TEST REPORT

AS/NZS 4777.2

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

Report Reference No. ....:	161008062GZU-005
Tested by (name + signature) ....:	Jason Fu
Approved by (name + signature) ......:	Tommy Zhong
Date of issue...................................:	18 Nov., 2016
Contents …………………………...:	48 pages
Testing Laboratory ....:	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Address...:	Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GliETDD, Guangzhou, China
Testing location / procedure ....:	TL ☒ SMT ☐ TMP ☐
Testing location / address.................:	The same as testing laboratory
Applicant's name ....:	Shenzhen SOFARSOLAR Co., Ltd.
Address...:	5L,Fourth Building,Antongda Industrial Park,Liuxian Avenue No.1,Xinan Street,Baoan District,Shenzhen,China.

Test specification:

Standard ....:	AS/NZS 4777.2: 2015
Test procedure.................................:	Australia registration
Non-standard test method…………..:	N/A

Test Report Form/blank test report

Test Report Form No.........................:	TTRF_AS/NZS _4777.2B
TRF Originator ....:	Intertek Guangzhou
Master TRF......................................:	Dated 2015-11

Test item description ....:	AC-coupled Storage Converter
Trade Mark ....:	SOFAR SOLAR
Manufacturer....................................:	Same as applicant
Model/Type reference.......................:	ME 3000SP

Rating………………………………….:	Battery Type: Lead-acid, Lithium-ion
	Battery Voltage Range: 42-58Vdc
	Max. Charging Current: 60A
	Max. Discharging Current: 60A
	Max. Charging & Discharging Power: 3000VA
	Nominal Grid Voltage: 230Vac
	Nominal output Voltage (stand-alone): 230Vac
	Max. output Current: 13A
	Nominal Grid frequency: 50Hz
	Power factor: 1 (adjustable +/-0.8)
	Ingress protection: IP65
	Operating Temperature Range: -25℃ - 60℃
	Protective Class: Class I

Test item particulars ....:	
Classification of installation and use............................:	Class I, outdoor used
Supply Connection ....:	Permanent connection
Possible test case verdicts:	
- test case does not apply to the test object ....:	N/A
- test object does meet the requirement ....:	P(Pass)
- test object does not meet the requirement ....:	F(Fail)
Testing ....:	
Date of receipt of test item ....:	08 Oct 2016
Date (s) of performance of tests ....:	08 Oct 2016 to 10 Nov 2016

General remarks:

The test results presented in this report relate only to the object tested.
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"(see Enclosure #)" 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.

When determining for test conclusion, measurement uncertainty of tests has been considered.
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The test results presented in this report relate only to the item tested. The results indicate that the specimen complies with standard" AS/NZS 4777.2: 2015".
Factory: same as applicant

This report shall be used together with the report 161008062GZU-002, 161008062GZU-003 and 161008062GZU-004

General product information:

The equipment under test is single phase energy storage inverter. They are responsible for converting the direct current generated by battery into single-phase 230V, 50 Hz. It is basic insulation between grid and battery. Two mechanical disconnection device (relay) and high frequency isolated transformer are provided between grid and battery on line and neutral conductor

The inverters intended to operate at ambient temperature -25℃ - +60℃, which will be specified in the user manual, however, the inverters will output full power when operated at 45℃, if operated at higher than 45℃ temperature, the output power would be derate.

The equipment have three working mode. Charge mode, Discharge mode, Stand-alone mode :
Charge mode: The AC voltage from mains charges the battery provided in the final system.
Discharge mode: The inverter converters the energy from the battery to 230Va.c.,50 Hz voltage and connected to AC mains. In this mode the inverter works as grid connected inverter.
Stand-alone mode: The inverter converter the energy from the battery to 230Va.c.,50 Hz voltage and feed the general load. In this mode the inverter worked as stand-alone inverter.

Version of software: V1.00

Version of hardware:V1.00

The type of grid source: simulated test grid

The impedance of the grid source:0.1Ω

Copy of marking plate(representative):

S☀FAR SOLAR	
AC-coupled Storage Converter	
Model No.	**ME 3000SP**
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58 Vdc
Max. Charging Current	60A
Max. Discharging Current	60A
Max. Charging & Discharging Power	3000 VA
Nominal Grid Voltage	230Vac
Nominal Output Voltage	230Vac
Max. Output Current	13A
Nominal Grid Frequency	50 Hz
Power factor	1(adjustable+/-0.8)
Ingress protection	IP65
Operating Temperature Range	-25-+60°C
Protective Class	Class I

Manufacturer: Shenzhen SOFARSOLAR Co., Ltd.

VDE0126-1-1,VDE-AR-N4105,G83/2,EN50438,C10/11, RD1699,UTE C15-712-1,AS4777

DRM0

S/N

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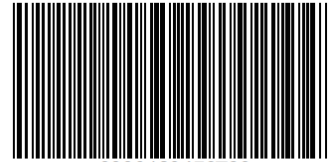
Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.

2. Label is attached on the side surface of enclosure and visible after installation

AS/NZS 4777.2			
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.	IEC 62109-1 and IEC 62109-2 have been considered	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.	AS 62040.1.1have been considered	P
	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. However, for energy source inputs other than PV arrays or batteries, the requirements of IEC 62109-1 and IEC 62109-2 shall be applied with consideration of the inverter topology, the energy source voltage, installation requirements and potential faults which could present a hazard.	IEC 62109-1 and IEC 62109-2 have been considered	P
5.2	Provision for external connections		P
	Inverters shall be used and installed as fixed equipment only. Inverters shall not be used as portable equipment.		P
	Inverter provisions for external connection—		P
	(a) shall be for fixed equipment only; and	Fixed equipment only	P
	(b) shall provide for safe and reliable connection to any d.c. source or load or any a.c. source or load.	Certified DC input connection and AC output connection used	P
	All inverter ports (except communications ports) shall incorporate connection types for either—		P
	(i) permanently connected equipment; or		P
	(ii) pluggable type B 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.		P
	Pluggable type B equipment shall have one of the following means of connection:		N/A
	(A) A non-detachable cord for connection to the supply by means of a connector.		N/A
	(B) An appliance inlet suitable for connection to a matching connector.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	Pluggable type B equipment shall not incorporate—		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		N/A
	(3) a connection by a connector or inlet where hazardous voltages are accessible by the standard test finger.		N/A
5.3	Photovoltaic (PV) array earth fault/earth leakage detection		N/A
	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.		N/A
	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
	Compliance shall be checked by inspection of the inverter's markings and manufacturer's documentation, and testing in accordance with IEC 62109-2.		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—		N/A
	(a) open circuit the functional earth connection to the PV array;		N/A
	(b) measure the resistance to earth of each conductor of the PV array;		N/A
	I if the earth resistance is above the resistance limit (R_{iso} limit) threshold specified in Table 1, the system shall reconnect the functional earth and shall be allowed to start; and		N/A
	(d) if the earth resistance is equal to or less than the resistance limit (R_{iso} 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.		N/A
5.4	Compatibility with electrical installation		P
	The inverter shall be compatible with wiring practices for LV electrical 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).		P
5.5	Power factor		P

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Clause	Requirement - Test	Result - Remark	Verdict
	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 appended table	P
	NOTE: For all inverter current outputs below 25% of rated current, it is acceptable for the displacement power factor to be controlled such that the vars supplied or drawn are less than the amount of vars supplied or drawn at 25% current output.		P
	Operation at power factor other than unity is acceptable where the inverter operates in power quality response modes. Additional requirements for displacement power factor control apply for inverters that are capable of operating in power quality response modes. See Clause 6.3.		P
	Compliance shall be determined by type testing in accordance with the power factor test specified in Appendix B.	See appended table	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%.		P
	Compliance shall be determined by type testing in accordance with the harmonic current limit test specified in Appendix C.	See appended table	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.).		P
	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 (Z_{max}) 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 values of P_{st} and P_{lt}, when tested using Z_{ref}, and the network impedance value (Z_{max} or Z_{ref}) required for compliance shall be included in the inverter documentation.		P
	Compliance shall be determined by testing in accordance with the appropriate Standard. The inverter shall remain connected throughout the test and the automatic disconnection device shall not operate.	See appended table	P
5.8	Transient voltage limits		P

AS/NZS 4777.2		
Clause	Requirement - Test	Result - Remark	Verdict

Clause	Requirement - Test	Result - Remark	Verdict
	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.		P
	Compliance shall be determined by type testing in accordance with the transient voltage limit test specified in Appendix D. The voltage-duration curve is derived from the measurements taken at the grid-interactive port of the inverter.	See appended table	P
5.9	Direct 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.		P
	In the case of a three-phase inverter, the d.c. output current of the inverter at any 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.		N/A
	If the inverter does not incorporate a mains frequency isolating transformer or is not used with a dedicated external isolation transformer, it shall be type tested to ensure the d.c. output current at any a.c. port of the inverter is below the limits specified above at all output current levels.		P
	Compliance shall be determined by type testing in accordance with the d.c. current injection test specified in Appendix E.	See appended table	P
5.10	Current balance for three-phase inverters		N/A
	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.	Single-phase inverter	N/A
	Compliance shall be determined by type testing in accordance with the following requirement. 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.		N/A
	Inverters which can be used in a voltage balance mode, as defined in Clause 6.3.2.4, are allowed to generate unbalanced currents.		N/A
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		P

Clause	Requirement - Test	Result - Remark	Verdict
		AS/NZS 4777.2	

Clause	Requirement - Test	Result - Remark	Verdict
	inverter.		
6.2	Inverter demand response modes (DRMs)		P
6.2.1	General		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.		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.		P
	The inverter shall comply with the relevant requirements of Clause 5 and this Clause (6), and with all of the requirements of Clause 7, while any demand response mode is asserted.		P
	Compliance shall be determined by testing as specified in Appendix I.	See appended table	P
6.2.2	Interaction with demand response enabling device (DRED)		P
	The inverter shall have a means of connecting to a DRED. This means of connection shall include a terminal block or RJ45 socket. The terminal block or RJ45 socket shall comply with the minimum electrical specifications in Table 6. The terminal block or RJ45 socket may be physically mounted in the inverter or in a separate device that remotely communicates with the inverter.	Terminal block used	P
	The DRED asserts demand response modes by shorting together terminals or pins as specified in Table 7. In detecting the state of the DRED, the inverter shall comply with the following requirements:		P
	(a) The inverter shall not inject more than 30 mA (d.c. or a.c.) into—		P
	(i) terminals 'DRM1/5', 'DRM2/6', 'DRM3/7' or 'DRM4/8', where a terminal block is used; or	Terminal block used	P
	(ii) pins 1, 2, 3 or 4, where an RJ45 socket is used.		N/A
	(b) The inverter shall allow for a drop of up to 1.6 V across the DRED and associated wiring when nominally shorted.		P
	I The inverter shall not supply more than 34.5 V (d.c. or a.c.) to any terminal of the terminal block or RJ45 socket.		P
	(d) If the impedance between pins 5 and 6 is detected to be above 20 kΩ, the inverter shall fail-safe to DRM 0 asserted.		P

Clause	Requirement - Test	Result - Remark	Verdict
		AS/NZS 4777.2	
	The DRED may assert more than one DRM at a time, in which case the requirements of every active DRM that is supported by the inverter shall be simultaneously satisfied.	Only DRM0	N/A
	The inverter shall detect the assertion of any combination of DRMs which result in terminal 5 and 6 being shorted simultaneously as assertion of DRM 0.	Only DRM0	N/A
	Where DRM 3 or DRM 7 are supported, the reactive power set-point shall be set by default to operate at unity power factor. The reactive power set-point should be adjustable up to a minimum of 60% of the inverter's kVA rating.		N/A
	The inverter may optionally provide a power supply for use by the DRED. If included this shall be d.c. and of a voltage less than 34.5 V.	Not provide power supply	N/A
	Where an RJ45 socket is used, pins 7 and 8 may be utilized as positive and negative DRED power supply pins respectively. The power supply shall be capable of delivering at least 0.5 A at a minimum of 6 V d.c., otherwise the inverter shall short pins 7 and 8 together.		N/A
	Where a terminal block is used, only those terminals needed for the supported DRMs are required.		P
6.3	Inverter power quality response modes		P
6.3.1	General		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 outside the typical operation of an inverter for the purpose of providing support to a grid.		P
	These various operating modes may be enabled or disabled in an inverter and may include the following:		P
	(i) Volt response modes.	Only Volt watt response mode	P
	(ii) Fixed power factor or reactive power mode.		P
	(iii) Power response mode.		P
	(iv) Power rate limit.		P
	If these power quality response modes are available in the inverter, the inverter shall comply with the relevant requirements of this Clause (6) and Clause 5, and all of the requirements of Clauses 7 and 8, when these modes are enabled or disabled.		P
	Compliance shall be determined by type testing as specified in Appendix I with the applicable modes disabled and enabled.		P

	AS/NZS 4777.2		
Clause	Requirement - Test	Result - Remark	Verdict
	If these power quality response modes of operation are controlled by an external device, the external device shall not interfere with the inverter complying with the relevant requirements of this Clause (6) and Clause 5, and all of the requirements of Clauses 7 and 8, when the external device is controlling these modes.		N/A
6.3.2	Volt response modes		P
6.3.2.1	General		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. Each volt response mode may have volt response reference values which are independent of other volt response modes. This is to allow different volt response curves for different volt response modes.		P
6.3.2.2	Volt－watt response mode		P
	The volt－watt response mode varies the output power of the inverter in response to the voltage at its terminal. The inverter should have the volt－watt response mode. If this mode is available, it shall be enabled by default.	See appended table	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.		P
6.3.2.3	Volt－var response mode		N/A
	The volt－var response mode varies the reactive power output of the inverter in response to the voltage at its grid-interactive port. The inverter should have the volt－var response capability. If this mode is available, it shall be disabled by default.		N/A
	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.		N/A
6.3.2.4	Voltage balance modes		N/A
	If the voltage balance mode is available, the following requirements apply:		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	(a) The voltage balance mode shall be disabled by default.		N/A
	(b) For single-phase inverters used in a three-phase combination, the requirements of Clause 8.2 apply.		N/A
	I The voltage balancing mode shall be able to—		N/A
	(i) operate correctly with a single fault applied;		N/A
	(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		N/A
	(iii) detect the fault or loss of operability and disconnect the inverter from the electrical installation.		N/A
6.3.3	Fixed power factor mode and reactive power mode		P
	The fixed power factor mode and the reactive power mode may be required in some situations by the electrical distributor to meet local grid requirements. These modes shall be disabled by default.	See appended table	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%. The reactive power modes may be required to be fixed at a constant reactive power by the electrical distributor.		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. The fixed power factor mode is for control of the displacement power factor over the range of inverter power output.		P
6.3.4	Characteristic power factor curve for cos ϕ (P) (Power response)		P
	The characteristic power factor curve for cos ϕ (P) (Power response) mode varies the displacement power factor of the output of the inverter in response to changes in the output power of the inverter, i.e. cos ϕ (P) modes. If this mode is available, it shall be disabled by default.	See appended table	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.		P
6.3.5	Power rate limit		P
6.3.5.1	General		P

	AS/NZS 4777.2		
Clause	Requirement - Test	Result - Remark	Verdict
	The power rate limit for an inverter is a power quality response mode. The inverter shall have the capability to rate limit changes in power generation through the grid-interactive port. 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).	See appended table	P
	The power rate limit only applies to the changes specified in Clause 6.3.5.3.		P
	The power rate limit does not apply when the inverter disconnection device is required to operate (i.e. to disconnect).		P
6.3.5.2	Gradient of power rate limit		P
	The power rate limit (W_{Gra}) is the ramp rate of real power output in response to changes in power and is defined as a percentage of rated power per minute. The nominal ramp time (Tn) is the nominal time for a 100% change in output power with a power rate limit of W_{Gra}. An inverter shall have an adjustable power rate limit (W_{Gra}) which limits the change in power output to the set power rate limit. The default setting for the power rate limit (W_{Gra}) for increase and decrease shall be 16.67% of rated power per minute which is a nominal ramp time of 6 min.		P
	The power rate limit (W_{Gra}) shall be adjustable within the range 5% to 100% of rated power per minute. It is acceptable to have two separate power rate limits for increase and decrease in output power, as follows:		P
	(a) To rate limit an increase in power (W_{Gra}+).		P
	(b) To rate limit a decrease in power (W_{Gra}−).		N/A
6.3.5.3	Power rate limit modes		P
6.3.5.3.1	General		P
	The inverter power rate limit (W_{Gra}) is applicable to operate in the following modes:		P
	(a) Soft ramp up after connect or reconnect.		P
	(b) Changes in a.c. operation and control.		N/A
	(c) Changes in energy source operation.		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.		P
6.3.5.3.3	Changes in a.c. operation and control		N/A

AS/NZS 4777.2			
Clause	Requirement - Test	Result - Remark	Verdict
	If available, this mode shall be enabled for a change in a demand response mode of Clause 6.2 (except for DRM 0). When a demand response mode of Clause 6.2 (except for DRM 0) is asserted or unasserted the power rate limit (W_{Gra}) shall apply to the increase or decrease in power generation or consumption and the transitions between power output levels.	Only 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		P
	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. For this mode the power rate limit (W_{Gra}) should apply to the increase or decrease in power generation or consumption, and to the transitions between power output levels. For this mode, the power rate limit (W_{Gra}) should be able to be enabled or disabled. The power rate limit shall be disabled by default. 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). Only for increases or decreases in the output which are faster than the power rate limit (W_{Gra}) does a control action to limit the ramp rate apply.	See appended table	P
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		P
6.4.1	General		P
	The requirements in this Clause for multiple mode inverters are in addition to the requirements for inverters.		P
	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.		P
	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.		P
	Multiple mode inverters shall be arranged such that only the allowed installation methods of AS/NZS 3000 and AS/NZS 4777.1 can be used.		P

AS/NZS 4777.2			
Clause	Requirement - Test	Result - Remark	Verdict
	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.		P
6.4.2	Sinusoidal output in stand-alone mode		P
	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%.		P
	Compliance shall be checked by measuring the THD and the individual harmonic voltages with the inverter delivering 5% power or the lowest continuous available output power greater than 5%, and 50% and 100% of its continuous rated power, into a resistive load, with the inverter supplied with nominal d.c. input voltage. The THD measuring instrument shall measure the sum of the harmonics from $n = 2$ to $n = 50$ as a percentage of the fundamental ($n = 1$) component at each load level.		P
6.4.3	Volt – watt response mode for charging of energy storage		P
	The volt – watt response mode for charging of energy storage varies the power input of the inverter from the grid in response to the voltage at its grid-interactive port. A multiple mode inverter with energy storage which can be charged from the grid shall have this volt – watt response mode. This volt – watt response mode is only active when power from the grid is required to charge the energy storage.		P
	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.		P
6.5	Security of operational settings		P
	The internal settings of the demand response or power quality response modes of the inverter 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.		P
	The installer-accessible settings shall be capable of being adjusted within the values specified in this Clause (6).		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Compliance shall be determined by inspection.		P
7	PROTECTIVE FUNCTIONS FOR CONNECTION TO ELECTRICAL INSTALLATIONS AND THE GRID		P
7.1	General		P
	There shall be an automatic disconnection device to prevent injection of energy into the point of supply and prevent the formation of an unintentional island with the grid or part thereof when supply is disrupted from the grid.	two relays in active conductors and isolated transformer used as automatic disconnection means	P
7.2	Automatic disconnection device		P
	The automatic disconnection device shall prevent power (both a.c. and d.c.) from entering the grid when the automatic disconnection device operates.		P
	The automatic disconnection device shall provide isolation in all live conductors.		P
	Automatic disconnection devices for isolation shall comply with the following requirements:		P
	(a) They shall be capable of withstanding an impulse voltage likely to occur at the point of installation, or have an appropriate contact gap.	There are two relays in serial used as automatic disconnection means. Contact gap is >1.5 mm for each relay	P
	(b) They shall not be able to falsely indicate that the contacts are open.		P
	(c) They shall be designed and installed so as to prevent unintentional closure, such as might be caused by impact, vibration or the like.	Self-check it before the inverter work	P
	(d) They shall be devices that disconnect all live conductors (active and neutral) of the inverter from the grid-interactive port.		P
	(e) They shall be such that with a single fault applied to the automatic disconnection device or to any other location in the inverter, at least basic insulation or simple separation is maintained between the energy source port and the grid-interactive port when the means of disconnection is intended to be in the open state.	two relays in active conductors and isolated transformer provide basic insulation	P
	(f) They shall be such that with a single fault applied to the automatic disconnection device or to any other location in the inverter, power is prevented from entering the grid.	the inverter would shutdown and disconnect from grid	P
	The automatic disconnection device shall be capable of interrupting at least the rated current.		P
	The settings of the automatic disconnection device shall not exceed the capability of the inverter.		P
	A semiconductor (solid-state) device shall not be used for isolation purposes.	Not solid-state device	P

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Clause	Requirement - Test	Result - Remark	Verdict
7.3	Active anti-islanding protection		P
	The automatic disconnection device shall incorporate at least one method of active anti-islanding protection.		P
	The method used to provide active anti-islanding protection shall be declared.	frequency shift 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.		P
	Compliance shall be determined by type testing in accordance with the active anti-islanding tests specified in Appendix F or IEC 62116.	See appended table	P
7.4	Voltage and frequency limits (passive anti-islanding protection)		P
	The automatic disconnection device shall incorporate the following forms of passive anti-islanding protection:		P
	(a) Undervoltage and overvoltage protection.		P
	(b) Under-frequency and over-frequency protection.		P
	For sustained variation of the voltage and frequency beyond each limit specified in Table 13, the automatic disconnection device (see Clause 7.2) shall operate no sooner than the required trip delay time and before the maximum disconnection time.		P
	This requires the inverter to remain in continuous, uninterrupted operation for voltage variations with a duration shorter than the trip delay time specified in Table 13.		P
	Each protective function limit shall be preset and secured against change.		P
	Compliance shall be determined by type testing in accordance with the voltage and frequency limits tests specified in Appendix G.	See appended table	P
7.5	Limits for sustained operation		P
7.5.1	General		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.		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 V_{nom_max}, where $V_{nom-max}$ lies in the range 244 – 258 V.		P
	The sustained operation for voltage variations shall not interfere with the active and passive anti-islanding requirements of Clauses 7.3 and 7.4.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	The limit $V_{nom-max}$, shall be preset to the default set-point and may be programmable up to the maximum 258 V. The default set-point for $V_{nom-max}$ shall be as follows:		P
	(a) In Australia: 255 V.		P
	(b) In New Zealand: 248 V.		P
	The 10 min average value shall be compared against the limit $V_{nom-max}$ at least every 3 s to determine when to disconnect.		P
	Compliance shall be determined by type testing in accordance with the sustained operation for voltage variations test specified in Appendix H.	See appended table	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.		P
	The inverter shall be capable of supplying rated power between 45 Hz and 50.25 Hz for New Zealand.		P
	When a grid frequency disturbance results in an increase in grid frequency which exceeds 50.25 Hz, the inverter shall reduce the power output linearly with an increase of frequency until f_{stop} is reached, where f_{stop} lies in the range 51 – 52 Hz.		P
	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.		P
	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.		P
	The output power shall remain at or below the lowest power level reached in response to an over-frequency event between 50.25 Hz and f_{stop}. This is to provide hysteresis in the control of the inverter. When the grid frequency has decreased back to 50.15 Hz or less for at least 60 s, the power level shall be increased at a rate no greater than the power rate limit (W_{Gra}) of Clause 6.3.5 until the available energy source power is reached. Figure 7(A) shows this.		P
	Unconstrained power operation may recommence 6 min after the frequency returns to and remains at less than 50.15 Hz.		P
	Compliance shall be determined by type testing in accordance with the sustained operation for frequency variations test specified in Appendix H.	See appended table	P
7.5.3.2	Response to a decrease in grid frequency		P
	This requirement applies only to inverters with energy storage.		P

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Clause	Requirement - Test	Result - Remark	Verdict

Clause	Requirement - Test	Result - Remark	Verdict
	The inverter shall be capable of charging the energy storage between 49.75 Hz and 52.0 Hz.		P
	When a grid frequency disturbance results in a decrease in grid frequency which falls below 49.75 Hz, an inverter with energy storage which is charging from the grid port should reduce the power input for charging linearly with a decrease of frequency until $f_{stop-CH}$ is reached, where $f_{stop-CH}$ lies in the range 47 – 49 Hz.		P
	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 frequency.		P
	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 $f_{stop-CH}$ should be 49 Hz.		P
	The power input level for charging of the storage element shall remain at or below the lowest charge rate reached in response to a low-frequency event between $f_{stop-CH}$ and 49.75 Hz. This is to provide hysteresis in the control of the inverter.		P
	When the grid frequency has increased back to 49.85 Hz or more for at least 60 s, the charge rate of the storage element may be increased at a rate no greater than the power rate limit (W_{Gra}) of Clause 6.3.5 until the charge rate present at the time of the frequency disturbance is reached. Figure 7(B) shows this.		P
	Unconstrained charging of the storage element may recommence 6 min after the frequency returns to and remains above than 49.85 Hz.		P
	Compliance shall be determined by type testing in accordance with the sustained operation for frequency variations test specified in Appendix H.	See appended table	P
7.6	Disconnection on external signal		P
	The automatic disconnection device shall incorporate the ability to disconnect on an external signal.		P
	If an external signal or demand response 'DRM 0' condition is asserted, the automatic disconnection device shall operate within 2 s.		P
	Compliance shall be determined by type testing as specified in Appendix I.	See appended table	P
7.7	Connection and reconnection procedure		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—		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;		P

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Clause	Requirement - Test	Result - Remark	Verdict

Clause	Requirement - Test	Result - Remark	Verdict
	(b) the frequency of the grid has been maintained within the range 47.5 Hz to 50.15 Hz for at least 60 s;		P
	(c) the inverter and the grid are synchronized and in-phase with each other; and		P
	(d) no external signal is present or DRM 0 asserted requiring the system to be disconnected.		P
	After the automatic disconnection device operates to connect or reconnect the inverter the output shall rate limit increase in power generation to the set power rate limit (W_{Gra}) for increase in power of Clause 6.3.5. Unconstrained power operation may recommence after the automatic disconnection device operates to connect or reconnect the inverter, when either the rated power output is reached or the required output power level of the inverter exceeds the available energy source.		P
	Compliance shall be determined by type testing in accordance with the tests as specified in Appendix F and Appendix G.	See appended table	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.		P
	The installer-accessible settings of the automatic disconnection device shall be capable of being adjusted within the limits specified in Clause 7.5.		P
	The manufacturer settings of the automatic disconnection device, specified in Clause 7.4, shall be secured against changes.		P
	Compliance shall be determined by inspection.		P
8	MULTIPLE INVERTER COMBINATIONS		N/A
8.1	General		N/A
	There are installations where multiple inverter energy systems are used and the electrical installation connects at a single point of supply to the grid. Inverter energy systems are often comprised of multiple inverters used in combination to provide the desired inverter energy system capacity or to ensure that voltage balance is maintained in multiple phase connections to the grid.	No in such used	N/A
	This Clause (8) specifies the requirements and tests for inverter energy systems used in such combinations. 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.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	Possible combinations are single-phase inverters used in parallel, single-phase inverters used in multiple phase installations and three-phase inverters used in parallel.		N/A
8.2	Inverter current balance across multiple phases		N/A
	In a three-phase inverter system comprised of individual single-phase inverters the a.c. output current should be generated and injected into the three-phase electrical installation as a three-phase balanced current. The maximum current imbalance in a three-phase inverter system comprised of individual single-phase inverters shall be no more than 21.7 A.		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. This applies to all inverters used in combination for single-phase or multiple phases.		N/A
8.4	Grid connection and reconnection		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		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.		N/A
	To determine the number of inverters to be tested, the following equation shall be used: $N = 6/I_{rated}$		N/A
	If $N \geq 2$, 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.		N/A
8.5.2	Single-phase inverters used in three-phase combinations		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)].		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)].		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
8.5.3	Required tests for multiple inverter combinations		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.		N/A
	The tests specified in Table 14 for multiple inverter combinations shall be performed.		N/A
	Compliance shall be determined by type testing as specified in Appendix J.		N/A
8.5.4	Multiple inverters with one automatic disconnection device		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, 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.		N/A
	Compliance shall be determined by performing all of the type tests specified in Clause 5.		N/A
9	INVERTER MARKING AND DOCUMENTATION		P
9.1	General		P
	The inverter shall comply with the marking and documentation requirements of IEC 62109-1 and IEC 62109-2, as varied by this Clause (9).		P
	All markings and documentation shall be in the English language.		P
9.2	Marking		P
9.2.1	General		P
	The following variations apply to the marking requirements of IEC 62109-1 and IEC 62109-2:		P
	(a) Inverters that are designated for use in inverter energy systems incorporating energy sources other than PV arrays or batteries shall bear additional or alternative markings appropriate to the energy source.		P
	(b) Inverters that are designated for use in closed electrical operating areas shall be marked with a warning stating that they are not suitable for installation in households or areas of a similar type or use (i.e. domestic).		N/A
9.2.2	Equipment ratings		P

Clause	Requirement - Test	Result - Remark	Verdict
	The inverter shall be marked with its ratings and the ratings of each port, as specified in Table 15. Only those ratings that are applicable to the type of inverter are required. The ratings shall be plainly and permanently marked on the inverter, in a location that is clearly visible after installation.		P
9.2.3	Ports		P
	Each port shall be marked with its classification and indicate whether a.c or d.c. voltage as appropriate.		P
	Typical classifications include the following:		P
	(a) PV (photovoltaic).		N/A
	(b) Wind turbine.		N/A
	(c) Energy storage.		P
	(d) Battery.		P
	(e) Generator.		N/A
	(f) Grid-interactive.		P
	(g) Stand-alone.		P
	(h) Communications (type).		P
	(i) DRM.		P
	(j) Load.		P
9.2.4	External and ancillary equipment		N/A
	If the inverter requires external or ancillary equipment for compliance with this Standard, the requirement for any such equipment shall be marked on the inverter along with the following or an equivalent statement: 'Refer to the installation instructions for type and ratings' or symbol.		N/A
	Any external or ancillary equipment shall be marked in accordance with this Clause (9).		N/A
9.2.5	Residual current devices (RCDs)		N/A
	Inverter energy systems used with PV array systems require residual current detection in accordance with IEC 62109-1 and IEC 62109-2. The requirements can be met by the installation of a suitably rated RCD external to the inverter or by an RCMU integral to the inverter.		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:		N/A
	WARNING: AN RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER		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:		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	WARNING: A TYPE B RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER		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 response interface port to indicate the demand response modes of which the unit is capable.	DRM 0	P
	Figure 9 illustrates an acceptable form of marking. If this form of marking is used, each box shall contain a tick or a cross (if the inverter has that capability) or remain blank (if it does not have that capability). Alternatively, only the modes supported may be marked.		P
	If the physical interface is a terminal block, then—	Terminal block used	P
	(a) the terminals shall be engraved or otherwise durably marked; or		P
	(b) a permanent label with 'DRM Port' shall be affixed near the terminal block.	DRM0 affixed near the terminal block	N/A
	The marking shall indicate which terminal corresponds to which demand response mode.		P
	The range of markings is indicated against Pins 1 to 6 in Table 7.	DRM0	P
9.3	Documentation		P
9.3.1	General		P
	The documentation supplied with the inverter shall provide all information necessary for the correct installation, operation and use of the system and any required external devices including information specified in Clause 9.2.		
	All inverters, including those intended for use in systems incorporating energy sources other than PV arrays or batteries, shall comply with the documentation requirements of IEC 62109-1 and IEC 62109-2.		P
9.3.2	Equipment ratings		P
	The documentation supplied with the inverter shall state the ratings of the inverter and the ratings for each port, as specified in Table 16. Only those ratings that are applicable to the type of inverter are required.		P
	For equipment with rated current greater than 16 A per phase, additional documentation requirements apply. See Clause 5.7.		P
9.3.3	Ports		P
	In addition to the requirements of Clause 9.3.2, the documentation supplied with the inverter shall state the following for each port, as a minimum:		P
	(a) Means of connection.		P
	(b) For pluggable equipment type B, the type of matching connectors to be used.		P

Clause	Requirement - Test	Result - Remark	Verdict
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	(c) External controls and protection requirements.		P
	(d) Explanation of terminals or pins used for connection including polarity and voltage.		P
	(e) Tightening torque to be applied to terminals.		N/A
	(f) Instructions for protective earthing.		P
	(g) Instructions for connection of loads and installation of RCD protection to stand-alone ports.		N/A
	(h) The decisive voltage class (DVC).		P
9.3.4	External and ancillary equipment		N/A
	Where an inverter or multiple inverter combinations requires external or ancillary equipment for compliance with this Standard, the documentation shall—		N/A
	(a) state the requirement for any such equipment;		N/A
	(b) provide sufficient information to identify the external or ancillary equipment, either by manufacturer and part number or by type and rating; and		N/A
	(c) specify assembly, location, mounting and connection requirements.		N/A
9.3.5	RCDs		N/A
	Where an external RCD is required, the following or an equivalent statement shall be included in the documentation: 'External RCD Required'. The documentation shall also state the rating and type of RCD required and provide instructions for the installation of the RCD.		N/A
9.3.6	Multiple mode inverters	Not Multiple mode inverters	N/A
	Where the inverter is capable of multiple mode operation, the documentation shall include the following:		N/A
	(a) Ratings and means of connection to each source of supply to the inverter or output from the inverter.		N/A
	(b) Any requirements related to wiring and external controls, including the method of maintaining neutral continuity within the electrical installation to any stand-alone ports as required.		N/A
	(c) Disconnection means and isolation means.		N/A
	(d) Overcurrent protection needed.		N/A
9.3.7	Multiple inverter combinations	No in such used	N/A
	Where an inverter has been tested for use in a multiple inverter combination as per Clause 8, the documentation shall include the following:		N/A
	(a) Valid combinations of inverters.		N/A
	(b) Installation instructions for correct operation as a multiple inverter combination.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict

APPENDIX A	GENERAL TEST AND REPORTING REQUIREMENTS	P
APPENDIX B	POWER FACTOR TEST	P
APPENDIX C	HARMONIC CURRENT LIMIT TEST	P
APPENDIX D	TRANSIENT VOLTAGE LIMIT TEST	P
APPENDIX E	D.C. INJECTION TEST	P
APPENDIX F	ACTIVE ANTI-ISLANDING TEST	P
APPENDIX G	VOLTAGE AND FREQUENCY LIMITS (PASSIVE ANTI-ISLANDING PROTECTION) TESTS	P
APPENDIX H	LIMITS FOR SUSTAINED OPERATION	P
APPENDIX I	DEMAND AND POWER QUALITY RESPONSE MODE TESTING INCLUDING DISCONNECTION ON EXTERNAL SIGNAL	P
APPENDIX J	MULTIPLE INVERTER TESTING	N/A
APPENDIX K	RELATED DOCUMENTS	Info.

Appendix Table:

5.5		TABLE: Power factor test					P
Mode		Measurement	15%	25%	50%	75%	100%
Unity		Power (W)	445.34	741.14	1506.71	2245.93	2951.31
		Reactive power (Var)	152.512	161.981	188.999	218.613	238.962
		PF	0.9463	0.9769	0.9922	0.9953	0.9967
		Lead/lag	lag	lag	lag	lag	lag
Note: For fixed reactive power and power factor mode test result refer to table 6.3.3							

5.6	TABLE: Harmonic current limit test						P
Background voltage harmonics							
Component	Limit of fundamental	Value V	% of fundamental	Component	Limit of fundamental	Value V	% of fundamental
1	--	230.341	100.000	26	0.1%	0.007	0.003
2	0.2%	0.017	0.007	27	0.1%	0.004	0.002
3	0.9%	0.028	0.012	28	0.1%	0.001	0.000
4	0.2%	0.006	0.003	29	0.1%	0.006	0.003
5	0.4%	0.065	0.028	30	0.1%	0.010	0.004
6	0.2%	0.005	0.002	31	0.1%	0.009	0.004
7	0.3%	0.083	0.036	32	0.1%	0.002	0.001
8	0.2%	0.008	0.003	33	0.1%	0.007	0.003
9	0.2%	0.011	0.005	34	0.1%	0.005	0.002
10	0.1%	0.011	0.005	35	0.1%	0.004	0.002
11	0.1%	0.031	0.013	36	0.1%	0.004	0.002
12	0.1%	0.004	0.002	37	0.1%	0.006	0.002
13	0.1%	0.014	0.006	38	0.1%	0.005	0.002
14	0.1%	0.017	0.008	39	0.1%	0.007	0.003
15	0.1%	0.017	0.008	40	0.1%	0.003	0.001
16	0.1%	0.006	0.003	41	0.1%	0.005	0.002
17	0.1%	0.011	0.005	42	0.1%	0.001	0.000
18	0.1%	0.017	0.007	43	0.1%	0.006	0.003
19	0.1%	0.017	0.008	44	0.1%	0.002	0.001
20	0.1%	0.001	0.001	45	0.1%	0.007	0.003
21	0.1%	0.007	0.003	46	0.1%	0.003	0.001
22	0.1%	0.012	0.005	47	0.1%	0.006	0.002
23	0.1%	0.014	0.006	48	0.1%	0.003	0.001

24	0.1%	0.002	0.001	49	0.1%	0.007	0.003
25	0.1%	0.005	0.002	50	0.1%	0.003	0.001
Total harmonic distortion (to 50th component)	5%	0.055%					

Harmonic current limit test

Component	Limit of fundamental	50% of rated current			100% of rated current		
		Value A	Angle degrees	% of fundamental	Value A	Angle degrees	% of fundamental
1	100%	6.5045	--	100.000	12.9412	--	100.000
2	1%	0.0153	--	0.2355	0.0182	--	0.1408
3	4%	0.1033	--	1.5874	0.1316	--	1.0169
4	1%	0.0058	--	0.0896	0.0026	--	0.0198
5	4%	0.0456	--	0.7008	0.0269	--	0.2077
6	1%	0.0036	--	0.0548	0.0186	--	0.1438
7	4%	0.0337	--	0.5189	0.0554	--	0.4278
8	1%	0.0072	--	0.1107	0.0092	--	0.0711
9	2%	0.0330	--	0.5068	0.0283	--	0.2190
10	0.5%	0.0043	--	0.0664	0.0156	--	0.1209
11	2%	0.0343	--	0.5268	0.0594	--	0.4590
12	0.5%	0.0075	--	0.1150	0.0110	--	0.0850
13	2%	0.0332	--	0.5105	0.0316	--	0.2445
14	0.5%	0.0039	--	0.0604	0.0125	--	0.0964
15	1%	0.0337	--	0.5185	0.0575	--	0.4443
16	0.5%	0.0033	--	0.0508	0.0069	--	0.0535
17	1%	0.0322	--	0.4943	0.0344	--	0.2660
18	0.5%	0.0008	--	0.0123	0.0094	--	0.0725
19	1%	0.0299	--	0.4599	0.0472	--	0.3651
20	0.5%	0.0021	--	0.0321	0.0039	--	0.0305
21	0.6%	0.0269	--	0.4129	0.0329	--	0.2542
22	0.5%	0.0015	--	0.0229	0.0087	--	0.0671
23	0.6%	0.0224	--	0.3451	0.0334	--	0.2578
24	0.5%	0.0051	--	0.0785	0.0065	--	0.0500
25	0.6%	0.0183	--	0.2806	0.0293	--	0.2266
26	0.5%	0.0044	--	0.0676	0.0093	--	0.0716
27	0.6%	0.0163	--	0.2512	0.0249	--	0.1924
28	0.5%	0.0031	--	0.0473	0.0061	--	0.0469

29	0.6%	0.0135	--	0.2068	0.0244	--	0.1882
30	0.5%	0.0037	--	0.0568	0.0084	--	0.0650
31	0.6%	0.0100	--	0.1537	0.0201	--	0.1553
32	0.5%	0.0044	--	0.0675	0.0036	--	0.0279
33	0.6%	0.0075	--	0.1154	0.0207	--	0.1597
Total harmonic distortion (to 50th component)	5%	2.343%			1.585%		
Note: The impedance of the grid source:0.1 Ω							

5.7	TABLE: Voltage fluctuations and flicker				P
	Starting	Stopping	Running		
Limit	4%	4%	Pst = 1.0	Plt = 0.65	
Test value	0.039	0.176	0.041	0.029	
The Test inverters' flicker level was found to be lower than the permissible limit as per AS61000.3.11					

5.8	TABLE: Transient voltage limit test				P
Condition	Duration Seconds	Required (V)	Line-to-neutral volts	Required (V)	Line-to-line volts
10(±5)% of rated output (VA)	0,000 2	910	262.5	1580	--
	0,000 6	710	310.0	1240	--
	0,002	580	352.5	1010	--
	0,006	470	150.0	810	--
	0,02	420	347.5	720	--
	0,06	390	385.0	670	--
	0,2	390	312.5	670	--
	0,6	390	257.5	670	--
50(±5)% of rated output (VA)	0,000 2	910	365.0	1580	--
	0,000 6	710	335.0	1240	--
	0,002	580	355.0	1010	--
	0,006	470	0	810	--
	0,02	420	302.5	720	--
	0,06	390	282.5	670	--
	0,2	390	220.0	670	--

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	0,6	390	107.5	670	--
100(±5)% of rated output (VA)	0,000 2	910	350.0	1580	--
	0,000 6	710	362.5	1240	--
	0,002	580	360.0	1010	--
	0,006	470	277.5	810	--
	0,02	420	275.0	720	--
	0,06	390	272.5	670	--
	0,2	390	255.0	670	--
	0,6	390	207.5	670	--
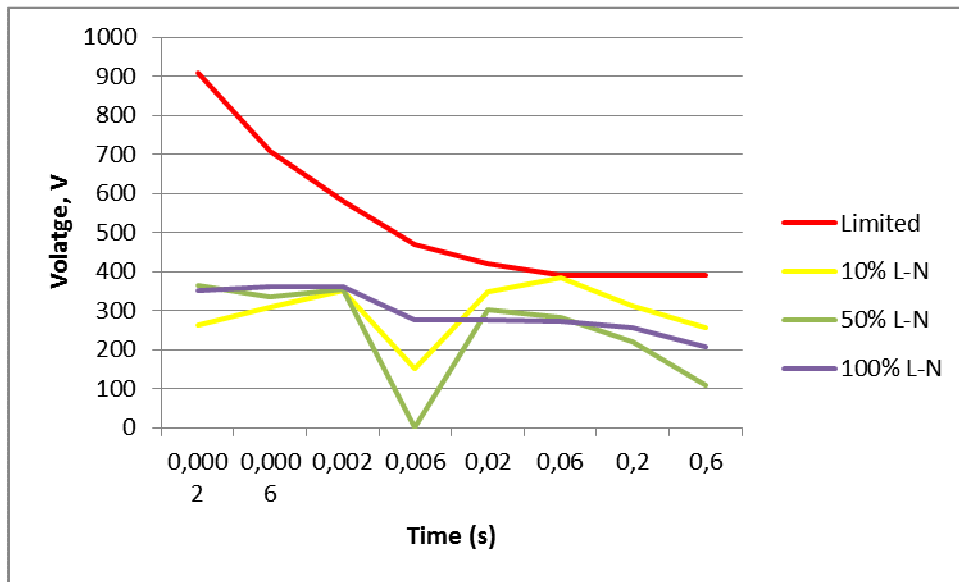
5.9	TABLE: Direct current injection test				P
		20%	60%	100%	
Inverter current, A	Setting	2.60	7.83	13.00	
	Actual	2.67	7.87	12.83	
Limit(A)	$0.5\% \times I_{rated}$ (A)	0.065	0.065	0.065	
Result	A	0.04116	0.04414	0.04745	
Compliance	(P/F)	P	P	P	

6.3.2.2	TABLE: Volt－watt response mode				P
Item	Aus. default Value, V	Power measurement, W	Measurement value (P/Prated), %	Maximum value (P/Prated), %	
1	200	2621.28	87.38	100	
2	207	2712.55	90.42	100	

3	210	2748.33	91.61	100
4	220	2877.21	95.91	100
5	230	2907.42	96.91	100
6	240	2895.53	96.52	100
7	250	2896.48	96.55	100
8	265	584.92	19.50	20
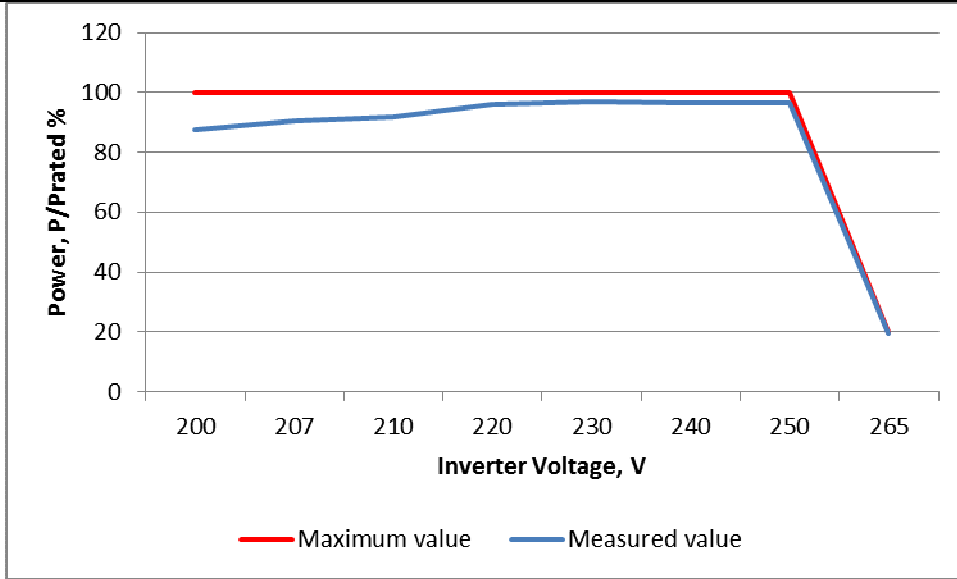
CURVE FOR A VOLT – WATT RESPONSE MODE (AUSTRALIA)

Item	NZ default Value	Power measurement, W	Measurement value (P/Prated), %	Maximum value (P/Prated), %
1	200	2617.552	87.25	100
2	207	2706.753	90.23	100
3	210	2746.118	91.54	100
4	220	2874.174	95.81	100
5	230	2940.626	98.02	100
6	240	2943.315	98.11	100
7	244	2371.016	79.03	100
8	255	597.238	19.91	20

CURVE FOR A VOLT – WATT RESPONSE MODE (New Zealand)
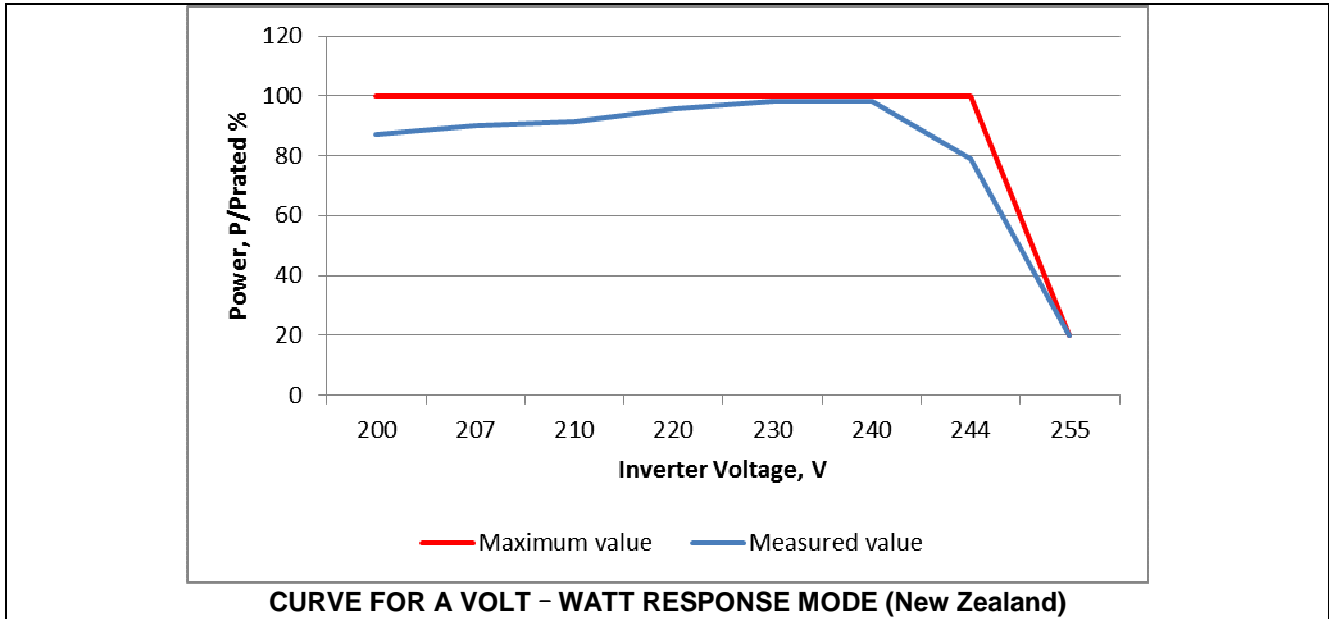
6.3.3	Fixed reactive power mode					P
Setting of rated W	P(W) ind.	Q(Var) ind, max	PF ind, max	P(W) cap.	Q(Var) cap. max	PF cap, max
0%	133.515	1157.505	0.1146	144.752	736.725	0.1928
10%	286.805	1880.704	0.1509	298.544	1586.230	0.1850
20%	591.141	1786.394	0.3141	593.031	1738.650	0.3228
30%	893.942	1768.905	0.4510	889.153	1779.142	0.4471
40%	1200.034	1755.253	0.5644	1192.788	1793.602	0.5538
50%	1498.947	1759.966	0.6484	1494.579	1794.476	0.6399
60%	1800.094	1760.857	0.7148	1793.247	1809.382	0.7039
70%	2097.021	1765.236	0.7650	2097.456	1810.593	0.7570
80%	2390.891	1775.152	0.8029	2324.419	1813.360	0.7884
90%	2497.671	1781.753	0.8141	2330.665	1810.979	0.7896
100%	2496.438	1773.461	0.8152	2339.158	1806.517	0.7914

6.3.3	Fixed power factor mode				P
Setting of rated W	PF (setting)	P(W)	S(VA)	Q(Var)	PF
0%	0.80 lagging	295.918	361.426	207.512	0.8187
10%	0.80 lagging	296.661	362.545	208.402	0.8183

20%	0.80 lagging	606.378	743.643	430.476	0.8154
30%	0.80 lagging	902.839	1116.795	657.351	0.8084
40%	0.80 lagging	1205.681	1499.310	891.214	0.8041
50%	0.80 lagging	1506.680	1880.221	1124.785	0.8013
60%	0.80 lagging	1799.236	2252.266	1354.784	0.7988
70%	0.80 lagging	2097.509	2630.715	1587.797	0.7973
80%	0.80 lagging	2392.254	3005.910	1820.052	0.7958
90%	0.80 lagging	2436.812	3062.178	1854.415	0.7958
100%	0.80 lagging	2436.974	3063.547	1856.463	0.7955
Setting of rated W	PF (setting)	P(W)	S(VA)	Q(Var)	PF
0%	0.80 leading	140.117	206.799	152.096	0.6775
10%	0.80 leading	292.303	412.059	290.433	0.7094
20%	0.80 leading	599.090	778.621	497.332	0.7694
30%	0.80 leading	916.071	1145.576	687.861	0.7997
40%	0.80 leading	1199.994	1487.176	878.464	0.8069
50%	0.80 leading	1506.005	1880.096	1125.480	0.8010
60%	0.80 leading	1810.385	2254.123	1342.970	0.8031
70%	0.80 leading	2108.282	2615.395	1547.710	0.8061
80%	0.80 leading	2380.860	2950.503	1742.680	0.8069
90%	0.80 leading	2381.746	2951.334	1742.880	0.8070
100%	0.80 leading	2382.890	2952.687	1743.600	0.8070
Setting of rated W	PF (setting)	P(W)	S(VA)	Q(Var)	PF
0%	1	57.229	152.700	141.571	0.3748
10%	1	298.856	334.135	149.436	0.8944
20%	1	595.174	616.058	159.047	0.9661
30%	1	889.809	905.741	169.136	0.9824
40%	1	1213.520	1226.912	180.753	0.9891
50%	1	1507.270	1519.289	190.717	0.9921
60%	1	1802.510	1813.751	201.612	0.9938
70%	1	2098.030	2108.894	213.800	0.9948
80%	1	2393.520	2404.167	225.976	0.9958
90%	1	2689.480	2700.165	239.931	0.9960
100%	1	2953.900	2963.691	240.722	0.9967

6.3.4	Characteristic power factor curve for cos φ (P) (Power response)			P
P(setting)	PF (setting)	P(W)	Q(Var)	PF(measured)
25%	1	755.735	764.868	0.9881
50%	1	1502.399	1506.631	0.9971
75%	0.975	2272.503	2321.881	0.9787
100%	0.950	2909.519	3039.028	0.9574

Characteristic power factor curve for cos φ (P) (Power response)
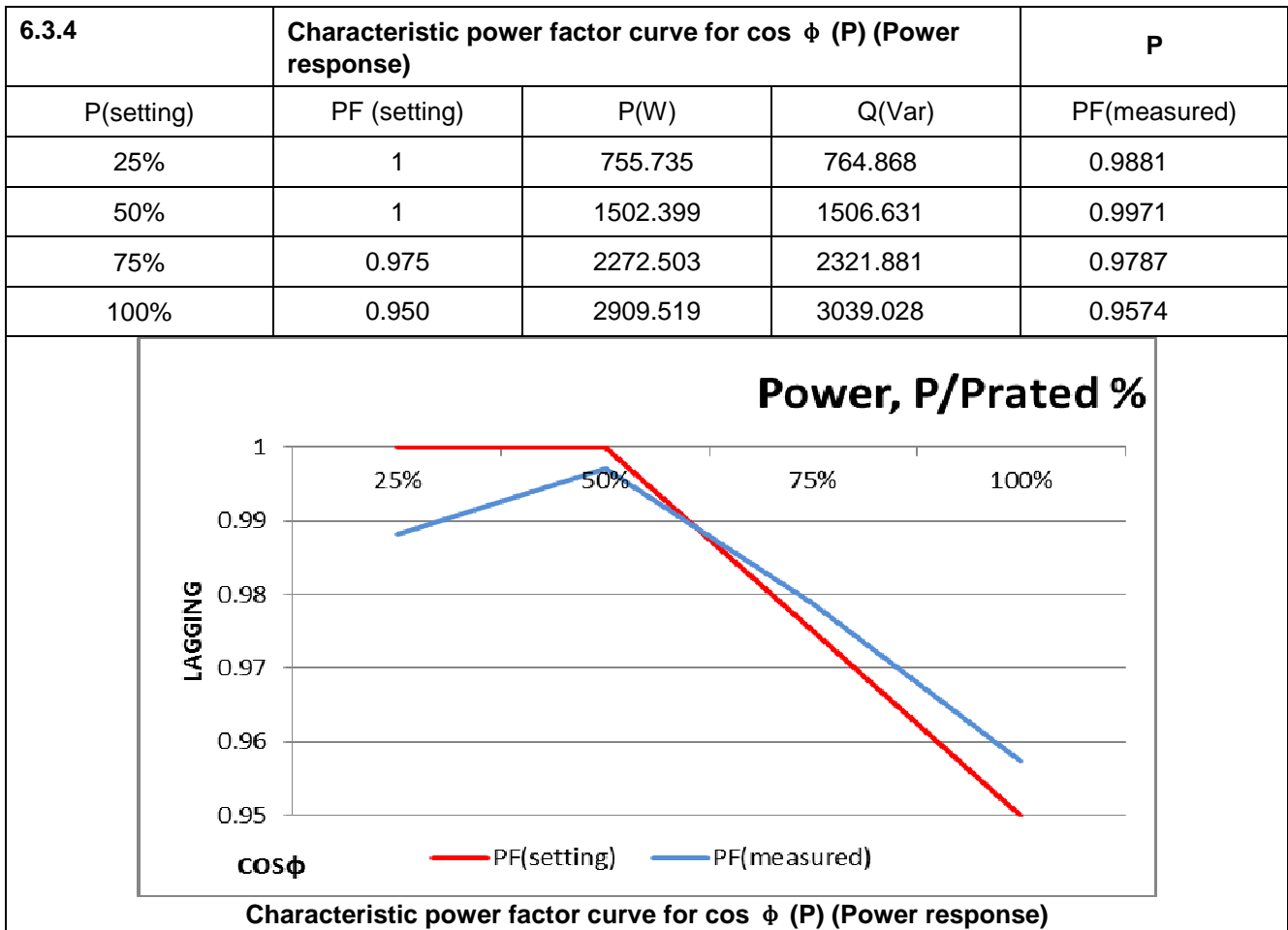
6.4.2	TABLE: Sinusoidal output in stand-alone mode test									P
Component	Limit	5% power or the lowest continuous available output power greater than 5%			50% of rated power			100% of rated power		
	% of fundamental	Value V	Angle degrees	% of fundamental	Value V	Angle degrees	% of fundamental	Value V	Angle degrees	% of fundamental
1	100%	226.529	--	100	222.864	--	100	221.419	--	100
2	5%	0.059	--	0.026	0.016	--	0.007	0.022	--	0.010
3	5%	1.554	--	0.686	3.517	--	1.578	4.307	--	1.945
4	5%	0.042	--	0.018	0.003	--	0.001	0.001	--	0.000
5	5%	0.216	--	0.095	1.969	--	0.884	2.111	--	0.953
6	5%	0.016	--	0.007	0.003	--	0.001	0.003	--	0.001
7	5%	0.713	--	0.315	1.347	--	0.604	1.439	--	0.650
8	5%	0.010	--	0.004	0.002	--	0.001	0.001	--	0.001

9	5%	0.624	--	0.275	1.006	--	0.451	1.081	--	0.488
10	5%	0.020	--	0.009	0.001	--	0.001	0.004	--	0.002
11	5%	0.258	--	0.114	0.789	--	0.354	0.857	--	0.387
12	5%	0.015	--	0.007	0.002	--	0.001	0.003	--	0.001
13	5%	0.083	--	0.037	0.642	--	0.288	0.706	--	0.319
14	5%	0.012	--	0.005	0.002	--	0.001	0.002	--	0.001
15	5%	0.098	--	0.043	0.529	--	0.237	0.585	--	0.264
16	5%	0.008	--	0.004	0.003	--	0.001	0.005	--	0.002
17	5%	0.229	--	0.101	0.449	--	0.201	0.498	--	0.225
18	5%	0.011	--	0.005	0.003	--	0.001	0.004	--	0.002
19	5%	0.206	--	0.091	0.387	--	0.174	0.430	--	0.194
20	5%	0.013	--	0.006	0.007	--	0.003	0.004	--	0.002
21	5%	0.097	--	0.043	0.332	--	0.149	0.373	--	0.168
22	5%	0.016	--	0.007	0.002	--	0.001	0.011	--	0.005
23	5%	0.083	--	0.037	0.296	--	0.133	0.324	--	0.147
24	5%	0.016	--	0.007	0.007	--	0.003	0.004	--	0.002
25	5%	0.206	--	0.091	0.251	--	0.113	0.275	--	0.124
26	5%	0.026	--	0.011	0.005	--	0.002	0.003	--	0.001
27	5%	0.263	--	0.116	0.220	--	0.099	0.248	--	0.112
28	5%	0.026	--	0.011	0.009	--	0.004	0.006	--	0.003
29	5%	0.254	--	0.112	0.196	--	0.088	0.215	--	0.097
30	5%	0.030	--	0.013	0.010	--	0.004	0.005	--	0.002
31	5%	0.264	--	0.117	0.162	--	0.073	0.184	--	0.083
32	5%	0.035	--	0.016	0.005	--	0.002	0.003	--	0.002
33	5%	0.279	--	0.123	0.126	--	0.057	0.158	--	0.071
34	5%	0.043	--	0.019	0.009	--	0.004	0.008	--	0.004
35	5%	0.278	--	0.123	0.110	--	0.050	0.137	--	0.062
36	5%	0.027	--	0.012	0.015	--	0.007	0.003	--	0.001
37	5%	0.231	--	0.102	0.077	--	0.034	0.117	--	0.053
38	5%	0.029	--	0.013	0.009	--	0.004	0.008	--	0.004
39	5%	0.165	--	0.073	0.070	--	0.031	0.108	--	0.049
40	5%	0.028	--	0.012	0.006	--	0.002	0.001	--	0.001
41	5%	0.173	--	0.076	0.051	--	0.023	0.095	--	0.043
42	5%	0.027	--	0.012	0.008	--	0.003	0.008	--	0.004
43	5%	0.160	--	0.071	0.046	--	0.021	0.075	--	0.034
44	5%	0.009	--	0.004	0.007	--	0.003	0.003	--	0.001
45	5%	0.099	--	0.044	0.034	--	0.015	0.069	--	0.031

46	5%	0.013	--	0.006	0.004	--	0.002	0.006	--	0.003
47	5%	0.068	--	0.030	0.034	--	0.015	0.063	--	0.029
48	5%	0.011	--	0.005	0.003	--	0.001	0.003	--	0.002
49	5%	0.070	--	0.031	0.031	--	0.014	0.053	--	0.024
50	5%	0.014	--	0.006	0.004	--	0.002	0.005	--	0.002
Total harmonic distortion (to 50th component)	5%	0.897			2.064			2.424		

7.3		Active anti-islanding protection								P
Test condition		Frequency=50Hz, U_N=230, Quality = 1 , Distortion factor of chokes < 2%								
Test method		According to IEC 62116.								

No.	PEUT[1] (% of EUT rating)	Reactive load (% of QL in 6.1.d)[1]	PAC[2] (% of nominal)	QAC[3] (% of nominal)	Run on time (ms)	PEUT (W)	Actual Qf	VDC	Remarks[4]		
1	100	100	0	0	386.0	3000	1.01	50	Test	A	at	BL
2	66	66	0	0	429.0	1980	1.02	50	Test	B	at	BL
3	33	33	0	0	312.0	990	1.03	50	Test	C	at	BL
4	100	100	-5	-5	312.5	3000	0.98	50	Test	A	at	IB
5	100	100	-5	0	250.5	3000	0.98	50	Test	A	at	IB
6	100	100	-5	5	263.0	3000	1.01	50	Test	A	at	IB
7	100	100	0	-5	298.0	3000	1.00	50	Test	A	at	IB
8	100	100	0	5	287.0	3000	1.02	50	Test	A	at	IB
9	100	100	5	-5	280.0	3000	1.05	50	Test	A	at	IB
10	100	100	5	0	298.5	3000	1.02	50	Test	A	at	IB
11	100	100	5	5	336.0	3000	0.95	50	Test	A	at	IB
12	66	66	0	-5	209.0	1980	0.99	50	Test	B	at	IB
13	66	66	0	-4	237.0	1980	0.97	50	Test	B	at	IB
14	66	66	0	-3	311.0	1980	0.98	50	Test	B	at	IB
15	66	66	0	-2	325.0	1980	1.02	50	Test	B	at	IB
16	66	66	0	-1	282.5	1980	1.03	50	Test	B	at	IB
17	66	66	0	1	285.5	1980	0.99	50	Test	B	at	IB
18	66	66	0	2	228.5	1980	1.02	50	Test	B	at	IB
19	66	66	0	3	248.5	1980	1.03	50	Test	B	at	IB
20	66	66	0	4	292.0	1980	1.03	50	Test	B	at	IB
21	66	66	0	5	288.0	1980	1.04	50	Test	B	at	IB
22	33	33	0	-5	201.5	990	0.95	50	Test	C	at	IB
23	33	33	0	-4	247.0	990	0.99	50	Test	C	at	IB

24	33	33	0	-3	220.5	990	0.97	50	Test	C	at	IB
25	33	33	0	-2	235.0	990	0.98	50	Test	C	at	IB
26	33	33	0	-1	334.0	990	1.01	50	Test	C	at	IB
27	33	33	0	1	324.5	990	0.99	50	Test	C	at	IB
28	33	33	0	2	326.0	990	1.00	50	Test	C	at	IB
29	33	33	0	3	333.0	990	0.99	50	Test	C	at	IB
30	33	33	0	4	286.5	990	1.01	50	Test	C	at	IB
31	33	33	0	5	263.0	990	1.01	50	Test	C	at	IB

Remark:
1) PEUT: EUT output power
2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0% test condition value.
3) QAC: Reactive power flow at S1 in Figure 1. Positive means power form EUT to utility. Nominal is the 0% test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition	EUT output power, P_{EUT}	EUT input voltage [c]	EUT trip settings [d]
A	Maximum [a]	> 75 % of rated input voltage range	Voltage and frequency trip settings according to National standards and/or local code
B	50 % to 66 % of maximum	50 % of rated input voltage range, ±10 %	Voltage and frequency trip settings according to National standards and/or local code
C	25 % to 33 % [b] of maximum	< 20 % of rated input voltage range	Voltage and frequency trip settings according to National standards and/or local code

[a] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
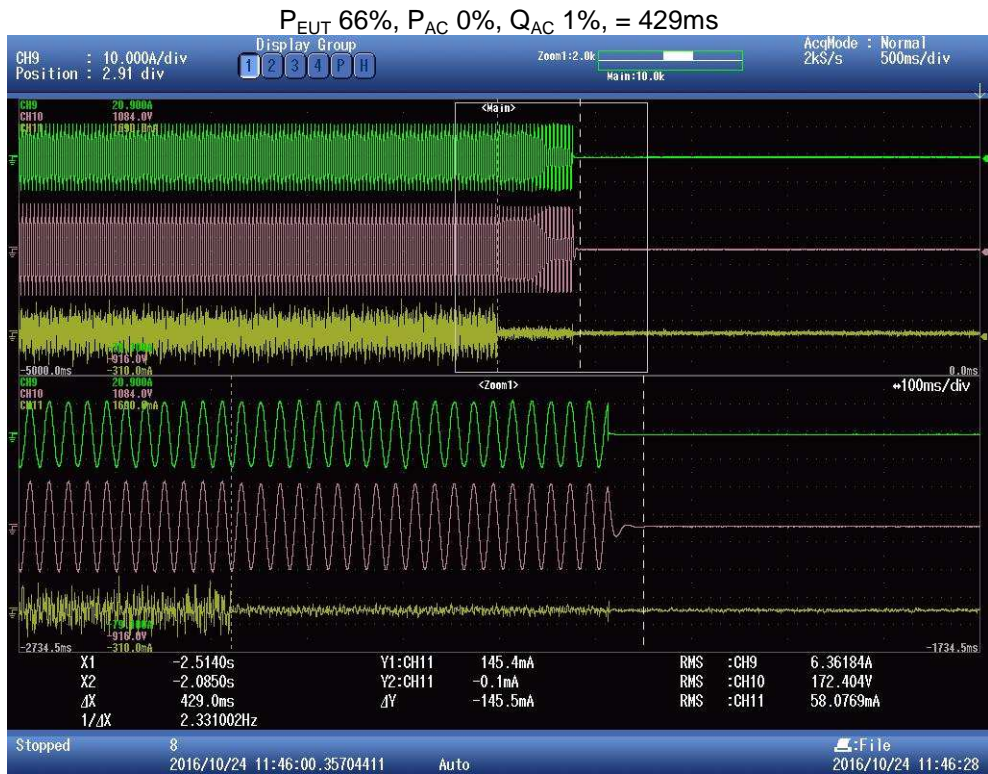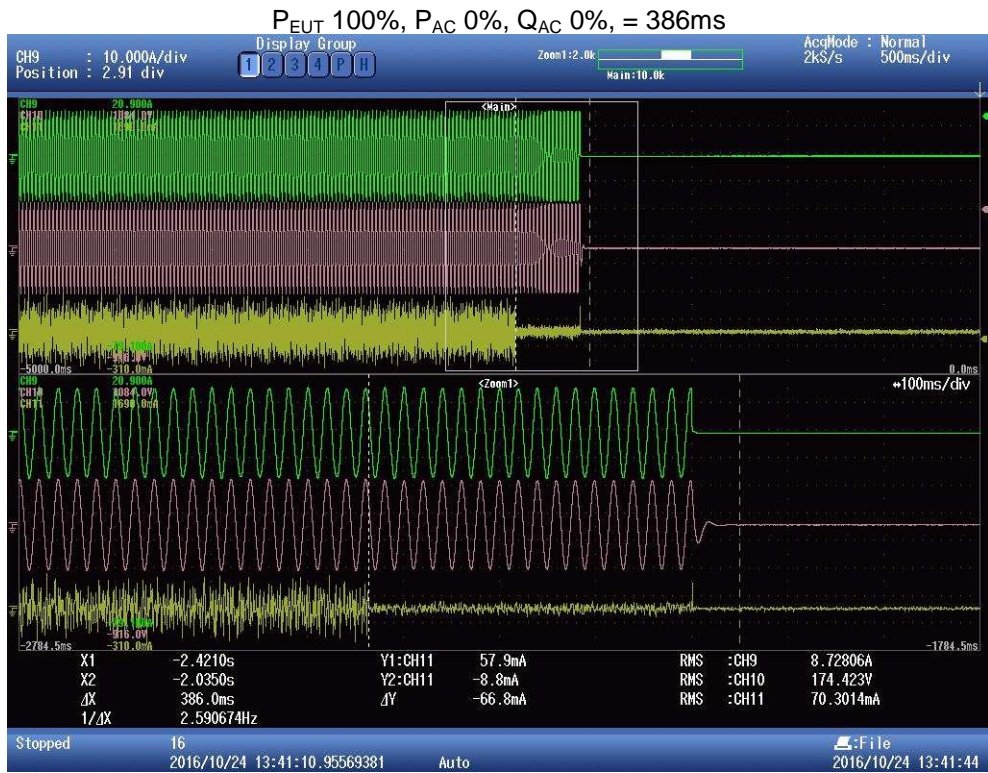
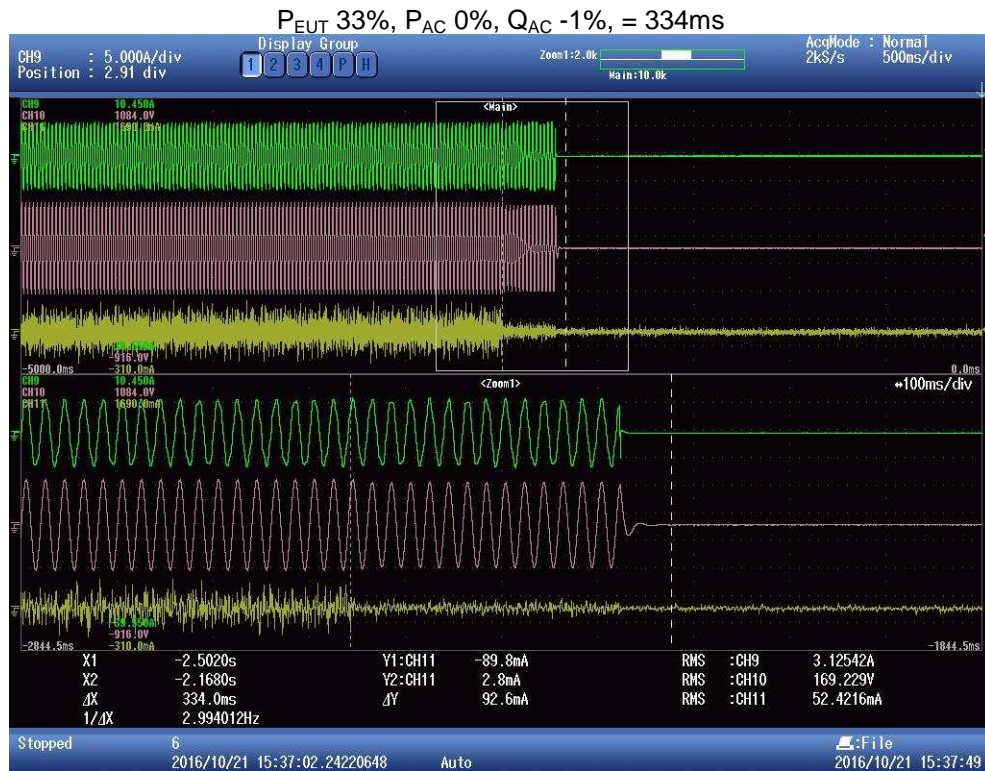[b] Or minimum allowable EUT output level if greater than 33 %.

[c] Based on EUT rated input operating range. For example, if range is between X volts and Y volts, 75 % of range = $X + 0{,}75 \times (Y - X)$. Y shall not exceed $0{,}8 \times$ 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.

Note: test A (100%): If any of the recorded run-on times are longer than the one recorded for the rated balance condition, i.e. test procedure 6.1 f), then the non-shaded parameter combinations (no.32~47) also require testing.

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P_{EUT} 100%, P_{AC} 0%, Q_{AC} 0%, = 386ms

P_{EUT} 66%, P_{AC} 0%, Q_{AC} 1%, = 429ms

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P_{EUT} 33%, P_{AC} 0%, Q_{AC} -1%, = 334ms
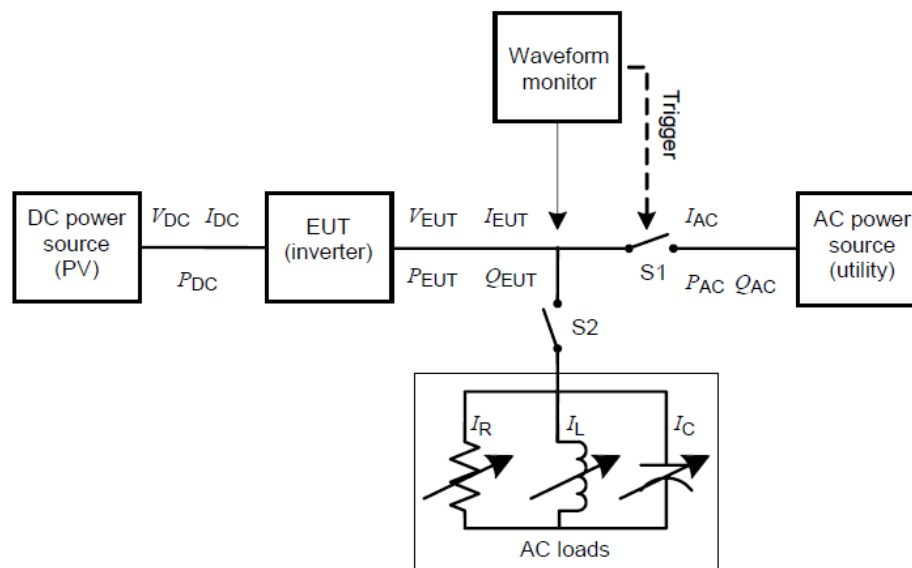
Note: CH9 current of EUT; CH10 voltage of EUT; CH11: IAC (the signal for disconnect from grid)

Appendix G2	TABLE: UNDERVOLTAGE AND OVERVOLTAGE TRIP SETTINGS AND RECONNECTION TEST			P
Grid Frequency (Hz)	50	Grid Voltage (Vac)	230	
Model	Under-voltage (V)	Disconnect time (seconds)	Reconnect time (seconds)	Setting trip voltage (Vac)
ME 3000SP	178.8	1.235	67.8	180
Model	Over-voltage (V)	Disconnect time (seconds)	Reconnect time (seconds)	Setting trip voltage (Vac)
ME 3000SP	260.4	1.225	70.6	260
ME 3000SP	265.5	0.114	70.6	265

Appendix G3	TABLE: UNDER-FREQUENCY AND OVER-FREQUENCY TRIP SETTINGS AND RECONNECTION TEST			P
Grid Frequency (Hz)	50	Grid Voltage (Vac)	230	
Model	Under-frequency (Hz)	Disconnect time (seconds)	Reconnect time (seconds)	Setting trip frequency (Hz)
ME 3000SP	46.98	1.240	70.6	47 (for Australia)
ME 3000SP	44.98	1.115	70.2	45 Hz (for New Zealand)

Model	Over-frequency (Hz)	Disconnect time (seconds)	Reconnect time (seconds)	Setting trip frequency (Hz)
ME 3000SP	52.01	0.180	69.4	52

Appendix H2	TABLE: SUSTAINED OPERATION FOR VOLTAGE VARIATIONS TEST		P
Test at 50 ±5% rated apparent power (VA):	1500	V_{nom_max} setting (V):	248 (for New Zealand)
Step	Measured average voltage (V)	Deviated from V_{nom_max} set-point (%)	Limit
(f)-1	248.084	0.034	±1%
(f)-2	248.159	0.065	±1%
(f)-3	248.206	0.083	±1%
	The time to disconnect (s)		Limit (s)
(i)	4.08		30
	The time to reconnect (s)		Limit (s)
(j)	81.0		60
Test at 50 ±5% rated apparent power (VA):	1500	V_{nom_max} setting (V):	255 (for Australia)
Step	Measured average voltage (V)	Deviated from V_{nom_max} set-point (%)	Limit
(f)-1	255.234	0.092	±1%
(f)-2	255.275	0.108	±1%
(f)-3	255.254	0.100	±1%
	The time to disconnect (s)		Limit (s)
(i)	16.25		30
	The time to reconnect (s)		Limit (s)
(j)	103.6		>60

Appendix H3.2	TABLE: Response to an increase in frequency test		P
(c) Test at 50 ±5% rated apparent power (VA):	1500	F_{stop} (Hz):	52
(d) The average inverter power for 5 min P_{ref} (W):		1508.24	
(f) Output frequency (Hz)	Average frequency (Hz)	Average power (W)	
50.1	50.10	1506.62	
50.2	50.20	1507.02	
50.3	50.30	1464.09	
50.4	50.40	1380.35	

|		
50.5	50.50	1279.46
50.6	50.60	1194.63
50.7	50.70	1109.59
50.8	50.80	1024.54
50.9	50.90	940.22
51.0	51.00	872.52
51.1	51.10	770.59
51.2	51.20	701.78
51.3	51.30	617.36
51.4	51.40	514.66
51.5	51.50	428.98
51.6	51.60	344.44
51.7	51.70	267.17
51.8	51.80	190.59
51.9	51.90	74.59
52.0	52.00	0
52.1	52.10	0
52.2	52.20	0
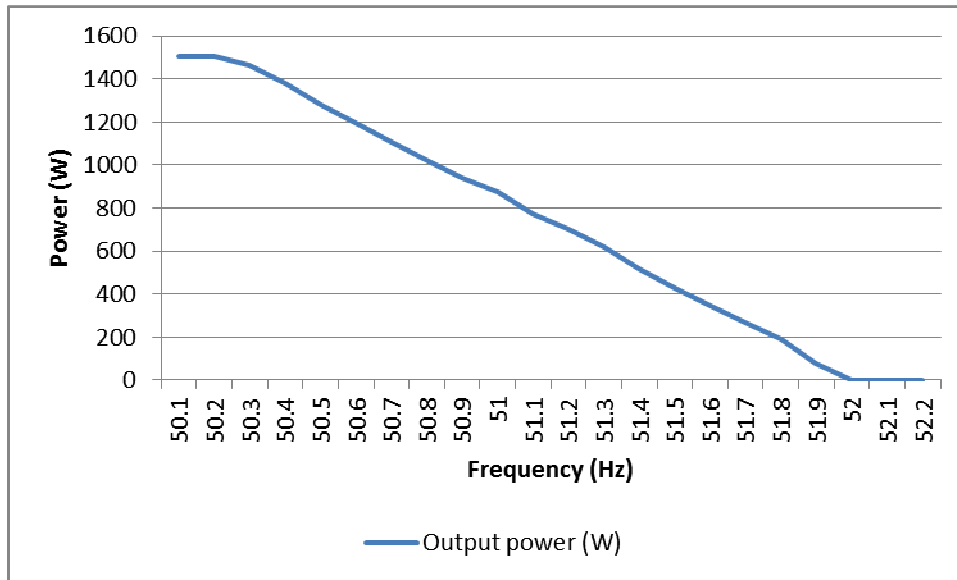
The graph of the step (f)

(i) Measured hysteresis time (s)	70.2
Hysteresis limit (s)	> 60
Increase power rate (W/min.):	494.51
Rated power output (W):	3000
Increase power rate based on rated power output (%):	16.48

Power rate limit W_{Gra} (%):	16.67

The graph of the step (i)

(j)	Repeat (c) Test at 50 ±5% rated apparent power (VA):	1500
	Repeat (d) The average inverter power for 5 min P_{ref} (W):	1504.75

(k) Output frequency (Hz)	Average frequency (Hz)	Average power (W)
50.1	50.10	1504.55
50.2	50.20	1504.17
50.3	50.30	1461.55
50.4	50.40	1378.42
50.5	50.50	1276.98
50.6	50.60	1192.72
50.7	50.70	1115.97
50.8	50.80	1022.77
50.9	50.90	946.63
51.0	51.00	870.86
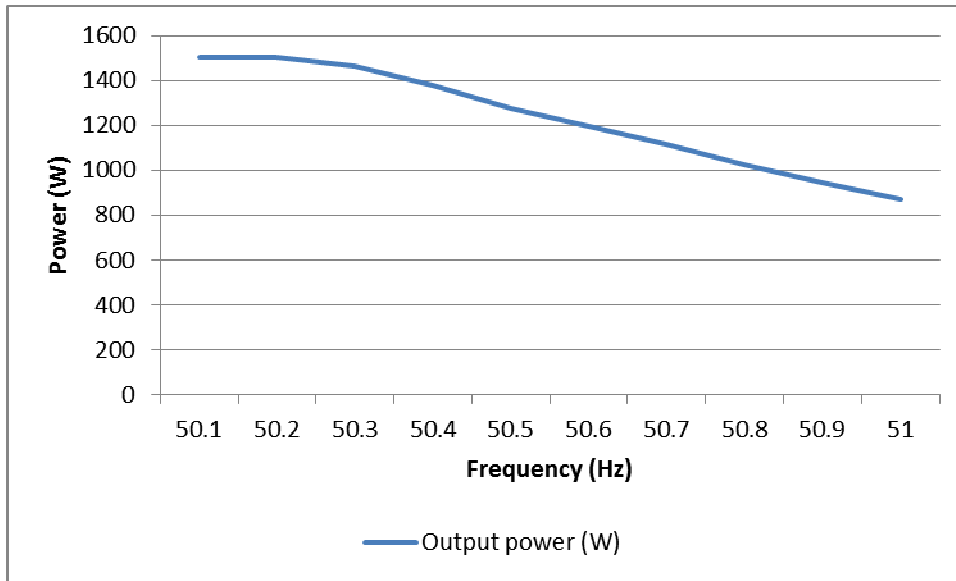
The graph of the step (k)

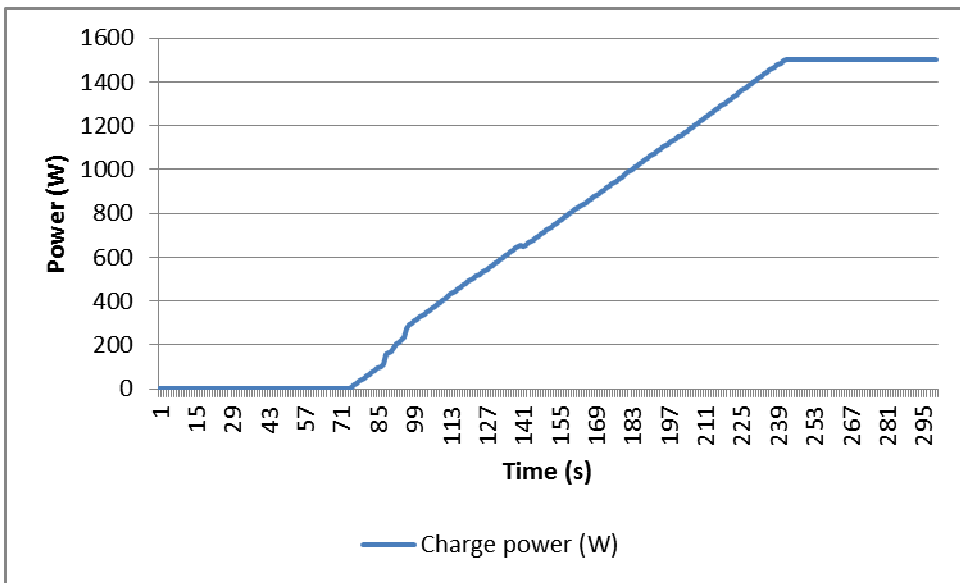| (m) Output frequency (Hz)	Average frequency (Hz)	Average power (W)
51.0	51.00	870.86
50.8	50.80	870.64
50.6	50.60	870.62
50.4	50.40	870.79
50.2	50.20	870.84
(n) Increase power rate (W/min.):	485.93	
Rated power output (W):	3000	
Increase power rate based on rated power output (%):	16.20	
Power rate limit W_{Gra} (%):	16.67	

The graph of the step (n)
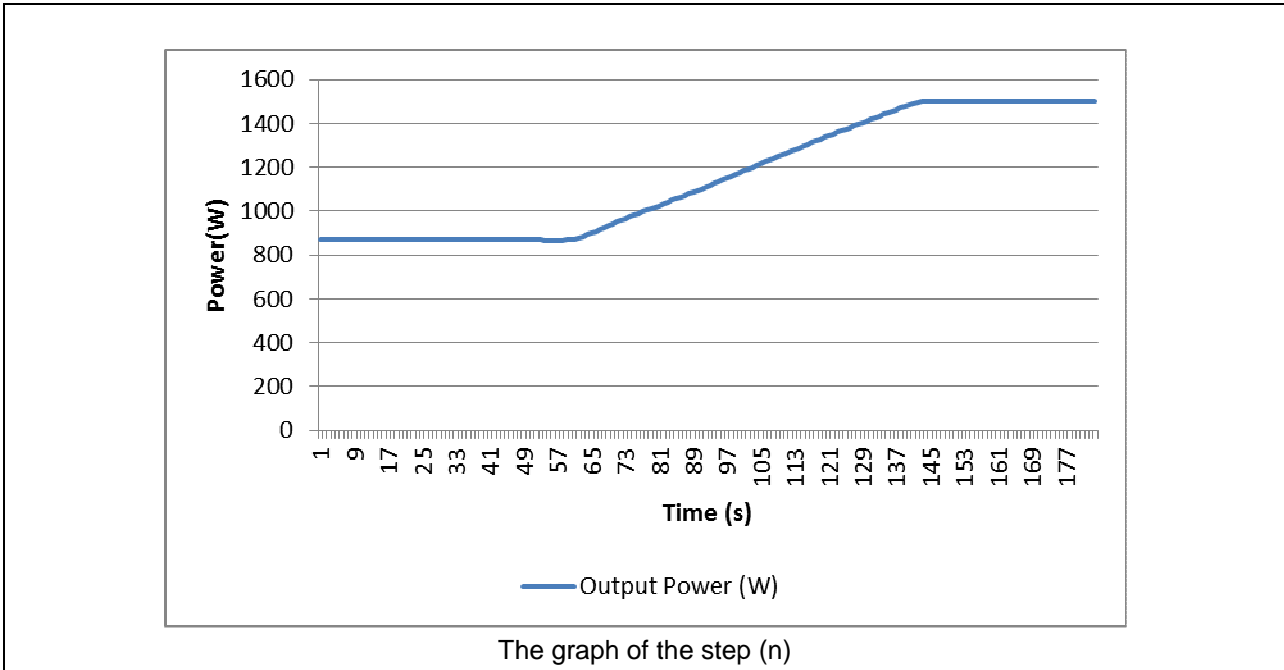
| Appendix H3.4	Test procedure for inverters with energy storage		P
(c) Test at 50 ±5% rated apparent power (VA):	1500	F_{stop} (Hz):	49
(d) The average inverter power for 5 min P_{ref} (W):		1513.74	
(f) Output frequency (Hz)	Average frequency (Hz)	Charge power (W)	
49.90	49.90	1514.68	
49.80	49.80	1515.49	
49.70	49.70	1429.26	
49.60	49.60	1194.01	
49.50	49.50	955.54	
49.40	49.40	763.21	
49.30	49.30	574.68	
49.20	49.20	350.49	
49.10	49.10	11.11	
49.00	49.00	0	
49.90	49.90	0	
48.80	48.80	0	
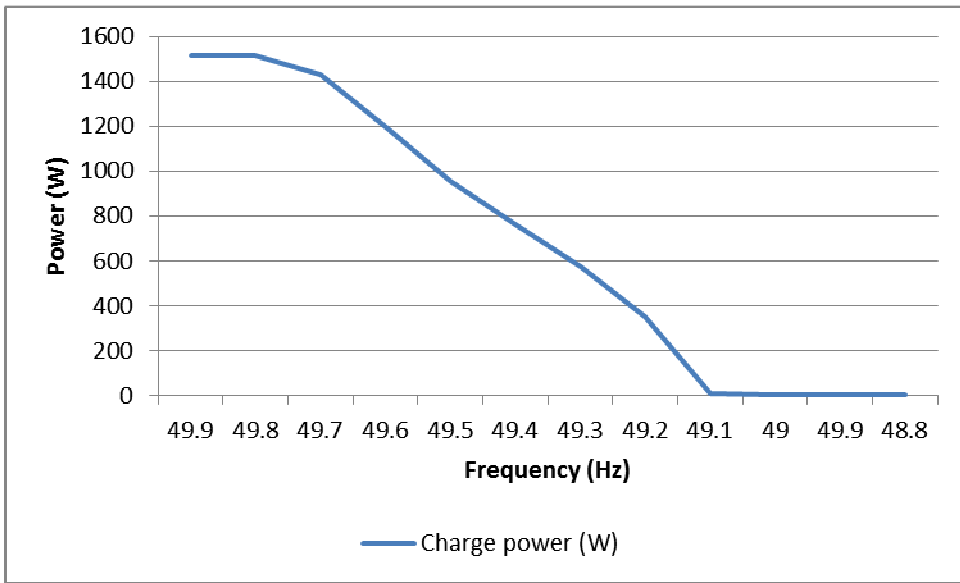
The graph of the step (f)

(i) Measured hysteresis time (s)	74.0
Hysteresis limit (s)	> 60
Increase Charge rate (W/min.):	506.70
Rated Charge power (W):	3000
Increase charge rate based on rated Charge power (%):	16.89
Power rate limit W_{Gra} (%):	16.67

The graph of the step (i)

(j)	Repeat (c) Test at 50 ±5% rated apparent power (VA):	1500
	Repeat (d) The average inverter power for 5 min P_{ref} (W):	1513.88

| (k) Output frequency (Hz)	Average frequency (Hz)	Charge power (W)

50.0	50.00	1513.88
49.9	49.90	1515.12
49.8	49.80	1516.00
49.7	49.70	1439.02
49.6	49.60	1215.27
49.5	49.50	954.24
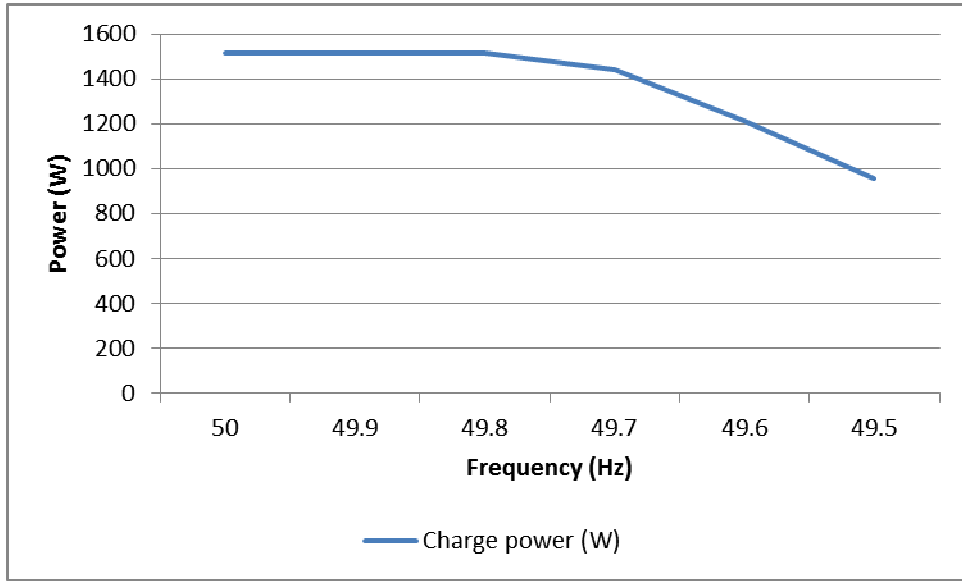
The graph of the step (k)

(m) Output frequency (Hz)	Average frequency (Hz)	Charge power (W)
49.5	49.50	954.24
49.6	49.60	952.78
49.7	49.70	952.51
49.8	49.80	952.76

Measured hysteresis time (s)	61.0
Hysteresis limit (s)	> 60
(n) Increase charge rate (W/min.):	504.51
Rated charge poweroutput (W):	3000
Increase charge rate based on rated Charge power (%):	16.80
Power rate limit W_{Gra} (%):	16.67
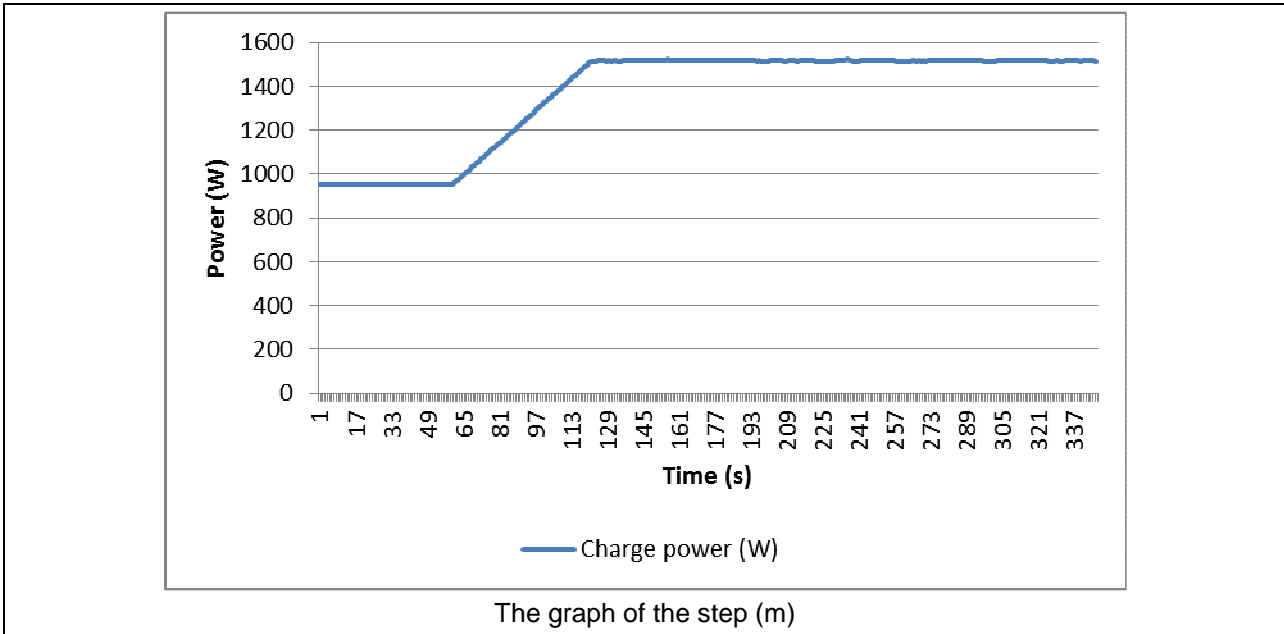
The graph of the step (m)

Appendix I	DEMAND AND POWER QUALITY RESPONSE MODE TESTING INCLUDING DISCONNECTION ON EXTERNAL SIGNAL			P
Demand response test	Real power(W)	Reactive power(Var)	Switching time(s)	Pass/ Fail
DRM 0 at 100%	2954.63	240.01	0.978	Pass
DRM 7	--	--	--	--
DRM 6 and DRM 7	--	--	--	--
DRM 6	--	--	--	--
DRM 5 and DRM 6	--	--	--	--
DRM 8	--	--	--	--
DRM 3	--	--	--	--
DRM 3 and DRM 2	--	--	--	--
DRM 2	--	--	--	--
DRM 1 and DRM 2	--	--	--	--
DRM 4	--	--	--	--