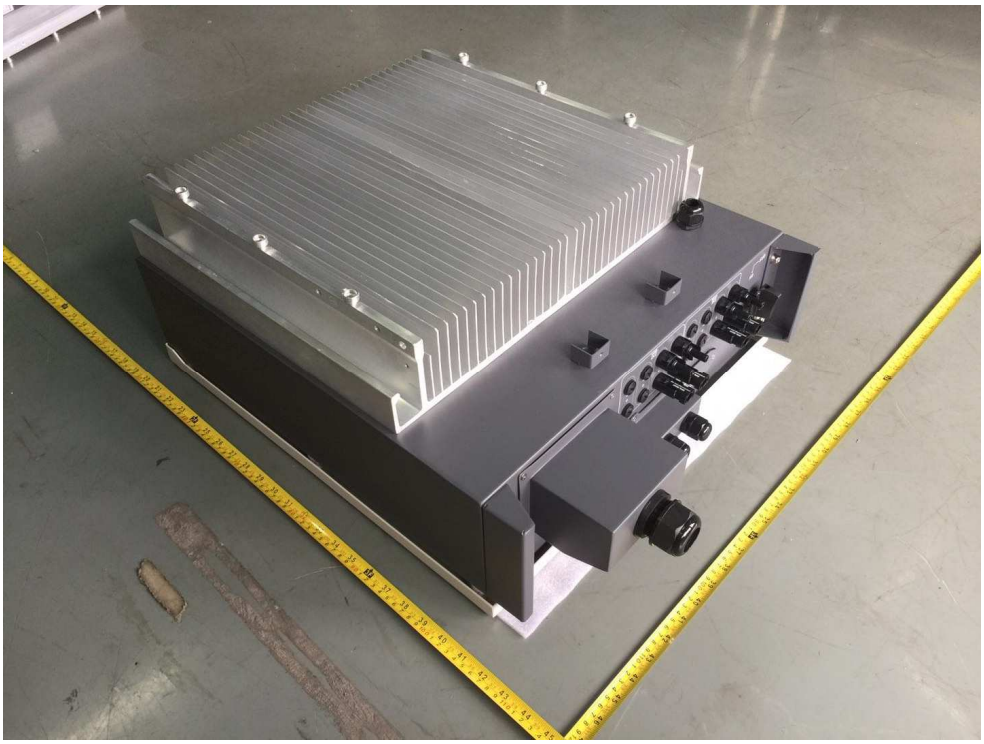
Project No.: 180712N013

Date: 20190424

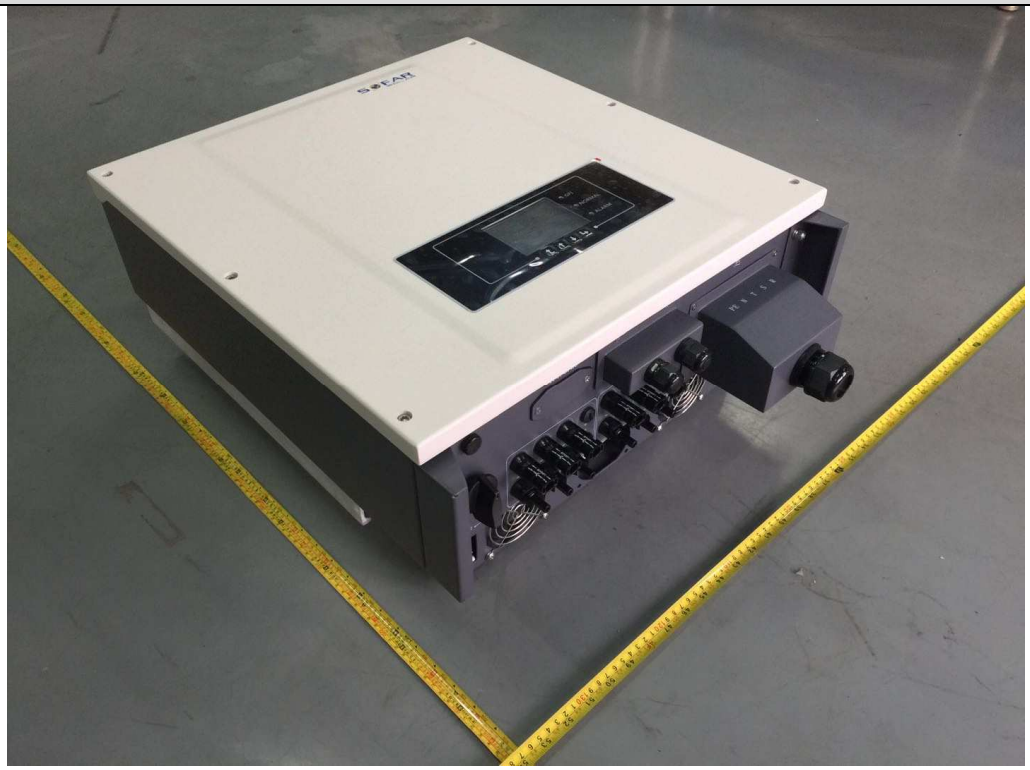
Enclosure front view: SOFAR 20000TL-G2



Enclosure rear view: SOFAR 20000TL-G2

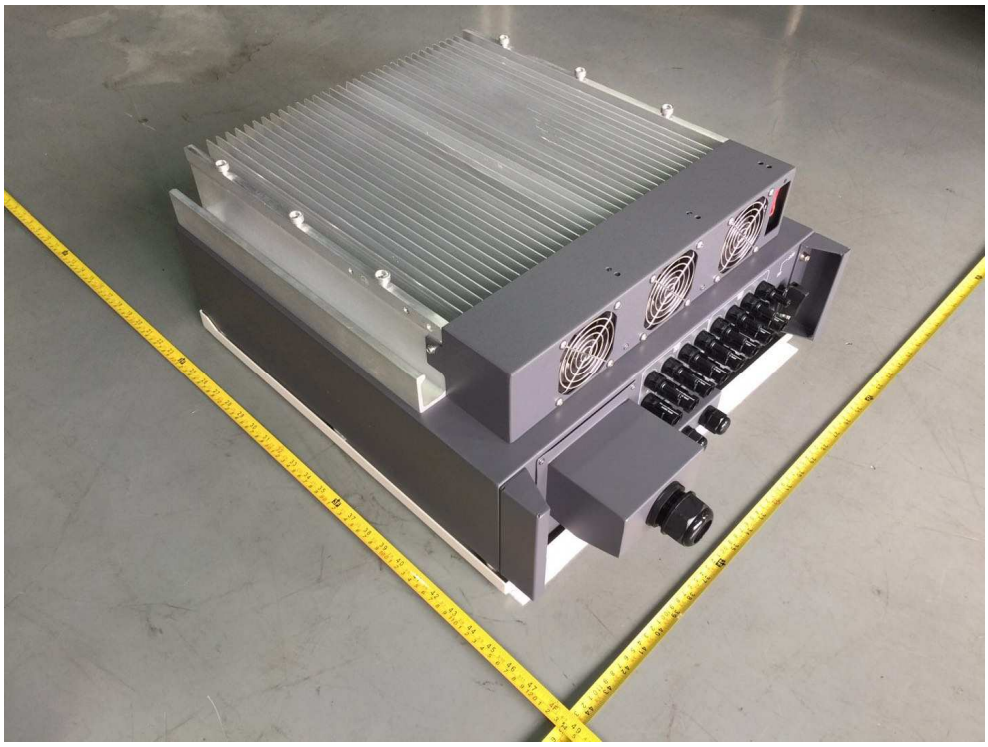


Enclosure front view: SOFAR 25000TL-G2



Enclosure rear view: SOFAR 25000TL-G2

Enclosure front view: SOFAR 30000TL-G2, SOFAR 33000TL-G2

Enclosure rear view: SOFAR 30000TL-G2, SOFAR 33000TL-G2


Annex 2
Test equipment list

Test location: Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Dates of performance test: 2018-07-12 to 2019-05-09

Equipment	Internal no.:	Manufacturer:	Type:	Serial no.:	Last calibration
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	Dec. 13, 2018
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyzer
AC Source	A7040020DG	Chroma	61512	61512000438	
AC Source	SCGJ276	Chroma	6560	656038001201	
DC Simulation Power Supply	A7040015DG	Chroma	62150H-1000S	62150EF00488	
DC Simulation Power Supply	A7040016DG	Chroma	62150H-1000S	62150EF00490	
DC Simulation Power Supply	A7040017DG	Chroma	620028	620028EF00120	
DC Simulation Power Supply	A7040021DG	Chroma	62150H-1000S	62150EF00609	
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	
Eight Channel Digital Phosphor Oscilloscope	A4089017DG	YOKOGAWA	DL850	91N726247	Sep. 14, 2018
Four Channel Digital Phosphor Oscilloscope	A4089003DG	Tektronix	DPO4104B	C010624	Oct. 25, 2018
Oscilloscope probel	A1490009DG	YOKOGAWA	701901	//	Nov. 01, 2018
Oscilloscope probel	A1490010DG	YOKOGAWA	701901	//	Nov. 01, 2018
Oscilloscope probel	A1490011DG	YOKOGAWA	701901	//	Nov. 01, 2018
Current transducer	A1060008DG	YOKOGAWA	CT200	1130700017	Nov. 17, 2018
Current transducer	A1060009DG	YOKOGAWA	CT200	1130700019	Nov. 17, 2018
Current transducer	A1060009DG	YOKOGAWA	CT200	1130700019	Nov. 17, 2018