

Test Report No.: PVAU160620C23

Client

Name : Delta Electronics, Inc.
Address : 39, Sec.2, Huandong Road, Shanhua Dist., Tainan City 74144, Taiwan

Test Item : Hybrid Grid-tied photovoltaic inverter

Identification : E5

Testing laboratory

Name : Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Address : No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test specification

Standard : AS 4777.2:2015

Test Result : The test item passed.

Prepared By :



Signature

Dino Kao

Senior Engineer

2016-9-2

Date

Approved By:



Signature

Edward Chiueh

Technical Manager

2016-9-2


Date

Other Aspects:

The completed test report includes the following documents:
AS 4777.2:2015 report (169 pages)



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TEST REPORT	
AS/NZS 4777.2:2015	
Grid connection of energy systems via inverters – Part 2: Inverter requirements	
Report reference No.	PVAU160620C23
Tested by (printed name and signature)	See cover sheet
Approved by (printed name and signature)	See cover sheet
Date of issue	2016-08-26
Testing Laboratory Name	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Address	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
Testing location	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Address	No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City, Taiwan
Applicant's Name	Delta Electronics, Inc.
Address	39, Sec.2, Huandong Road, Shanhua Dist., Tainan City 74144, Taiwan
Test specification	
Standard	AS 4777.2:2015
Non-standard test method	None
Test Report Form No.	AS4777_C
Master TRF	Bureau Veritas Consumer Product Services GmbH
Copyright © Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch	
Test item description	Hybrid Grid-tied photovoltaic inverter
Trademark	
Model / Type	E5
Ratings	See below.
Input Voltage range	100-550, 600Vdc maximum
MPPT Voltage range	220-450Vdc
Battery Input DC voltage range [V] ... [Discharge]	40-450 Vdc
Battery Input DC current [A]	40 A
[Discharge]	

Output DC voltage [V]	40-450 Vdc
[Battery Charge]	
Output DC current [A]	40 A
[Battery Charge]	
Output AC voltage [V]	230Vac, 50Hz
Output AC current [A]	24 A max
Output power [kVA]	5kVA

History Sheet:			
Name	Date	Comment	Revision
Dino Kao	2016-09-02	Initial report was written	--

Address of the manufacturer sites:
<p>Delta Electronics (Jiang Su), Ltd.</p> <p>No. 1688, Jiangxing East Rd., Wujiang Economic Development Zone, Wujiang City, Jiang Su Province, 215200, P.R. China</p>

Copy of marking plate:



Hybrid Inverter
Model : E5
Part Number: RPI502E121000

DC Input
 Operating: 100-550Vdc, 5.5kW max, 12A*2 max
 Absolute: 600Vdc max, Isc: 15A*2 max
 MPP: 220-450Vdc

AC Output-Grid
 230Vac, 50Hz/60Hz, 5kVA nom, 24A Iac max
 4.6kVA for Germany
 cosφ 0.8Ind~0.8cap adjustable

AC Output-Standalone
 230Vac, 50Hz/60Hz, 15.7A max

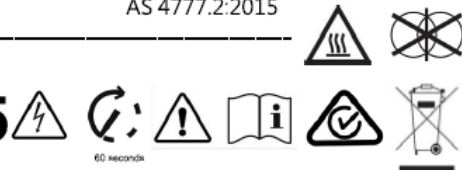
Battery
 Operating: 40-450Vdc, 40A max
 Absolute: 450Vdc max



VDE-AR-N 4105 EN 50438: 2013
 UK G59/3 AS 4777.2:2015

IP65

CE Authorized representative
 Delta Electronics B.V.
 Zandsteen 15, 2132 MZ Hoofddorp, The Netherlands

Safety Class: I
 OVC: III



XXXXXXXXXXXXXXXXXX

DRM Label

DRM 0	✗	DRM 1	□	DRM 2	□
DRM 3	□	DRM 4	□	DRM 5	✗
DRM 6	✗	DRM 7	✗	DRM 8	✗

Particulars:	
Equipment mobility	Permanent connection
Operating condition.....	Continuous
Class of equipment	Class I
Protection against ingress of water	IP65 according to EN 60529
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	2016-06-20
Date(s) of performance of test	2016-06-27 to 2016-08-25
<p>General remarks:</p> <p>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.</p> <p>"(see Annex #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report.</p> <p>Throughout this report a comma is used as the decimal separator.</p> <p>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.</p> <p>This Test Report consists of the following documents:</p> <ol style="list-style-type: none"> 1. Test Results 2. Annex No. 1 – EMC Test Report 3. Annex No. 2 – Pictures of the unit 4. Annex No. 3 – Test equipment list 	

General product information:

The Solar converter converts DC voltage into AC voltage.

The Solar converter is a single-phase type and only one machine is allowed on each line conductor.

The 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 (transformerless). The output is switched off redundant by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of one error.

The Solar converter provides with PV array and external battery pack of input.

The Solar converter supplies for battery charging power from PV array input only.

The inverters can only be combined as a single phase power system, and parallel to three inverter maximum.

Description of the electrical circuit & functional safety (redundancy):

The internal control is redundant built. It consists one main CPU (UM10), one Redundant CPU (UM12) and a communication CPU (UM809). The master CPU (UM10) which controls relays, measures voltage, frequency, AC current, DC-injection current, insulation resistance and residual current. In addition it tests the array isolation impedance and the RCMU circuit before each start up. The Redundant CPU (UM12) measures the grid voltage, frequency and RCMU. The communication CPU (UM809) allows them to communicate with each other. Both main and redundant CPU can open relays.

The unit provides two relays in series in each phase. The relays are tested before each start up. Both main and redundant CPU can control relays.

The current of each phase is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the main CPU. The main CPU tests and calibrates before each start up all current sensors.

The RCMU is located at the AC output. The RCMU is tested before each start up by the main CPU. While the working of the unit, the output signal of the RCMU is a square wave signal which differs in frequency if residual current occurs. The construction assures a fail safe principle. The signal is sent to the main CPU.

The PV array insulation is measured by the main CPU.

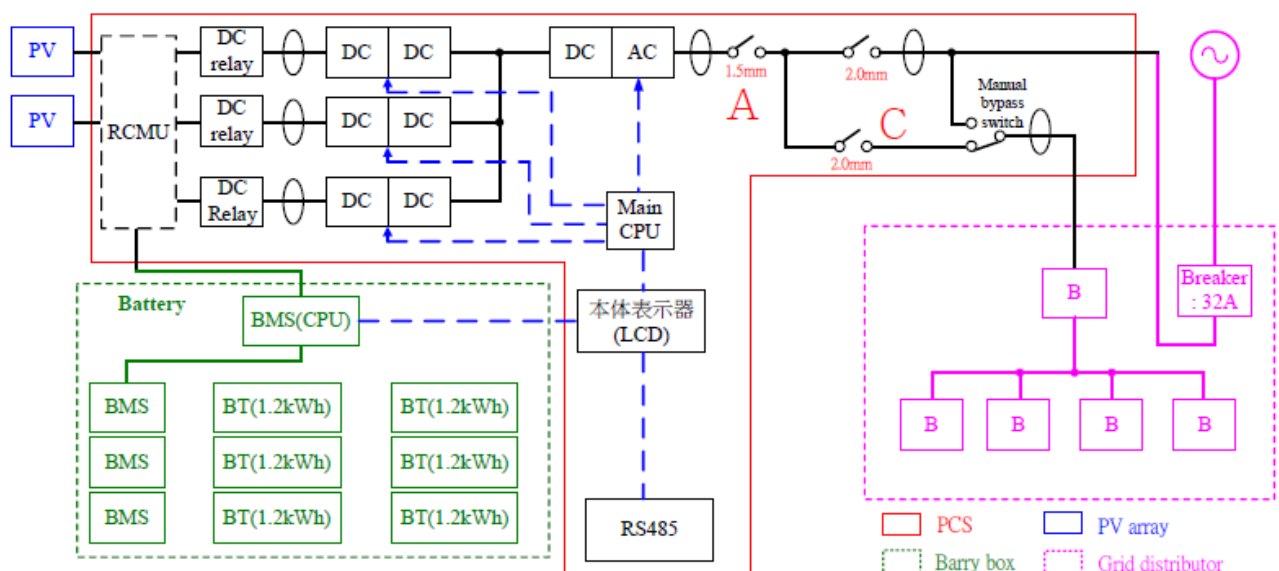


Figure 1 – Block diagram

System illustration:

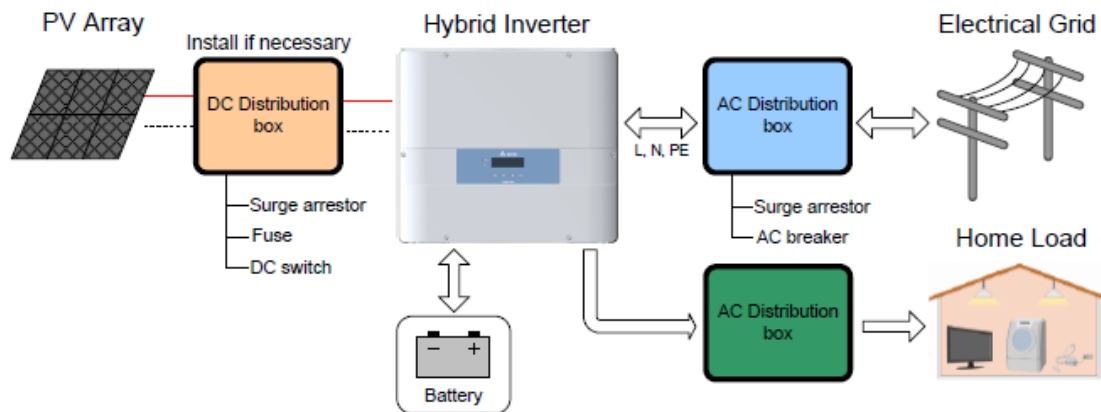


Figure 1-1 Storage system operation illustration

The product was tested on:

Hardware version: EVT

Software Version:

DSP: 1.11, 1.15, 1.20, 1.25, 1.30

RED: 1.20, 1.25, 1.30, 1.35, 1.40

COMM: 1.02, 1.05, 1.15, 1.30, 1.50

Test condition:

Temperature: 25°C

Relative humidity: 60%

Air pressure: 980 mba

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.	Comply with IEC 62109-1 and IEC 62109-2. Details see report no. LD150415C06.	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.	Comply with IEC 62040-1-1. Details see report no. TD160620C26.	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.	The unit provides with PV array and external battery pack of input only.	N/A
5.2	Provision for external connections		P
	Inverters shall be used and installed as fixed equipment only.	This equipment can be installed as fixed.	P
	Inverter provisions for external connection -	See below.	P
	(a) shall be for fixed equipment only; and		P
	(b) shall provide for safe and reliable connection to any d.c. source or load or any a.c. source or load.	The EUT provides for safe and reliable connection to any d.c. source or load or any a.c. source or load.	P
	All inverter ports (except communications ports) shall incorporate connection types for either -	See below.	P
	(i) permanently connected equipment; or	It's a permanently connected equipment	P
	(ii) pluggable type B equipment.	No such type of unit.	N/A
	Inverter source or load connections shall not incorporate connection types for pluggable type A equipment.	Permanently connected 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.		N/A

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	(B) An appliance inlet suitable for connection to a matching connector.		N/A
	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	See below.	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.	This EUT is fully comply with IEC 62109-1 and IEC 62109-2 and with a build-in RCMU. Details see report no. LD150415C06.	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;		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	The resistance is above 30k ohm. The system will reconnect the functional earth and shall be allowed to start.	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.	If the earth resistance is equal to or less than 30k ohm, the inverter will shut down and initiate an earth fault alarm in accordance with the requirements of IEC 62109-2. Details see report no. LD150415C06.	P
5.4	Compatibility with electrical installation		P

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	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).	Comply with requirements.	P
5.5	Power factor	See below.	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	See below.	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.	P
5.7	Voltage fluctuations and flicker	See below.	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.).	Rated current greater than 16 A.	N/A
	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.	P
5.8	Transient voltage limits	See below.	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.	P
5.9	D.C. current injection	See below.	P

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	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.	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.	See appendix table.	P
5.10	Current balance for three-phase inverters	This inverters can only be combined as a single phase power system.	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.		

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.	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.	Comply with the requirement.	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.	The inverter have a means of connecting to a DRED with a terminal block.	P
	The terminal block or RJ45 socket shall comply with the minimum electrical specifications in Table 6.	Comply with the requirement.	P

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	The DRED asserts demand response modes by shorting together terminals or pins as specified in Table 7.	The DRED asserts demand response modes according to Table 7.	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		N/A
	(b) provide characteristics which are outside the typical operation of an inverter for the purpose of providing support to a grid.	The firmware provides characteristics for the purpose of providing support to a grid.	P
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.	The EUT has being assessed according to this clause.	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.	Table 9 being adopted to perform the function of Clause 6.3.2.2 and Clause 6.3.2.3	P
6.3.2.2	Volt–watt response mode	See below.	P
	The inverter should have the volt–watt response mode. If this mode is available, it shall be enabled by default.	Complied.	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.	P
6.3.2.3	Volt–var response mode	See below.	P
	The inverter should have the volt–var response capability. If this mode is available, it shall be disabled by default.	Complied.	P

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	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	This inverters can only be combined as a single phase power system.	N/A
	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.		N/A
	If the voltage balance mode is available, the following requirements apply:		N/A
	(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
	(c) 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	See below.	P
	These modes shall be disabled by default.	Complied.	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.	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.	P
6.3.4	Characteristic power factor curve for $\cos \phi$ (P) (Power response)	See below.	P

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	If this mode is available, it shall be disabled by default.	Complied.	P
	The response curve required for the $\cos \phi$ (P) response should be defined within displacement power factor range of 0.9 leading to 0.9 lagging. One possible $\cos \phi$ (P) curve is shown in Figure 4.	See appendix table.	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.	The power rate limit 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.	The inverter has the capability.	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).	The inverter has the capability.	P
	The power rate limit does not apply when the inverter disconnection device is required to operate (i.e. to disconnect).	Meet the requirement.	P
6.3.5.2	Gradient of power rate limit	See below.	P
	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.	Meet the requirement	P
	The power rate limit (W_{Gra}) shall be adjustable within the range 5% to 100% of rated power per minute.	It's adjustable within the range 1% to 100%.	P
	It is acceptable to have two separate power rate limits for increase and decrease in output power, as follows:	See below.	P
	(a) To rate limit an increase in power (W_{Gra+}).	It's adjustable within the range 1% to 100%.	P
	(b) To rate limit a decrease in power (W_{Gra-}).	It's adjustable within the range 1% to 100%.	P
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:	Applicable	P
6.3.5.3.2	Soft ramp up after connect or reconnect		P

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	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		P
	If available, this mode shall be enabled for a change in a demand response mode of Clause 6.2 (except for DRM 0).		P
	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.	See appendix table.	P
6.3.5.3.4	Changes in energy source operation	See below.	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.	While PV array input is vary through the time, this inverter will automatically charge and discharge the battery energy according to the need of the grid.	P
	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.	See appendix table.	P
	For this mode, the power rate limit (W_{Gra}) should be able to be enabled or disabled.	W_{Gra} is only set disable for this mode.	P
	The power rate limit shall be disabled by default.	See above.	P
	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).	While PV array input is vary through the time, this inverter will automatically charge and discharge the battery energy according to the need of the grid.	P
	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.	Complied	P
6.3.5.4	Nonlinearity of power rate limit changes	See appendix table 6.3.5. The test result is the same as 6.3.5.3.2 and 6.3.5.3.4.	P
	The nonlinearity (NL) of the power rate limit (W_{Gra}) 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%.	See above.	P
6.4	Multiple mode inverter operation		P
6.4.1	General	See below.	P

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	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.	The unit is consist relays per each phase and disconnected to the grid-interactive port while is operated at stand-alone mode.	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.	Complied.	P
	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.	The unit provides an integrated RCDs and also detects output current while is operated at stand-alone mode.	P
6.4.2	Sinusoidal output in stand-alone mode	See below.	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%.	See appendix table.	P
6.4.3	Volt–watt response mode for charging of energy storage	The Solar converter supplies for battery charging power from PV array input only.	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

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
	The internal settings of the demand response or power quality response modes of the inverter shall be secured against inadvertent or unauthorized tampering.	It is secured.	P
	Changes to the internal settings shall require the use of a tool and special instructions not provided to unauthorized personnel.	Only authorized personnel can change the internal setting.	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 -		P
	(a) if supply from the grid is disrupted;		P
	(b) when the grid goes outside preset parameters (e.g. undervoltage/overvoltage, under-frequency/over-frequency); or		P
	(c) when the demand response mode DRM 0 (see Clause 6.2) is asserted.		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.	Only connected to single phase systems.	N/A
7.2	Automatic disconnection device	See below.	P
	The automatic disconnection device shall provide isolation in all live conductors	The output is switched off redundant by two relays in series for each line.	P
	The automatic disconnection device shall be capable of interrupting at least the rated current.	Complied.	P
	The settings of the automatic disconnection device shall not exceed the capability of the inverter.	Complied.	P
	A semiconductor (solid-state) device shall not be used for isolation purposes.	The relays are mechanical type.	P
7.3	Active anti-islanding protection		P
	The automatic disconnection device shall incorporate at least one method of active anti-islanding protection.	See below.	P
	The method used to provide active anti-islanding protection shall be declared.	a) Frequency shift	P

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Clause	Requirement – Test	Result - Remark	Verdict
	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.	P
	Compliance shall be determined by type testing in accordance with the active anti-islanding tests specified in Appendix F or IEC 62116.	Meet the requirements of Appendix F	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:	See below.	P
	(a) Undervoltage and overvoltage protection.	See appendix table.	P
	(b) Under-frequency and over-frequency protection.	See appendix table.	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.	Meet the requirement.	P
7.5.2	Sustained operation for voltage variations	See below.	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.	See appendix table.	P
	The default set-point for V_{nom_max} shall be as follows: (a) In Australia: 255 V. (b) In New Zealand: 248 V.	See appendix table.	P
7.5.3	Sustained operation for frequency variations		P
7.5.3.1	Response to an increase in frequency	See below.	P
	The inverter shall be capable of supplying rated power between 47 Hz and 50.25 Hz for Australia.	Complied.	P
	The inverter shall be capable of supplying rated power between 45 Hz and 50.25 Hz for New Zealand.	Complied.	P

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Clause	Requirement – Test	Result - Remark	Verdict
	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.	Complied.	P
	<p>This is expressed in the equation below:</p> $P_{out} = P_{ref} \left[1 - \frac{(f - 50.25)}{(f_{stop} - 50.25)} \right]$ <p>where</p> <p>P_{out} = required output for a frequency between 50.25 Hz and f_{stop}</p> <p>P_{ref} = reference power level when the frequency reaches or exceeds 50.25 Hz</p> <p>f = frequency between 50.25 Hz and f_{stop}</p> <p>When the frequency exceeds f_{stop} the inverter power output shall be ceased (i.e. 0 W).</p> <p>The default set-point for f_{stop} shall be 52 Hz.</p>	See appendix table.	P
	Unconstrained power operation may recommence 6 min after the frequency returns to and remains at less than 50.15 Hz.	Onstrained power operation.	N/A
7.5.3.2	Response to a decrease in grid frequency	The Solar converter supplies for battery charging power from PV array input only.	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 frequency.		N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	<p>This is expressed in the equation below:</p> $P_{\text{charge}} = P_{\text{ref}} \left[1 - \frac{(49.75 - f)}{(49.75 - f_{\text{stop-CH}})} \right]$ <p>where</p> <p>P_{charge} = charge rate of the storage element for a frequency between 49.75 Hz and $f_{\text{stop-CH}}$</p> <p>$P_{\text{ref-CH}}$ = charge rate of the storage element when the frequency reaches or falls below 49.75 Hz</p> <p>f = frequency between 49.75 Hz and $f_{\text{stop-CH}}$</p> <p>When the frequency falls below $f_{\text{stop-CH}}$, the inverter should have ceased charging the storage element (i.e. 0 W). The default set-point for $f_{\text{stop-CH}}$ should be 49 Hz.</p>		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.	Meet the requirement.	P
	If an external signal or demand response 'DRM 0' condition is asserted, the automatic disconnection device shall operate within 2 s.	See appendix table 6.2.	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.	Complied.	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;	See appendix table 7.4.	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;	See appendix table 7.4.	P
	(c) the inverter and the grid are synchronized and in-phase with each other; and	Complied.	P
	(d) no external signal is present or DRM 0 asserted requiring the system to be disconnected.	Complied.	P


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Clause	Requirement – Test	Result - Remark	Verdict
7.8	Security of protection settings	See below.	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.	Only authorized personnel can change the internal setting.	P

8	MULTIPLE INVERTER COMBINATIONS		P
8.1	General	See below.	P
	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.		P
	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 inverters can only be combined as a single phase power system. See 8.5.1.	P
8.2	Inverter current balance across multiple phases	This inverters can only be combined as a single phase power system.	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.		N/A
8.3	Grid disconnection	See below.	P
	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 inverters can only be combined as a single phase power system. See 8.5.1.	P
	This applies to all inverters used in combination for single-phase or multiple phases.	This inverters can only be combined as a single phase power system	P
8.4	Grid connection and reconnection	This inverters can only be combined as a single phase power system	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

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Clause	Requirement – Test	Result - Remark	Verdict
	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	See below.	P
8.5.1	Single-phase combinations	See appendix table.	P
	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.	Rated current greater than 6 A.	N/A
	<p>To determine the number of inverters to be tested, the following equation shall be used:</p> $N = \frac{6}{I_{rated}}$ <p>where N = number to be tested, rounded up to next whole number I_{rated} = rating of the inverter in amperes</p> <p>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.</p>	The inverters can only be parallel to three inverter maximum.	P
8.5.2	Single-phase inverters used in three-phase combinations	This inverters can only be combined as a single phase power system	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
8.5.3	Required tests for multiple inverter combinations	See below.	P
	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.	Complied, see 8.5.1.	P

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Clause	Requirement – Test	Result - Remark	Verdict
8.5.4	Multiple inverters with one automatic disconnection device	This inverters have internal automatic disconnection relays.	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

9	INVERTER MARKING AND DOCUMENTATION		P
9.1	General		P
	All markings and documentation shall be in the English language.		P
9.2	Marking		P
9.2.1	General	See below.	P
9.2.2	Equipment ratings		P
	Photovoltaic		-
	V _{max} PV (absolute maximum)	600Vdc max	P
	I _{sc} PV (absolute maximum)	15A x 2	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)	40-450Vdc	P
	Rated current (maximum continuous)	40A	P
	Storage type	The explanation is marked on external energy storage unit	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

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Clause	Requirement – Test	Result - Remark	Verdict
	Frequency (nominal or range) (a.c. sources only)	--	N/A
	a.c. output ratings (for each port)		-
	Voltage (nominal or range)	230Vac	P
	Rated current	24A max.	P
	Frequency (nominal or range)	50/60 Hz	P
	Rated apparent power	5kVA	P
	Power factor range	0,8ind to 0,8cap	P
	d.c. output ratings		-
	Voltage (nominal or range)	40-450Vdc	P
	Rated current	40A	P
	Inverter topology	Non-Isolated type, The symbol is  marked “ ” on the label.	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 as appropriate.	Photovoltaic ports are marked as DC1+, DC1-, DC2+ and DC2-. External battery pack ports are marked as BT+ and BT-, and communication port as CAN. Grid-interactive port is marked as AC Output. Communication Port is marked as COMM./DRM.	P
9.2.4	External and ancillary equipment	Integrated RCD used.	N/A
9.2.5	Residual current devices (RCDs)		P
	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	Integrated RCD used.	N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	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	Integrated RCD used.	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 label is placed near the demand response interface port to indicate the demand response modes of which the unit is capable.	P
9.3	Documentation		P
9.3.1	General		P
9.3.2	Equipment ratings		P
	Photovoltaic		-
	Vmax PV (absolute maximum)	600Vdc max	P
	PV input operating voltage range	100-550Vdc, 600Vdc max	P
	Maximum operating PV input current	12A x 2	P
	Isc PV (absolute maximum)	15A x 2	P
	Maximum inverter backfeed current to array	0 A	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)	80-450Vdc	P
	Nominal battery voltage	The information is explained at manual of external energy storage unit.	N/A
	Rated current (maximum continuous) input and output	40A	P
	Storage type	The information is explained at manual of external energy storage unit.	N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	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)		-
	Voltage (nominal or range)	230Vac	P
	Rated current	24A	P
	Current (inrush)	16 A peak, 100 us	P
	Frequency (nominal or range)	50/60 Hz	P
	Rated apparent power	5kVA	P
	Power factor range	0,8ind to 0,8cap	P
	Maximum output fault current	28A RMS	P
	Maximum output overcurrent protection	30A or 32A	P
	d.c. output ratings		-
	Voltage (nominal or range)	40-450Vdc, nominal 96Vdc	P
	Rated current	40A	N/A
	Inverter topology	Transformerless	P
	Active anti-islanding method	c) Reactive power injection	P
	Protective class (I, II or III)	Class I	P
	Over voltage category	AC output : III ; DC input : II	P
	Ingress protection (IP) rating	IP65	P
	Temperature operating range	-25-60°C (Battery 0-50°C) full power up to 40°C	P
9.3.3	Ports	It is explained in the manual: Photovoltaic ports are marked as DC1+, DC1-, DC2+ and DC2-. External battery pack ports are marked as BT+ and BT-, and communication port as CAN. Grid-interactive port is marked as AC Output. Communication Port is marked as RS 485 and DRM.	P
9.3.4	External and ancillary equipment	No such part	N/A
9.3.5	RCDs	No such part	N/A

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Clause	Requirement – Test	Result - Remark	Verdict
9.3.6	Multiple mode inverters	It is explained in the manual: Ratings and means of connection. Means of connected wiring Means of disconnected AC and DC circuit The fuse is built in external energy storage unit. The information is explained at manual of external energy storage unit.	P
9.3.7	Multiple inverter combinations	It is explained in the manual: The inverters can only be parallel to three inverter maximum. Means of Multiple inverter combinations.	P

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)	P
APPENDIX K	RELATED DOCUMENTS (Informative)	P

Test results

5.5 Power factor Appendix B Power factor test						P
Mode	Measurement	Rated Output Current				
		15+/-5%	25+/-5%	50+/-5%	75+/-5%	100+/-5%
Unity	Vrms (V)	230,25	230,32	230,41	230,69	230,81
	Arms (A)	3,26	5,47	10,94	16,36	21,53
	Apparent Power (kVA)	0,750	1,259	2,523	3,774	4,970
	Power (kW)	0,748	1,258	2,521	3,772	4,968
	Recative power (kVar)	0,048	0,059	0,096	0,129	0,157
	Power Factor (cosΦ)	0,998	0,999	0,999	0,999	0,999
Lag limit	Vrms (V)	230,29	230,35	230,48	230,62	230,61
	Arms (A)	4,01	6,71	13,38	19,99	22,18
	Apparent Power (kVA)	0,923	1,546	3,084	4,611	5,116
	Power (kW)	0,743	1,247	2,495	3,724	4,114
	Recative power (kVar)	-0,547	-0,914	-1,813	-2,719	-3,041
	Power Factor (cosΦ)	0,805	0,807	0,809	0,808	0,804
Lead limit	Vrms (V)	230,29	230,39	230,58	230,70	230,74
	Arms (A)	4,06	6,77	13,47	20,10	23,36
	Apparent Power (kVA)	0,935	1,559	3,106	4,636	5,391
	Power (kW)	0,747	1,252	2,503	3,734	4,324
	Recative power (kVar)	0,561	0,929	1,840	2,749	3,220
	Power Factor (cosΦ)	0,800	0,803	0,806	0,805	0,802
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						

5.6 Harmonic currents Appendix C Harmonic Current Limit Test							P
Generating Unit rating per phase (rpp)							
	At 50% of rated ouput current			100% of rated output currentA			
	Watts (kW)	2,485		Watts (kW)	4,962		
	VA (kVA)	2,507		VA (kVA)	4,976		
	Vrms (Vac)	230,47		Vrms (Vac)	230,74		
	Arms (A)	10,88		Arms (A)	21,57		
	PF	0,991		PF	0,997		
	Frequency (Hz)	50		Frequency (Hz)	50		
Harmonic	Value (A)	Angle degrees	% of fundamental	Value (A)	Angle degrees	% of fundamental	Limit in % of fundamental
0 (IDC)	0,031	--	0,143	0,045	--	0,207	0,5
1st	10,877	--	50,034	21,564	--	99,192	--
2nd	0,008	--	0,039	0,017	--	0,079	1
3rd	0,108	--	0,502	0,163	--	0,750	4
4th	0,007	--	0,032	0,008	--	0,034	1
5th	0,050	--	0,231	0,055	--	0,251	4
6th	0,010	--	0,047	0,009	--	0,040	1
7th	0,048	--	0,224	0,055	--	0,251	4
8th	0,015	--	0,070	0,013	--	0,061	1
9th	0,052	--	0,239	0,054	--	0,249	2
10th	0,018	--	0,085	0,015	--	0,070	0,5
11th	0,051	--	0,237	0,055	--	0,255	2
12th	0,019	--	0,089	0,016	--	0,074	0,5
13th	0,053	--	0,248	0,058	--	0,265	2
14th	0,019	--	0,089	0,015	--	0,068	0,5
15th	0,052	--	0,242	0,057	--	0,264	1
16th	0,018	--	0,084	0,013	--	0,060	0,5
17th	0,054	--	0,251	0,060	--	0,277	1
18th	0,020	--	0,092	0,014	--	0,062	0,5
19th	0,053	--	0,244	0,060	--	0,276	1
20th	0,021	--	0,096	0,015	--	0,067	0,5
21th	0,049	--	0,227	0,060	--	0,277	0,6
22th	0,020	--	0,095	0,015	--	0,071	0,5
23th	0,043	--	0,200	0,058	--	0,266	0,6
24th	0,019	--	0,087	0,015	--	0,070	0,5
25th	0,034	--	0,160	0,054	--	0,250	0,6
26th	0,016	--	0,072	0,014	--	0,066	0,5
27th	0,026	--	0,120	0,047	--	0,216	0,6
28th	0,012	--	0,054	0,013	--	0,059	0,5
29th	0,018	--	0,082	0,041	--	0,187	0,6
30th	0,008	--	0,037	0,011	--	0,048	0,5
31th	0,012	--	0,057	0,032	--	0,149	0,6
32th	0,005	--	0,025	0,009	--	0,040	0,5
33th	0,008	--	0,036	0,025	--	0,114	0,6
THD (to 50th)	0,962			1,232			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%.							

5.6 Harmonic currents Appendix C3 Harmonic Voltage Limit Test				P
Harmonic	Value (Vac)	% of fundamental	Limit in % of fundamental	
1st	230,640	--	--	
2nd	0,020	0,01	0,2	
3rd	0,040	0,02	4	
4th	0,010	0,00	0,2	
5th	0,030	0,01	4	
6th	0,000	0,00	0,2	
7th	0,000	0,00	4	
8th	0,000	0,00	0,2	
9th	0,000	0,00	2	
10th	0,000	0,00	0,2	
11th	0,010	0,00	0,1	
12th	0,000	0,00	0,1	
13th	0,010	0,00	0,1	
14th	0,000	0,00	0,1	
15th	0,010	0,00	0,1	
16th	0,000	0,00	0,1	
17th	0,010	0,00	0,1	
18th	0,000	0,00	0,1	
19th	0,010	0,00	0,1	
20th	0,000	0,00	0,1	
21th	0,010	0,00	0,1	
22th	0,000	0,00	0,1	
23th	0,020	0,01	0,1	
24th	0,000	0,00	0,1	
25th	0,020	0,01	0,1	
26th	0,000	0,00	0,1	
27th	0,010	0,00	0,1	
28th	0,000	0,00	0,1	
29th	0,010	0,00	0,1	
30th	0,000	0,00	0,1	
31th	0,010	0,00	0,1	
32th	0,000	0,00	0,1	
33th	0,010	0,00	0,1	
34th	0,000	0,00	0,1	
35th	0,010	0,00	0,1	
36th	0,000	0,00	0,1	
37th	0,000	0,00	0,1	
38th	0,000	0,00	0,1	
39th	0,000	0,00	0,1	
40th	0,000	0,00	0,1	
41th	0,010	0,00	0,1	
42th	0,000	0,00	0,1	
43th	0,000	0,00	0,1	
44th	0,000	0,00	0,1	
45th	0,000	0,00	0,1	
46th	0,000	0,00	0,1	
47th	0,000	0,00	0,1	
48th	0,000	0,00	0,1	
49th	0,000	0,00	0,1	
50th	0,000	0,00	0,1	
THD	0,031		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%.

5.7 Voltage Fluctuations and Flicker			P
Limit	Pst = 1,0	Plt = 0,65	
Test value	See EMC Report.		
<p>Note:</p> <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> <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 (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.</p> <p>For test results see Annex 1 – EMC Report.</p>			

5.8 Transient Voltage Limits (phase to neutral) Appendix D Transient Voltage Limit Test

P

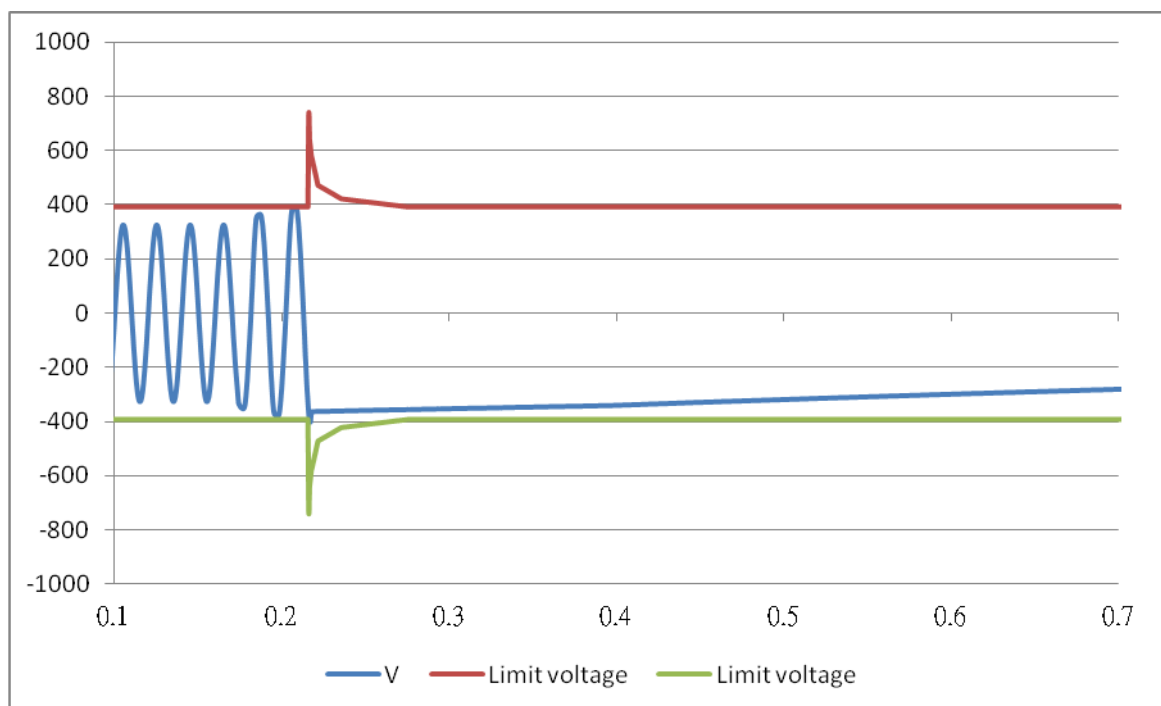
	10+/-5% Output Power (VA)		50+/-5% Output Power (VA)		100+/-5% Output Power (VA)	
	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)	Duration (s)	Line to neutral (V)
Limit	0,06	390	0,06	390	0,06	390
Test value	0,001	-399	0	374	0,001	393

Note:

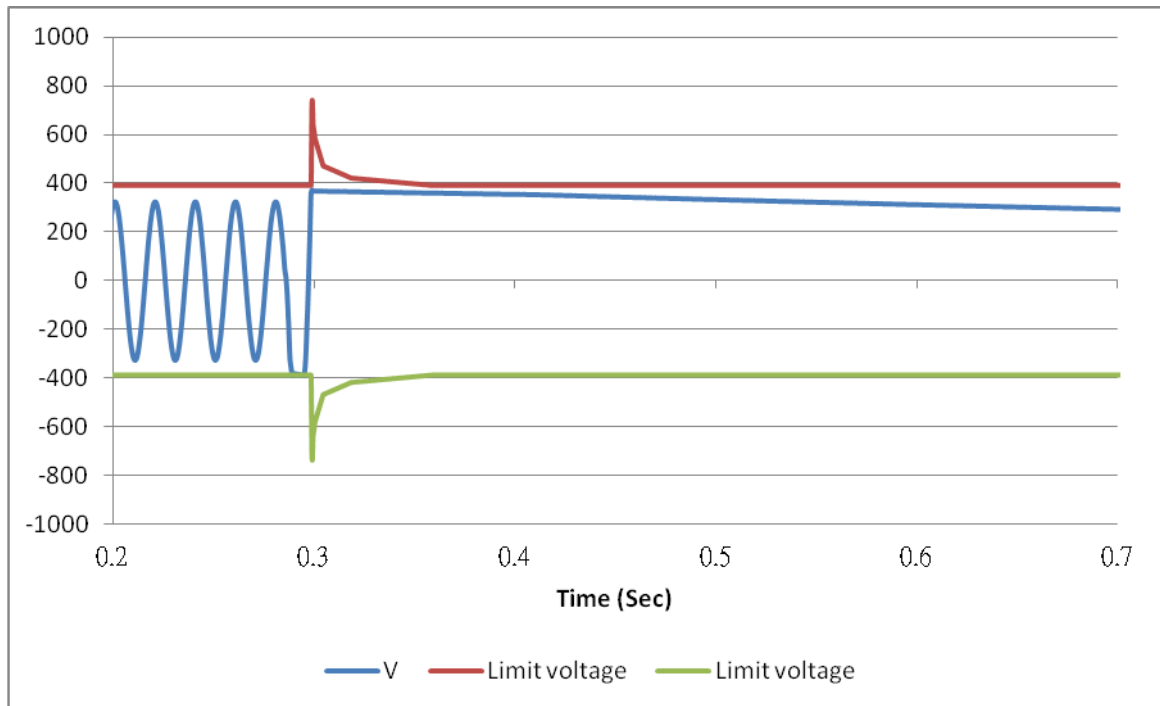
Results shall not exceed limits in Table 4 of AS/NZS 4777.2. Test Specifications: Inverter shall be connected to test circuit AS/NZS 4777.2 Figure D1. Grid nominal voltage within +/-5%, Via DC-input set AC- output power so that it equals to 10+/-5% of rated output (VA). Switch S shall be opened and the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

Test data refers to report "PVAU150415C06"

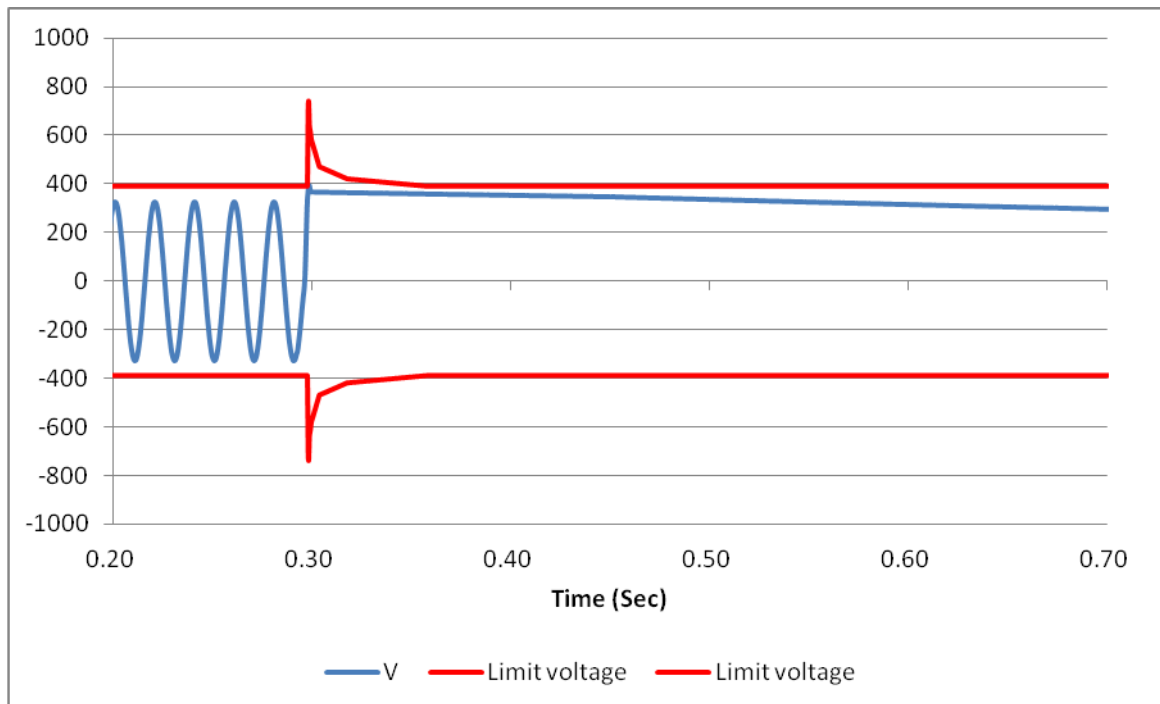
Graph for 10% output power



Graph for 50% output power



Graph for 100% output power

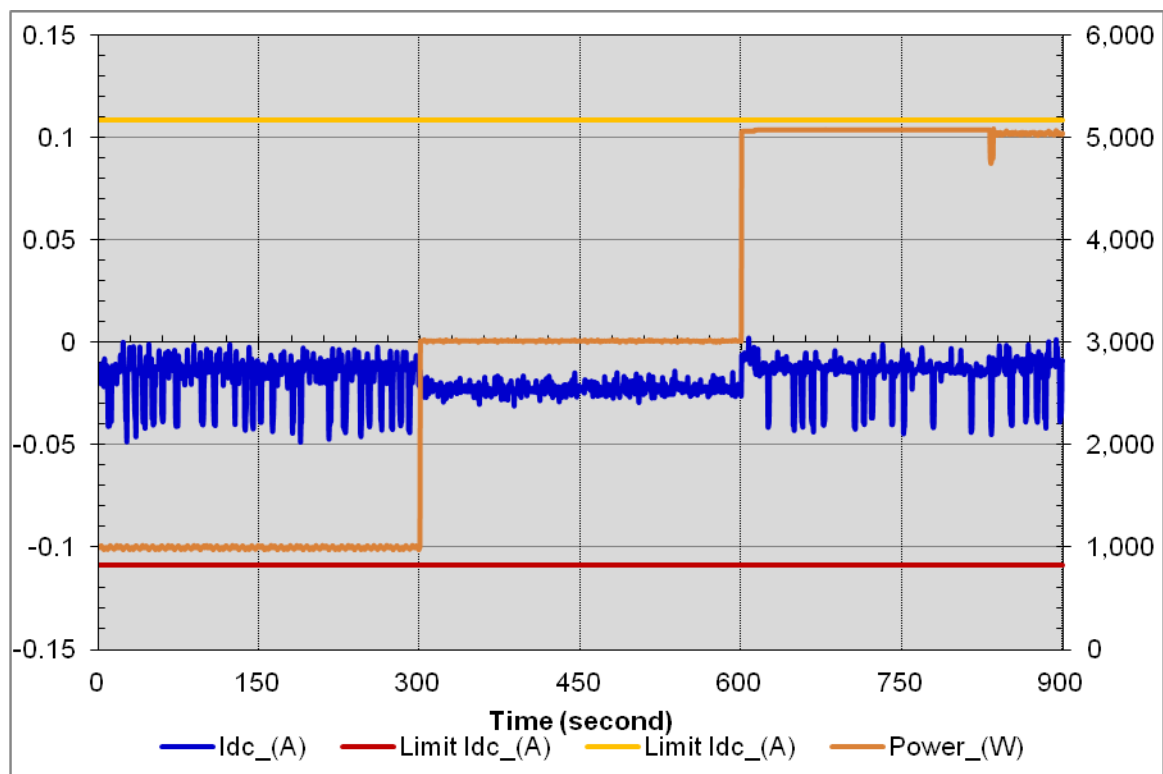


5.9 Direct current injection Appendix E D.C. injection test

P

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)
Test value	Single phase!	Single phase!	Single phase!	-47,90	Single phase!	Single phase!
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)
Test value	Single phase!	Single phase!	Single phase!	-31,00	Single phase!	Single phase!
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)
Test value	Single phase!	Single phase!	Single phase!	-45,00	Single phase!	Single phase!

Diagram of permanent dc-injection



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.

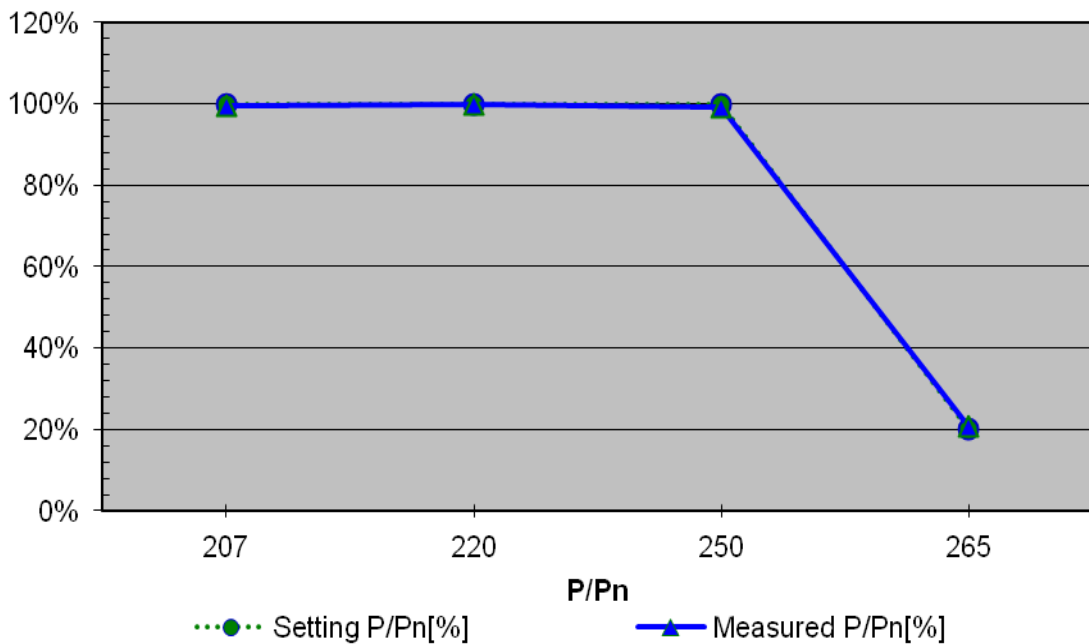
5.10 Current balance for three-phase inverters						N/A
Setting values	PF cos φ = 1			Rated output current: A		
Test value	L1	L2	L3	L1 – L2	L2 – L3	L3 – L1
100% of rated current	--	--	--	--	--	--
Limit [A]: 5% of rated current	--					
Note: The a.c. output current for each phase for three-phase balanced current shall be within 5% of the measured value of the other phases at rated current when injected into a balanced three phase voltage.						

6.2 Inverter demand response modes (DRMs) Appendix I Demand and power quality response					P
Mode	Requirement	Measurement			Result
		Real Power (kW)	Reactive Power (kVar)	Switching Time (s)	
DRM 0	Operate the disconnection device	0,00	0,00	1,161	Pass
DRM 1	Do not consume power	--	--	--	--
DRM 2	Do not consume at more than 50% of rated power	--	--	--	--
DRM 1 and DRM 2		--	--	--	--
DRM 3	Do not consume at more than 75% of rated power AND Source reactive power if capable	--	--	--	--
DRM 2 and DRM 3		--	--	--	--
DRM 4	Increase power consumption (subject to constraints from other active DRMs)	--	--	--	--
DRM 5	Do not generate power	0,001	0,054	0,848	PASS
DRM 6	Do not generate at more than 50% of rated power	0,155	0,347	0,896	PASS
DRM 5 and DRM 6		0,001	0,054	0,888	PASS
DRM 7	Do not generate at more than 75% of rated power AND Sink reactive power if capable	3,516	0,326	0,882	PASS
DRM 6 and DRM 7		2,487	0,318	0,885	PASS
DRM 8	Increase power generation (subject to constraints from other active DRMs)	4,988	0,432	0,106	PASS
Note: Switching time limit : 2s					

6.3.2.2 Volt-watt response mode				P
Test: (Australia Default Setting)				
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,90	220,84	249,51	264,94
Active power P (kW):	4,982	4,991	4,964	1,034
P/P _{rated} (%):	99,64	99,82	99,28	20,68
Power Factor Value:	0,997	0,997	0,996	0,937

Graph:

Volt-Watt response mode For Australia

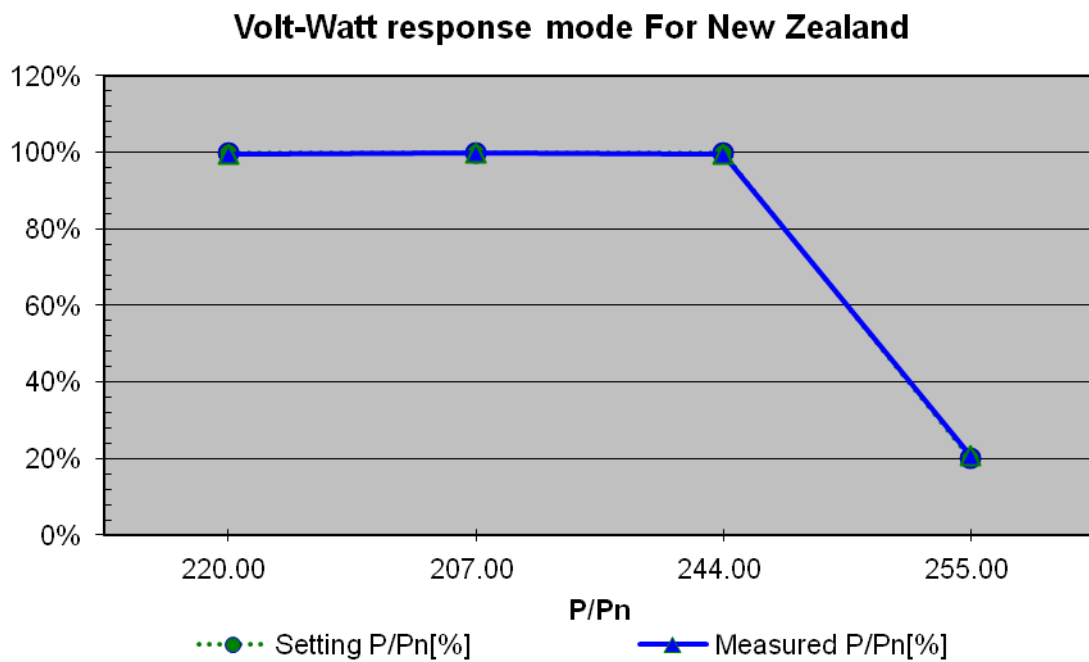


Note:
The output current limit is 24A.

Test: (New Zealand Default Setting)

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,36	220,80	243,19	256,09
Active power P (kW):	4,978	4,990	4,970	1,038
P/P _{rated} (%):	99,56	99,80	99,40	20,76
Power Factor Value:	0,998	0,997	0,996	0,944

Graph:



Note:

The output current limit is 24A.

6.3.2.3 Volt-var response mode

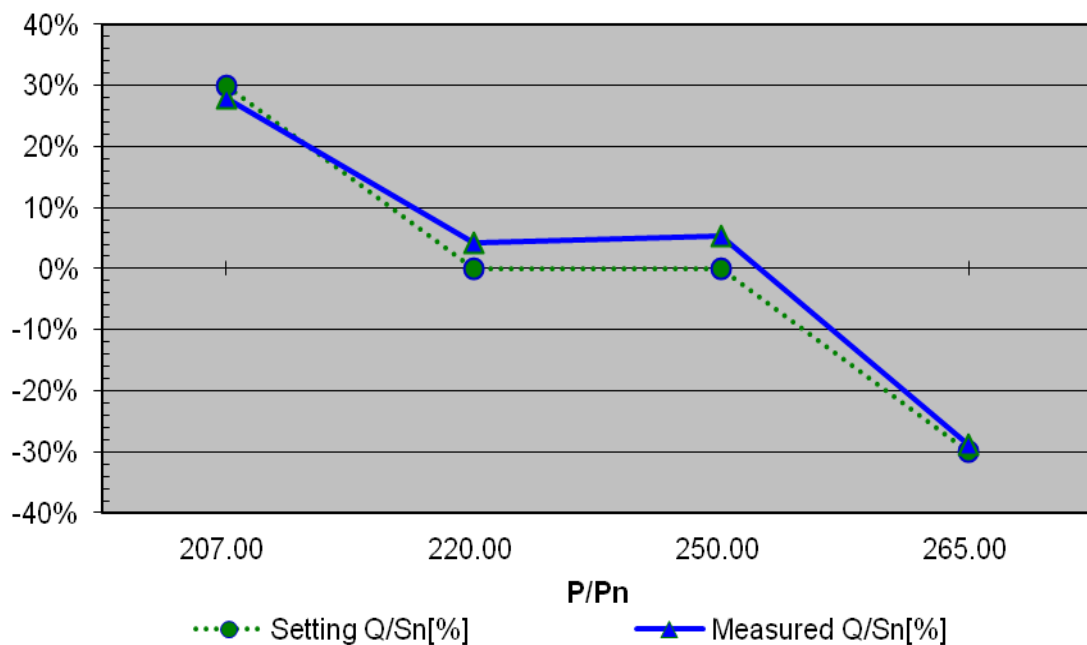
P

Test: (Australia Default Setting)

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,93	220,81	249,51	265,37
Reactive power Q (kVar):	1,397	0,216	0,268	-1,445
Q/S _{rated} (%):	27,94	4,32	5,36	-28,90
Power Factor Value:	0,962	0,999	0,999	0,960

Graph:

Volt-Var response mode For Australia



Note:

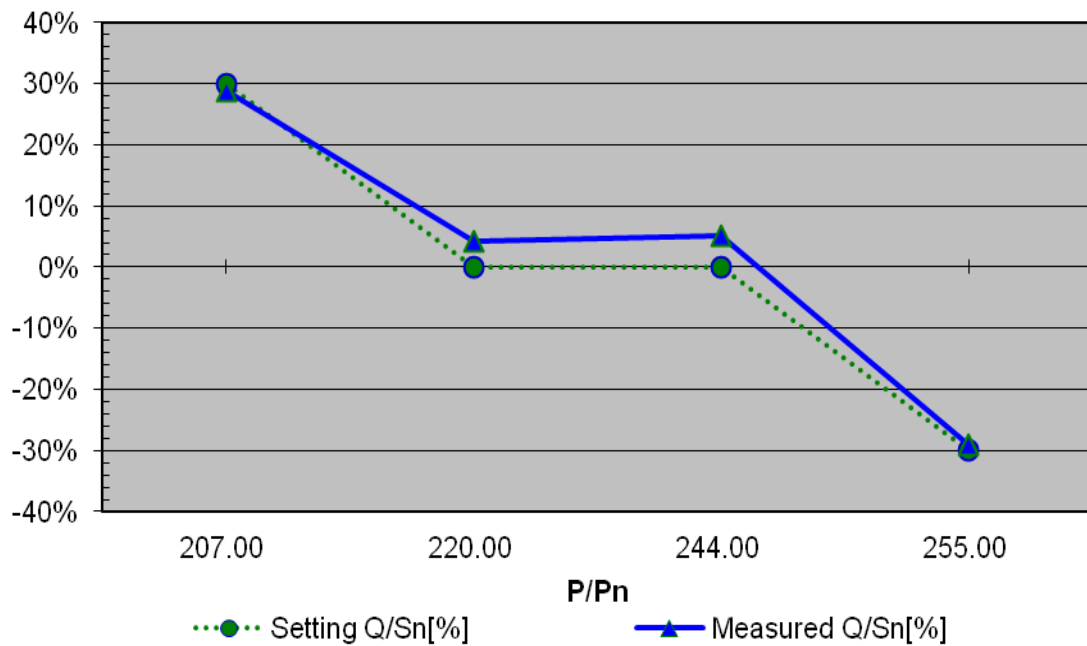
1. The percentage var/VA level leading is the inverter sourcing vars to the grid, whereas the percentage var/VA level lagging is the inverter sinking vars from the grid.
2. Inverters may provide a range up to 60% leading or lagging.
3. % of rated apparent power use for test.

Test: (New Zealand Default Setting)

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,44	220,81	244,04	255,60
Reactive power Q (kVar):	1,442	0,215	0,252	-1,450
Q/S_{rated} (%):	28,84	4,30	5,04	-29,00
Power Factor Value:	0,959	0,999	0,999	0,959

Graph:

Volt-Var response mode For New Zealand

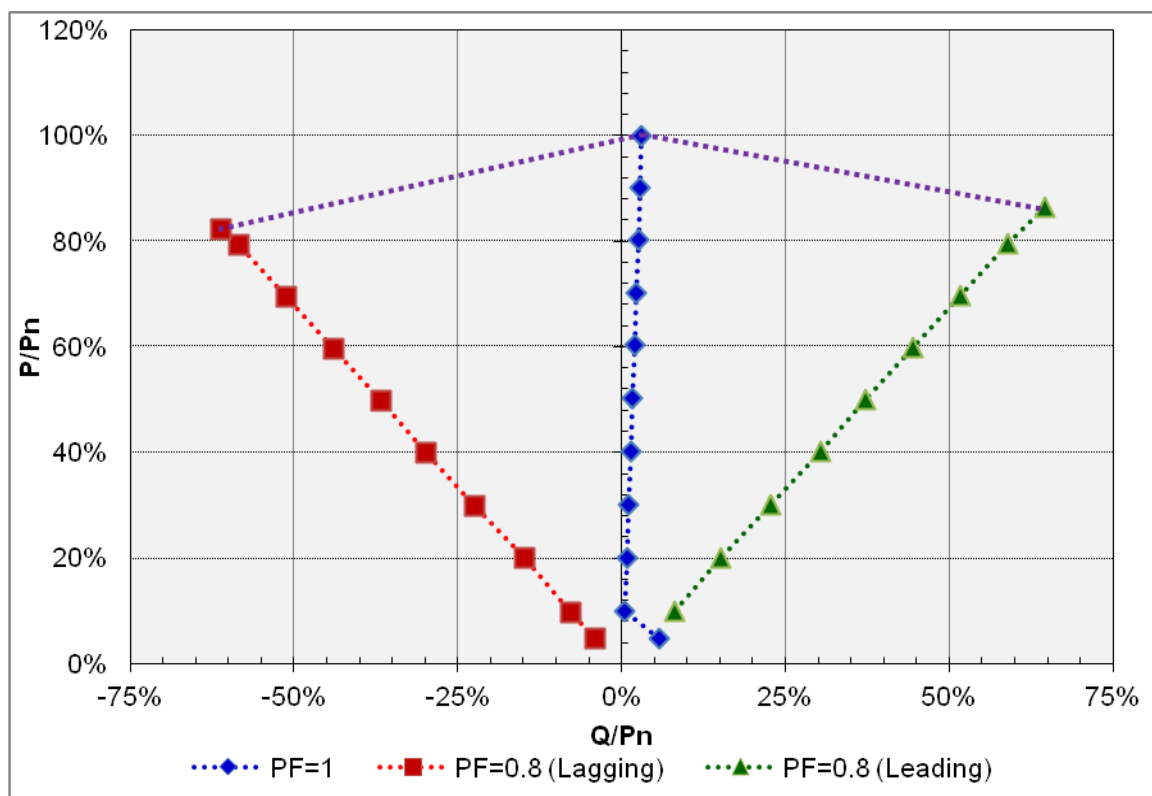


Note:

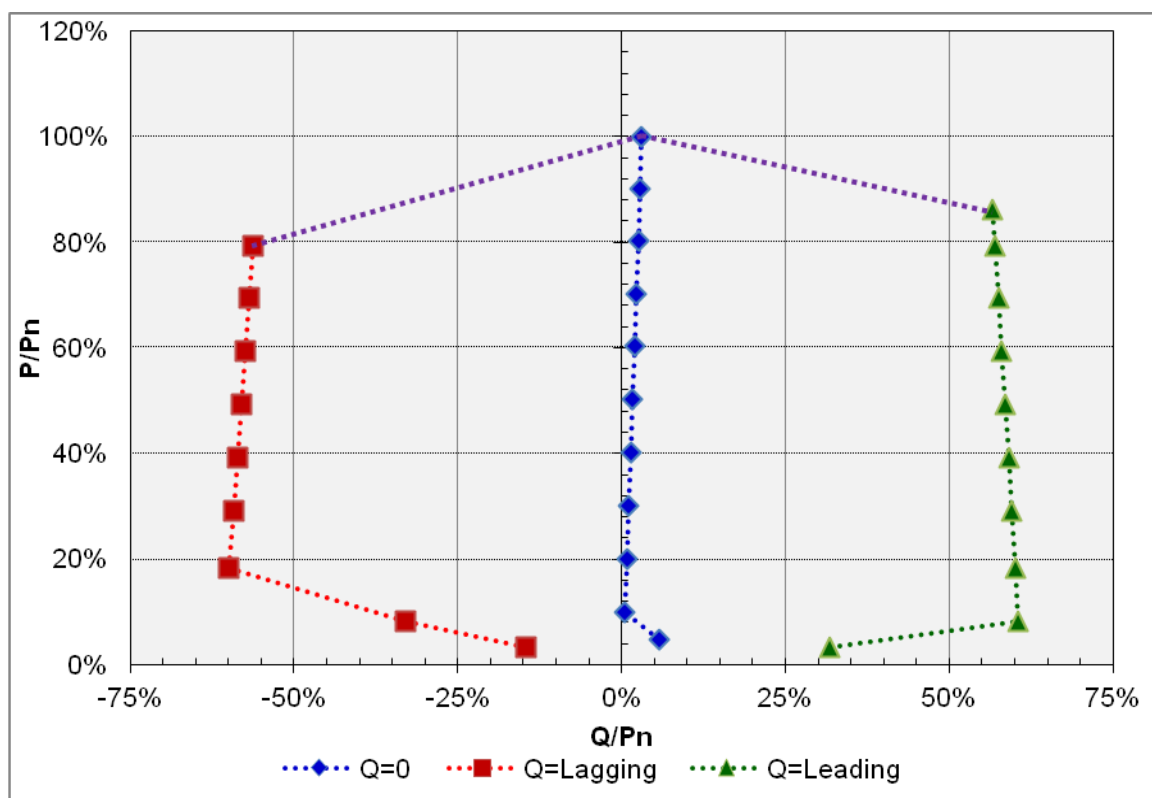
1. The percentage var/VA level leading is the inverter sourcing vars to the grid, whereas the percentage var/VA level lagging is the inverter sinking vars from the grid.
2. Inverters may provide a range up to 60% leading or lagging.
3. % of rated apparent power use for test.

6.3.3 Fixed power factor mode and reactive power mode										P
Test:										
Fixed power factor mode										
P/P _{rated} in %	10	20	30	40	50	60	70	80	90	100
Setting Power Factor (cosφ) = 1										
Voltage (V):	230.22	230.29	230.37	230.47	230.56	230.58	230.66	230.68	230.76	230.78
Active power (kW):	0,492	1,002	1,509	2,014	2,516	3,017	3,516	4,013	4,507	4,998
Reactive power (kVar):	0,022	0,039	0,054	0,068	0,085	0,100	0,116	0,130	0,143	0,153
Power factor:	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
Setting Power Factor (cosφ) 0,8 leading										
Voltage (V):	230.19	230.28	230.38	230.48	230.53	230.59	230.64	230.69	230.71	230.71
Active power (kW):	0,492	1,000	1,503	2,004	2,501	2,996	3,487	3,975	4,324	4,324
Reactive power (kVar):	0,402	0,753	1,137	1,515	1,857	2,220	2,586	2,951	3,232	3,232
Power factor:	0.774	0.799	0.798	0.797	0.802	0.803	0.803	0.802	0.801	0.801
Setting Power Factor (cosφ) lagging										
Voltage (V):	230.18	230.23	230.32	230.37	230.43	230.49	230.55	230.61	230.63	230.63
Active power (kW):	0,488	0,995	1,497	1,998	2,494	2,987	3,478	3,965	4,116	4,116
Reactive power (kVar):	-0,388	-0,737	-1,118	-1,493	-1,831	-2,193	-2,559	-2,923	-3,061	-3,061
Power factor:	0.783	0.803	0.801	0.801	0.806	0.806	0.805	0.804	0.802	0.802
Fixed Reactive power mode										
P/P _{rated} in %	10	20	30	40	50	60	70	80	90	100
Setting Reactive power in leading										
Voltage (V):	230,36	230,38	230,45	230,48	230,56	230,59	230,67	230,69	230,72	230,72
Active power (kW):	0,438	0,952	1,463	1,972	2,477	2,979	3,480	3,977	4,472	4,472
Reactive power (kVar):	3,026	3,001	2,977	2,953	2,927	2,901	2,876	2,852	2,827	2,827
Power factor:	0,143	0,302	0,441	0,555	0,646	0,716	0,771	0,813	0,845	0,845
Setting Reactive power in lagging										
Voltage (V):	230,20	230,21	230,28	230,36	230,44	230,51	230,60	230,63	230,68	230,68
Active power (kW):	0,408	0,913	1,450	1,960	2,465	2,968	3,469	3,967	4,307	4,307
Reactive power (kVar):	-1,653	-2,998	-2,963	-2,933	-2,904	-2,875	-2,846	-2,817	-2,786	-2,786
Power factor:	0,241	0,291	0,440	0,556	0,647	0,718	0,773	0,815	0,840	0,840
Note:										
The grid-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 60%.										
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.										

Graph for Fixed power factor mode



Graph for Fixed Reactive power mode



6.3.4 characteristic power factor curve for cos φ (P) (Power response)										P																																																		
Test:																																																												
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):	230,23	230,30	230,33	230,40	230,47	230,48	230,52	230,55	230,59	230,58																																																		
P (kW):	0,492	1,258	1,511	2,017	2,521	3,017	3,508	3,896	4,299	4,286																																																		
P / P _{rated} (%):	9,84	25,16	30,22	40,34	50,42	60,34	70,16	77,92	85,98	85,72																																																		
Q (kVar):	0,056	0,060	0,068	0,082	0,096	-0,907	-1,566	-2,100	-2,832	-2,871																																																		
cos φ:	0,994	0,999	0,999	0,999	0,999	0,958	0,913	0,880	0,835	0,831																																																		
cos φ _{setpoint} of P:	N/A	1,000	1,000	1,000	1,000	0,960	0,920	0,880	0,840	0,840																																																		
Limit cos φ :	cos φ _{setpoint} ± 0,01																																																											
<div>Graph</div> <table><thead><tr><th>P/P_n</th><th>PE60 (W)</th><th>QE60 (Var)</th><th>PF60</th><th>Limit cos φ</th></tr></thead><tbody><tr><td>25%</td><td>1100</td><td>-500</td><td>0,999</td><td>0,999</td></tr><tr><td>30%</td><td>1300</td><td>-500</td><td>0,999</td><td>0,999</td></tr><tr><td>40%</td><td>1700</td><td>-500</td><td>0,999</td><td>0,999</td></tr><tr><td>50%</td><td>2100</td><td>-500</td><td>0,999</td><td>0,999</td></tr><tr><td>60%</td><td>2600</td><td>-700</td><td>0,958</td><td>0,958</td></tr><tr><td>70%</td><td>3100</td><td>-900</td><td>0,913</td><td>0,913</td></tr><tr><td>80%</td><td>3500</td><td>-1100</td><td>0,880</td><td>0,880</td></tr><tr><td>90%</td><td>3800</td><td>-1300</td><td>0,835</td><td>0,835</td></tr><tr><td>100%</td><td>3800</td><td>-1300</td><td>0,831</td><td>0,831</td></tr></tbody></table>											P/P _n	PE60 (W)	QE60 (Var)	PF60	Limit cos φ	25%	1100	-500	0,999	0,999	30%	1300	-500	0,999	0,999	40%	1700	-500	0,999	0,999	50%	2100	-500	0,999	0,999	60%	2600	-700	0,958	0,958	70%	3100	-900	0,913	0,913	80%	3500	-1100	0,880	0,880	90%	3800	-1300	0,835	0,835	100%	3800	-1300	0,831	0,831
P/P _n	PE60 (W)	QE60 (Var)	PF60	Limit cos φ																																																								
25%	1100	-500	0,999	0,999																																																								
30%	1300	-500	0,999	0,999																																																								
40%	1700	-500	0,999	0,999																																																								
50%	2100	-500	0,999	0,999																																																								
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100%	3800	-1300	0,831	0,831																																																								
<div>Note:</div> <div>The response curve required for the cos φ (P) response should be defined within displacement power factor range of 0.8 leading to 0.8 lagging.</div>																																																												

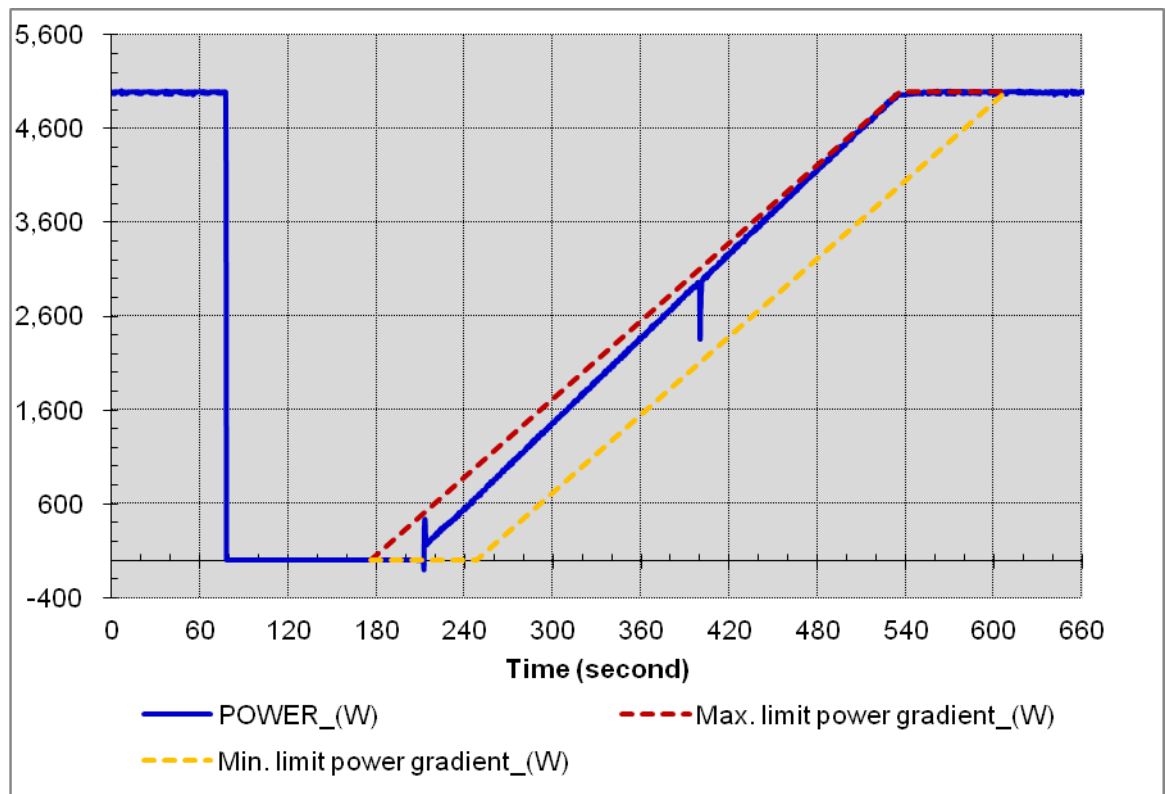
6.3.5	Power rate limit	P
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6.3.5.3.2	Test (a): Soft ramp up after connect or reconnect	P
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Test:

Time measurement from 0% to 100% P_{rated} (minutes)	5,83
Average W_{Gra} (% per minute)	17,16

Graph for Soft ramp up after connect or reconnect



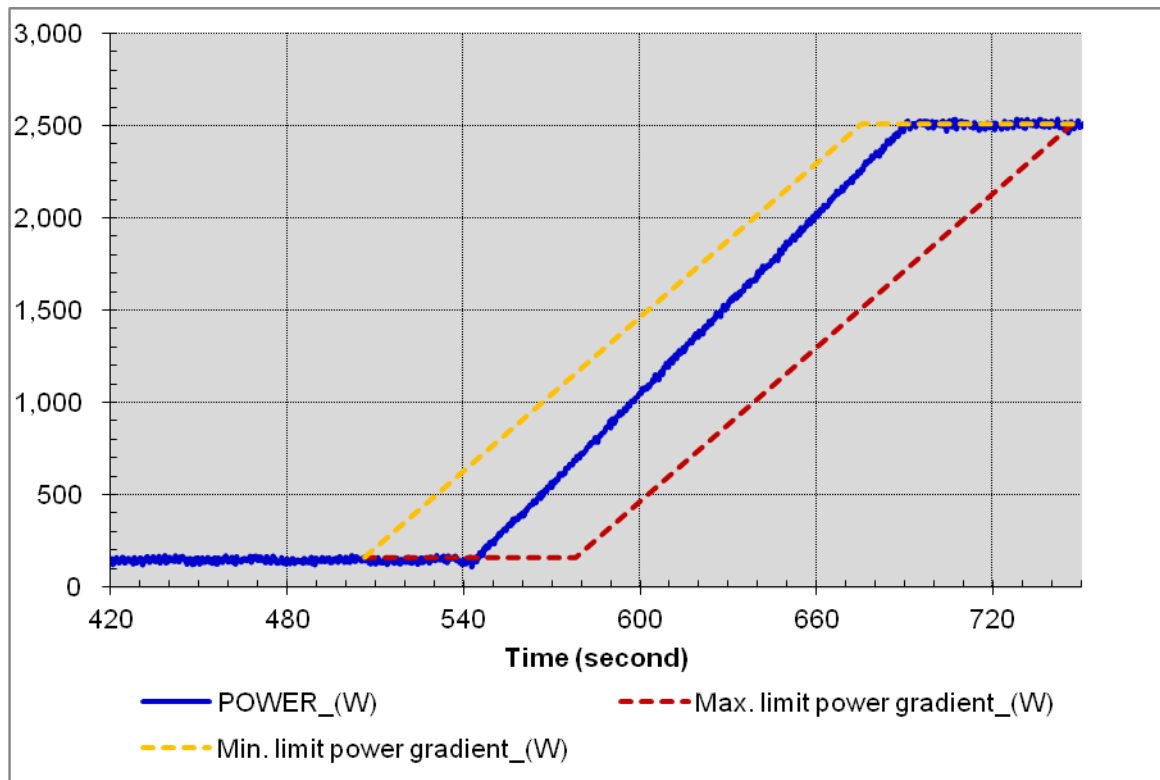
6.3.5.3.3 Test (b): Change in a.c. operation and control (DRM control only)

P

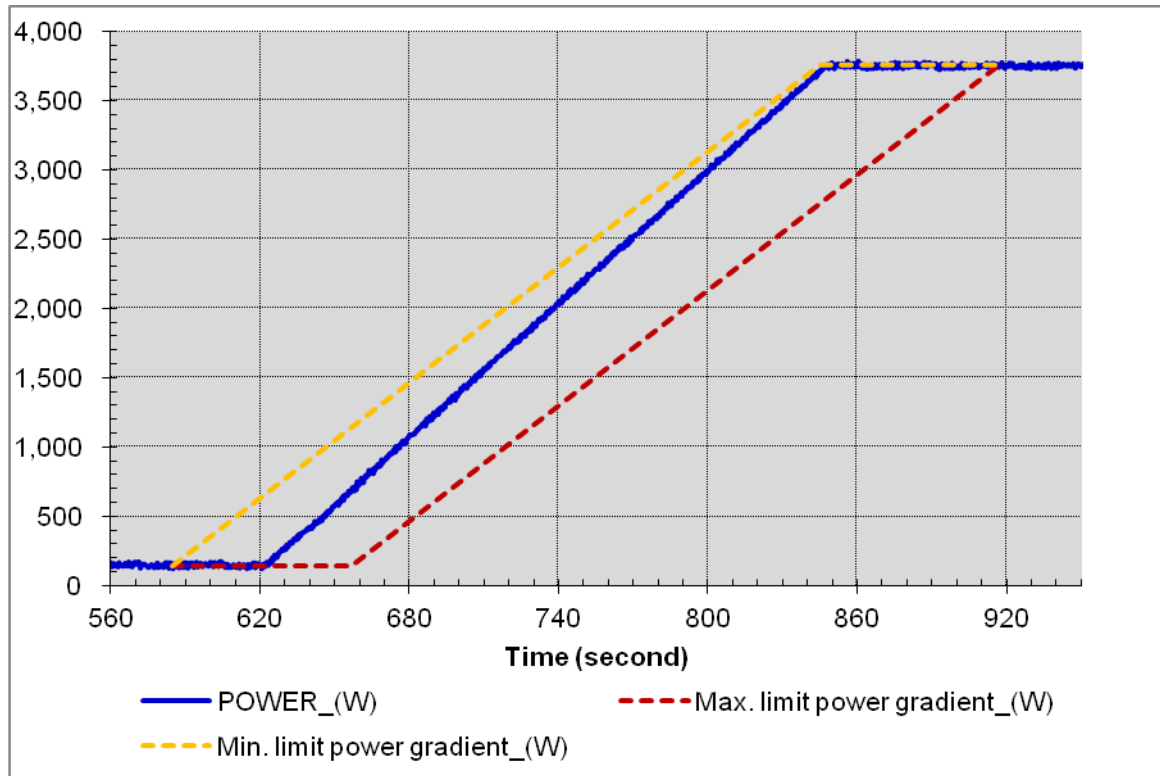
Test:

DRM mode	DRM 5 to 6	DRM 5 to 7	DRM 5 to 8
Power change (%)	Increase: 0 % to 50 %	Decrease: 0% to 75%	Decrease: 0% to 100%
Time measurement (s)	155,4	239,8	359,0
Average W_{Gra} (% per minute)	18,22	18,22	16,17

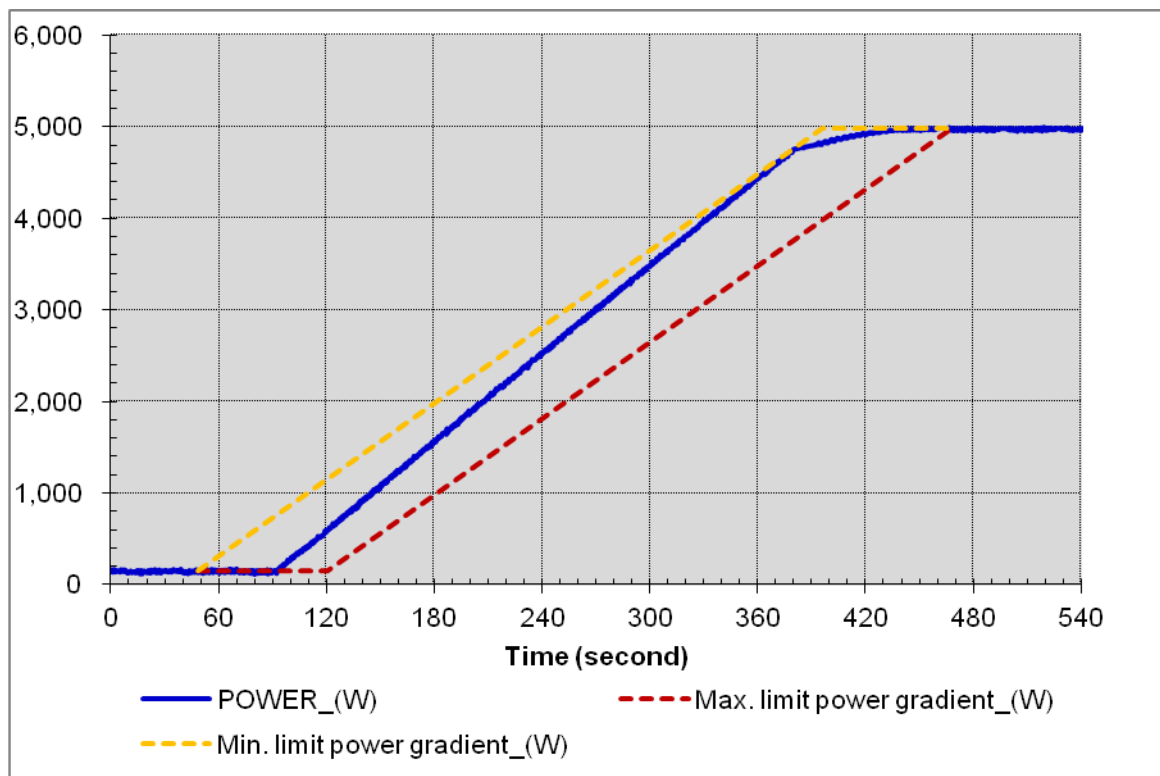
Graph for Change in a.c. operation and control (DRM 5 to 6)



Graph for Change in a.c. operation and control (DRM 5 to 7)



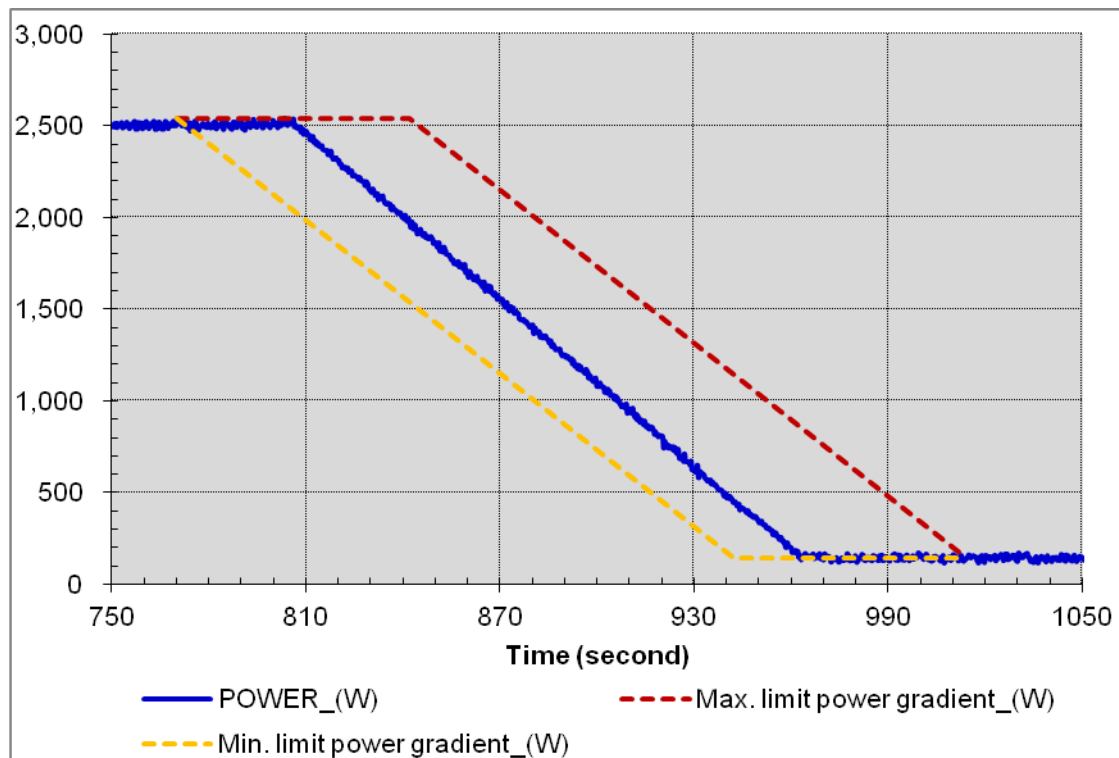
Graph for Change in a.c. operation and control (DRM 5 to 8)



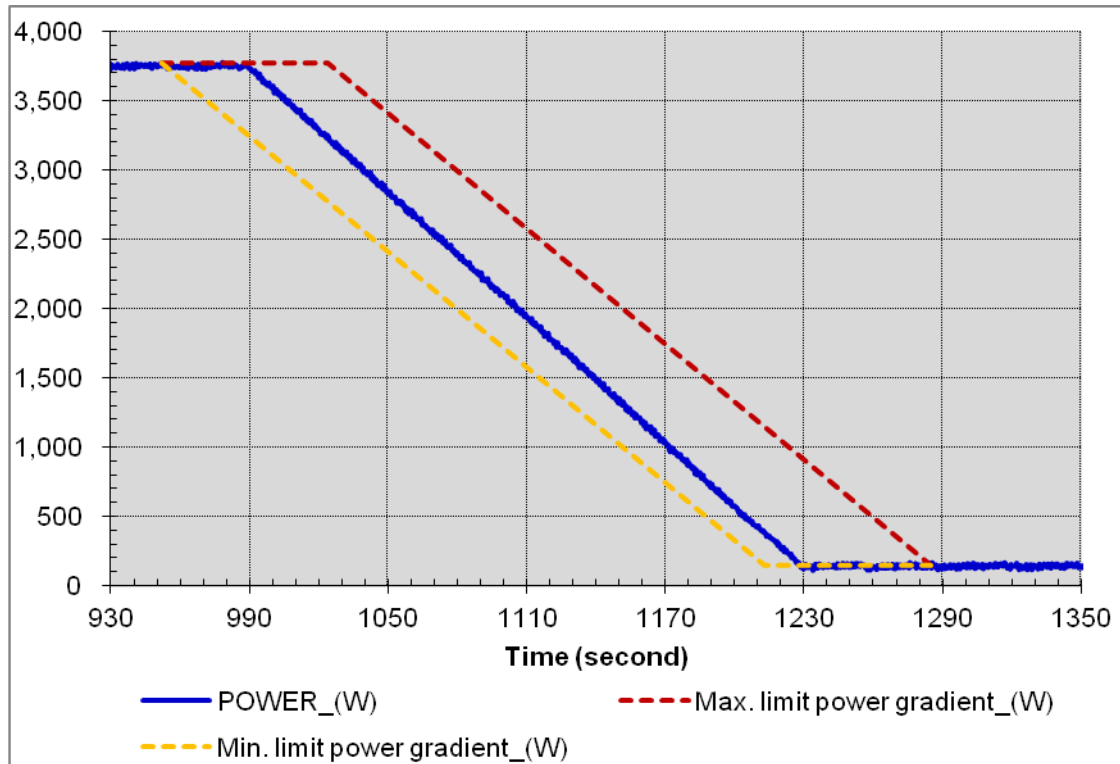
DRM mode	DRM 6 to 5	DRM 7 to 5	DRM 8 to 5
Power change (%)	Increase: 50% to 0%	Decrease: 75% to 0%	Decrease: 100% to 0%
Time measurement (s)	160,6	242,0	340,2
Average W_{Gra} (% per minute)	-17,96	-17,88	-17,12

Note:

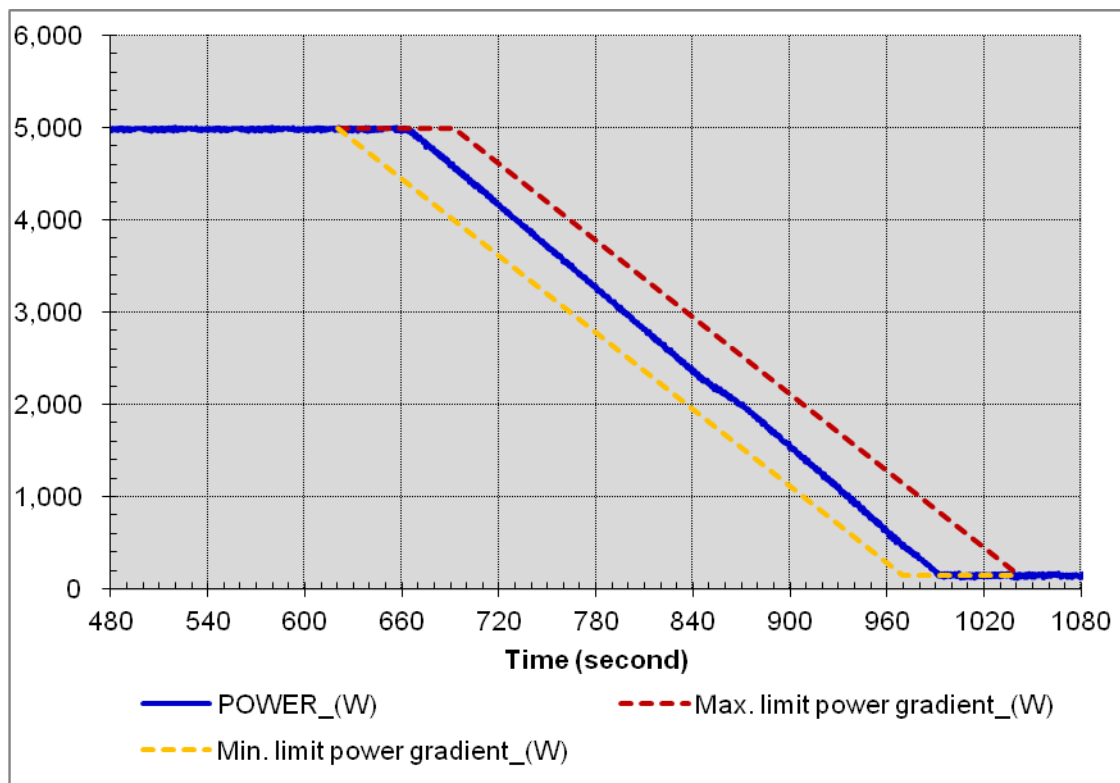
Graph for Change in a.c. operation and control (DRM 6 to 5)



Graph for Change in a.c. operation and control (DRM 7 to 5)



Graph for Change in a.c. operation and control (DRM 8 to 5)

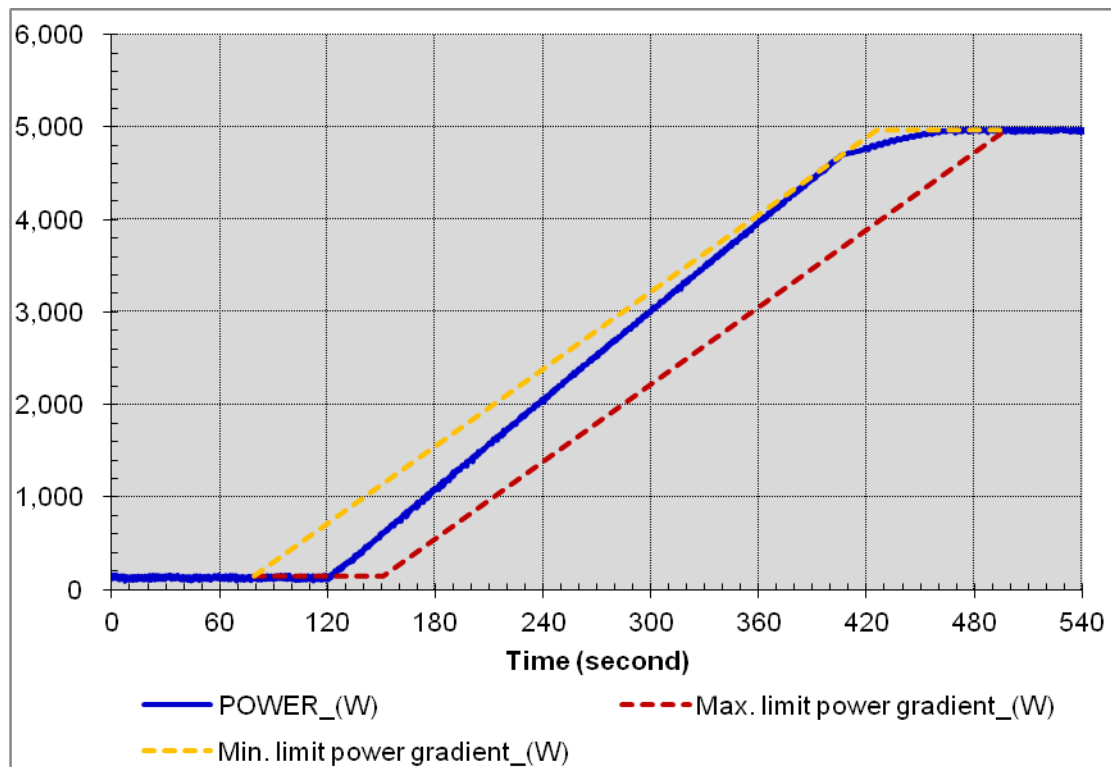


6.3.5.3.4 Test (c): Change in energy source operation (only for multiple mode inverters with energy storage)		P
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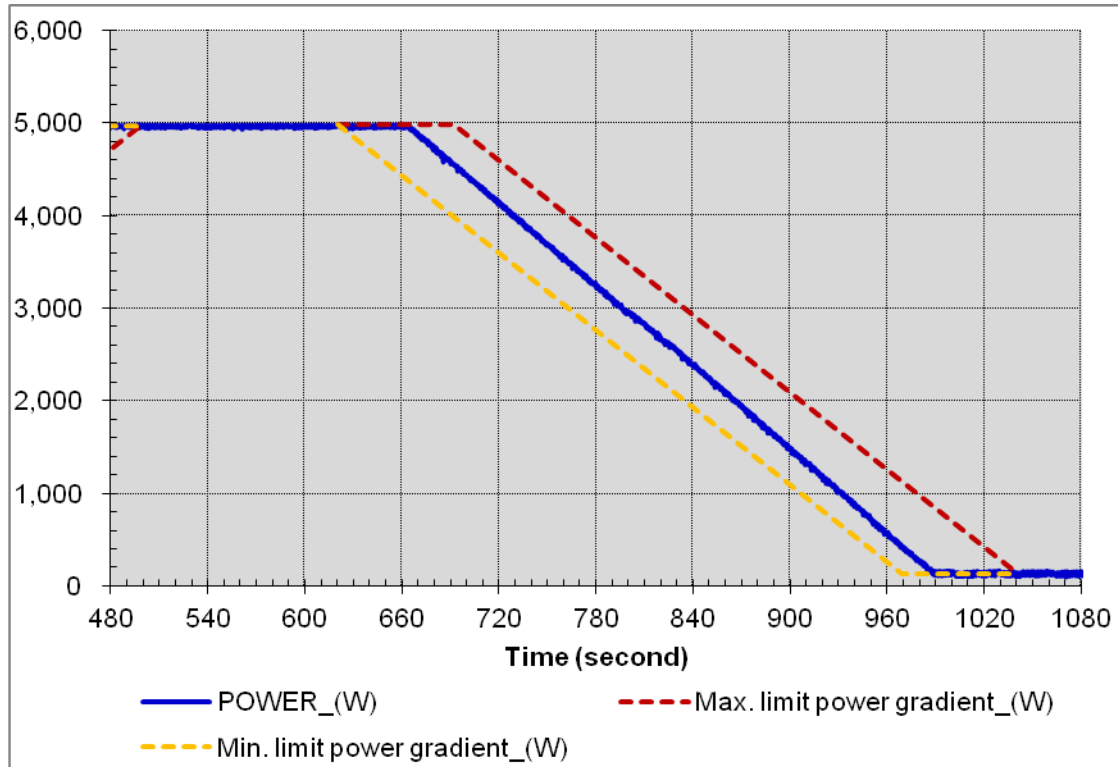
DRM mode	DRM 5 to 8	DRM 8 to 5
Power change	Decrease: 0% to 100%	Decrease: 100% to 0%
Time measurement	353,2	337,6
Average W_{Gra}	16,04	-17,27
Limit W_{Gra} : (Default : 16,67%)	+16,67	-16,67

Note:

Graph for Change in a.c. operation and control (DRM 5 to 8)



Graph for Change in a.c. operation and control (DRM 8 to 5)



6.3.5.3.4 Nonlinearity of power rate limit changes		P
DRM mode	--	--
Power change	Increase: _____% to _____%	Decrease: _____% to _____%
Time measurement	--	--
W_{Gra}	--	--
Limit W_{Gra} : (Default : 16,67%)	+16,67	-16,67
Note: The test result is the same as 6.3.5.3.2 to 6.3.5.3.4.		

6.4.2 Sinusoidal output in stand-alone mode Appendix C Harmonic Current Limit Test (stand-alone mode)							P
Generating Unit rating per phase (rpp)							
	At rated ouput current	5%	50%	100%			
	Watts (kW)	0,201	1,814	3,594			
	VA (kVA)	0,201	1,814	3,594			
	Vrms (Vac)	230.21	229,85	229,40			
	Arms (A)	0.872	7,892	15,669			
	PF	1.000	1,000	1,000			
	Frequency (Hz)	50.00	50,00	50,00			
Harmonic	5%		50%		100%		
	Value (A)	% of fundamental	Value (A)	% of fundamental	Value (A)	% of fundamental	Limit in % of fundamental
0	0,048	0,306	0,031	0,198	0,045	0,289	0,5
1st	0.872	5.571	7,890	50,411	15,664	100,076	100
2nd	0.001	0.009	0,009	0,055	0,016	0,104	1
3rd	0.006	0.037	0,085	0,545	0,175	1,119	4
4th	0.001	0.006	0,010	0,063	0,018	0,116	1
5th	0.008	0.049	0,083	0,528	0,222	1,421	4
6th	0.001	0.006	0,008	0,053	0,016	0,099	1
7th	0.006	0.040	0,077	0,492	0,181	1,159	4
8th	0.001	0.006	0,007	0,041	0,009	0,058	1
9th	0.003	0.019	0,060	0,383	0,134	0,857	2
10th	0.001	0.006	0,005	0,033	0,007	0,043	0,5
11th	0.001	0.006	0,040	0,255	0,094	0,601	2
12th	0.001	0.005	0,005	0,031	0,005	0,032	0,5
13th	0.002	0.013	0,024	0,152	0,061	0,391	2
14th	0.001	0.004	0,004	0,026	0,004	0,026	0,5
15th	0.002	0.014	0,014	0,091	0,042	0,268	1
16th	0.001	0.004	0,003	0,020	0,004	0,024	0,5
17th	0.002	0.011	0,009	0,055	0,031	0,199	1
18th	0.001	0.003	0,002	0,015	0,003	0,018	0,5
19th	0.001	0.008	0,005	0,034	0,024	0,154	1
20th	0.001	0.003	0,002	0,013	0,003	0,017	0,5
21th	0.001	0.006	0,004	0,022	0,019	0,120	0,6
22th	0.001	0.003	0,002	0,013	0,002	0,013	0,5
23th	0.001	0.005	0,003	0,016	0,015	0,096	0,6
24th	0.000	0.003	0,002	0,011	0,002	0,013	0,5
25th	0.001	0.005	0,002	0,013	0,012	0,075	0,6
26th	0.000	0.003	0,002	0,011	0,002	0,014	0,5
27th	0.001	0.006	0,002	0,013	0,010	0,061	0,6
28th	0.000	0.003	0,002	0,010	0,002	0,010	0,5
29th	0.001	0.006	0,002	0,013	0,008	0,052	0,6
30th	0.000	0.003	0,002	0,010	0,002	0,010	0,5
31th	0.001	0.005	0,002	0,011	0,006	0,041	0,6
32th	0.000	0.003	0,001	0,009	0,001	0,008	0,5
33th	0.001	0.004	0,002	0,010	0,005	0,032	0,6
THD (to 50th)	0,083		1,041		2,466		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 maximum rated current is 15 652A at stand-alone mode							

6.4.3 Volt-watt response mode for charging of energy storage				N/A
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	--	--	--	--
P (kW)	--	--	--	--
P/P _{rated} (%)	--	--	--	--
Diagram of volt-watt response mode --				
Note: The Solar converter supplies for battery charging power from PV array input only.				

7.3 Active anti-islanding protection

Appendix F Active anti-islanding test

F3 Test under load condition A = Light Electronic Load

P

Inverter output Power	Approx. Inverter power (kW)	Time to trip (Average in Sec)	Disconnection Limit (in sec)
10+/-5%	0,520	0,138	2s
50+/-5%	2,510	0,145	2s
100+/-5%	4,997	0,146	2s

Light Electronic Load:

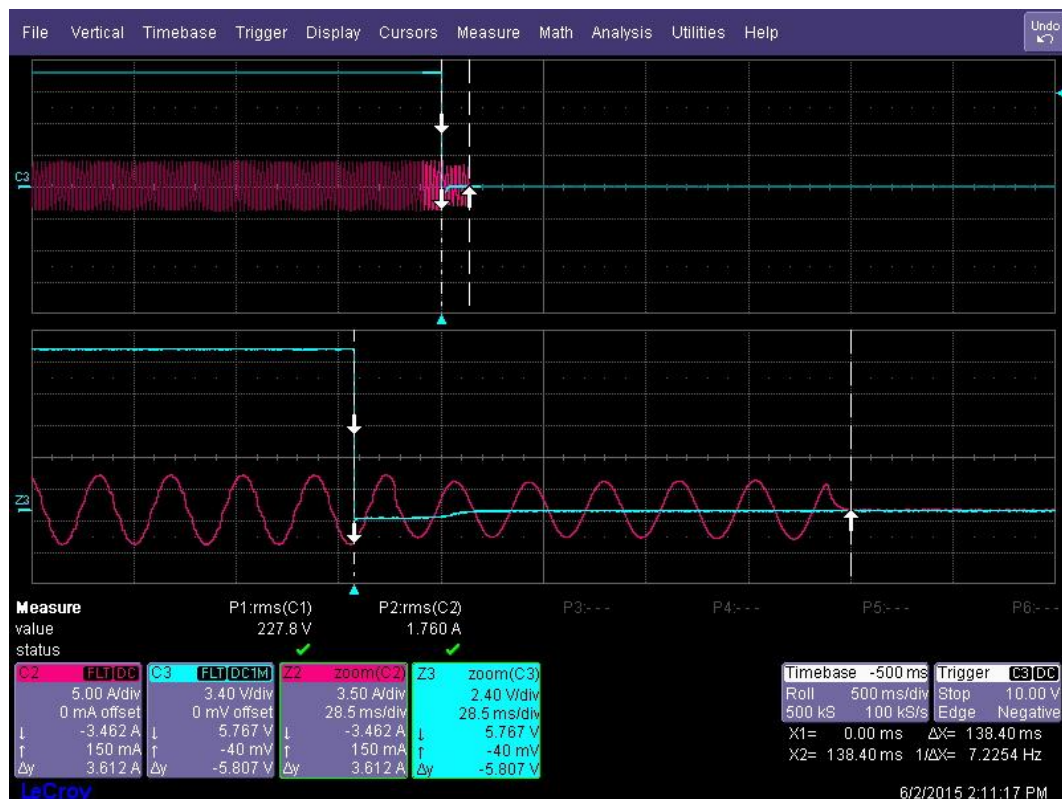
Test circuit according to AS 4777.2 Annex F (Figure F1 and F2). Grid voltage equal to nominal load. Via dc input control ac output power so that it equals to 10+/-5% of rated output. Switch S shall be opened and time interval for the inverter being disconnected shall be recorded. Same procedure for 50+/-5% and 100+/-5%.

The load of Figure F2 is used for the inverters with rated apparent power not more than 5kVA.

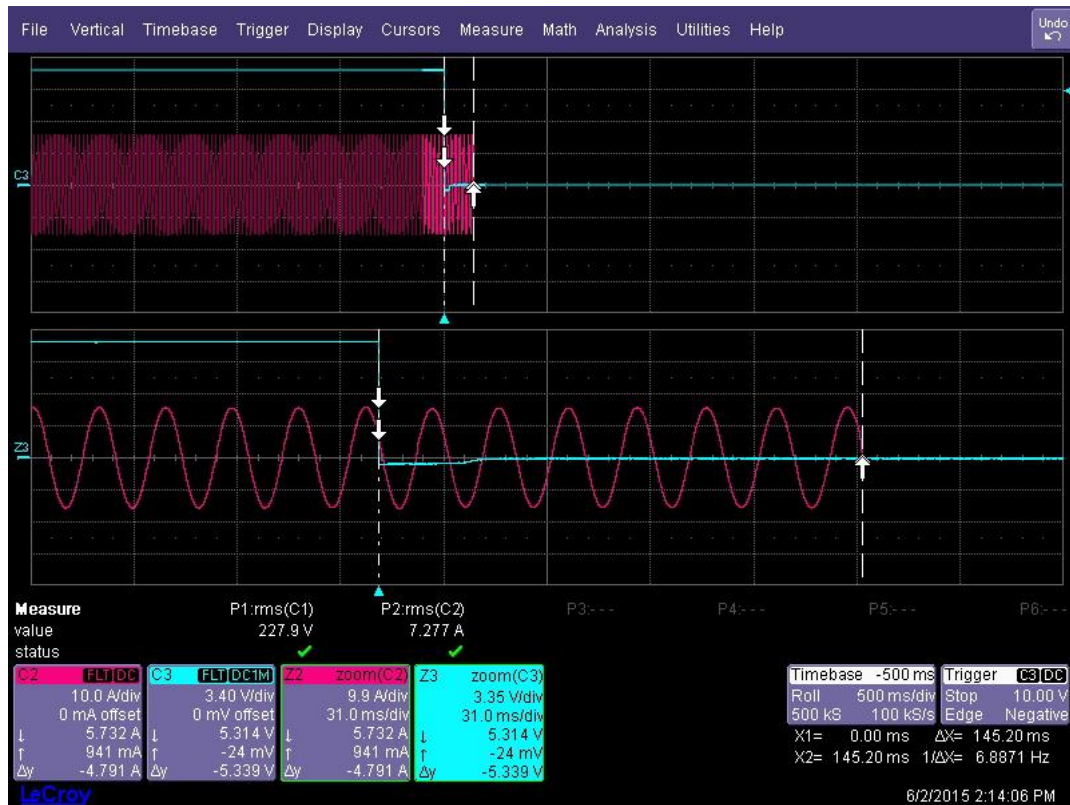
For other inverters, the resistor load of Figure 2 equal to 0,1% of rated apparent power.

Test data refers to report "PVAU150415C06".

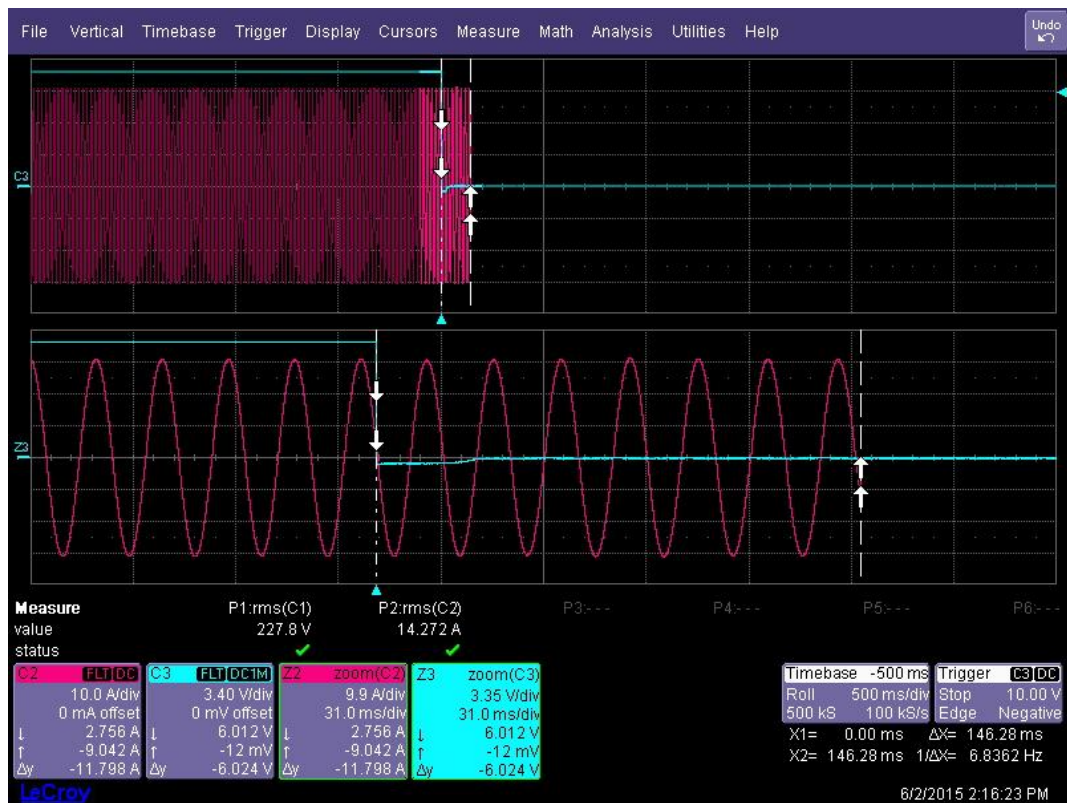
Graph for Light electronic load (10%P_n):



Graph for Light electronic load (50%P_n):



Graph for Light electronic load (100%P_n):



7.3 Active anti-islanding protection

Appendix F Active anti-islanding test

F4 Test under load condition B = Load match

P

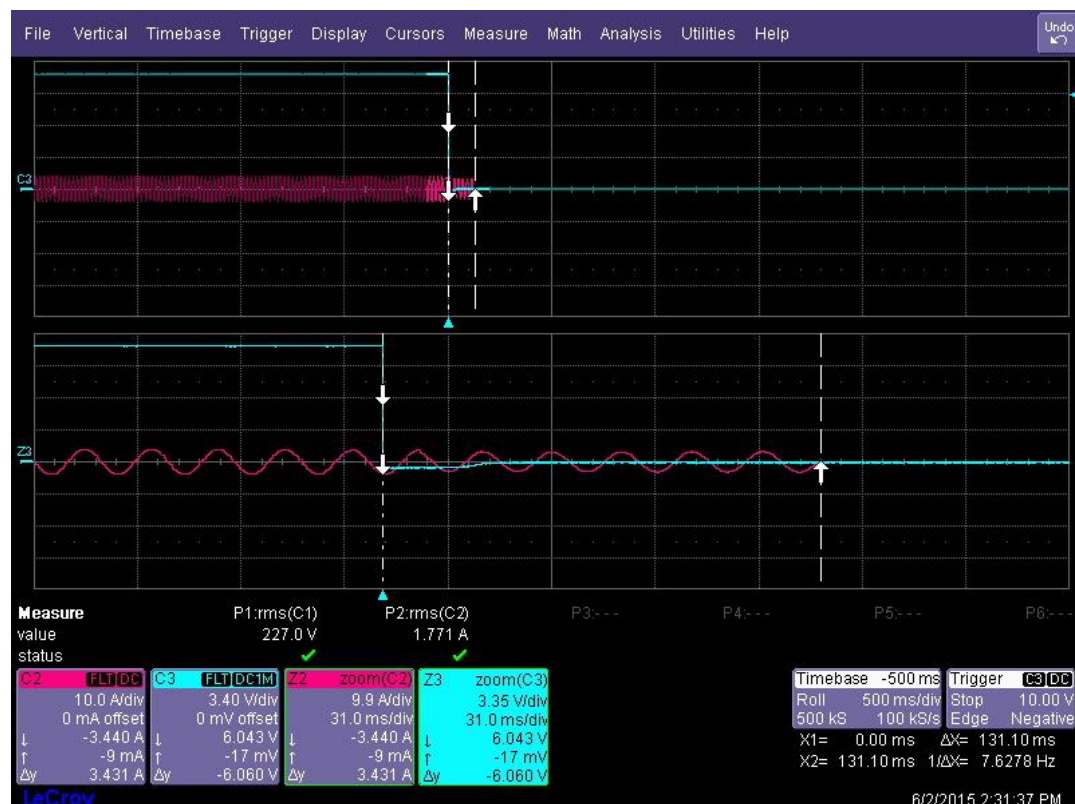
Inverter output Power	Approx. Inverter power (kW)	Time to trip (Average in Sec)	Disconnection Limit (in sec)
10+/-5%	0,520	0,131	2s
50+/-5%	2,501	0,137	2s
100+/-5%	4,999	0,152	2s

Load match:

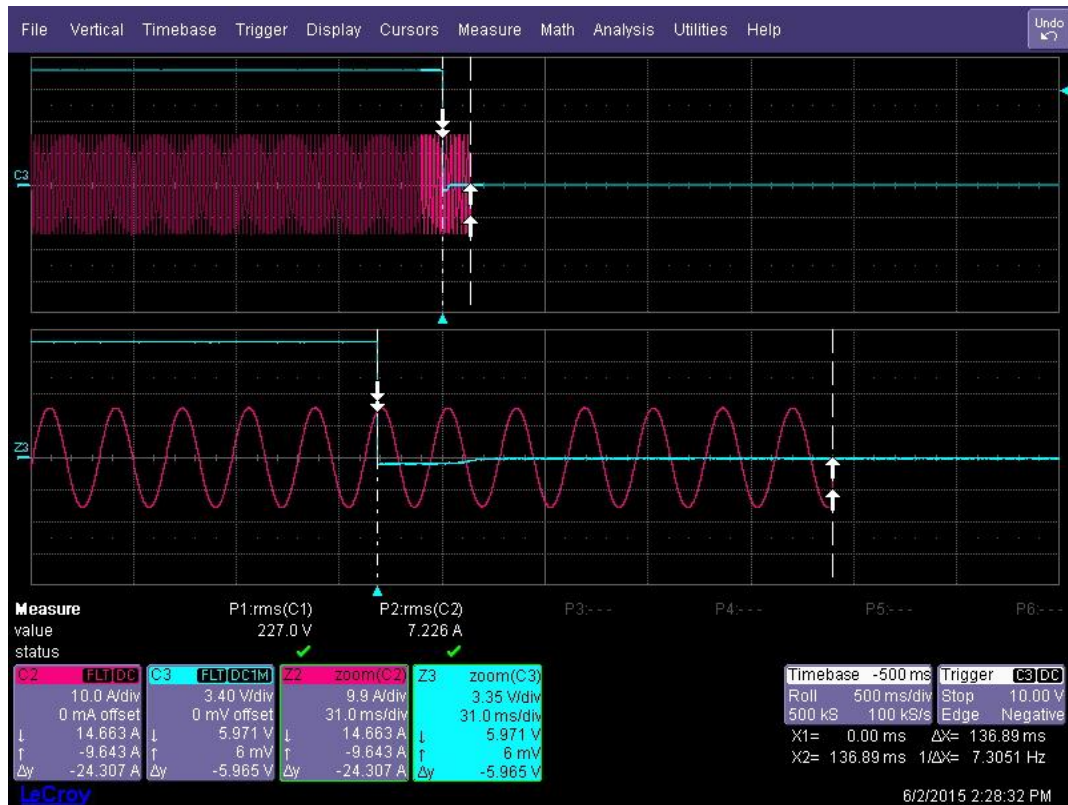
Test circuit according to AS 4777.2 Annex F (Figure F1 and F3) Grid voltage equal to nominal load +/-5%, R shall match real power output, L and C shall draw reactive power according to Table F1. Via dc input control ac output power so that it equals to 10+/-5% of rated output. R shall be in- or decreased until resonant load matches real power output to within +/-5%. Inductive or capacitive load shall be adjusted until reactive power consumption matches the reactive power output of the inverter to within +/-5%. Switch S shall be opened and time interval of the inverter being disconnected shall be recorded. Same procedure for 50+/-5% and 100+/-5%.

Test data refers to report "PVAU150415C06".

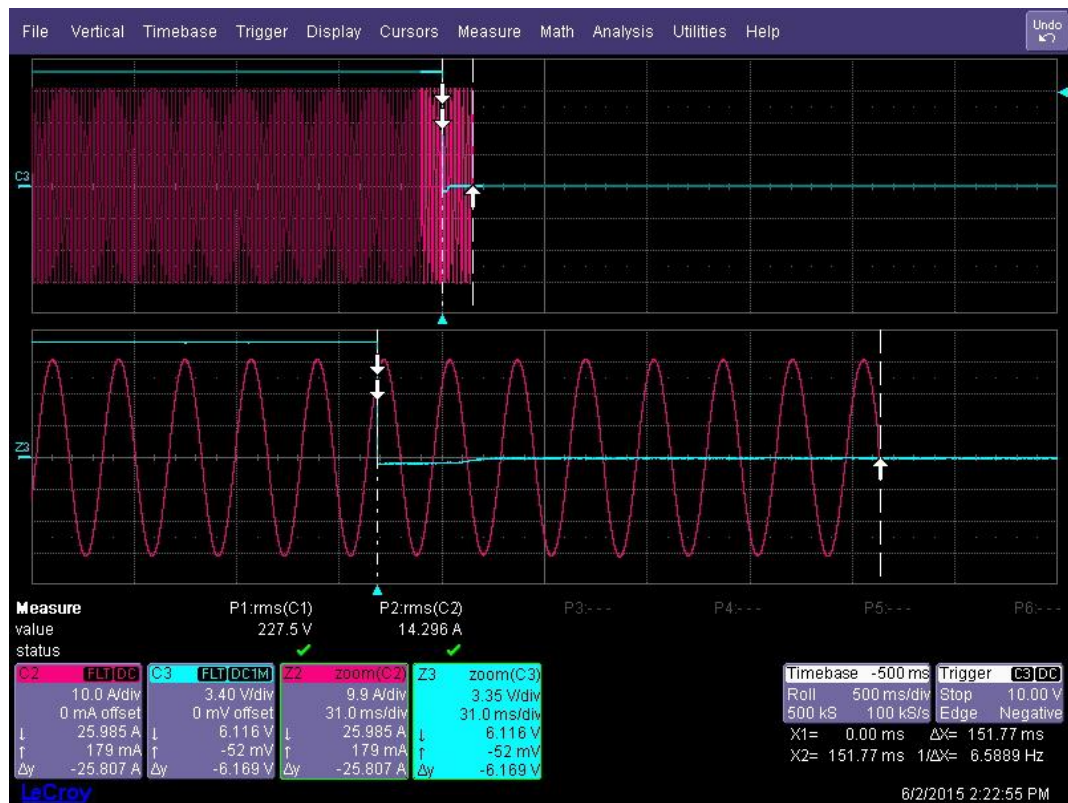
Graph for Load match: (10%P_n):



Graph for Load match: (50%P_n):



Graph for Load match: (100%P_n):



7.3 Active anti-islanding protection

Appendix F Active anti-islanding test

F5 Test under load condition B = Load match + 10%

P

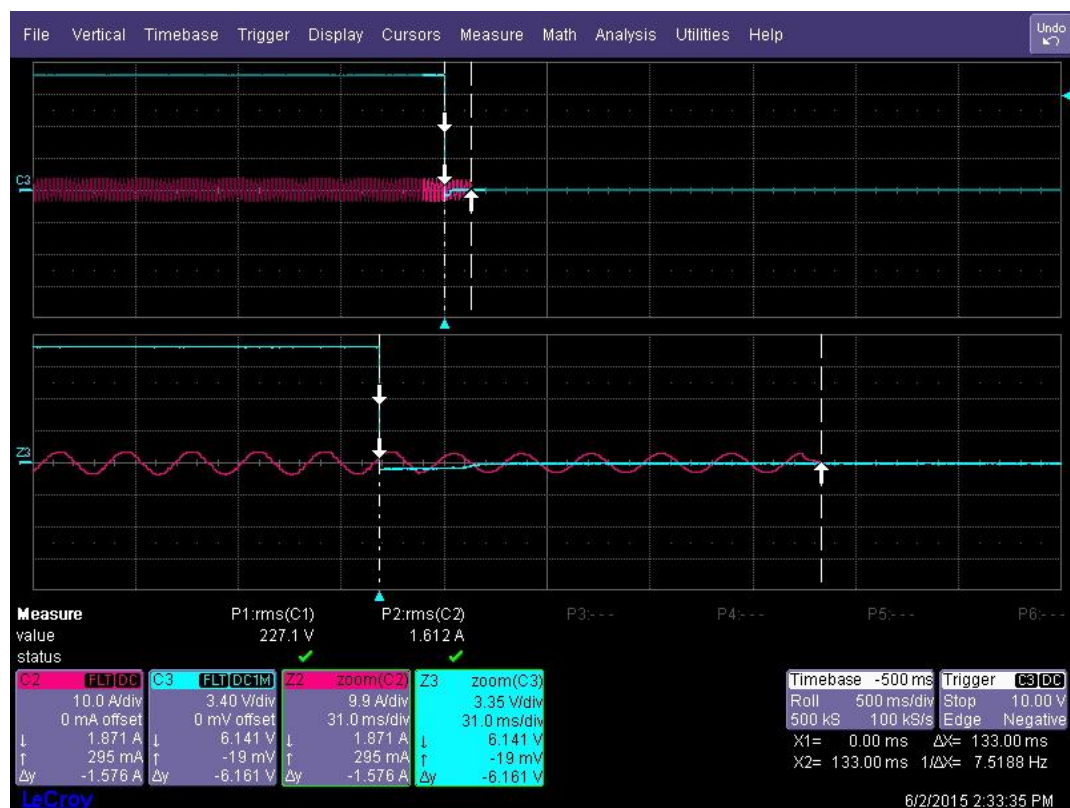
Inverter output Power	Approx. Inverter power (kW)	Time to trip (Average in Sec)	Disconnection Limit (in sec)
10+/-5%	0,520	0,133	2s
50+/-5%	2,505	0,141	2s
100+/-5%	5,000	0,148	2s

Load match + 10%:

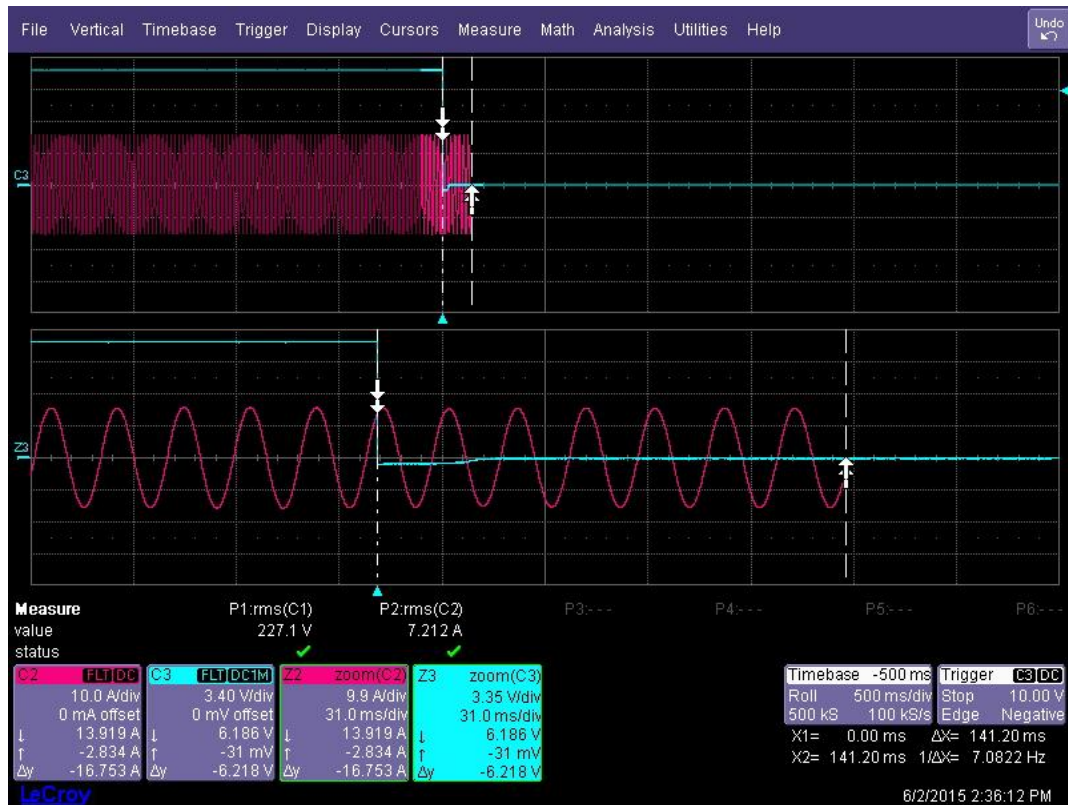
Test circuit according to AS 4777.2 Annex F (Figure F1 and F3) Grid voltage equal to nominal load +/-5%, R shall match real power output, L and C shall draw reactive power according to Table F1. Via dc input control ac output power so that it equals to 10+/-5% of rated output. R shall be in- or decreased until resonant load matches real power output to within +/-5%. Inductive or capacitive load shall be adjusted until reactive power consumption matches the reactive power output of the inverter to within +/-5%. Switch S shall be opened and time interval of the inverter being disconnected shall be recorded. Same procedure for 50+/-5% and 100+/-5%.

Test data refers to report "PVAU150415C06".

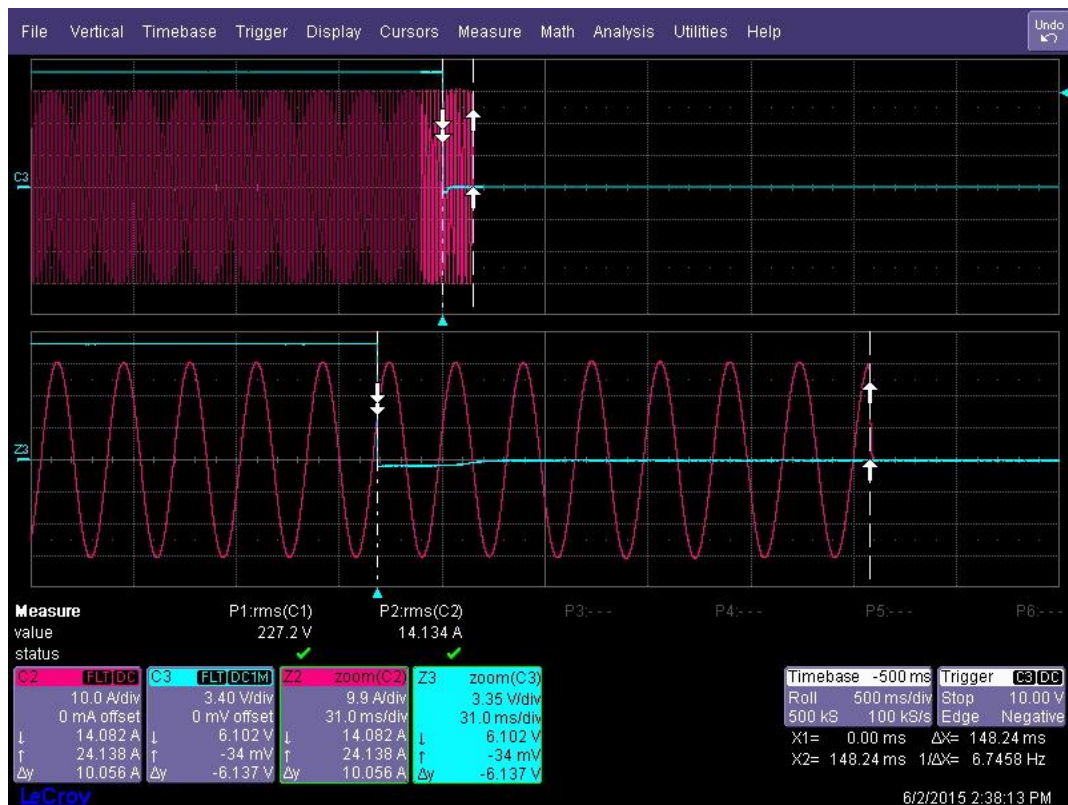
Graph for Load match + 10%: (10%P_n):



Graph for for Load match + 10%: (50%P_n):

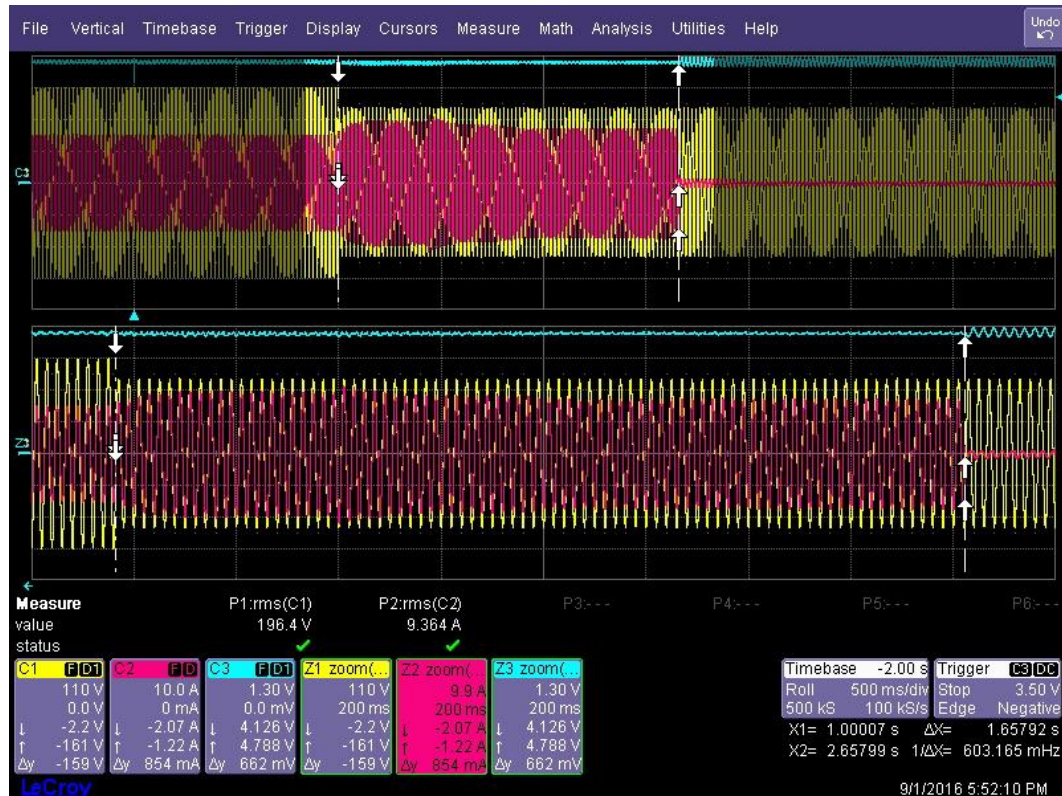


Graph for Load match + 10%: (100%P_n):

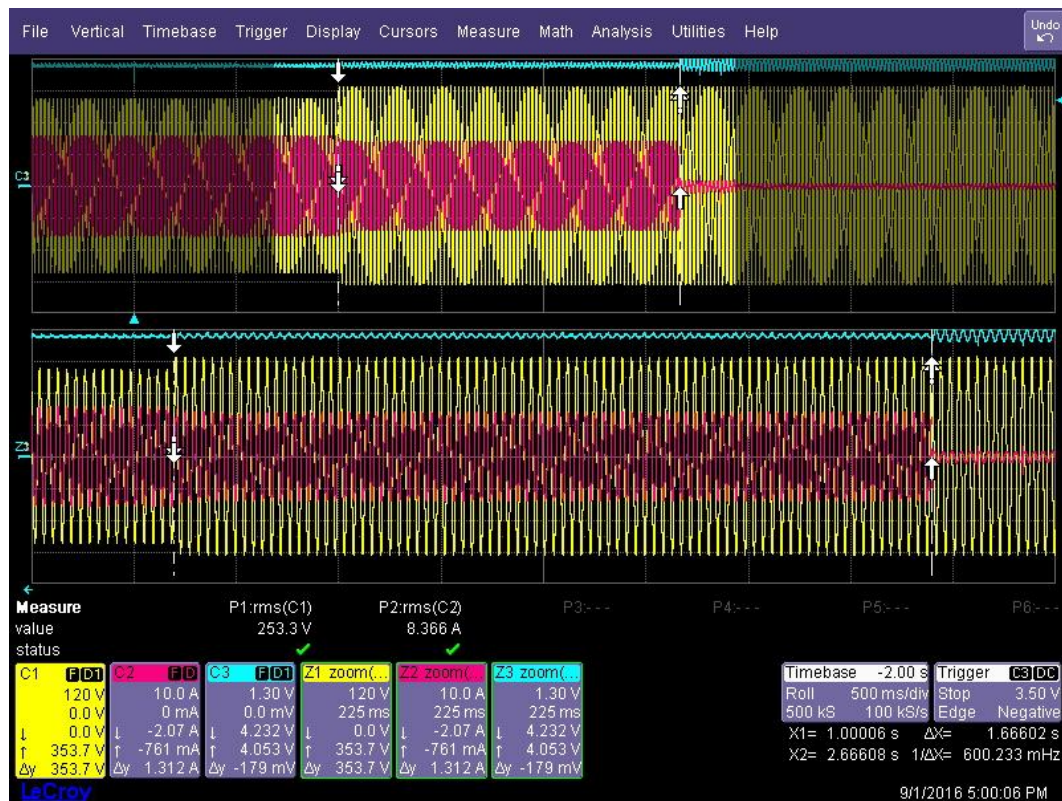


7.4 Voltage and frequency limits (passive anti-islanding protection) Appendix G2 Under- and over-voltage trip settings and reconnection test			P
	Output Current level: 50+/-5% rated current		
Test	Under Voltage (V)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)
Limit	< 180 V	<=2s	>=60s
Actual setting	180	1,6	60
Trip value	179,0	1,656	65
	179,1	1,658	64
	179,1	1,657	64
Test	Over Voltage 1 (V)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)
Limit	> 260 V	<=2s	>=60s
Actual setting	260	1,6	60
Trip value	259,7	1,662	64
	259,6	1,666	64
	259,7	1,664	64
Test	Over Voltage 2 (V)	Time to disconnect (s)	Time to reconnect (s)
Limit	> 265 V	<=0,2s	>=60s
Actual setting	265	0,1	60
Trip value	264,9	0,154	64
	264,8	0,164	65
	264,9	0,162	65
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. 1. Actual under-voltage setting set to minimum value but minimum 180V, set AC-supply to nominal grid voltage and frequency 50+/-0,2Hz and 50+/-5% rated output current, slowly decrease ac supply voltage until inverter disconnects. Record disconnection voltage. Set AC-supply voltage back to nominal voltage, record reconnection time, then decrease AC-supply voltage to recorded disconnection voltage + 2V. Rapidly decrease voltage, measure time interval between passing through recorded disconnection voltage and inverter disconnection. 2. Actual over voltage setting set to maximum value but maximum 270V, ac supply to nominal grid voltage and 50+/-5% output power, but maximum 1kVA. Slowly increase ac supply voltage until inverter disconnects, recording disconnection voltage. Ac supply voltage back to nominal voltage, recording reconnection time, increase ac supply voltage to recorded switch off voltage – 2V. Rapidly increase voltage, measure time interval between passing through recorded switch off voltage and inverter disconnection. In this test, every trip value has been tested for 3 times, and only the worst case (the closest to the limit) will be recorded into this table.			

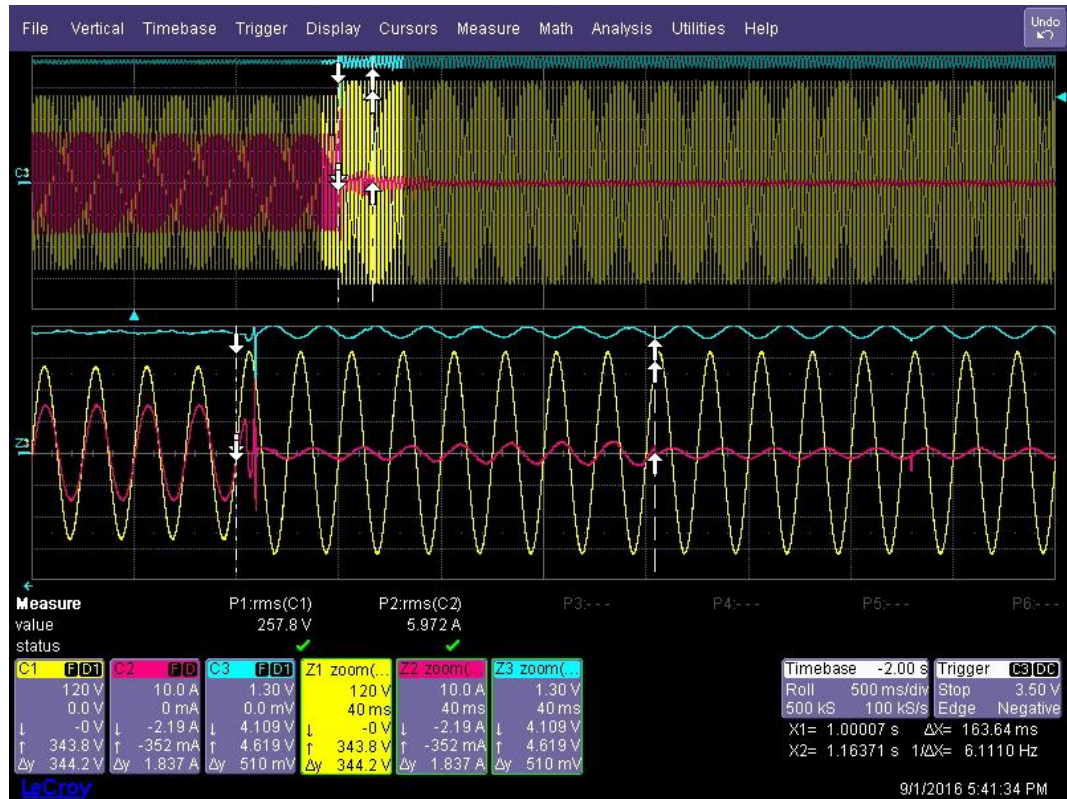
Graph for under-voltage protection



Graph for over-voltage protection (Level 1)

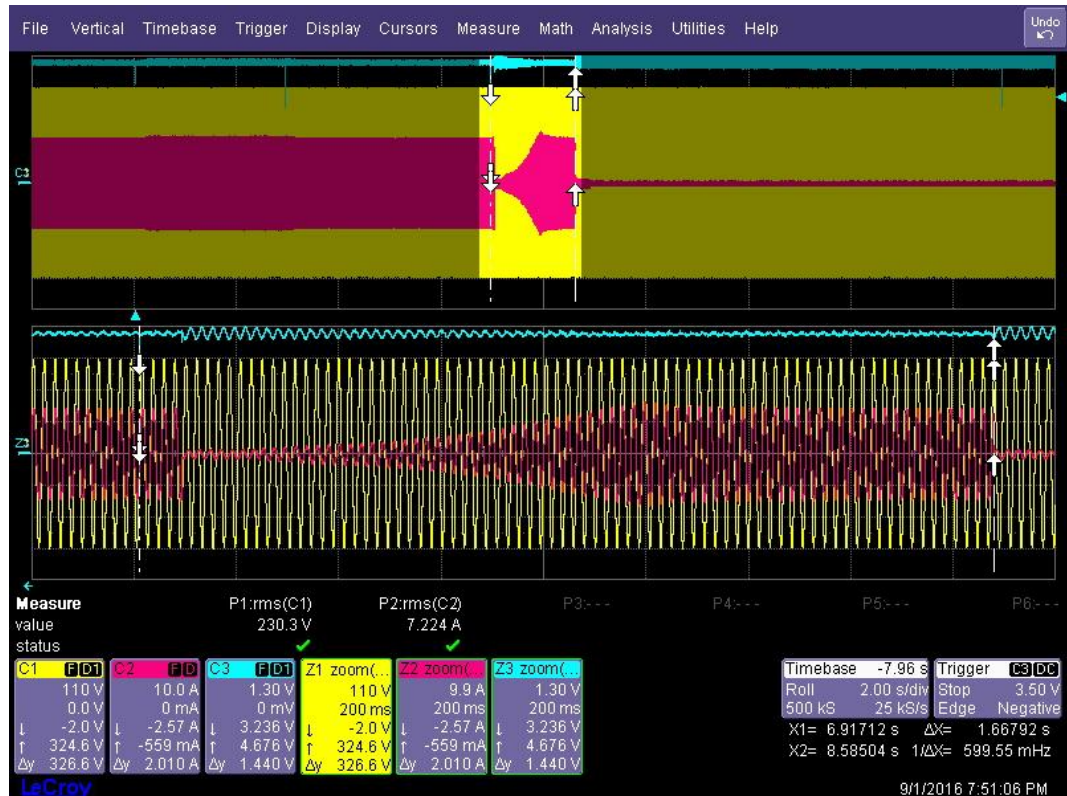


Graph for over-voltage protection (Level 2)

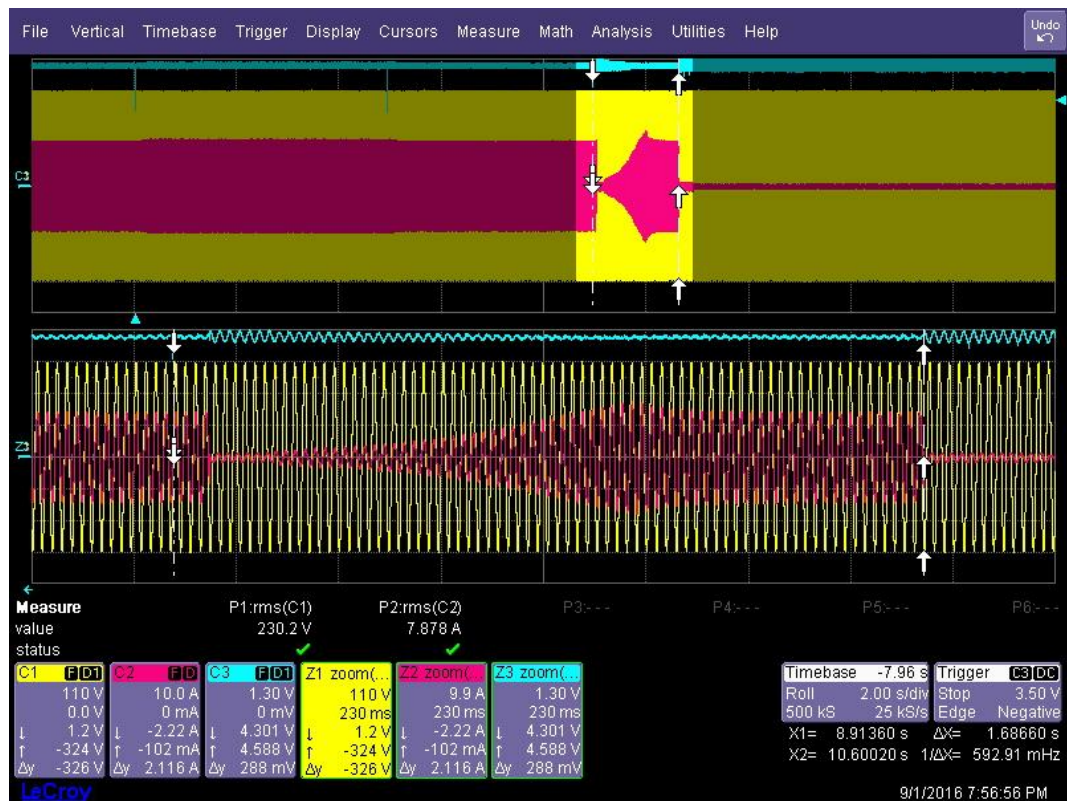


7.4 Voltage and frequency limits (passive anti-islanding protection) Appendix G3 Under- and over-frequency trip settings and reconnection test			P
	Output Current level: 50+/-5% rated current or 10A (whichever is the lesser)		
Test	Under Frequency (Hz)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)
Australia Limit	$\geq 47\text{Hz}$	$\leq 2\text{s}$	$\geq 60\text{s}$
Actual setting	47	1,7	60
Trip value	47,01	1,664	65
	47,00	1,668	65
	47,00	1,660	64
Test	Under Frequency (Hz)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)
New Zealand Limit	$\geq 45\text{Hz}$	$\leq 2\text{s}$	$\geq 60\text{s}$
Actual setting	45	1,7	60
Trip value	45,01	1,686	65
	45,01	1,686	65
	45,01	1,687	65
Test	Over Frequency (Hz)	Time to disconnect (s)	Time to reconnect (s)
Limit	$\leq 52\text{Hz}$	$\leq 0,2\text{s}$	$\geq 60\text{s}$
Actual setting	52	0,2	60
Trip value	52,01	0,108	64
	52,01	0,113	65
	52,00	0,110	65
<p>Note: Actual settings are the settings of the inverter. The trip value is the measured value. It has to be in the range of $\pm 0.1\text{Hz}$ of the actual setting.</p> <p>1. Actual under frequency setting set to minimum value but minimum 47 or 45Hz, AC-supply frequency 50+/-0,1Hz and 50+/-5% rated output current or 10A, whichever is the lesser. Slowly decrease ac supply frequency until inverter disconnects. Record disconnection frequency. Ac supply frequency back to 50+/-0,1Hz, record reconnection time, decrease ac supply frequency to recorded disconnection frequency + 0.1Hz. Rapidly decrease frequency, measure time interval between passing through recorded disconnection frequency and inverter disconnection.</p> <p>2. Actual over frequency setting set to maximum value but maximum 52Hz, ac supply frequency 50+/-0,1Hz and 50+/-5% rated output current or 10A, whichever is the lesser. Slowly increase ac supply frequency until inverter disconnects. Record disconnection frequency. Set ac supply frequency back to 50+/-0,1Hz, recording reconnection time, increase ac supply frequency to recorded switch off frequency - 0.1Hz. Rapidly increase frequency, measure time interval between passing through recorded switch off frequency and inverter disconnection.</p> <p>In this test, every trip value has been tested for 3 times, and only the worst case (the closest to the limit) will be recorded into this table.</p>			

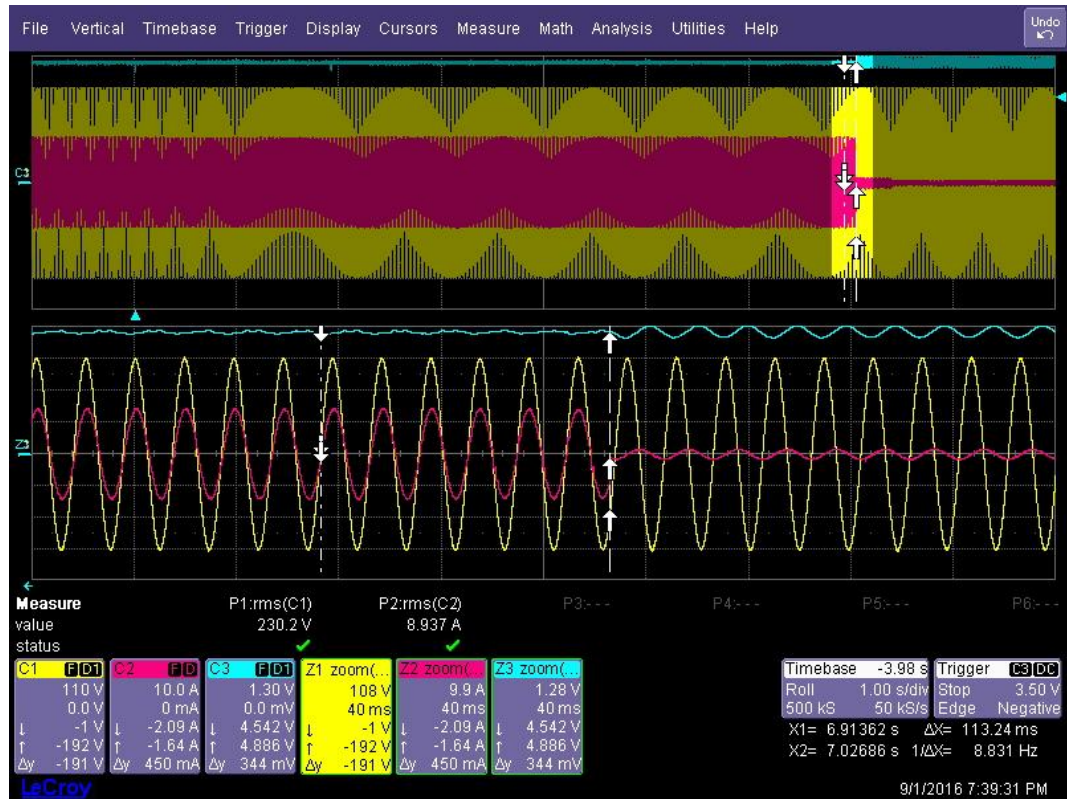
Graph for under-frequency protection (for Australia)



Graph for under-frequency protection (for New Zealand)

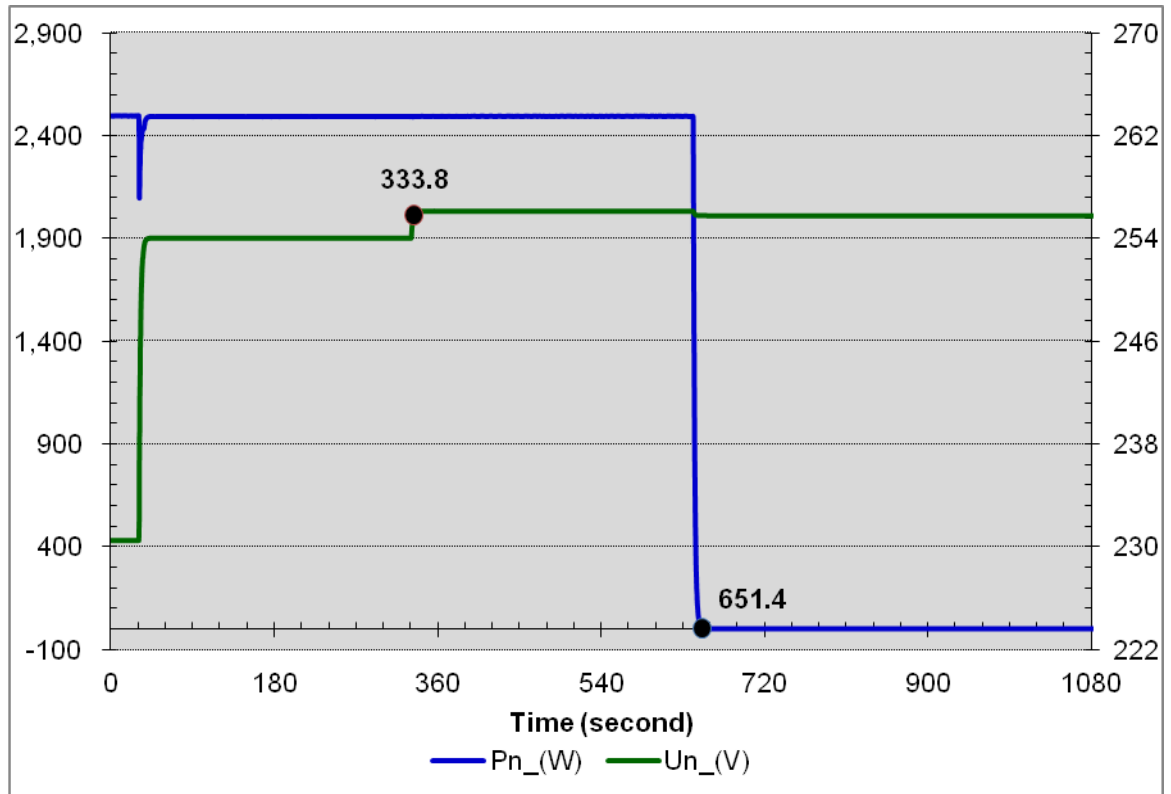


Graph for over-frequency protection

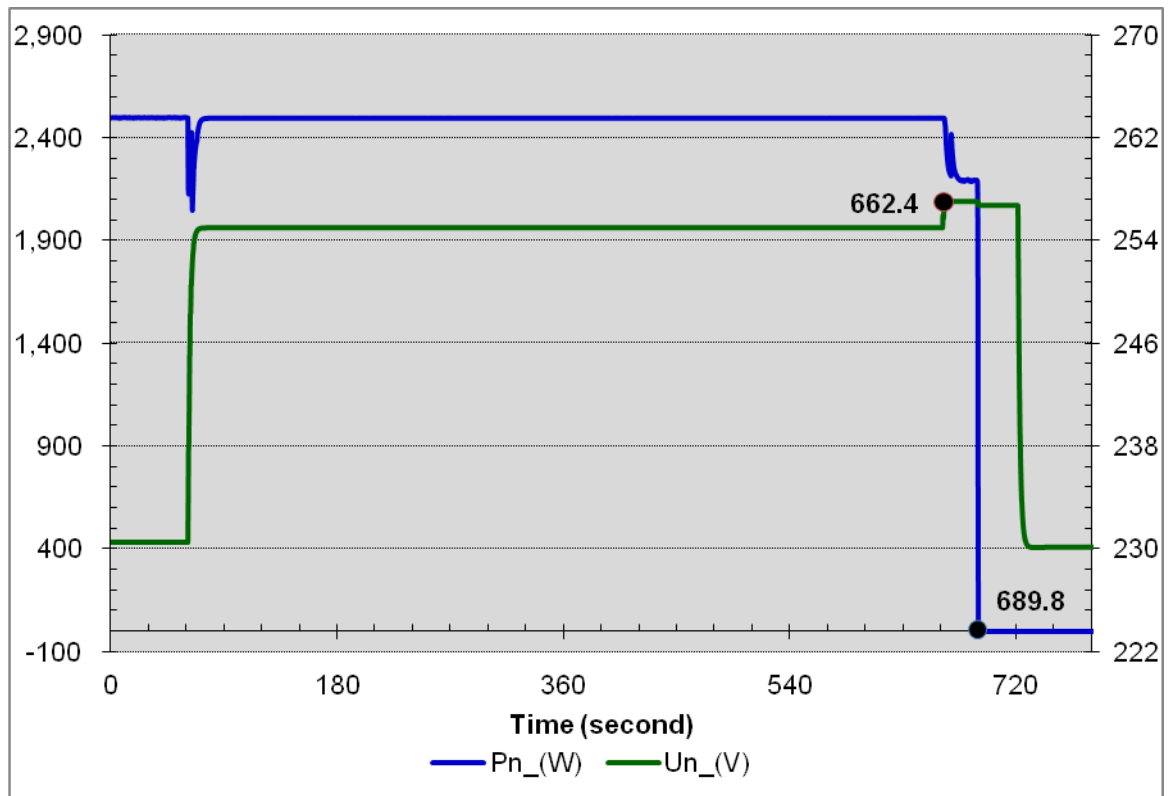


7.5.2 Limits for sustained operation				P
Appendix H2 Sustained operation for voltage variations				
		Output power level: 50+/-5% Apparent Power		
Setting values		Setting Vnom_max [V]	255	
		Setting T _{disconnection} [s]	600	
Test of Australia Setting:				
a)	Step 1. The voltage is set to Vnom_max – 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	1 st time(s)	255,13	1. Disconnection should take place. 2. Voltage within +/-1 % of the set-point.
		2 nd time(s)	255,10	
		3 rd time(s)	255,10	
	Phase 2	1 st time	--	
		2 nd time	--	
		3 rd time	--	
	Phase 3	1 st time	--	
		2 nd time	--	
		3 rd 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	27		Disconnection time < 30s
	Phase 2	--		
	Phase 3	--		
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	69		Reconnection time > 60s
	Phase 2	--		
	Phase 3	--		
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.				

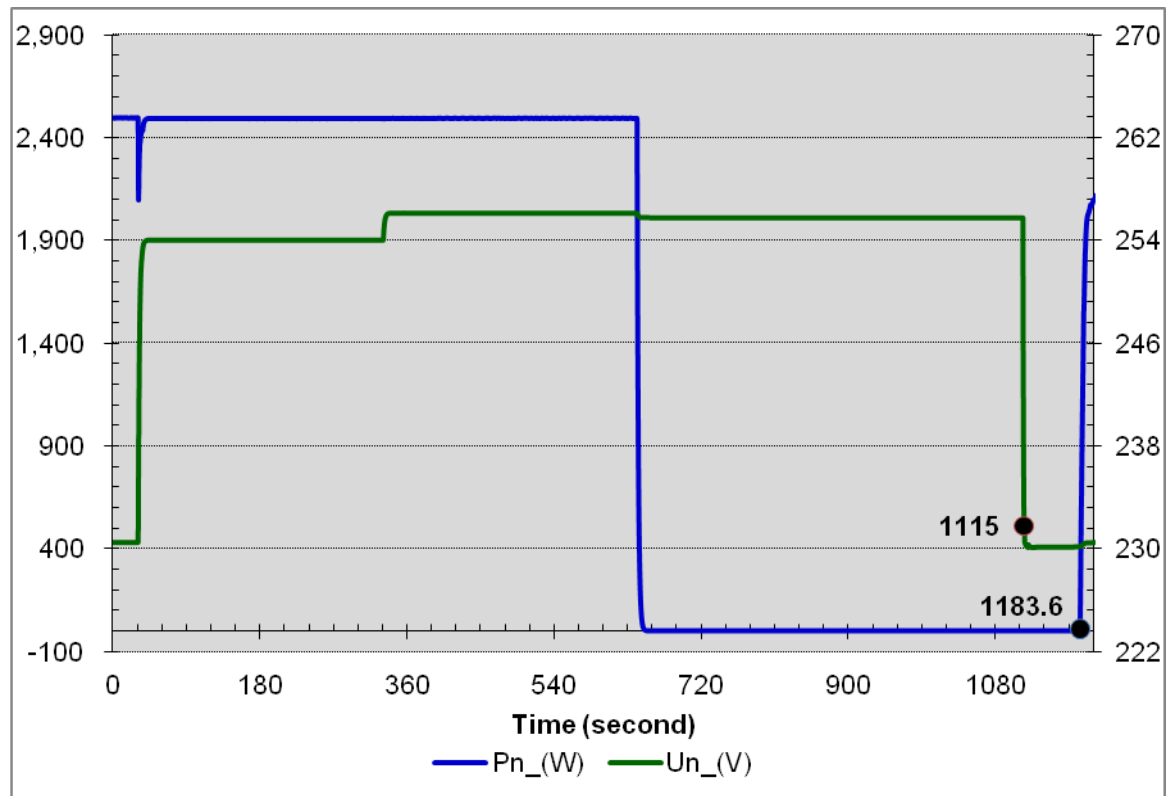
Graph: a)



Graph: b)

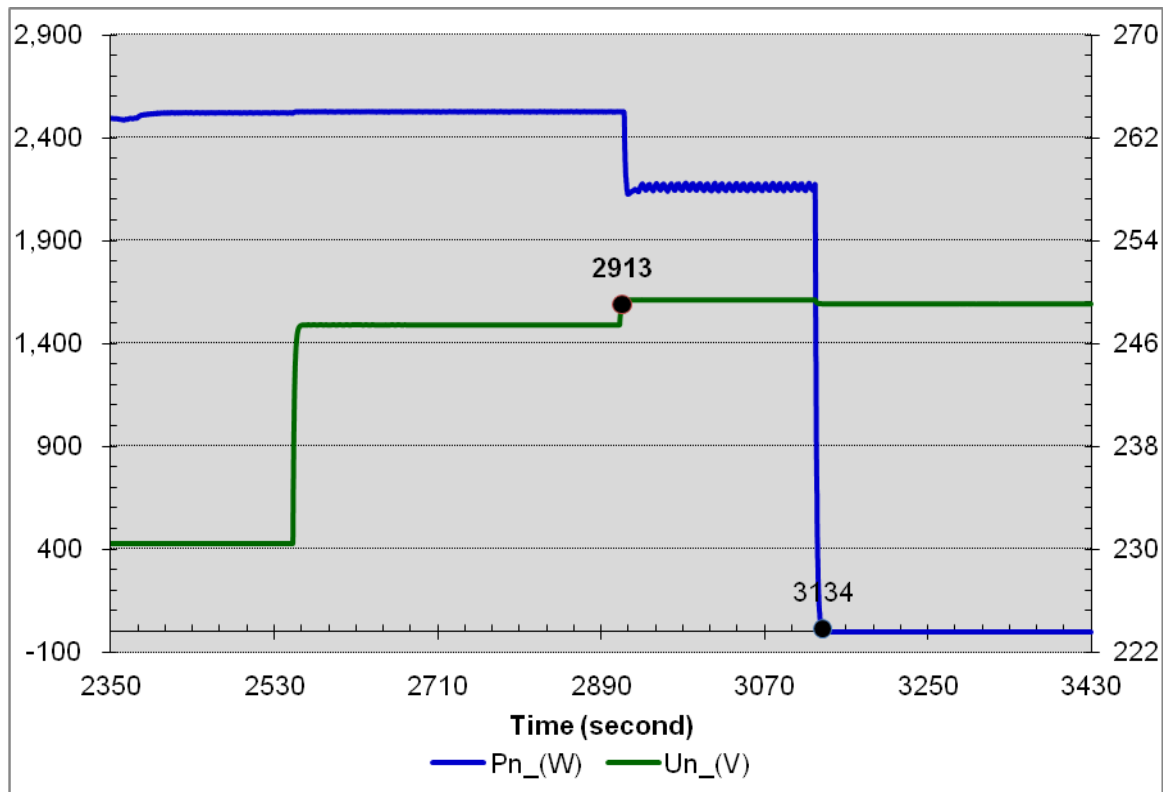


Graph: c)

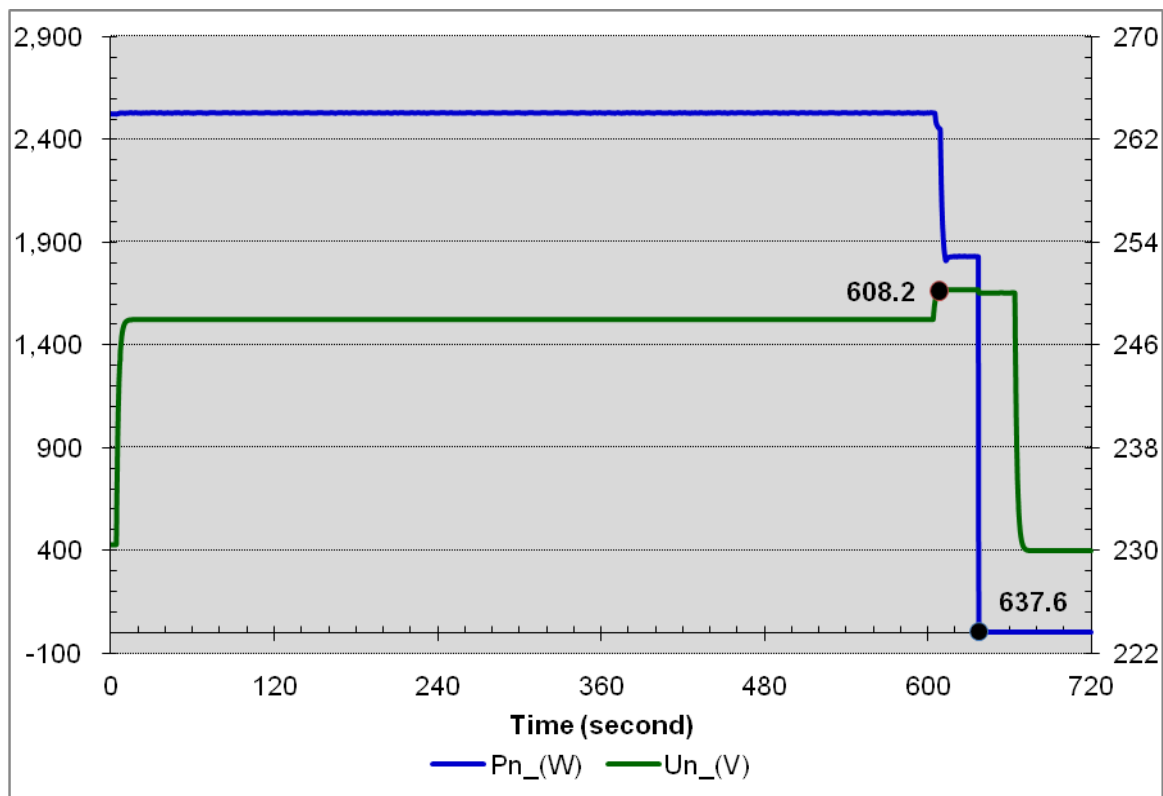


			Output power level: 50+/-5% Apparent Power	
Setting values			Setting Vnom_max [V]	248
			Setting T _{disconnection} [s]	600
Test of New Zealand Setting:				
a)	Step 1. The voltage is set to Vnom_max – 1 V. Maintained for 5 min. Step 2. The voltage increase to Vnom_max + 1 V and proceeding 10 min. Step 3. The 10 min average voltage shall be recorded.			
			Average Voltage (V)	Limit
	Phase 1	1 st time	247,63	1. Disconnection should take place. 2. Voltage within +/-1 % of the set-point.
		2 nd time	247,65	
		3 rd time	247,65	
	Phase 2	1 st time	--	
		2 nd time	--	
		3 rd time	--	
	Phase 3	1 st time	--	
		2 nd time	--	
		3 rd 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	29		Disconnection time < 30s
	Phase 2	--		
	Phase 3	--		
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	70		Reconnection time > 60s
	Phase 2	--		
	Phase 3	--		
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.				

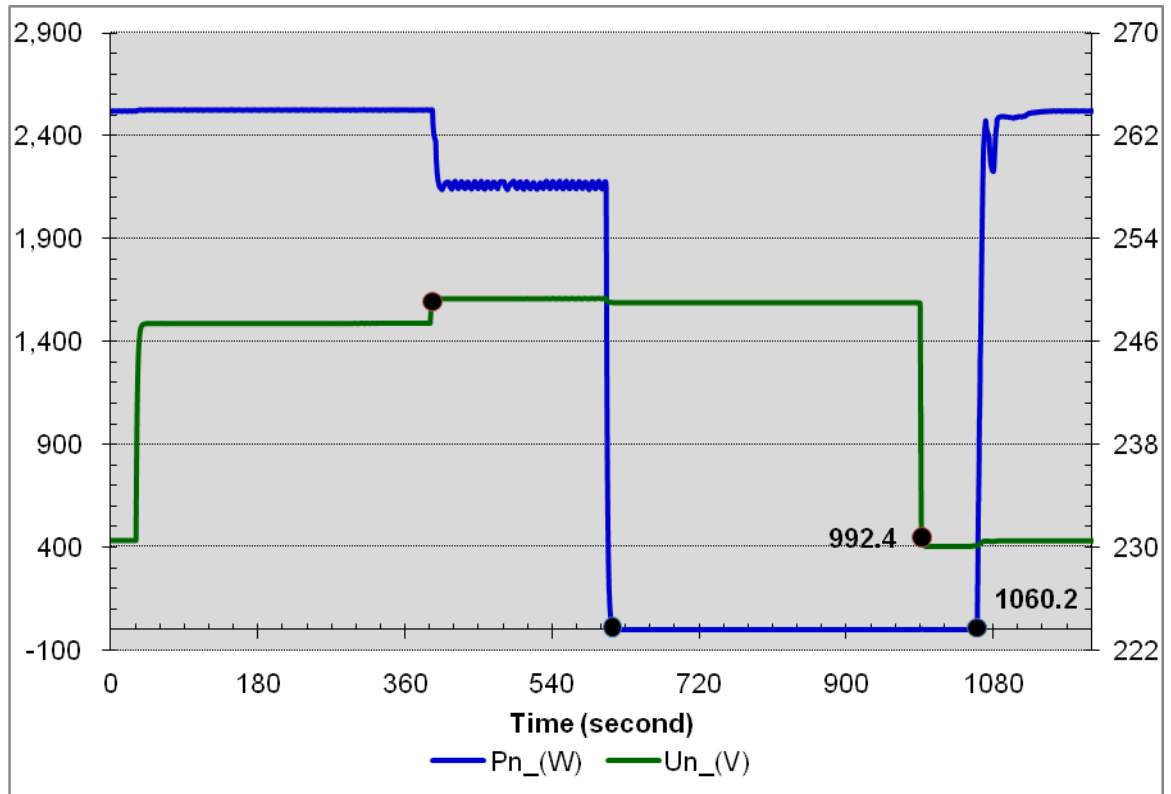
Graph: a)



Graph: b)

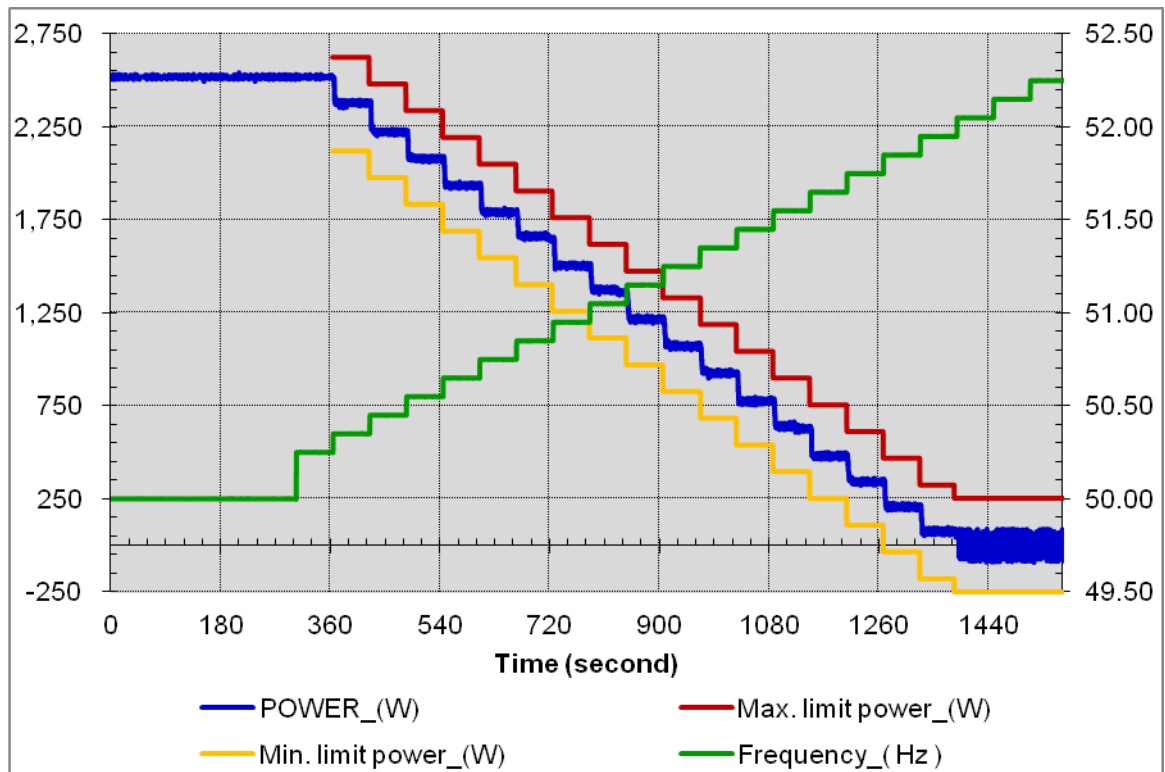


Graph: c)

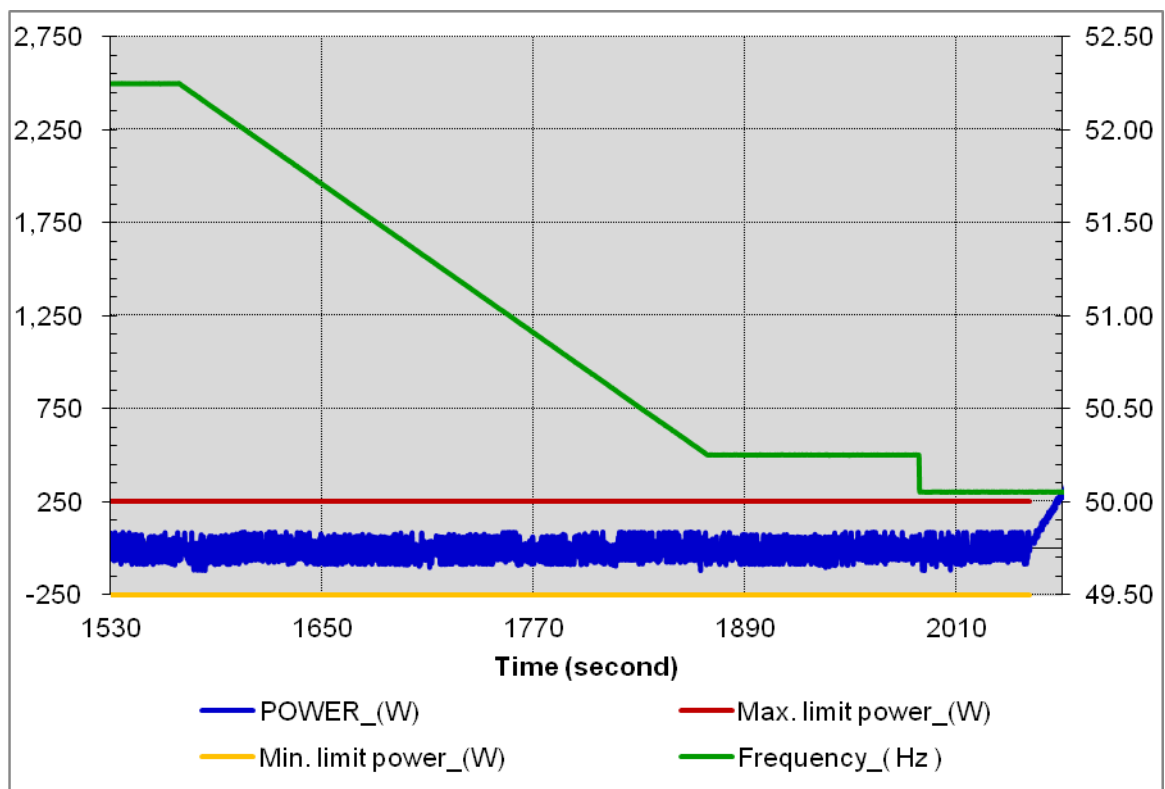


7.5.3.1 Response to an increase in frequency Appendix H3.2 Test procedure							P
1. Measurement a) to w): Power output: 50+/-5% of rated apparent power							
30s mean value	a) 50,00Hz	b) 50,25Hz	c) 50,35Hz	d) 50,45Hz	e) 50,55Hz	f) 50,65Hz	g) 50,75Hz
Frequency [Hz]:	50,00	50,25	50,35	50,45	50,55	50,65	50,75
P _{setpoint} [kW]:	N/A	N/A	2,373	2,229	2,086	1,942	1,798
P [kW]:	2,517	2,517	2,380	2,222	2,078	1,935	1,791
$\Delta P/P_n$ [%]:	N/A	N/A	0,14	-0,15	-0,15	-0,13	-0,14
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]:	1,654	1,510	1,366	1,223	1,079	935	791
P [kW]:	1,662	1,503	1,369	1,215	1,069	925	774
$\Delta P/P_n$ [%]:	0,16	-0,14	0,05	-0,15	-0,19	-0,20	-0,34
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]:	0,647	0,503	0,360	0,216	0,072	0	0
P [kW]:	0,633	0,482	0,342	0,207	0,075	-0,013	-0,010
$\Delta P/P_n$ [%]:	-0,28	-0,43	-0,35	-0,17	0,06	-0,26	-0,20
<i>The frequency shall be decreased every 30 s in 0.2 Hz decrements from 52,25Hz until less than 50,15Hz.</i> <i>Maintained for 10 min or until the inverter reaches the maximum output power available.</i> <i>After frequency decreased to less than 50,15Hz, adjust output power to 100% rated power.</i>							
30s mean value	v) 52,25Hz	->	w) 50,05Hz start	w) 50,05Hz full load	--	--	--
Frequency [Hz]:	52,25	--	50,05	50,05	--	--	--
P _{setpoint} [kW]:	0	--	0	N/A	--	--	--
P [kW]:	-0,012	--	-0,014	4,992	--	--	--
$\Delta P/P_n$ [%]:	-0,24	--	-0,28	N/A	--	--	--
Limit W _{Gra} :	+ 16,67 %						

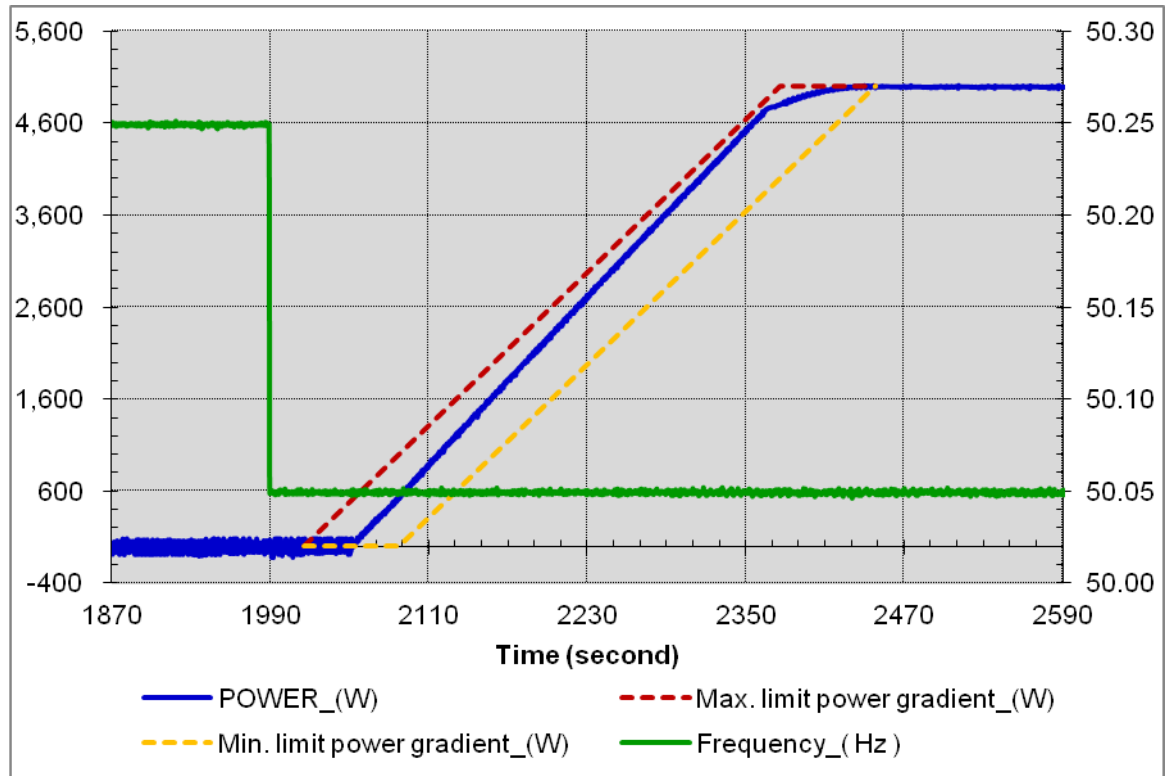
Graph:



Graph:



Graph:

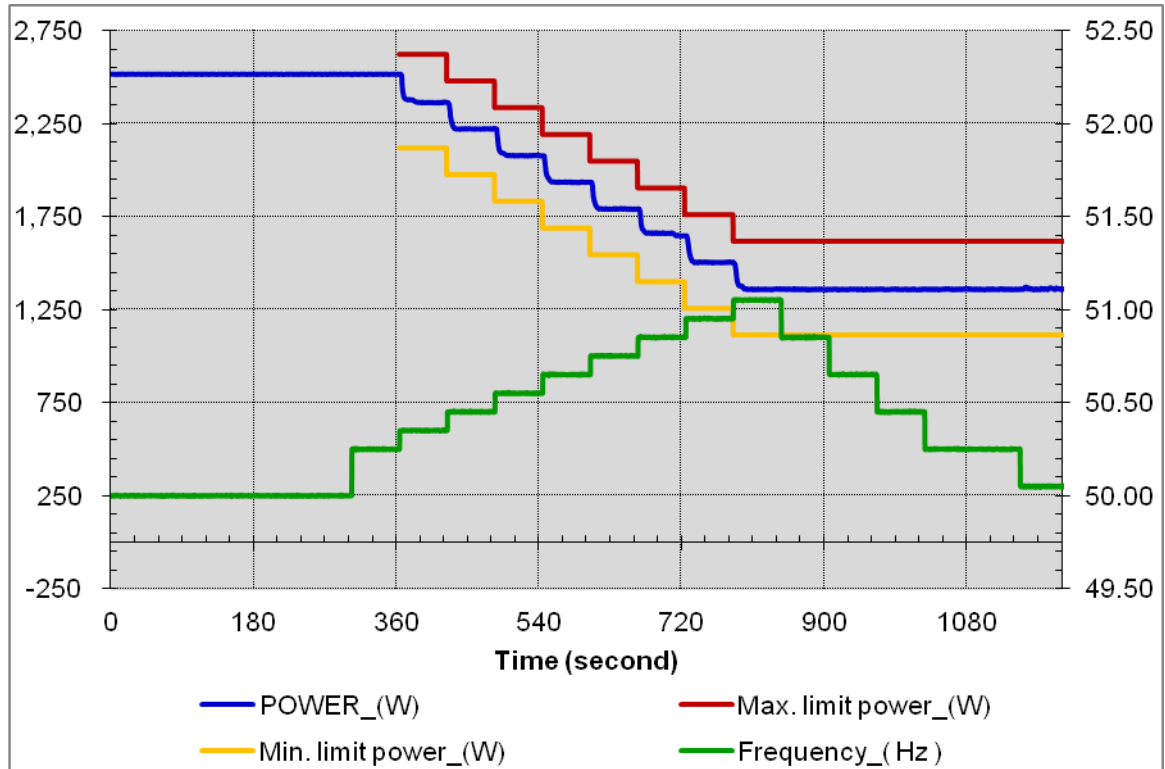


Note:

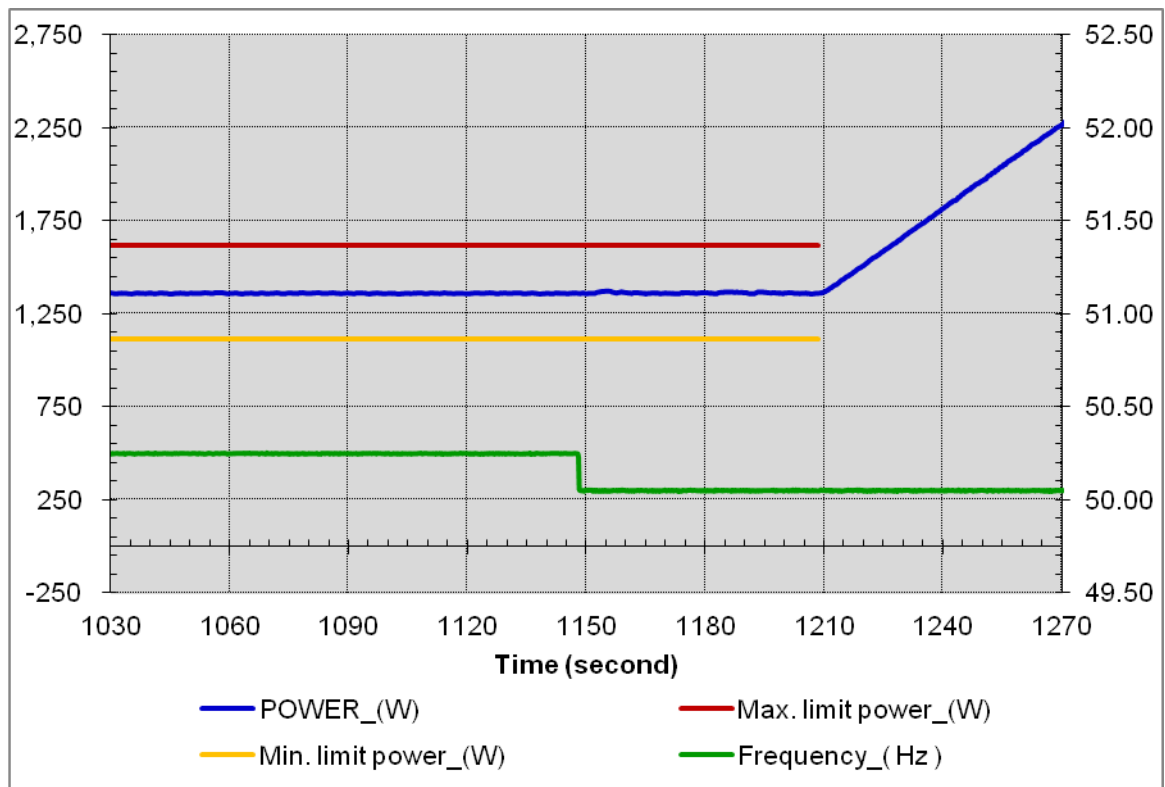
1. The output power at grid test voltage/50,00Hz shall be maintained for 6 min and the average power shall be used as the frozen value of power (Pref)
2. The frequency increase rate: 0.1Hz/step/30s.
3. The frequency decrease rate: 0.2Hz/step/30s.
4. While the frequency decrease less than 50,15Hz, the 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.

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]:	N/A	N/A	2,373	2,229	2,086	1,942	1,798
P [kW]:	2,517	2,517	2,365	2,223	2,079	1,936	1,792
$\Delta P/P_n$ [%]:	N/A	N/A	-0,16	-0,13	-0,13	-0,11	-0,12
30s mean value	h) 50,85Hz	i) 50,95Hz	j) 51,05Hz	--	--	--	--
Frequency [Hz]:	50,85	50,95	51,05	--	--	--	--
P _{setpoint} [kW]:	1,654	1,510	1,366	--	--	--	--
P [kW]:	1,658	1,504	1,359	--	--	--	--
$\Delta P/P_n$ [%]:	0,08	-0,12	-0,15	--	--	--	--
<i>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.</i>							
30s mean value	k) 50,85Hz	l) 50,65Hz	m) 50,45Hz	n) 50,25Hz	o) 50,05Hz start	p) 50,05Hz full load	--
Frequency [Hz]:	50,85	50,65	50,45	50,25	50,05	50,05	--
P _{setpoint} [kW]:	1,366	1,366	1,366	1,366	1,366	N/A	--
P [kW]:	1,359	1,359	1,359	1,360	1,362	4,987	--
$\Delta P/P_n$ [%]:	-0,15	-0,15	-0,15	-0,13	-0,09	N/A	--
Limit W_{Gra}:	+ 16,67 %						

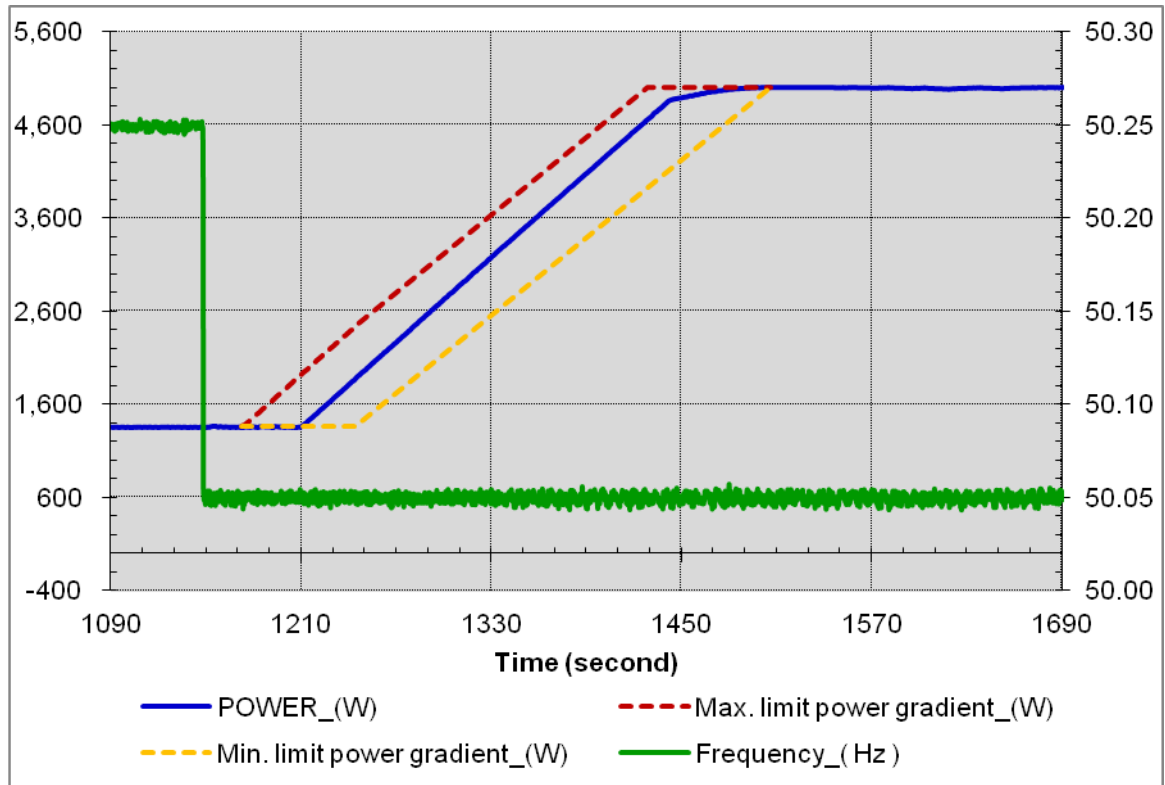
Graph:



Graph:



Graph:



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.

7.5.3.2 Response to a decrease in grid frequency (with energy storage only) Appendix H3.4 Test procedure for inverters with energy storage							N/A
1. Measurement a) to j): Charge rate: 50+/-5% of maximum charge rate							
30s mean value	a) 50,00Hz	b) 49,75Hz	c) 49,65Hz	d) 49,55Hz	e) 49,45Hz	f) 49,35Hz	g) 49,25Hz
Frequency [Hz]:	--	--	--	--	--	--	--
P _{setpoint} [kW]:	--	--	--	--	--	--	--
P [kW]:	--	--	--	--	--	--	--
ΔP/P _{Setpoint} [%]:	--	--	--	--	--	--	--
30s mean value	h) 49,15Hz	i) 49,05Hz	j) 48,95Hz	k) 48,85Hz	l) 48,75Hz		
Frequency [Hz]:	--	--	--	--	--	--	--
P _{setpoint} [kW]:	--	--	--	--	--	--	--
P [kW]:	--	--	--	--	--	--	--
ΔP/P _{Setpoint} [%]:	--	--	--	--	--	--	--
<i>The frequency shall be increased every 30 s in 0.1 Hz increments from 48,75Hz until more than 49,85Hz. Maintained for 10 min or until the inverter reaches the maximum output power available. After frequency increased to more less than 49,85Hz, adjust charging rate to maximum.</i>							
30s mean value	j) 49,95Hz						
Frequency [Hz]:	--	--	--	--	--	--	--
P _{setpoint} [kW]:	--	--	--	--	--	--	--
P [kW]:	--	--	--	--	--	--	--
ΔP/P _{Setpoint} [%]:	--	--	--	--	--	--	--
Limit W _{Gra} :	--						
Note: 1. The output voltage of the variable a.c. supply set to the grid test voltage shall be maintained at this level for 5 min. The average charge rate over this period shall be used as the frozen value of charge rate (Pref-CH) when the frequency falls below 49.75 Hz. 2. The frequency increase rate: 0.1Hz/step/30s. 3. The frequency decrease rate: 0.1Hz/step/30s. 4. While the frequency increase more than 49,85Hz, the voltage and frequency shall be maintained for 10 min or until the inverter reaches the maximum charging rate available. 5 After frequency decrease less than 50,15Hz, adjust charging rate to maximum. The Solar converter supplies for battery charging power from PV array input only.							

7.5.3.2		Response to a decrease in grid frequency (with energy storage only)						N/A
Appendix H3.4		Test procedure for inverters with energy storage (Continued)						
1. Measurement a) to j): Charge rate: 50+/-5% of maximum charge rate								
30s mean value	a) 50,00Hz	b) 49,75Hz	c) 49,65Hz	d) 49,55Hz	e) 49,45Hz			
Frequency [Hz]:	--	--	--	--	--	--	--	
P _{setpoint} [kW]:	--	--	--	--	--	--	--	
P [kW]:	--	--	--	--	--	--	--	
ΔP/P _{Setpoint} [%]:	--	--	--	--	--	--	--	
<i>The frequency shall be increased every 30 s in 0.1 Hz increments from 49,45Hz until more than 49,85Hz. Maintained for 10 min or until the inverter reaches the maximum output power available. After frequency increased to more less than 49,85Hz, adjust charging rate to maximum.</i>								
30s mean value	f) 49,55Hz	f) 49,65Hz	f) 49,75Hz	f) 49,85Hz	f) 49,95Hz			
Frequency [Hz]:	--	--	--	--	--	--	--	
P _{setpoint} [kW]:	--	--	--	--	--	--	--	
P [kW]:	--	--	--	--	--	--	--	
ΔP/P _{Setpoint} [%]:	--	--	--	--	--	--	--	
Limit W _{Gra} :	--							
Note: 1. The output voltage of the variable a.c. supply set to the grid test voltage shall be maintained at this level for 5 min. The average charge rate over this period shall be used as the frozen value of charge rate (Pref-CH) when the frequency falls below 49.75 Hz. 2. The frequency increase rate: 0.1Hz/step/30s. 3. The frequency decrease rate: 0.1Hz/step/30s. 4. While the frequency increase more than 49,85Hz, the voltage and frequency shall be maintained for 10 min or until the inverter reaches the maximum charging rate available. 5 After frequency decrease less than 50,15Hz, adjust charging rate to maximum. The Solar converter supplies for battery charging power from PV array input only.								

8.5.1
Appendix J2.1
7.3, Appendix F

Single-phase combinations
Test for single-phase combinations
Active anti-islanding protection

P

F4 Load condition B = Load match

- (i) Connect inverters in an equivalent arrangement for testing as shown in Figure F1, but replace the single inverter with the correct number of paralleled single-phase inverters.
- (ii) Perform the test as set out in Paragraph F4 for a single inverter for the combination of inverters to be tested.

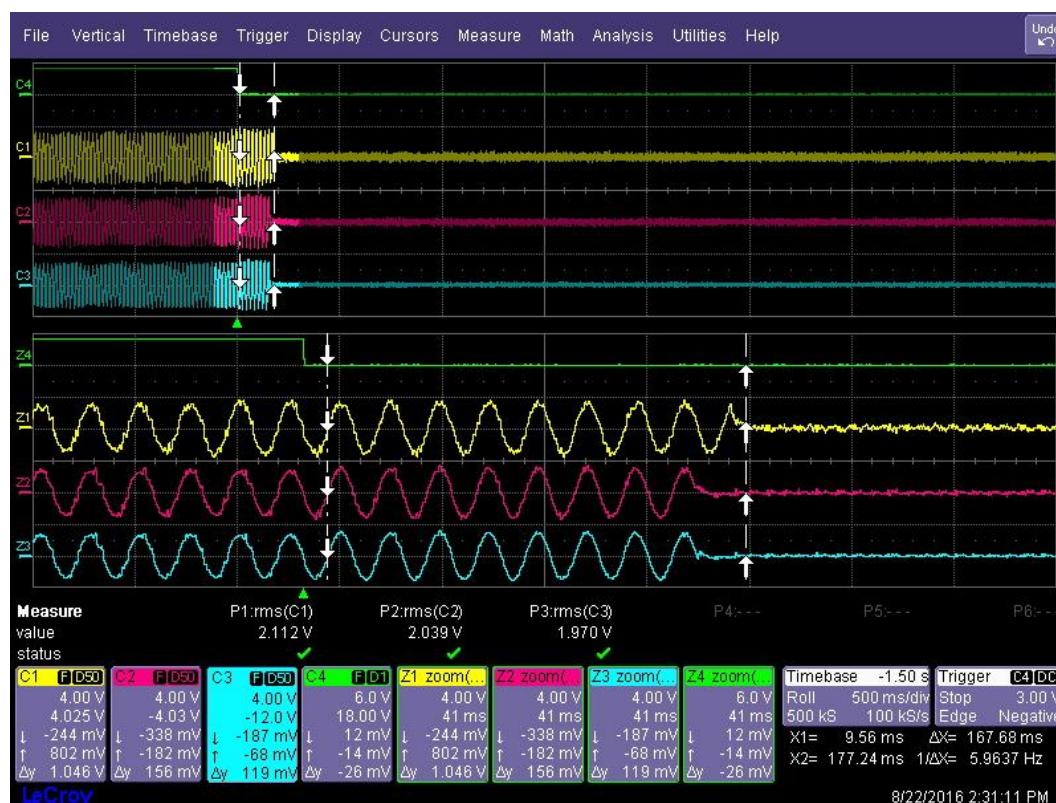
Inverter output Current	Approx. Inverter power (kW)	Time to trip (Average in sec)	Disconnection Limit (in sec)
10+/-5%	1,467	0,168	2s
50+/-5%	7,561	0,191	2s
100+/-5%	14,883	0,197	2s

Load match:

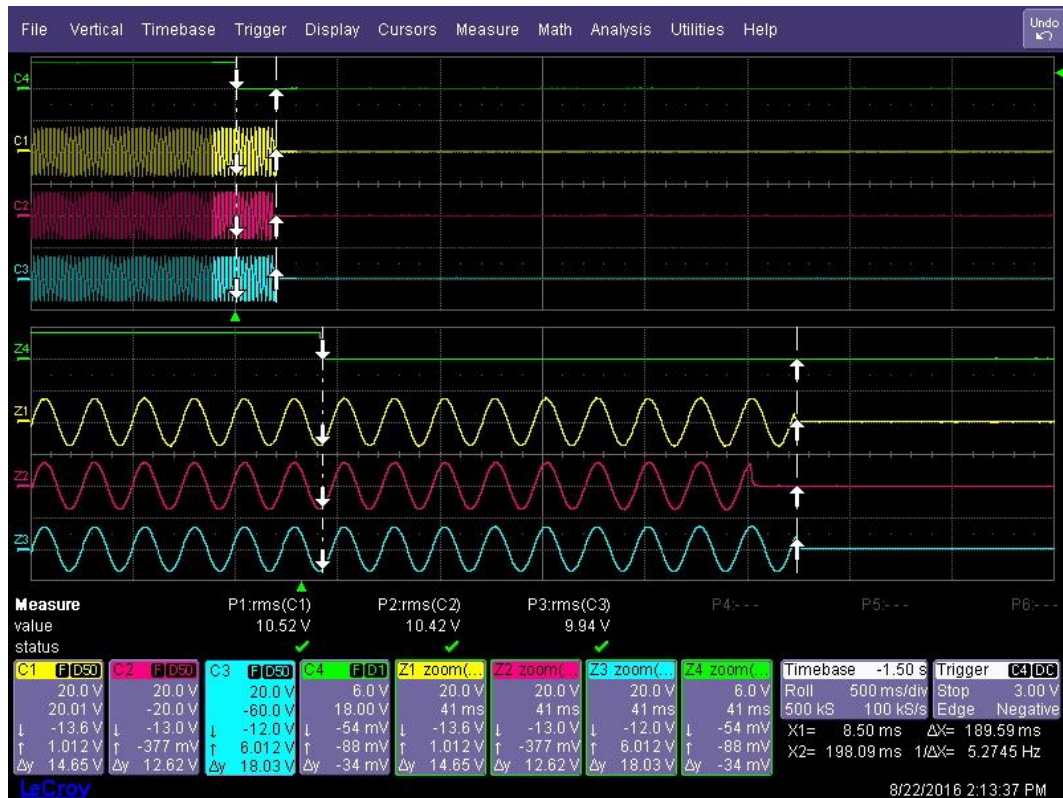
Test circuit according to AS 4777.2 Annex F (Figure F1 and F3). Grid voltage equal to nominal load +/-5%, R shall match real power output, L shall draw reactive power according to Table F1. Via dc input control ac output power so that it equals to 10+/-5% of rated output. R shall be in- or decreased until resonant load matches real power output to within +/-5%. Inductive or capacitive load shall be adjusted until reactive power consumption matches the reactive power output of the inverter to within +/-5%. Switch S shall be opened and time interval of the inverter being disconnected shall be recorded. Same procedure for 50+/-5% and 100+/-5%.

The inverters can only be combined as a single phase power system, and parallel to three inverter maximum.

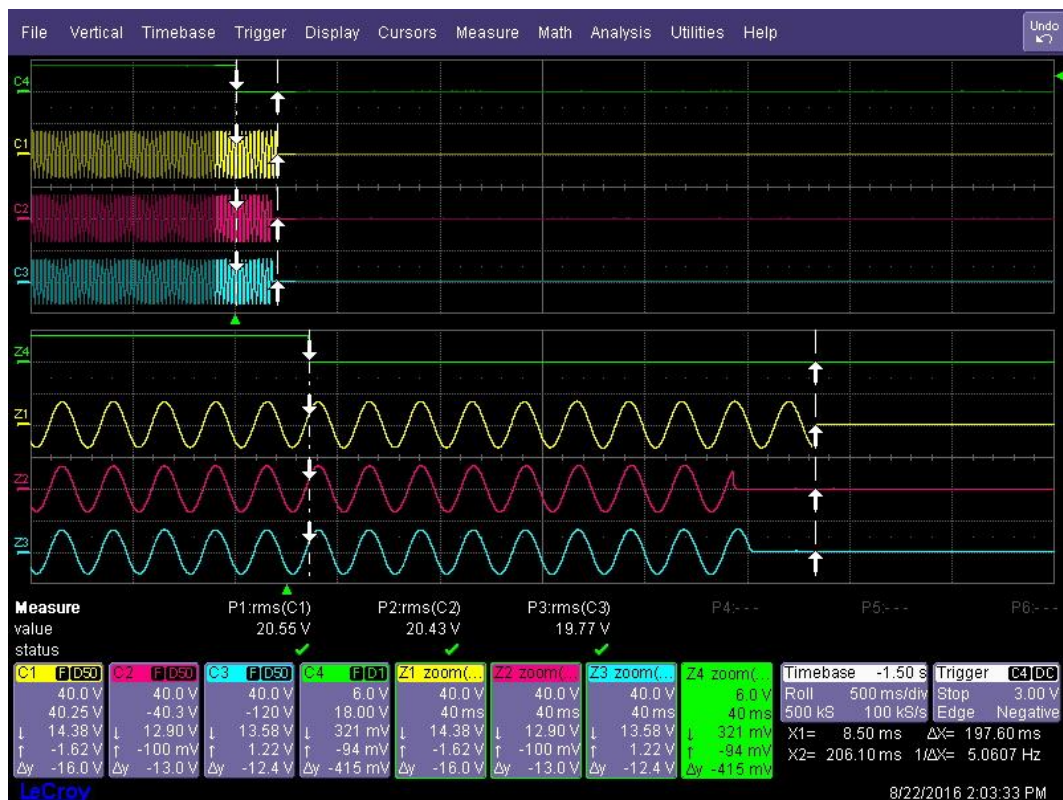
Load match: 10%



Load match: 50%



Load match: 100%



8.5.2 Appendix J2.2 7.4, Appendix G2	Single-phase inverters used in three-phase combinations Test for single-phase inverters used in three-phase combination (b) Under- and over-voltage trip settings and reconnection test			N/A
	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	--	--	--	
Trip value	--	--	--	
Test	Over Voltage 1 (V)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)	
Limit	> 260 V	<=2s	>=60s	
Actual setting	--	--	--	
Trip value	--	--	--	
Test	Over Voltage 2 (V)	Time to disconnect (s)	Time to reconnect (s)	
Limit	> 265 V	<=2s	>=60s	
Actual setting	--	--	--	
Trip value	--	--	--	
Note: Actual settings are the settings of the inverter. The Trip value the measured value. It has to be in the range of <u>+/- 2V</u> of the actual setting. 1. Actual under-voltage setting set to minimum value but minimum 180V, set AC-supply to nominal grid voltage and frequency 50+/-0,2Hz and 50+/-5% rated output current, slowly decrease ac supply voltage until inverter disconnects. Record disconnection voltage. Set AC-supply voltage back to nominal voltage, record reconnection time , than decrease AC-supply voltage to recorded disconnection voltage + 2V. Rapidly decrease voltage, measure time interval between passing through recorded disconnection voltage and inverter disconnection. 2. Actual over voltage setting set to maximum value but maximum 270V, ac supply to nominal grid voltage and 50+/-5% output power, but maximum 1kVA. Slowly increase ac supply voltage until inverter disconnects, recording disconnection voltage. Ac supply voltage back to nominal voltage, recording reconnection time, increase ac supply voltage to recorded switch off voltage – 2V. Rapidly increase voltage, measure time interval between passing through recorded switch off voltage and inverter disconnection. The inverters can only be combined as a single phase power system.				

8.5.2 Appendix J2.2		Single-phase inverters used in three-phase combinations Test for single-phase inverters used in three-phase combination (b)		N/A
7.4, Appendix G3		Under- and over-frequency trip settings and reconnection test		
	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	--	--	--	
Trip value	--	--	--	
Test	Under Frequency (Hz)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)	
New Zealand Limit	>=45Hz	<=2s	>=60s	
Actual setting	--	--	--	
Trip value	--	--	--	
Test	Over Frequency (Hz)	Time to disconnect (s)	Time to reconnect (s)	
Limit	<=52Hz	<=0,2s	>=60s	
Actual setting	--	--	--	
Trip value	--	--	--	
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. 1.Actual under frequency setting set to minimum value but minimum 47 or 45Hz, AC-supply frequency 50+/- 0,1Hz and 50+/-5% rated output current or 10A, whichever is the lesser. Slowly decrease ac supply frequency until inverter disconnects. Record disconnection frequency. Ac supply frequency back to 50+/-0,1Hz, record reconnection time, decrease ac supply frequency to recorded disconnection frequency + 0.1Hz. Rapidly decrease frequency, measure time interval between passing through recorded disconnection frequency and inverter disconnection. 2. Actual over frequency setting set to maximum value but maximum 52Hz, ac supply frequency 50+/-0,1Hz and 50+/-5% rated output current or 10A, whichever is the lesser. Slowly increase ac supply frequency until inverter disconnects. Record disconnection frequency. Set ac supply frequency back to 50+/-0,1Hz, recording reconnection time , increase ac supply frequency to recorded switch off frequency - 0.1Hz. Rapidly increase frequency, measure time interval between passing through recorded switch off frequency and inverter disconnection. The inverters can only be combined as a single phase power system.				

8.5.2 Appendix J2.2	Single-phase inverters used in three-phase combinations Test for single-phase inverters used in three-phase combination (c)			N/A
7.3, Appendix F	Active anti-islanding protection			
F4 Load condition B = Load match				
The test shall be performed such that when any one phase trips any inverter in the combination, all other inverters trip within the secondary trip time required by Clause 8.3 (i.e. 2 s).				
Inverter output Current	Approx. Inverter power (W)	Time to trip (Average in sec)	Disconnection Limit (in sec)	
10+/-5%	--	--	2s	
50+/-5%	--	--	2s	
100+/-5%	--	--	2s	
Load match: Test circuit according to AS 4777.2 Annex F (Figure F1 and F3). Grid voltage equal to nominal load +/-5%, R shall match real power output, L shall draw reactive power according to Table F1. Via dc input control ac output power so that it equals to 10+/-5% of rated output. R shall be in- or decreased until resonant load matches real power output to within +/-5%.Inductive or capacitive load shall be adjusted until reactive power consumption matches the reactive power output of the inverter to within +/-5%. Switch S shall be opened and time interval of the inverter being disconnected shall be recorded. Same procedure for 50+/-5% and 100+/-5%. The inverters can only be combined as a single phase power system.				

8.5.2 Appendix J2.2	Single-phase inverters used in three-phase combinations Test for single-phase inverters used in three-phase combination (d)						N/A
8.2	Inverter current balance across multiple phases						
Setting values		PF cos φ = 1			Rated output current:		A
Test value		L1	L2	L3	L1 – L2	L2 – L3	L3 – L1
100% of rated current		--	--	--	--	--	--
Limit [A]:		21,7 A					
Note: The maximum current imbalance in a three-phase inverter system comprised of individual single-phase inverters shall be no more than 21.7 A. The inverters can only be combined as a single phase power system.							

Annex 1

EMC report



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EMC

TEST REPORT

Report No: 150600131TWN-001

Model No: RPI E5

Issued Date: Jul. 01, 2015

Applicant: Delta Electronics, Inc.
Address: No. 39, Sec. 2 Huandong Road., Shanhua Dist., Tainan city
741, Taiwan

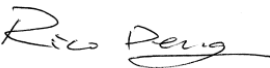
Test Methods/ EN 61000-6-3: 2007+A1: 2011+AC :2012
Standards: EN 61000-6-4: 2007+A1: 2011
IEC 61000-6-3: 2011 / IEC 61000-6-4: 2011
EN 61000-6-2: 2005 / IEC 61000-6-2: 2005
EN 61000-6-1: 2007 / IEC 61000-6-1: 2005
EN 61000-3-11: 2000 / EN 61000-3-12: 2011
EN 61000-4-2: 2009 / IEC 61000-4-2: 2008
EN 61000-4-3: 2006+A1: 2008+A2: 2010 / IEC 61000-4-3: 2010
EN 61000-4-4: 2012 / IEC 61000-4-4: 2012
EN 61000-4-5: 2006 / IEC 61000-4-5: 2005
EN 61000-4-6: 2009 / IEC 61000-4-6: 2008
EN 61000-4-8: 2010 / IEC 61000-4-8: 2009
EN 61000-4-11:2004 / IEC 61000-4-11:2004

Test By: Intertek Testing Services Taiwan Ltd.,
Hsinchu Laboratory
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,
Shiang-Shan District, Hsinchu City, Taiwan

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The test report was prepared by: Sign on File
Freda Huang / Assistant

These measurements were taken by: Sign on File
Ryan Lin / Engineer

The test report was reviewed by: 
Name Rico Deng
Title Senior Engineer



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Revision History

Report No.	Issue Date	Revision Summary
150600131TWN-001	Jul. 01, 2015	1. Original report 2. File Duplicate. Then this report based on report of TW14070353.

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1. General Information

1.1 Identification of the EUT

Product: Hybrid Grid-Tied Photovoltaic Inverter
Model No.: RPI E5
Software Version: DSP: V1.50 RED: V1.30
Hardware Version: EVT
Rated Power: DC Input: 100-550 Vdc, 2MPPT each 12A
AC Output: 230 Vac, 50Hz/60Hz, 24A max
Normal: 5000VA ; Stand-alone: 3600VA
Power Cord: 2C wires 3 meters cable
1-Phase/5-Wire 5 meter cable
Sample receiving date: Nov. 17, 2014
Sample condition: Workable
Testing date: Nov. 19, 2014 ~ Dec. 10, 2014

Note 1: This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

Note 2: The test report only allows to be revised within three years from its original issued date unless further standard or the requirement was noticed.

Note 3: When determining the test conclusion, the Measurement Uncertainty of test has been considered.



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2. Test Summary

2.1 Test requirements

Standard	Test Type	Enclosure	AC side	AC Load side	DC side	BT DC side	BT Signal port	Signal port
EN 61000-6-3:2007+ A1: 2011+AC:2012	Conducted Test	×	√	√	O	O	×	×
	Radiated Test	√	×	×	×	×	×	×
EN 61000-3-12: 2011	Harmonic current emissions	×	√	#	×	×	×	×
EN 61000-3-11: 2000	Voltage fluctuation & flicker	×	√	#	×	×	×	×
IEC 61000-4-2: 2008	ESD test	√	×	×	×	×	×	×
IEC 61000-4-3: 2010	RS test	√	×	×	×	×	×	×
IEC61000-4-4: 2012	EFT test	×	√	#	×	×	O	√
IEC 61000-4-5: 2005	Surge test	×	√	#	O	×	×	√
IEC 61000-4-6: 2008	CS test	×	√	#	×	×	×	√
IEC 61000-4-8: 2009	Magnetic Field test	√	×	×	×	×	×	×
IEC 61000-4-11: 2004	Dip test	×	√	#	×	×	×	×

√: Applicable

×: Not applicable

#: Require by client(No test)

O: Require by client(Test)



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2.2 Test results

Emission (EN 61000-6-3: 2007+A1: 2011+AC:2012/ IEC 61000-6-3: 2011)			
Standard	Test Type	Result	Remarks
EN 61000-6-3: 2007 +A1: 2011+AC:2012	Conducted Test	PASS	Meet the requirements
	Radiated Test	PASS	Meet the requirements
EN 61000-3-12: 2011	Harmonic current emissions	PASS	Meet the requirements
EN 61000-3-11: 2000	Voltage fluctuation & flicker	PASS	Meet the requirements

Immunity (EN 61000-6-2: 2005 / IEC 61000-6-2: 2005)				
Standard	Test Type	Minimum Criteria	Result	Test Judgment
IEC 61000-4-2: 2008	ESD test	Criterion B	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-3: 2010	RS test	Criterion A	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-4: 2012	EFT test	Criterion B	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-5: 2005	Surge test	Criterion B	PASS	Meets the requirements of Performance Criterion B
IEC 61000-4-6: 2008	CS test	Criterion A	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-8: 2009	Magnetic Field test	Criterion A	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-11: 2004	Dip test	1. 100% reduction- Performance Criterion B 2. 60% reduction- Performance Criterion C 3. 30% reduction- Performance Criterion C 4. 100% reduction- Performance Criterion C	PASS	Meets the requirements of Voltage Dips: 1. 100 % reduction- Performance Criterion A 2. 60 % reduction- Performance Criterion A 3. 30 % reduction- Performance Criterion A 4. 100 % reduction- Performance Criterion A



3. Test Specifications

3.1 Standards

EN 61000-6-3: 2007+A1: 2011+AC: 2012 / IEC 61000-6-3: 2011 Electromagnetic compatibility - Generic immunity standard
— For Residential, commercial and light industry environments.

EN 61000-6-1: 2007 / IEC 61000-6-1: 2005 Electromagnetic compatibility—Generic immunity standard—For Residential, commercial and light industry environments.

EN 61000-6-2: 2005 / IEC 61000-6-2: 2005 Generic standards—Immunity for industrial environments

EN 61000-6-4: 2007+A1: 2011 / IEC 61000-6-4: 2011 Generic standards—Emission standard for industrial environments.

EN 61000-3-11: 2000 Electromagnetic compatibility (EMC)—Part 3-11: Limits-Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems—Equipment with rated current ≤ 75 A and subject to conditional connection.

EN 61000-3-12: 2011 Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and 75 A per phase



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3.2 Test Facility accreditation

Intertek Testing Services Taiwan Ltd., Hsinchu Laboratory is accredited in respect of laboratory and the accreditation criterion is ISO/IEC 17025: 2005.

Certification	Bureau	Code	Accreditation Criteria
Accreditation Certificate	TAF	0597	ISO/IEC 17025
	BSMI	SL2-IS-E-0024 SL2-IN-E-0024 SL2-A1-E-0024 SL2-R2-E-0024 SL2-R1-E-0024 SL2-L1-E-0024	ISO/IEC 17025
Site Filling Code :	FCC	93910	Test facility list & NSA Data
	IC	2042D-1, 2042D-2	Test facility list & NSA Data
	VCCI	R-1534 C-1618 T-1586	Test facility list & NSA Data

Note 1: Each certificate can refer to attachment certification.pdf.

Note 2: Each certificate is within the valid calibration period.

3.3 Classification of ITE

ITE is subdivided into two categories denoted class A ITE and class B ITE.

Class B ITE

Class B ITE is a category of apparatus which satisfies the class B ITE disturbance limits.

Class B ITE is intended primarily for use in the domestic environment and may include:

- equipment with no fixed place of use; for example, portable equipment powered by built-in batteries;
- telecommunication terminal equipment powered by a telecommunication network;
- personal computers and auxiliary connected equipment.

NOTE: The domestic environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10 m of the apparatus concerned.

Class A ITE

Class A ITE is a category of all other ITE which satisfies the class A ITE limits but not the class B ITE limits. Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use:

WARNING

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.



3.4 External port

Items	Specifications
DC input port	+, -
AC mains output port	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Communication	RS-232, RJ-45

3.5 Performance verification

The EUT has been monitored based on manufacturer's specification; the performance fulfilled the requirements of standard.

3.6 Mode of operation during the test

(1). The input power port of EUT (Inverter) is connected with Batteries frame (DC source), the output power port of EUT (Inverter) is connected with AC source and load. When Batteries frame (DC source)'s power raises, The AC of EUT (Inverter)'s power will output to load and the EUT (Battery) will charging.

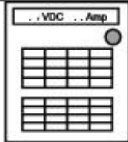

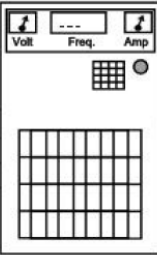
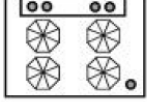

(2). When Batteries frame (DC source) shut down, The EUT (Battery) will output to EUT (Inverter) just like DC source. The AC of EUT (Inverter)'s power will output to load.

(3). When Batteries frame (DC source) shut down, The EUT (Battery) will output to EUT (Inverter) just like DC source. Switch to by pass and the AC (Load) of EUT (Inverter)'s power will output to load.



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3.7 Peripheral equipment

Peripherals	Brand	Model No.	Serial No.	Description of cable length	Symbol
DC power	Chroma	62120-600	N/A	N/A	
Batteries frame	YUASA& GS	UXH90-12& GPL 121000	N/A	N/A	
AC Converter	APC	AFC-33030J	F311040038	N/A	
Load	N/A	N/A	N/A	N/A	
Notebook PC	IBM	2609	BA-ZHNNH	RS 232 Cable 1 meter	
RS232 to RS-485 Converter*	TryCon	TRP-C06	NA	RJ-45 UTP Cat.5.0 3 meter	N/A

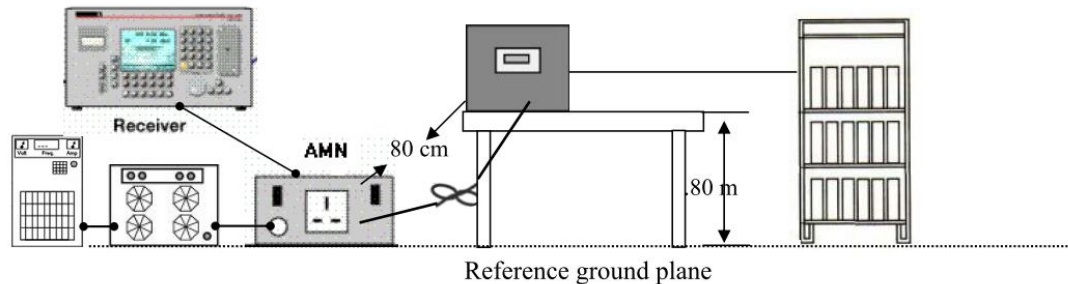
* The equipment is supplied by client.



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4. Conducted Emission Test

4.1 Test arrangement



4.2 Photographs of the test arrangement

Please refer to the appendix B1 of the present report.

4.3 Test Procedures

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Equipment designed for wall-mounted operation shall be tested as tabletop EUT. The orientation of the equipment shall be consistent with normal installation practice.
3. The EUT are placed on a 1.0 meter(W)×1.5meter(L) and 0.8 meter in height wooden table and the EUT was adjusted to maintain a 0.4meter space from a vertical reference plane.
4. The rear of the arrangement shall be flush with the back of the supporting tabletop unless that would not be possible or typical of normal use.
5. The EUT is connected to power mains through a Artificial Mains Network (AMN), which provided 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
6. The AMN is placed 0.8 meters from the EUT, All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN .
7. The excess power cable between the EUT and the AMN was bundled. All connecting cables of EUT and peripherals were moved to find the maximum emission
8. If the measuring receiver is connected to the voltage probe, the AMN shall be terminated with 50 Ω .
9. If any, measure the conducted emissions on each phase of power line of the EUT's power source by using the test receiver.
10. Sweep the signal from 150kHz to 30MHz by using the receiver with the maximum-Peak detector.
11. If the peak emission level is lower than the average limit, then the emission values presented will be the peak value only. Otherwise, both of Q.P. and average values shall be measured.



4.4 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration
EMI Receiver	Rohde & Schwarz	ESCS30	833364/011	2014/06/10	2015/06/09
200-A Four -Line V-Network	Rohde & Schwarz	ENV4200	848411/012	2014/10/03	2015/10/02
Shield Room	N/A	N/A	N/A	N/A	N/A

Note: The above equipments are within the valid calibration period.

4.5 Conducted Emission Limit for AC & DC mains port

Frequency (MHz)	Maximum RF Line Voltage	
	DC Power Port (dB μ V)	
	Q.P.	Avg.
0.15~0.50	79	66
0.50~30.00	73	60

Frequency (MHz)	Maximum RF Line Voltage	
	AC Power Port (dB μ V)	
	Q.P.	Avg.
0.15~0.50	66~56	56~46
0.50~5.00	56	46
5.00~30.0	60	50

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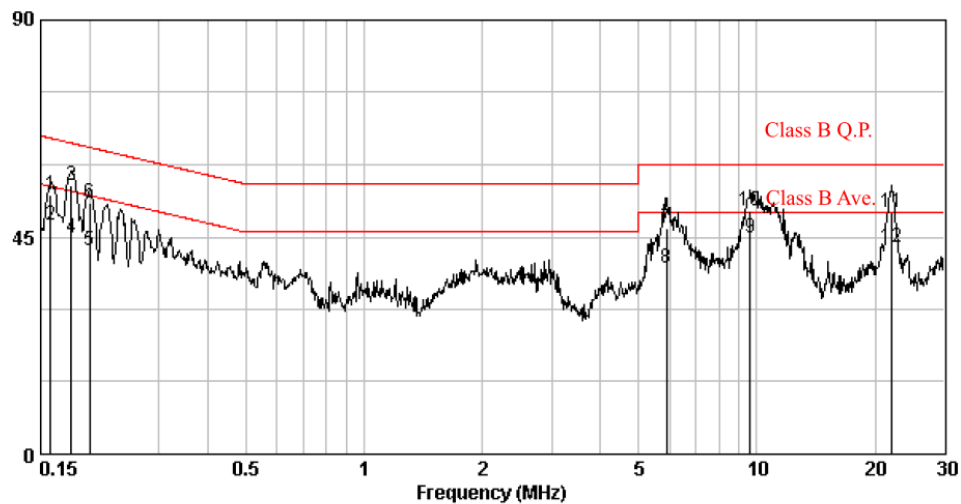
4.6 Test Result: Pass

Phase:	Live Line			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	PV + BT Charge
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB)	
0.159	9.93	53.67	65.52	47.62	55.52	-11.84	-7.89
0.180	9.94	55.76	64.50	44.73	54.50	-8.75	-9.78
0.200	9.94	52.16	63.62	42.34	53.62	-11.46	-11.28
5.898	10.00	46.66	60.00	38.68	50.00	-13.34	-11.32
9.603	10.02	50.60	60.00	44.89	50.00	-9.40	-5.11
21.946	10.00	50.10	60.00	42.92	50.00	-9.90	-7.08

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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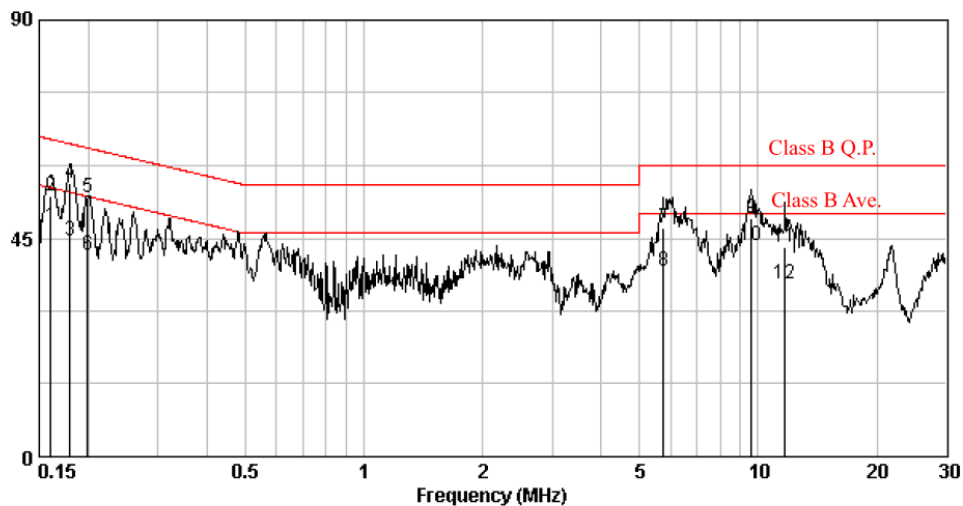
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Phase:	Neutral Line		
Temperature:	24	°C	Model No.: RPI E5
Relative Humidity:	53	%	Test Date: Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark: PV + BT Charge
Input voltage:	400 V	Vdc	Output voltage: 1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz		

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB) Qp	Over Limit (dB) Av
0.161	10.01	53.69	65.43	47.46	55.43	-11.74	-7.97
0.180	10.00	56.28	64.50	44.54	54.50	-8.23	-9.97
0.199	9.99	53.35	63.67	41.42	53.67	-10.32	-12.25
5.744	10.03	47.13	60.00	38.38	50.00	-12.87	-11.62
9.603	10.06	49.10	60.00	43.38	50.00	-10.90	-6.62
11.683	10.04	43.02	60.00	35.74	50.00	-16.98	-14.26

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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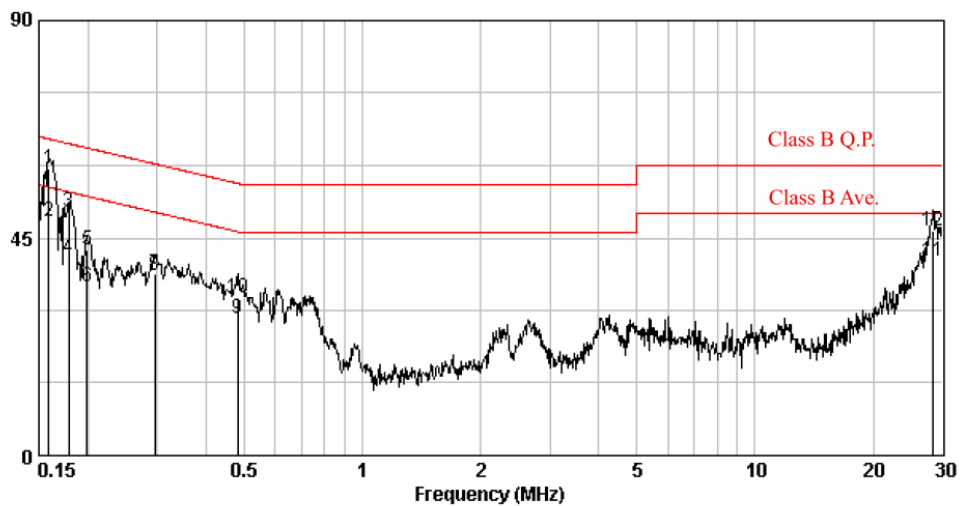
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Phase:	Live Line			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 10, 2014
Atmospheric Pressure:	1008	hPa	Remark:	Load Line
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB)	
						Qp	Av
0.159	9.93	59.39	65.52	48.49	55.52	-6.12	-7.03
0.179	9.94	50.34	64.55	40.98	54.55	-14.21	-13.57
0.199	9.94	42.41	63.67	35.07	53.67	-21.26	-18.60
0.296	9.92	37.53	60.37	37.22	50.37	-22.83	-13.14
0.481	9.89	32.67	56.32	28.20	46.32	-23.65	-18.12
28.452	10.06	46.37	60.00	40.38	50.00	-13.63	-9.62

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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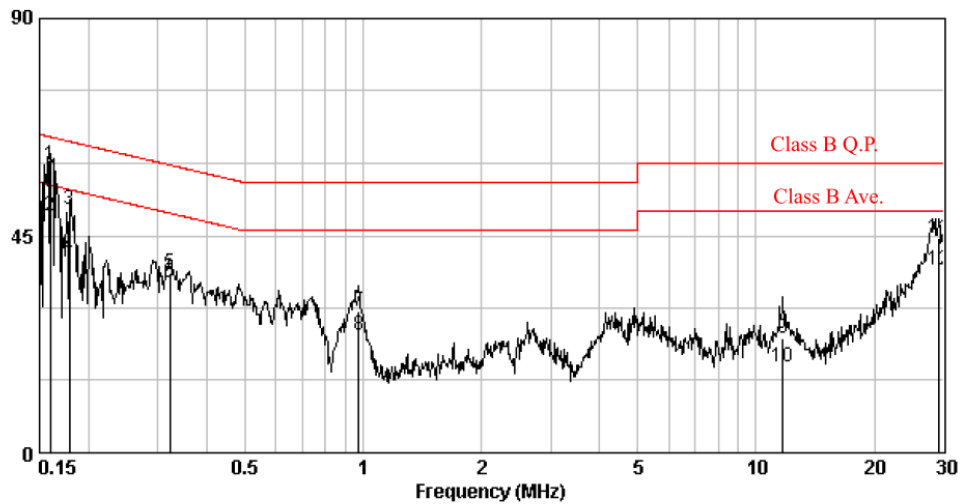
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Phase:	Neutral Line			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 10, 2014
Atmospheric Pressure:	1008	hPa	Remark:	Load Line
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB) Qp	Av
0.160	10.01	59.82	65.47	49.10	55.47	-5.65	-6.38
0.179	10.00	50.42	64.55	40.92	54.55	-14.12	-13.63
0.322	9.94	37.38	59.66	35.30	49.66	-22.28	-14.36
0.974	9.97	29.49	56.00	24.53	46.00	-26.51	-21.47
11.683	10.04	23.67	60.00	17.76	50.00	-36.33	-32.24
29.216	9.95	44.56	60.00	37.87	50.00	-15.44	-12.13

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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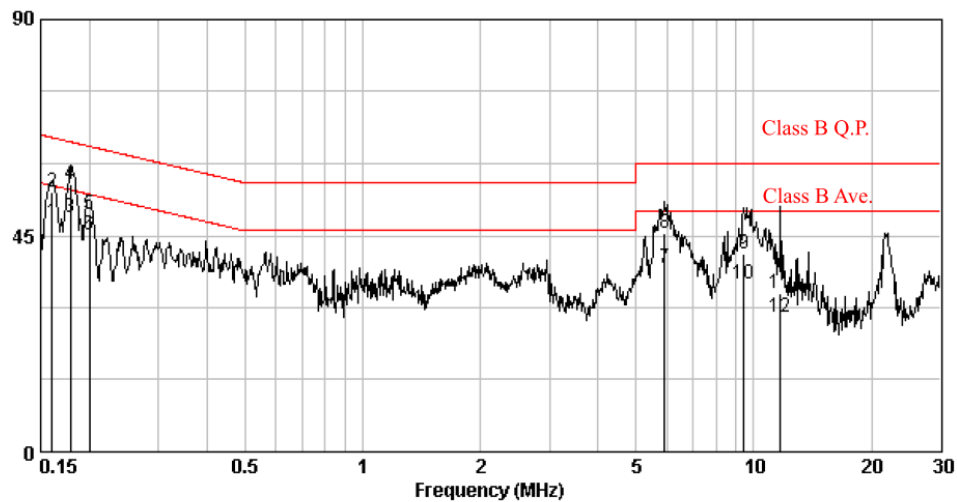
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Phase:	Live Line			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Nov. 27, 2014
Atmospheric Pressure:	1008	hPa	Remark:	BT discharge
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit Qp (dB)	Over Limit Av (dB)
0.161	9.93	54.11	65.43	47.96	55.43	-11.32	-7.47
0.179	9.94	55.86	64.55	48.83	54.55	-8.69	-5.72
0.200	9.94	49.32	63.62	45.13	53.62	-14.30	-8.49
5.929	10.00	45.52	60.00	38.13	50.00	-14.48	-11.87
9.451	10.02	41.08	60.00	35.06	50.00	-18.92	-14.94
11.683	10.02	33.10	60.00	28.04	50.00	-26.90	-21.96

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.





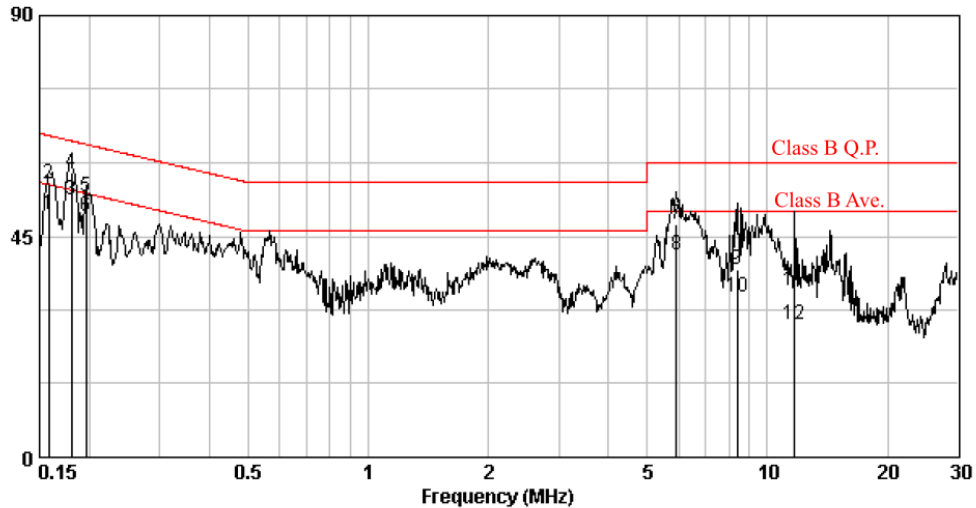
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Phase:	Neutral Line			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Nov. 27, 2014
Atmospheric Pressure:	1008	hPa	Remark:	BT discharge
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB)	
						Qp	Av
0.158	10.01	55.87	65.56	49.54	55.56	-9.69	-6.02
0.181	10.00	57.92	64.46	52.31	54.46	-6.54	-2.15
0.197	9.99	53.09	63.76	49.03	53.76	-10.66	-4.72
5.929	10.03	47.49	60.00	41.21	50.00	-12.51	-8.79
8.412	10.05	38.13	60.00	32.63	50.00	-21.87	-17.37
11.683	10.04	34.10	60.00	27.17	50.00	-25.90	-22.83

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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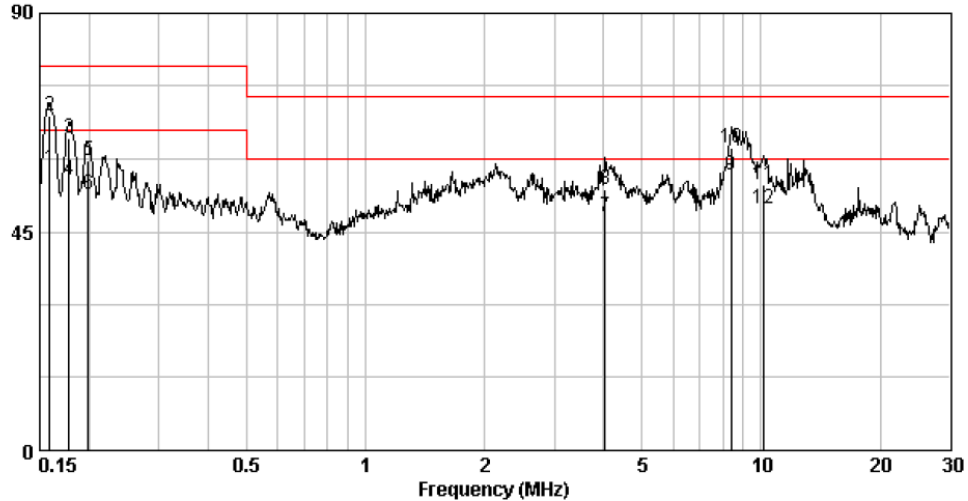
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Phase:	Positive			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	BT Charge
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit Qp (dB)	Over Limit Av (dB)
0.159	30.50	68.84	79.00	58.04	66.00	-10.16	-7.96
0.178	30.50	64.42	79.00	55.72	66.00	-14.58	-10.28
0.199	30.50	59.54	79.00	52.83	66.00	-19.46	-13.17
4.027	30.50	53.86	73.00	48.16	60.00	-19.14	-11.84
8.412	30.50	62.30	73.00	56.66	60.00	-10.70	-3.34
10.125	30.50	54.72	73.00	49.70	60.00	-18.28	-10.30

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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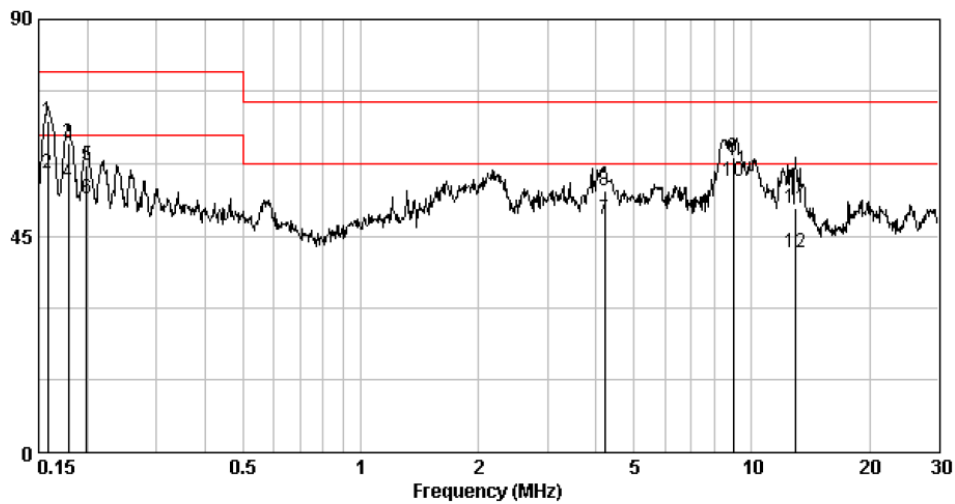
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Phase:	Negative			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	BT Charge
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB) Qp	Av
0.158	30.50	68.94	79.00	58.13	66.00	-10.06	-7.87
0.179	30.50	64.44	79.00	56.20	66.00	-14.56	-9.80
0.199	30.50	59.72	79.00	52.74	66.00	-19.28	-13.26
4.202	30.50	54.42	73.00	48.59	60.00	-18.58	-11.41
8.964	30.50	61.16	73.00	56.32	60.00	-11.84	-3.68
12.988	30.56	50.80	73.00	41.43	60.00	-22.20	-18.57

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.





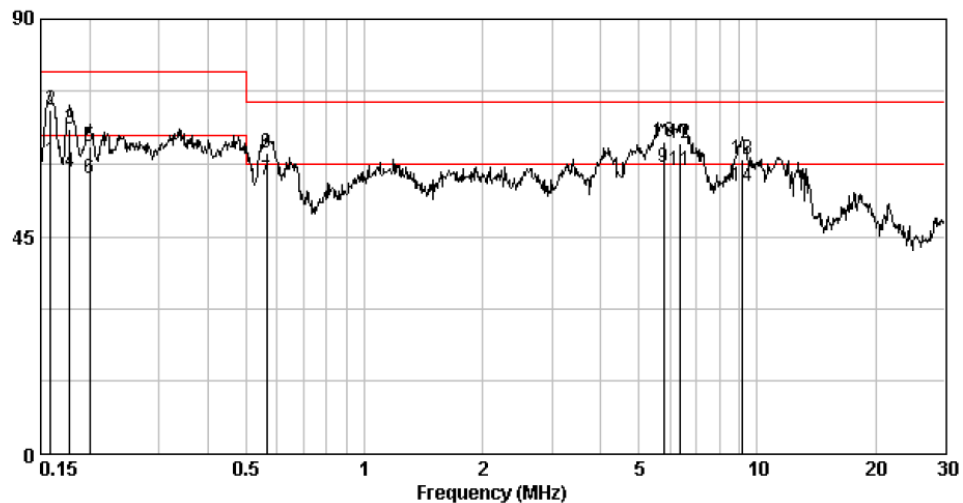
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Phase:	Positive			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	BT discharge
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB)	
						Qp	Av
0.159	30.50	71.26	79.00	60.70	66.00	-7.74	-5.30
0.178	30.50	67.38	79.00	58.50	66.00	-11.62	-7.50
0.200	30.50	63.52	79.00	57.19	66.00	-15.48	-8.81
0.564	30.50	62.42	73.00	56.60	60.00	-10.58	-3.40
5.774	30.50	64.64	73.00	59.43	60.00	-8.36	-0.57
6.386	30.50	64.26	73.00	58.59	60.00	-8.74	-1.41
9.156	30.50	61.10	73.00	55.47	60.00	-11.90	-4.53

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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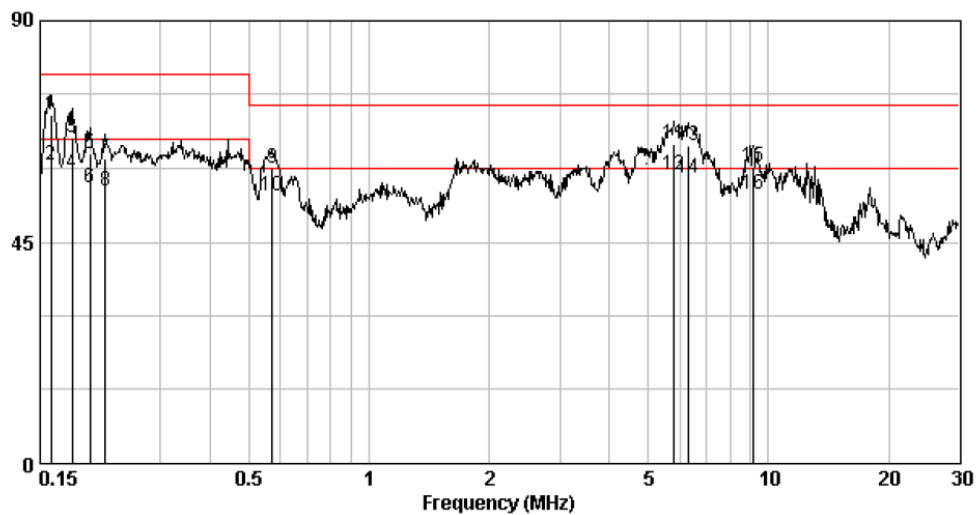
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Phase:	Negative			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	BT discharge
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB)	
						Qp	Av
0.160	30.50	70.98	79.00	60.63	66.00	-8.02	-5.37
0.181	30.50	66.42	79.00	58.85	66.00	-12.58	-7.15
0.200	30.50	63.10	79.00	55.91	66.00	-15.90	-10.09
0.219	30.50	62.02	79.00	55.54	66.00	-16.98	-10.46
0.573	30.50	60.04	73.00	54.32	60.00	-12.96	-5.68
5.774	30.50	65.06	73.00	58.74	60.00	-7.94	-1.26
6.285	30.50	64.52	73.00	58.18	60.00	-8.48	-1.82
9.156	30.50	60.46	73.00	54.75	60.00	-12.54	-5.25

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



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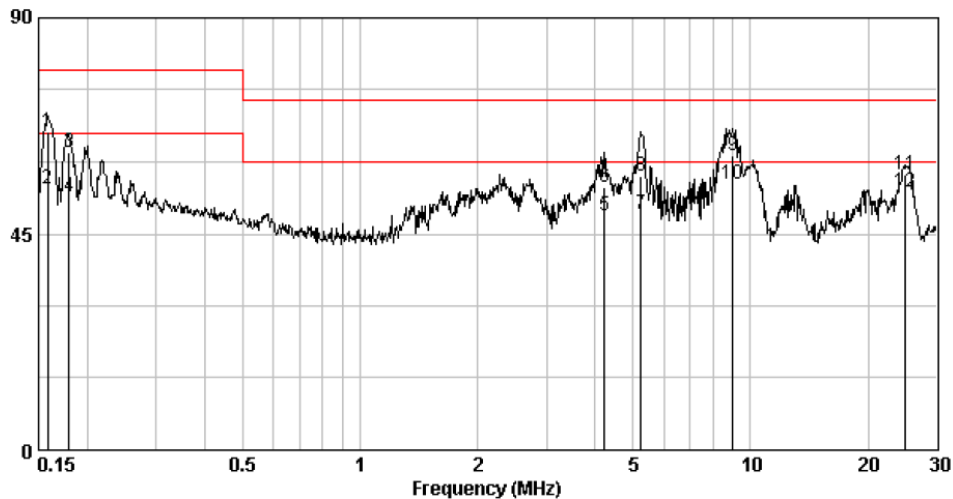
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Phase:	Positive			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	PV DC
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB)	
						Qp	Av
0.158	30.50	66.26	79.00	54.47	66.00	-12.74	-11.53
0.180	30.50	61.90	79.00	52.61	66.00	-17.10	-13.39
4.224	30.50	54.84	73.00	48.86	60.00	-18.16	-11.14
5.249	30.50	56.98	73.00	49.13	60.00	-16.02	-10.87
9.011	30.50	61.18	73.00	55.41	60.00	-11.82	-4.59
24.790	30.60	57.52	73.00	53.75	60.00	-15.48	-6.25

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.





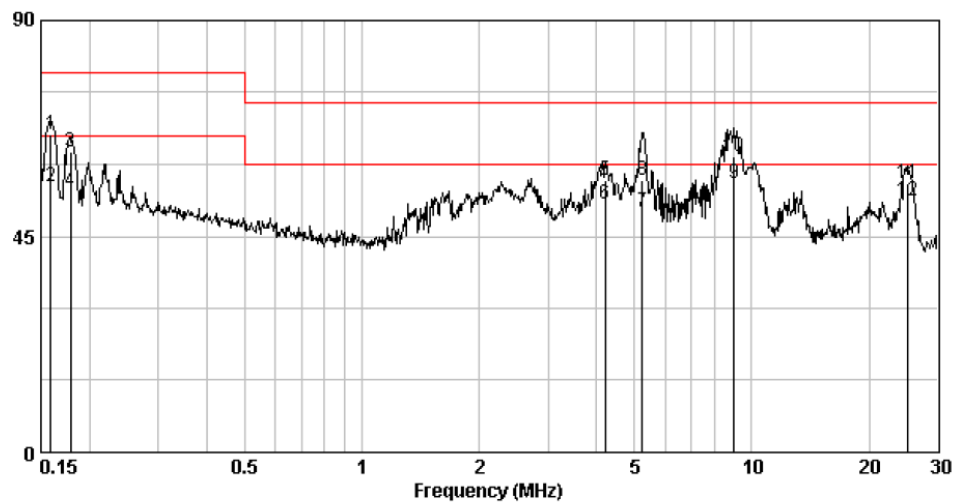
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Phase:	Negative			
Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	PV DC
Input voltage:	400 V	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Over Limit (dB)	
						Qp	Av
0.159	30.50	66.36	79.00	55.35	66.00	-12.64	-10.65
0.179	30.50	62.62	79.00	54.40	66.00	-16.38	-11.60
4.202	30.50	56.74	73.00	51.87	60.00	-16.26	-8.13
5.249	30.50	56.76	73.00	49.95	60.00	-16.24	-10.05
9.011	30.50	61.76	73.00	56.09	60.00	-11.24	-3.91
25.055	30.60	56.06	73.00	52.49	60.00	-16.94	-7.51

Remark:

1. Q.P. stands for Quasi-peak.
2. Correction factor = cable loss + insertion loss of AMN.
3. Over Limit = Level - Limit.



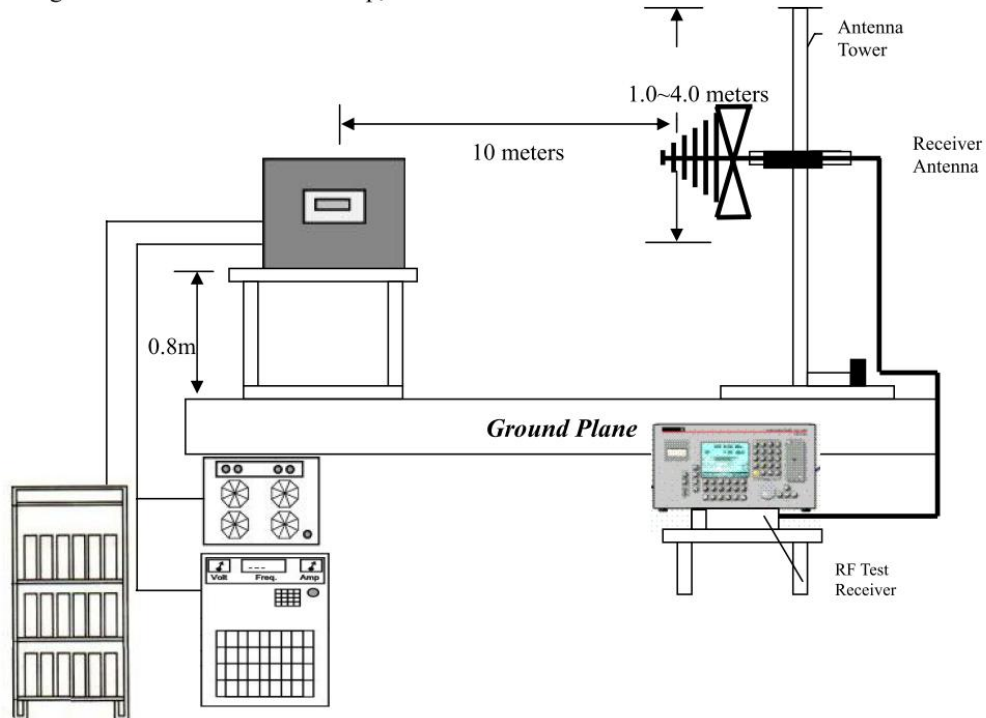
Intertek

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5. Radiated Emission Test

5.1 Test arrangement

The figure below shows the test setup, which is utilized to make these measurements.



5.2 Photographs of the test arrangement

Please refer to the appendix B2 of the present report.

5.3 Test Procedures

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Equipment designed for wall-mounted operation shall be tested as tabletop EUT. The orientation of the equipment shall be consistent with normal installation practice.
3. Radiated testing is placed on a wooden table with a height of 0.8 meters above the reference ground plane and 10 meters away from the reference point of the receiver antenna in the open area test site.
4. The table rotates 360 degrees to determine the position of the highest radiation. The antenna height is varied between one meter and four meters above reference ground plane to find the maximum value of the field strength.



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5. Both horizontal polarization and vertical polarization of the antenna is set to conduct the measurement.
6. The bandwidth was set on the EMI meter 120 kHz and the levels are quasi peak value readings. The frequency spectrum from 30 MHz to 1000 MHz is investigated.

5.4 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Receiver	Rohde & Schwarz	ESCS 30	825788/015	2014/05/30	2015/05/29
Antenna (Bi Log Type)	Schaffner	CBL6112B	2836	2014/05/26	2017/05/24
OATS_1	Intertek	N/A	N/A	2014/05/31	2015/05/30

Note: The above equipments are within the valid calibration period.

5.5 Radiated Emission Limit

Frequency (MHz)	Distance(m)	dB(μ V/m)
30~230	10	30
230~1000	10	37

Note:

1. The tighter limit shall apply at the edge between two frequency bands.
2. Distance refers to the distance in meters between the EUT to antenna.



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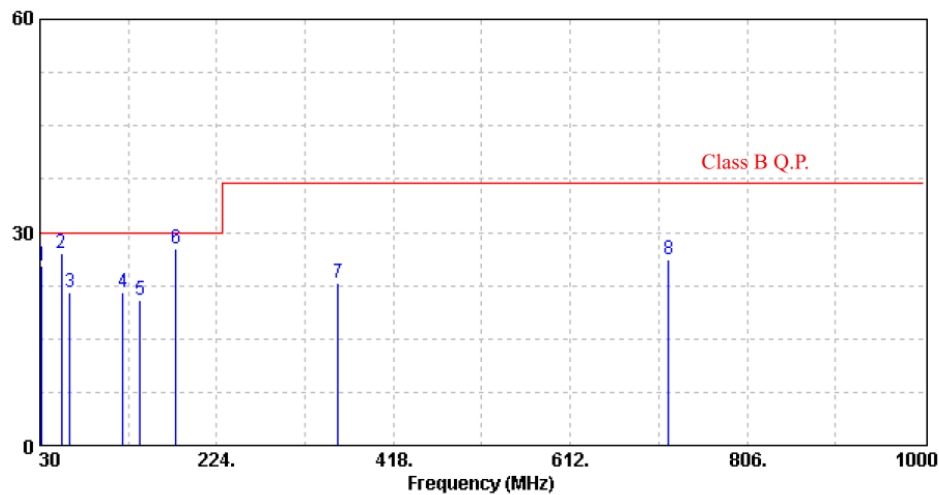
5.6 Test Result: Pass

Phase:	Vertical			
Temperature:	28	°C	Model No.:	RPI E5
Relative Humidity:	55	%	Test Date:	Dec. 09, 2014
Atmospheric Pressure:	1008	hPa	Remark:	PV+BT Charge
Input voltage:	230 V	Vac	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	30 MHz to 1000 MHz			

Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
31.99	VERTICAL	20.88	4.35	25.23	30.00	-4.77	QP
53.81	VERTICAL	8.42	18.68	27.09	30.00	-2.91	QP
63.00	VERTICAL	6.94	14.58	21.52	30.00	-8.48	QP
120.99	VERTICAL	13.48	7.98	21.46	30.00	-8.54	QP
140.20	VERTICAL	12.96	7.56	20.52	30.00	-9.48	QP
179.00	VERTICAL	10.86	16.89	27.74	30.00	-2.26	QP
357.00	VERTICAL	17.82	4.96	22.78	37.00	-14.22	QP
720.00	VERTICAL	25.94	0.15	26.08	37.00	-10.92	QP

Remark:

- Factor = Antenna Factor (dB/m) + Cable Loss (dB)
- Level (dBμV/m) = Factor (dB/m) + Read Level (dBμV)
- Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)



Note: 1. Q.P. stands for Quasi-peak.

2. Factor=Cable loss + Antenna factor

3. Over Limit= Level - Limit.



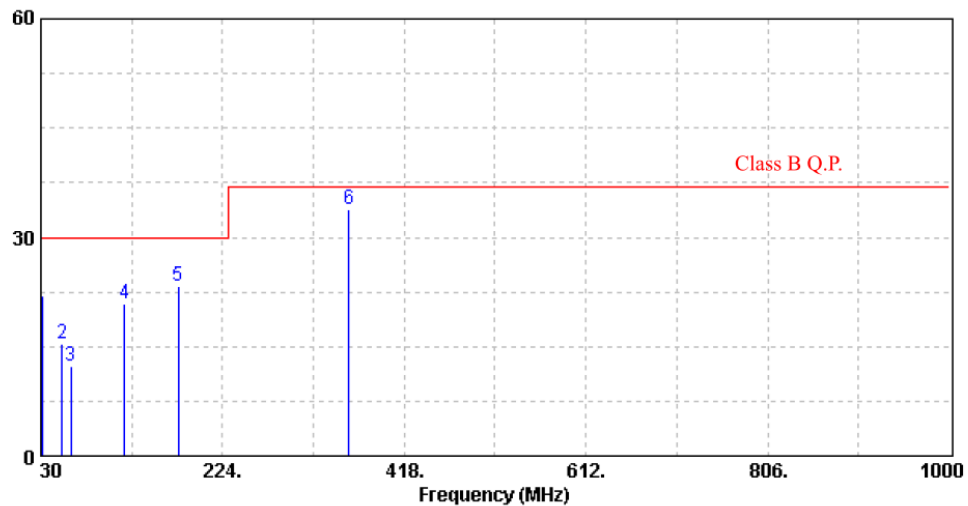
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Phase:	Horizontal			
Temperature:	28	°C	Model No.:	RPI E5
Relative Humidity:	55	%	Test Date:	Dec. 09, 2014
Atmospheric Pressure:	1008	hPa	Remark:	PV+BT Charge
Input voltage:	230 V	Vac	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L
Frequency range:	30 MHz to 1000 MHz			

Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
31.10	HORIZONTAL	21.41	0.57	21.98	30.00	-8.02	QP
53.00	HORIZONTAL	8.72	6.66	15.38	30.00	-14.62	QP
62.00	HORIZONTAL	6.83	5.57	12.40	30.00	-17.60	QP
119.00	HORIZONTAL	13.39	7.40	20.78	30.00	-9.22	QP
177.10	HORIZONTAL	10.89	12.36	23.25	30.00	-6.75	QP
359.00	HORIZONTAL	17.89	15.87	33.76	37.00	-3.24	QP

Remark:

- Factor = Antenna Factor (dB/m) + Cable Loss (dB)
- Level (dBμV/m) = Factor (dB/m) + Read Level (dBμV)
- Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)



Note: 1.Q.P. stands for Quasi-peak.

2. Factor=Cable loss + Antenna factor

3. Over Limit = Level - Limit.

Intertek

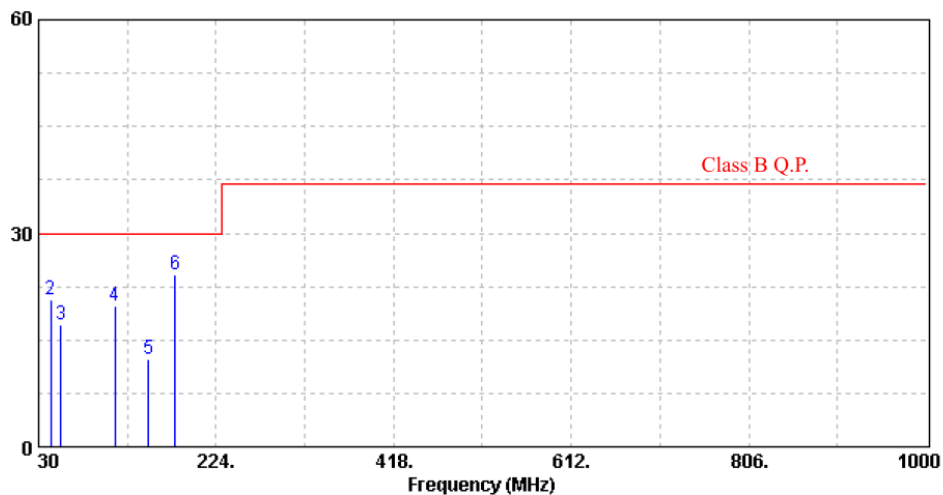
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Phase:	Vertical			
Temperature:	28	°C	Model No.:	RPI E5
Relative Humidity:	55	%	Test Date:	Dec. 09, 2014
Atmospheric Pressure:	1008	hPa	Remark:	BT discharge
Input voltage:	230 V	Vac	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	30 MHz to 1000 MHz			

Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
30.00	HORIZONTAL	21.94	0.78	22.72	30.00	-7.28	QP
43.10	HORIZONTAL	13.27	7.33	20.60	30.00	-9.40	QP
54.10	HORIZONTAL	8.42	8.63	17.05	30.00	-12.95	QP
113.10	HORIZONTAL	12.89	6.85	19.74	30.00	-10.26	QP
150.00	HORIZONTAL	12.06	0.29	12.35	30.00	-17.65	QP
179.00	HORIZONTAL	10.86	13.34	24.20	30.00	-5.80	QP

Remark:

1. Factor = Antenna Factor (dB/m) + Cable Loss (dB)
2. Level (dBμV/m) = Factor (dB/m) + Read Level (dBμV)
3. Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)



Note: 1. Q.P. stands for Quasi-peak.

2. Factor=Cable loss + Antenna factor

3. Over Limit= Level - Limit.



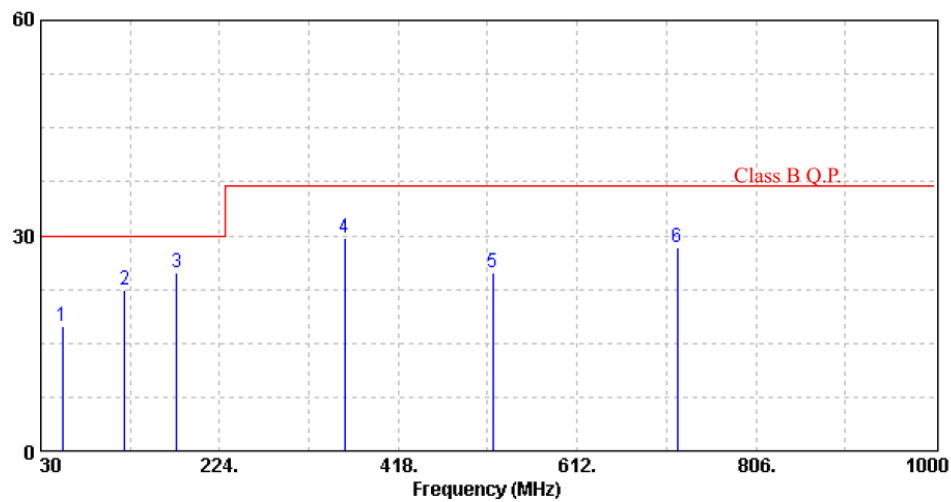
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Phase:	Horizontal		
Temperature:	28	°C	Model No.: RPI E5
Relative Humidity:	55	%	Test Date: BT discharge
Atmospheric Pressure:	1008	hPa	Remark: PV+BT Charge
Input voltage:	230 V	Vac	Output voltage: 1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)
Frequency range:	30 MHz to 1000 MHz		

Freq MHz	Pol/Phase	Factor dB	Read Level dBuV	Level dBuV/m	Limit Line dBuV/m	Over Limit dB	Remark
53.28	HORIZONTAL	8.72	8.55	17.28	30.00	-12.72	QP
121.18	HORIZONTAL	13.48	8.92	22.40	30.00	-7.60	QP
177.44	HORIZONTAL	10.90	13.87	24.77	30.00	-5.23	QP
359.80	HORIZONTAL	17.91	11.73	29.65	37.00	-7.35	QP
520.82	HORIZONTAL	22.29	2.62	24.90	37.00	-12.10	QP
720.64	HORIZONTAL	25.96	2.45	28.41	37.00	-8.59	QP

Remark:

- Factor = Antenna Factor (dB/m) + Cable Loss (dB)
- Level (dBμV/m) = Factor (dB/m) + Read Level (dBμV)
- Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)



Note: 1.Q.P. stands for Quasi-peak.

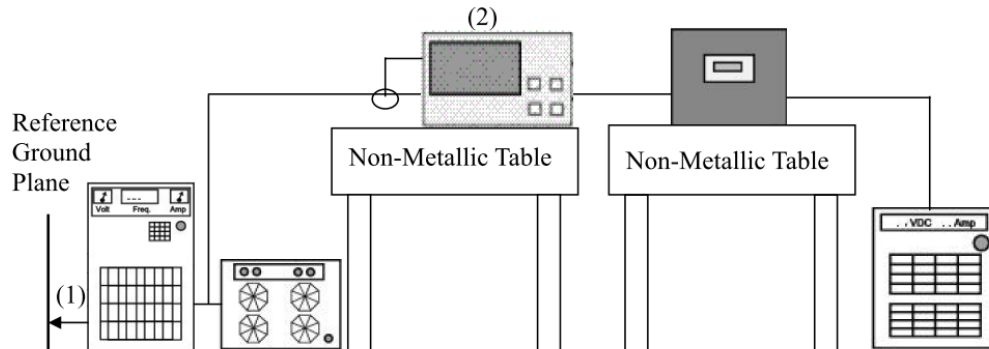
2. Factor=Cable loss + Antenna factor

3. Over Limit = Level - Limit.



6. Harmonic Test

6.1 Test arrangement



Note: (1) Connected to mains supply system
(2) Power Analyzer

6.2 Photographs of the test arrangement

Please refer to the appendix B3 of the present report.

6.3 Test Procedure & classification

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. For each harmonic order, measure the 1.5 s smoothed r.m.s. harmonic current in each discrete Fourier transform time window
3. Measure the 1.5 s smoothed active input power in each discrete Fourier transform time window.
4. The average values for the individual harmonic currents, taken over the entire test observation period shall be less than or equal to the applicable limits.

6.4 Classification

- Class A: – balanced three-phase equipment;
– household appliances, excluding equipment identified as class D;
– tools, excluding portable tools;
– dimmers for incandescent lamps;
– audio equipment.
- Class B: – portable tools;
– arc welding equipment which is not professional equipment.
- Class C: – lighting equipment.
- Class D: – personal computers and personal computer monitors;
– television receivers.



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6.5 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Precision Power Analyzer	YOKOGAWA	WT1600	91K651591	2014/04/21	2015/04/20
DC source	Chroma	62150H-1000S	N/A	N/A	N/A

Note: The equipments above are within the valid calibration period.
The equipments above are provided by Delta Electronics, Inc.



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6.6 Test Result

Phase:	s			
Temperature:	23	°C	Model No.:	RPI E5
Relative Humidity:	50	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Classification:	Class A
Input voltage:	400	Vdc	Output voltage:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

Phase: L1
PF : 0.99
THD : 1.78%
PWHD : 5.31%
FREQ = 50.00Hz

Vrms 231.4
Irms 20.809

Active input power 4.815 kw Power= 4815 (W) , Power Factor=0.99
Power= 4815 (W) , Power Factor=0.99

Harmonic Order	Limit 61000-3-12 Table 3	Phase 1		
		av.Current [A] 61000-3-12 Frame:2.5min	Limit 61000-3-12 Bal. 3 ph[A]	Margin to Limit
1	-	20.809	NA	NA
2	8.00%	0.071	1.66	0.341%
3	21.60%	0.168	4.49	0.807%
4	4.00%	0.003	0.83	0.014%
5	10.70%	0.081	2.23	0.389%
6	2.67%	0.004	0.56	0.019%
7	7.20%	0.083	1.50	0.399%
8	2.00%	0.003	0.42	0.014%
9	3.80%	0.089	0.79	0.428%
10	1.60%	0.002	0.33	0.010%
11	3.10%	0.096	0.65	0.461%
12	1.33%	0.004	0.28	0.019%
13	2.00%	0.105	0.42	0.505%
14	1.14%	0.005	NA	0.024%
15	-	0.113	NA	0.543%
16	1.00%	0.006	0.21	0.029%
17	-	0.114	NA	0.548%
18	0.89%	0.009	0.19	0.043%
19	-	0.113	NA	0.543%
20	0.80%	0.01	0.17	0.048%
21	-	0.103	NA	0.495%
22	0.73%	0.01	0.15	0.048%
23	-	0.081	NA	0.389%
24	0.67%	0.005	0.14	0.024%
25	-	0.054	NA	0.260%
26	0.62%	0.006	0.13	0.029%
27	-	0.031	NA	0.149%
28	0.57%	0.003	0.12	0.014%
29	-	0.019	NA	0.091%
30	0.53%	0.003	0.11	0.014%

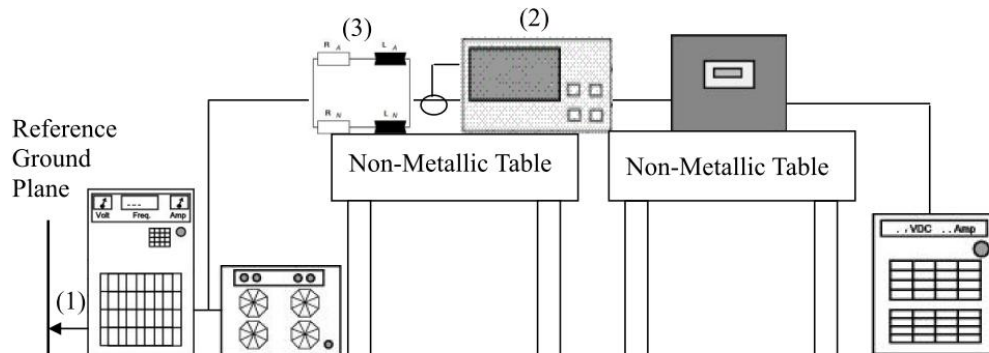


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Harmonic Order	Limit 61000-3-12 Table 3	Phase 1		
		av.Current [A]	Limit	Margin to Limit
		61000-3-12 Frame:2.5min	61000-3-12 Bal. 3 ph[A]	
31	-	0.016	NA	0.077%
32	0.50%	0.006	0.10	0.029%
33	-	0.023	NA	0.111%
34	0.47%	0.007	0.10	0.034%
35	-	0.016	NA	0.077%
36	0.44%	0.006	0.09	0.029%
37	-	0.02	NA	0.096%
38	0.42%	0.005	0.09	0.024%
39	-	0.023	NA	0.111%
40	0.40%	0.004	0.08	0.019%

7. Voltage Fluctuations-Flicker Test

7.1 Test arrangement



Note: (1) Connected to mains supply system
(2) Power Analyzer
(3) Impedance network

7.2 Photographs of the test arrangement

Please refer to the appendix B3 of the present report.

7.3 Test Procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. The voltage changes at the supply terminals were measured using the voltage method.
3. The test voltage was supplied from an AC source which meets the requirements according to the standard. The voltage source has virtually zero internal impedance and is connected

(1 phase)

$$Z = 0.4 + j 0.25 \Omega \text{ (total impedance)}$$

(3 phases)

Impedance in line conductor: $Z_a = 0.24 + j 0.15 \Omega$

Impedance in neutral conductor: $Z_n = 0.16 + j 0.10 \Omega$

4. The observation period, T_p , for the assessment of flicker values by flicker measurement, flicker simulation, or analytical method shall be:

- for P_{st} , $T_p = 10 \text{ min}$
- for P_{lt} , $T_p = 2 \text{ h}$



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5. The observation period shall include that part of the whole operation cycle in which the equipment under test produces the most unfavorable sequence of voltage changes.

24 measurements have been tasted and calculated the average from 22 records, exclude highest and lowest.

7.4 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Precision Power Analyzer	YOKOGAWA	WT1600	91K651591	2014/04/21	2015/04/20
DC source	Chroma	62150H-1000S	N/A	N/A	N/A
Reference impedance network	N/A	N/A	N/A	N/A	N/A

Note: The equipments above are within the valid calibration period.
The equipments above are provided by Delta Electronics, Inc.

7.5 Test result

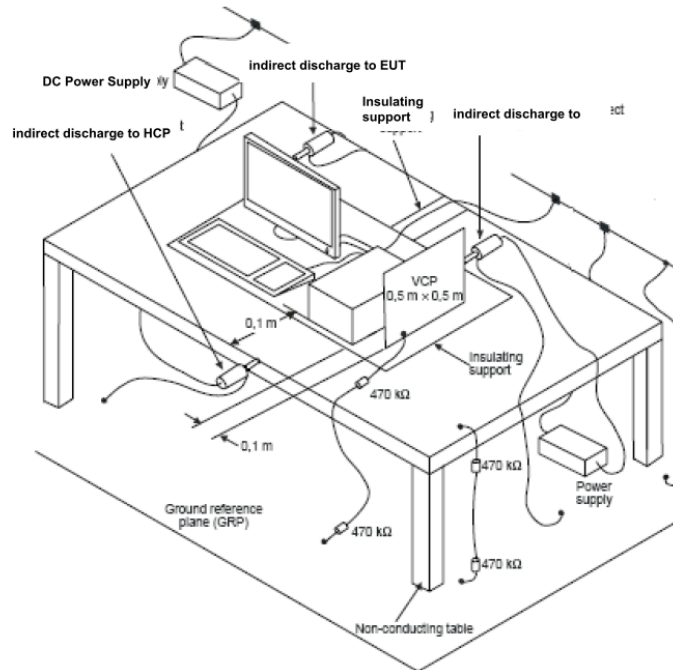
SUMMARY RESULT: PASS

Temperature:	25	°C	Model No.:	RPI E5
Relative Humidity:	51	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	N/A

	EUT DATA	LIMIT	RESULT	TEST ENABLED
Pst max	0.14	1.00	PASS	<input checked="" type="checkbox"/>
Plt max	0.09	0.65	PASS	<input checked="" type="checkbox"/>
d _c %	0.001	3.30	PASS	<input checked="" type="checkbox"/>
d _(t) Sec.	0.001	0.50	PASS	<input checked="" type="checkbox"/>
d _{max} %	0.001	4.00	PASS	<input checked="" type="checkbox"/>

8. Electrostatic Discharge Immunity Test

8.1 Test arrangement



8.2 Photographs of the test arrangement

Please refer to the appendix B4 of the present report.

8.3 Test Procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. ESD testing is placed on a wooden table with a height of 0.8 meters above the reference ground plane.
3. A horizontal coupling plane (HCP) was placed on a non-metallic table 0.8 meter above a ground reference plane (GRP) and connected to it with a cable with two 470 kΩ resistors. GRP shall project beyond the EUT or the HCP by at least 0.5 m on all sides.
4. The EUT is placed on a 0.5mm insulating support and be arranged, connected according to its functional requirements.

5. A distance of 0.8 m minimum shall be provided between the EUT and the walls of the tested room and any other metallic structure.
6. The discharge return cable of the ESD generator shall be connected to the ground reference plane and shall not come closer than 0.2 m to other conductive parts in the test setup except the ground reference plane.
7. Contact discharge is the preferred test method. Air discharges shall be used where contact discharge cannot be applied. Contact discharge to the conductive surfaces and to coupling planes and air discharge at insulating surfaces
8. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT, before the discharge switch is operated.
9. In the case of air discharges, the ESD generator shall approach the EUT as fast as possible until contact between the electrode and the EUT is made (without causing mechanical damage). After each discharge, the ESD generator shall be removed from the EUT.
10. Discharge to the HCP shall be made horizontally to the edge of the HCP. At least 10 single discharges shall be applied at the front edge of each HCP opposite the centre point of each unit of the EUT and 0.1 m from the front of the EUT. and perpendicular to its front edge during the discharge. The discharge electrode shall be in contact with the edge of the HCP before the discharge switch is operated
A vertical coupling plane (VCP) was connected to the GRP with a cable with two 470 kΩ resistors.
11. At least 10 single discharges shall be applied to the centre of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5 m × 0.5 m, is placed parallel to, and positioned at a distance of 0.1 m from, the EUT. Discharges shall be applied to the coupling plane, with sufficient different positions such that the four faces of the EUT are completely illuminated.

8.4 Test Specification

Test level:	Air discharge:	±2kV, ±4kV, ±8kV, ±15kV*
	Contact discharge:	±2kV, ±4kV, ±8kV*
	VCP:	±2kV, ±4kV, ±8kV
	HCP:	±2kV, ±4kV, ±8kV

Note:

1. Single discharge at 1 second interval positive discharge and negative discharge
The selected test points are listed in this table, the numbers refer to the figures attached.
2. The level of 15kV and 8kV for air discharge and contact discharge was required by client.



8.5 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Electrostatic Discharge System	NoiseKen	ESS-2002	ESS0291088	2014/10/08	2015/10/07

Note: The above equipments are within the valid calibration period.

8.6 Requirement

Performance table

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance(Note1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance(Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance(Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance(Note 2)
<p>Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		



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8.7 Test Result: Pass

Temperature:	24	°C	Model No.:	RPI E5
Relative Humidity:	53	%	Test Date:	Dec. 04, 2014
Atmospheric Pressure:	1008	hPa	Remark:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

Type of discharge	Applied Voltage (kV)	Total No. of Discharge (Each Point)	Minimum requirement	Result	
Contact (Red points)	±4	20	Criterion B	Criterion A	PASS
	±8	20	Criterion B	Criterion A	PASS
Air (Yellow points)	±4	20	Criterion B	Criterion A	PASS
	±8	20	Criterion B	Criterion A	PASS
	±15	20	Criterion B	Criterion A	PASS
VCP (4 sides)	±4	20	Criterion B	Criterion A	PASS
	±8	20	Criterion B	Criterion A	PASS
HCP (4 sides)	±4	20	Criterion B	Criterion A	PASS
	±8	20	Criterion B	Criterion A	PASS

Description of Discharge Point

Contact Discharge 80 Test points		Air Discharge	
<input checked="" type="checkbox"/>	Metallic Screws	<input type="checkbox"/>	Plastic Screws
<input checked="" type="checkbox"/>	Metallic Case	<input type="checkbox"/>	Plastic Case (gap)
<input type="checkbox"/>	Metallic Connect ports	<input checked="" type="checkbox"/>	Plastic Connect ports
<input checked="" type="checkbox"/>	Metallic Junctions	<input checked="" type="checkbox"/>	Plastic Junctions
<input type="checkbox"/>	Others:	<input checked="" type="checkbox"/>	LED indicator
		<input checked="" type="checkbox"/>	Panel Board
		<input checked="" type="checkbox"/>	Button

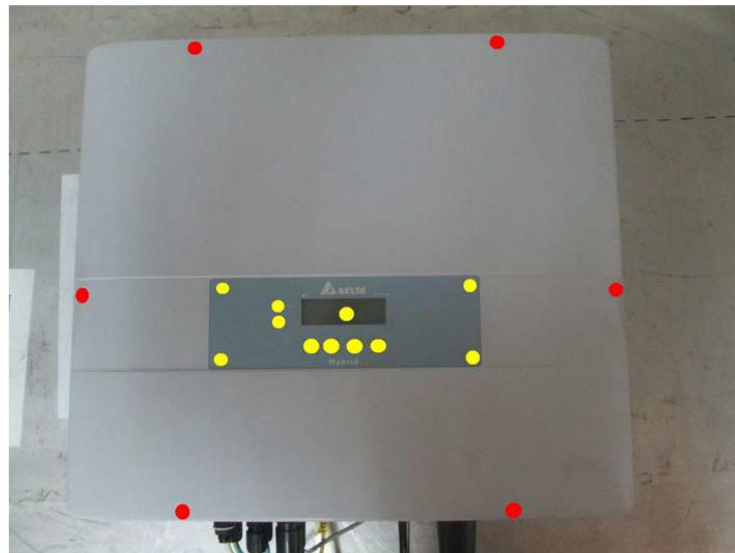
Criteria description:

- Criterion A: ☒ Function is operated as intended during and after the test
☐
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.
☐
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.
☐

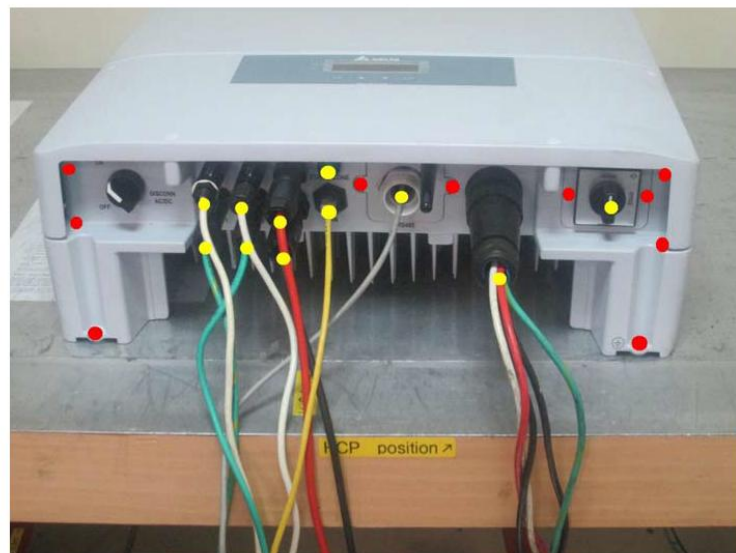


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The tested point of EUT (Face side)



The tested point of EUT (Front side)





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The tested point of EUT (Right side)



The tested point of EUT (Left side)



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The tested point of EUT (Back side)



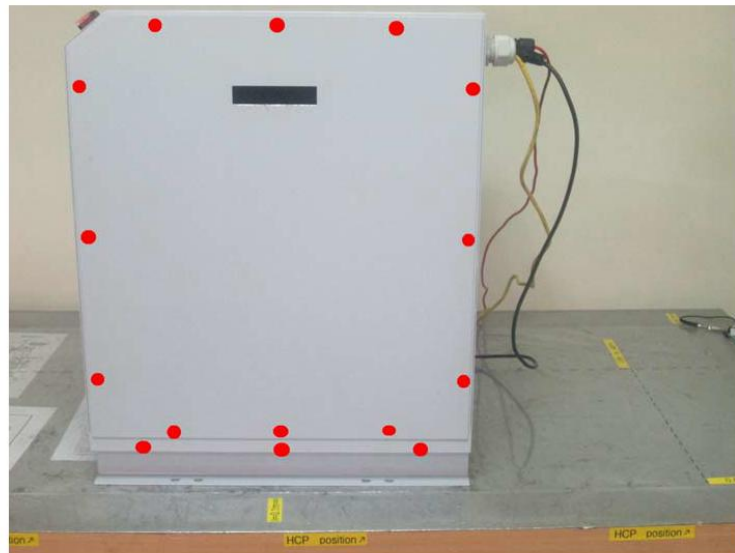
The tested point of Battery (Front side)



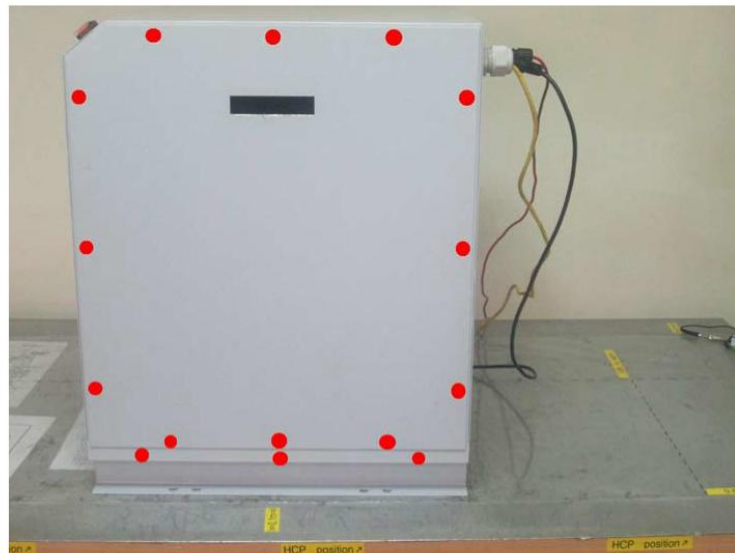


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The tested point of Battery (Right side)



The tested point of Battery (Left side)

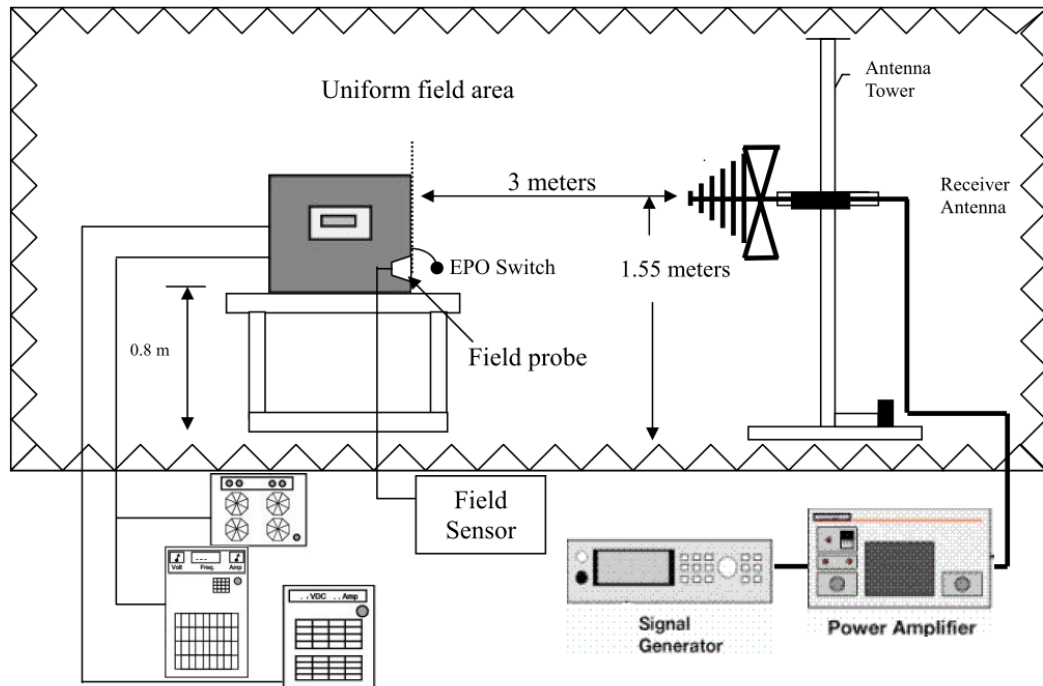


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9. Radiated Susceptibility Immunity Test

9.1 test arrangement



9.2 Photographs of the test arrangement

Please refer to the appendix B5 of the present report.

9.3 Test Procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Radio-Frequency, Electromagnetic Field Immunity testing is placed on a wooden table with a height of 0.8 meters and 3 meters away from the transmitting antenna in the fully anechoic chamber.
3. All EUT's whose individual faces (including any cabling) can be fully covered by the uniform field area.
4. Before testing the intensity of the calibrated field strength should be checked to verify that the test equipment/system is operating properly.



5. After the calibration has been verified, the test field can be generated using the values obtained from the calibration
6. Perform the test with the specified immunity level and modulation method in the test frequency range
7. The transmitting antenna is normally facing each of the four sides of the EUT with two polarizations (Vertical and Horizontal) to perform the test.
8. The test shall normally be performed with the generating antenna facing each side of the EUT. When equipment can be used in different orientations (i.e. vertical or horizontal) all sides shall be exposed to the field during the test.
9. Record the performance of the EUT.

9.4 Test Specification

Frequency range(MHz)	Test field strength V/m	Modulation method
80 to 1000	10	1 kHz 80 % AM
1400 to 2000	3	1 kHz 80 % AM
2000 to 2700	1	1 kHz 80 % AM

The frequency steps 1 %, Log sweep
Dwell time 3 sec
Polarization of antenna Horizontal and Vertical
Test port Enclosure

9.5 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
733 Compact Full Anechoic Chamber	Comtest(RS)	9708093	N/A	2014/08/31	2015/08/30
Signal Generator	Rohde & Schwarz	SMB100A	102385	2014/05/09	2015/05/08
Field Meter	Narda	NBM-520	C-0064	2014/06/23	2015/06/22
Field Probe	Narda	EF1891	A-0347	2014/06/23	2015/06/22

Note: The above equipments are within the valid calibration period.



9.6 Requirement

Performance table

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance(Note1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance(Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance(Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance(Note 2)
<p>Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		

9.7 Generation of the Electromagnetic Field

The electromagnetic field is generated from a computer controlled signal generator. The output power is amplified and then radiated from broadband log periodic antennas. For each sweep a pre-recorded empty chamber calibration file is used to establish the required field strength. When using these files the field strength inside an area of 1.5/1.0 meter x 1.5 meter is in accordance with the standard.



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9.8 Test Results: Pass

Temperature:	23	°C	Model No.:	RPI E5
Relative Humidity:	50	%	Test Date:	Dec. 03, 2014
Atmospheric Pressure:	1008	hPa	Remark:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

Exposed Side: ☒ Front ☒ Left ☒ Rear ☒ Right

Frequency (MHz)	Antenna Polarization	Test field strength	Result	Remark
80 MHz to 1 GHz	Vertical	10 V/m	PASS	Criterion A
80 MHz to 1 GHz	Horizontal	10 V/m	PASS	Criterion A
1.4 GHz to 2 GHz	Vertical	3 V/m	PASS	Criterion A
1.4 GHz to 2 GHz	Horizontal	3 V/m	PASS	Criterion A
2 GHz to 2.7 GHz	Vertical	1 V/m	PASS	Criterion A
2 GHz to 2.7 GHz	Horizontal	1 V/m	PASS	Criterion A

Criteria description:

Criterion A: ☒ Function is operated as intended during and after the test

☐

Criterion B: ☐ Function is temporary degradation and operated as intended after the test.

☐

Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.

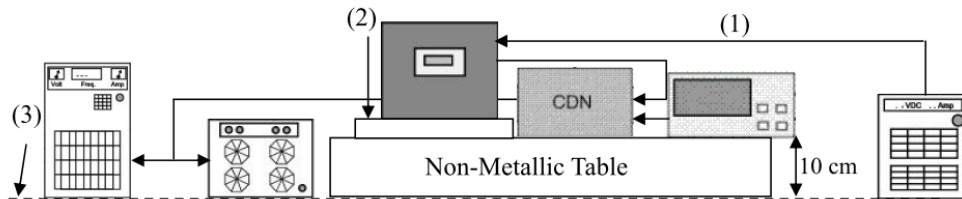
☐



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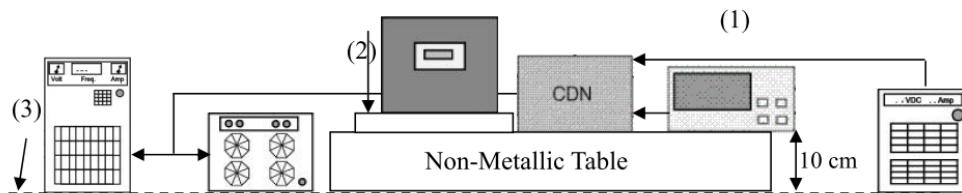
10. Electrical Fast Transient/Burst Immunity Test

10.1 Test arrangement (for Main power)



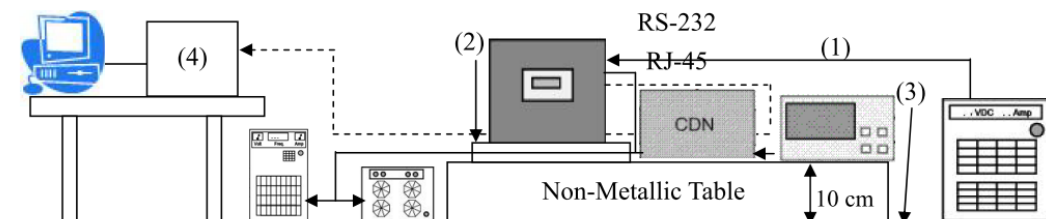
Note: (1) EFT/Burst Signal Generator
(2) 10cm insulating support
(3) Reference ground plane

10.2 Test arrangement (for DC port)



Note: (1) EFT/Burst Signal Generator
(2) 10cm insulating support
(3) Reference ground plane

10.3 Test arrangement (for Signal port)



Note: (1) EFT/Burst Signal Generator
(2) 10cm insulating support
(3) Reference ground plane
(4) RS232 to RS-485 Coverter (if connected to RJ45 port of EUT, it wouldn't use)



10.4 Photographs of the test arrangement

Please refer to the appendix B6 of the present report.

10.5 Test procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Equipment designed for wall-mounted operation shall be tested as tabletop EUT. The orientation of the equipment shall be consistent with normal installation practice.
3. Electrical Fast Transient/Burst Immunity testing is placed on a wooden table in height of 0.8 meters with reference ground plane sheet and The ground plane shall extend beyond the clamp by a least 0.1 m on all sides.
4. The test generator and the coupling/decoupling network shall be placed directly on, and bonded to, the ground reference plane.
5. All cables to the EUT shall be placed on the insulation support 0.1 m above the ground reference plane. Cables not subject to electrical fast transients shall be routed as far as possible from the cable under test to minimize the coupling between the cables.
6. The minimum distance between the EUT and all other conductive structures, except the ground reference plane shall be more than 0.5 m, as well as coupling clamp.
7. If the manufacturer provides a non-detachable supply cable more than 0.5 m long with the equipment, the excess length of this cable shall be folded to avoid a flat coil and situated at a distance of 0.1 m above the ground reference plane.
8. Connect the EUT's power source to the AC power source through the coupling/decoupling network/clamp and perform the specified test level.
9. Record the performance of the EUT.

10.6 Test Specification

Test level	X,4, 3, 2,1(4kv,2kv,1kv,0.5kv)
Voltage peak	$\pm 4\text{kV(AC)}$ *; $\pm 4\text{kV(RS-232\&RJ-45)}$
Repetition frequency	5kHz
Wave shape of the pulse	Rise time $t_r = 5 \text{ ns} \pm 30 \%$;duration $t_d \text{ (to } 50 \%) = 50 \text{ ns} \pm 30 \%$
Burst duration	15 ms $\pm 20 \%$ at 5 kHz
Burst period	300 ms $\pm 20 \%$

Note:

1. "X" mean is special



10.7 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMC Test System	Teseq	NSG 3060	1366	2014/11/17	2015/11/16
CDN 3063	Teseq	CDN 3063	1992	2014/11/17	2015/11/16
CDN 3425	Teseq	NSG 3425	1682	N/A	N/A

Note: The above equipments are within the valid calibration period.

10.8 Requirement

Performance table

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance(Note1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance(Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance(Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance(Note 2)
<p>Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		



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10.9 Test Results

Temperature:	23	°C	Model No.:	RPI E5
Relative Humidity:	50	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

Coupling line	Voltage peak	Signal Line & Control Line (see Note 1)	Minimum requirement	Result	
Signal power port	±4 kV	RS-232&RJ-45	Criterion B	Criterion A	Pass
AC port	±4 kV	-	Criterion B	Criterion A	Pass

Note 1: Signal Line and Control Line were tested for: RS-485 ports and RJ45

Criteria description:

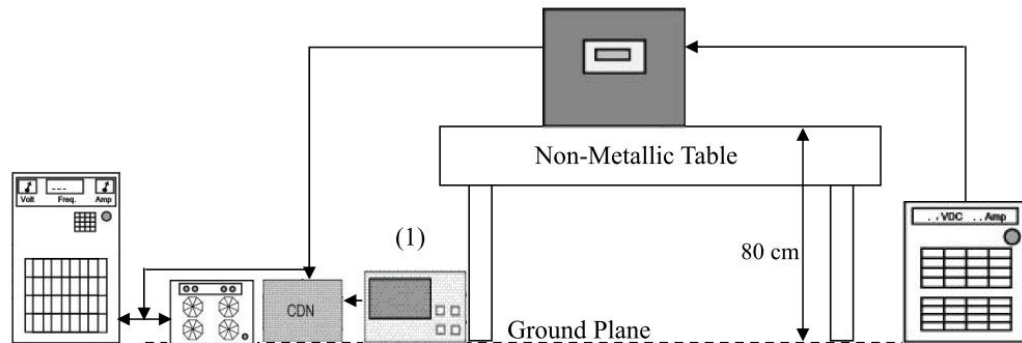
- Criterion A: ☒ Function is operated as intended during and after the test
☐
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.
☐
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.
☐



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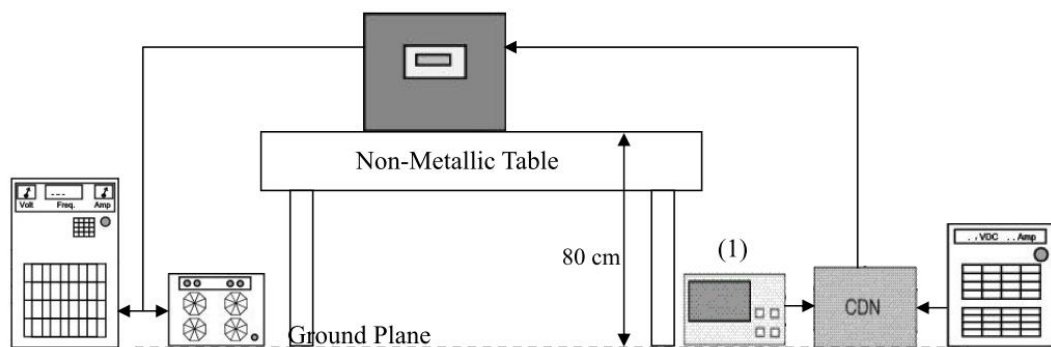
11. Surge Immunity Test

11.1 Test arrangement (AC side)



Note: (1) Surge Signal Generator

11.2 Test arrangement (DC side)

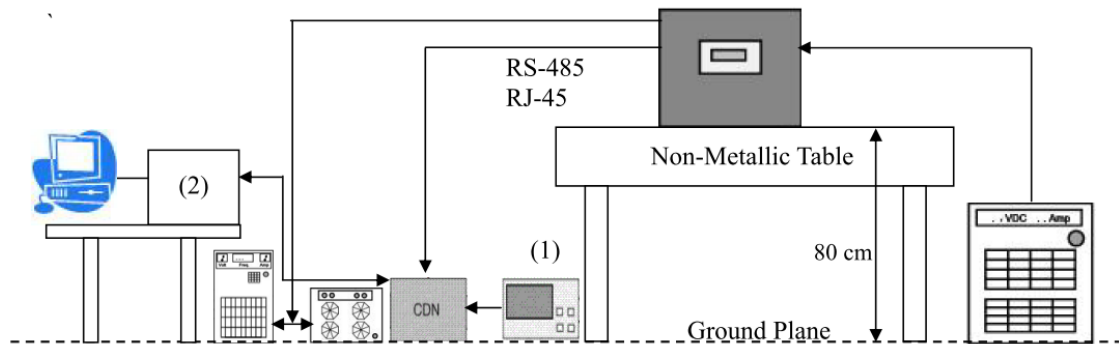


Note:(1) Surge Signal Generator

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11.3 Test arrangement (Signal port)



Note: (1) Surge Signal Generator
(2) RS232 to RS-485 Converter (if connected to RJ-45 port of EUT, it wouldn't use)

11.4 Photographs of the test arrangement

Please refer to the appendix B7 of the present report.

11.5 Test procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Surge Immunity testing is placed on a wooden table with a height of 0.8 meters.
3. The 1.2/50 us surge is to be applied to the EUT power supply terminals via the capacitive Coupling/decoupling network
4. If not otherwise specified the power cord between the EUT and the coupling/decoupling network shall not exceed 2 m in length.
5. All lower levels including the selected test level shall be satisfied.
6. Connect the EUT's power source to the AC power source through the coupling/decoupling network/clamp and perform the specified test level
7. Record the performance of the EUT.



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11.6 Test Specification

Test level	X,4,3, 2, 1,(4kv,2kv,1kv,0.5kv)
Open-circuit test voltage	±1 kV, ±2 kV, ±4 kV , ±6kV (AC Only); ±6 kV (DC Only) ±1 kV, ±2 kV , ±3 kV, ±4 kV (RS-232&R-J45)
Waveform(Tr/Th)	1.2/50us (open-circuit voltage)
Phase shifting(AC port only)	0°, 90°, 180°, 270° /Line, Neutral
Repetition rate	1 per minute, maximum
Number of surges	For d.c. power ports lines five positive and five negative surge pulses For a.c. power ports five positive and five negative pulses
Test port	AC & DC side & RS-232 & RJ45 Port

1. "X" mean is special

11.7 Test Equipment.

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMC Test System	Teseq	NSG 3060	1366	2014/11/17	2015/11/16
CDN 3063	Teseq	CDN 3063	1992	2014/11/17	2015/11/16
CDN 3425	Teseq	NSG 3425	1682	N/A	N/A

Note: The above equipments are within the valid calibration period.



11.8 Requirement

Performance table

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance(Note1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance(Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance(Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance(Note 2)
<p>Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		



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11.9 Test Results: Pass

11.9.1 Main power port

Phase	Line			
Temperature:	23	°C	Model No.:	RPI E5
Relative Humidity:	50	%	Test Date:	Dec. 05, 2014
Atmospheric Pressure:	1008	hPa	Remark:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

Test 5 times for each voltage

Open-circuit test voltage	Mode	Minimum requirement	Angle			
			0°	90°	180°	270°
±1 kV	L to N L to Gnd N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±2 kV	L to N L to Gnd N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L to N L to Gnd N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±6 kV	L to N L to Gnd N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A

Criteria description:

Criterion A: ☒ Function is operated as intended during and after the test

☐

Criterion B: ☐ Function is temporary degradation and operated as intended after the test.

☐

Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.

☐



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11.9.2 DC power port

Open-circuit test voltage	Mode	Minimum requirement	Result	Remark
±6 kV	+ to -	Criterion B	Criterion A	Power off
±6 kV	+ to Gnd	Criterion B	Criterion A	Power off
±6 kV	- to Gnd	Criterion B	Criterion A	Power off

Criteria description:

- Criterion A: ☒ Function is operated as intended during and after the test
☐
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.
☐
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.
☐

11.9.3 Signal port (RS232 port)

Phase		Result	Criteria Level	Remark
Volt	Mode			
+/- 1kV	Line to Ground	P	A	No connection
+/- 2kV	Line to Ground	P	A	No connection
+/- 3kV	Line to Ground	P	A	No connection
+/- 4kV	Line to Ground	P	A	No connection

Criteria description:

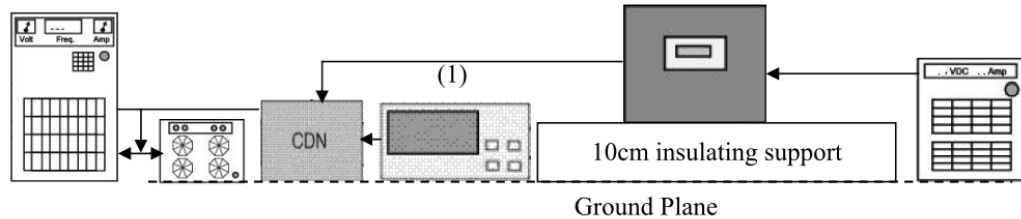
- Criterion A: ☒ Function is operated as intended during and after the test
☐
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.
☐
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.
☐

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12. Immunity to Conducted Disturbances, Inducted by Radio-Frequency Fields

12.1 Test arrangement



Note: (1) CS test system

12.2 Photographs of the test arrangement

Please refer to the appendix B8 of the present report.

12.3 Test procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Equipment designed for wall-mounted operation shall be tested as tabletop EUT. The orientation of the equipment shall be consistent with normal installation practice.
3. The equipment to be tested is placed on an insulating support of 0.1 m height above a ground reference plane. All cables exiting the EUT shall be supported at a height of at least 30 mm above the ground reference plane.
4. Where coupling and/or decoupling devices are required, they shall be located between 0.1 m and 0.3 m from the EUT. This distance is to be measured horizontally from the projection of the EUT on to the ground reference plane to the coupling and/or decoupling device.
5. The cable(s) between the AE and the decoupling network(s) or in between the AE and the injection clamp shall not be bundled nor wrapped and shall be kept between 30 mm and 50 mm above the ground reference plane.
6. Connect the EUT's power source to the AC power source through the clamp and perform the specified test level in the test frequency range with the specified modulation type.
7. The dwell time of the amplitude modulated carrier at each frequency shall not be less than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0.5 s.
8. Record the performance of the EUT.



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12.4 Test Specification

Test level	3
Voltage level (e.m.f.)	10Vrms
Frequency range	150 kHz – 80 MHz
Frequency Step	1%, Log sweep
Modulation	1kHz Sine Wave with 80% Amplitude Modulation
Dwell Time	3 sec
Test port	AC side

12.5 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
RF-Synthesizer/ Amplifier	SCHAFFNER	NSG 2070	1119	2014/11/07	2015/11/06
Mainsnetwork	COMTEST	4413-016	9818	2014/11/11	2015/11/10
Coupling And Decoupling Network	Schaffner	CDN M016	21272	2014/05/12	2015/05/11

Note: The above equipments are within the valid calibration period.



12.6 Requirement

Performance table

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance(Note1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance(Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance(Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance(Note 2)
<p>Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		

12.7 Generation and Calibration of the Disturbance Signal

The disturbance signal is generated from a computer controlled signal generator. The output signal is amplified and injected to the CDN/injection clamp. The disturbance signal level was calibrated as specified in the standard. A power meter was connected to the EUT side of the CDN through a 150 -50Ω adapter. The auxiliary equipment (AE) side of the network was terminated with 150Ω to ground during the calibration. The generator settings obtained during the calibration procedure were later repeated in the tests.



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12.8 Test Results: Pass

Temperature:	23	°C	Model No.:	RPI E5
Relative Humidity:	50	%	Test Date:	Dec. 03, 2014
Atmospheric Pressure:	1008	hPa	Remark:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

Measurement at power port:

Frequency range	Minimum requirement	Result	
0.15 MHz to 80 MHz	Criterion A	Criterion A	Pass

Measurement at signal port:

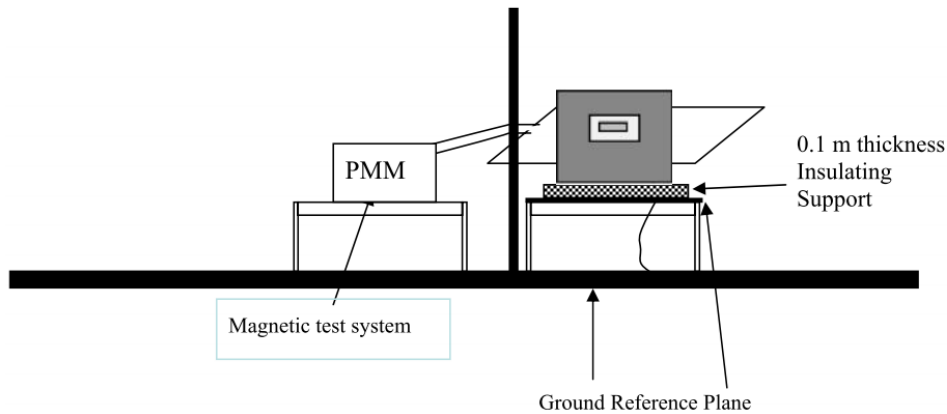
Frequency	Test Port	Result	Remark
0.15 MHz to 80 MHz	RS-232 port	PASS	Criterion A

Criteria description:

- Criterion A: ☒ Function is operated as intended during and after the test
☐ _____
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.
☐ _____
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.
☐ _____

13. Power Frequency Magnetic Field Immunity Test

13.1 Test arrangement



13.2 Photographs of the test arrangement

Please refer to the appendix B9 of the present report.

13.3 Test procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Power Frequency Magnetic Field Immunity testing is placed on a 0.1 m thickness insulating support wooden table with a height of 0.8 meters.
3. The inductive coil of standard dimensions with square form in 1 m side is used and shall put the EUT placed at its center.
4. The Magnetic Field generator shall be placed at twisted cable length maximum 2 m from the induction coil.
5. All cables shall be exposed to the magnetic field for 1 m of their length.
6. The power frequency magnetic field value of the testing environment shall be at least 20 dB lower than the selected test level.
7. Then adjust the currents of the test generator, using the Gauss Meter to calibrate the specified test level at the center of the induction coil.
8. The plane of the inductive coil shall then be rotated by 90° in order to expose the EUT to the test field with different orientations.
9. Record the performance of the EUT.



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13.4 Test Specification

Test level	4
Magnetic field strength A/m	30
Power frequencies	50Hz
Test duration	1 minute
Magnetic Field Orientation	X, Y, Z-axis
Test port	Enclosure

13.5 Test Equipment.

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Magnetic test system	PMM	PMM1008	000J90601	2014/12/02	2016/11/30

Note: The above equipments are within the valid calibration period.



13.6 Requirement

Performance table

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance(Note1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance(Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance(Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance(Note 2)
<p>Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		



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13.7 Test Result: Pass

Temperature:	29	°C	Model No.:	RPI E5
Relative Humidity:	50	%	Test Date:	Dec. 04, 2014
Atmospheric Pressure:	1008	hPa	Remark:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

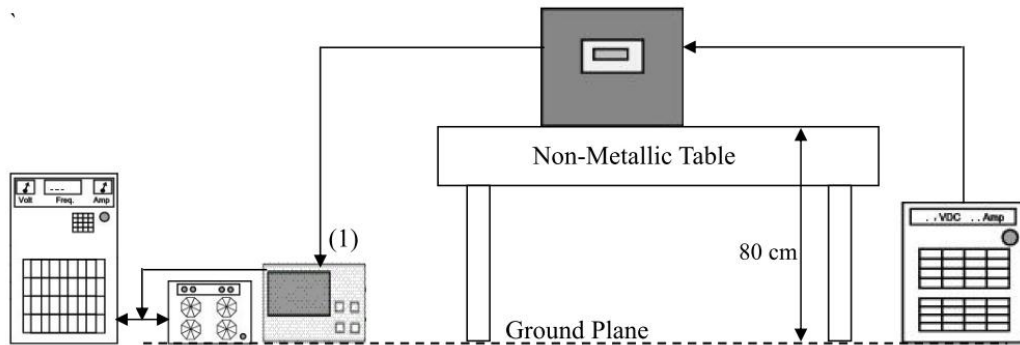
Magnetic Field Orientation	Magnetic field strength A/m	Minimum requirement	Result	
X	30	Criterion A	Criterion A	Pass
Y	30	Criterion A	Criterion A	Pass
Z	30	Criterion A	Criterion A	Pass

Criteria description:

- Criterion A: ☒ Function is operated as intended during and after the test
☐ _____
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.
☐ _____
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.
☐ _____

14. Voltage Dips, Short Interruptions and Voltage Variations Immunity Test

14.1 Test arrangement



Note: (1) Voltage Dip Tester

14.2 Photographs of the test arrangement

Please refer to the appendix B10 of the present report.

14.3 Test procedure

1. The EUT is set up per the test arrangement and simulate the typical usage based on the user's manual.
2. Voltage Dips testing is placed on a wooden table with a height of 0.8 meters.
3. If no cable length is specified, it shall be the shortest possible length suitable to the application of the EUT.
4. During the tests, the mains voltage for testing shall be monitored within an accuracy of 2 %.
5. The EUT shall be tested for each selected combination of test level and duration with a sequence of three dips/interruptions with intervals of 10 s minimum (between each test event). Each representative mode of operation shall be tested.
6. For voltage dips, changes in supply voltage shall occur at zero crossings of the voltage, and at additional angles considered critical by product committees or individual product specifications preferably selected from 45°, 90°, 135°, 180°, 225°, 270° and 315° on each phase.
7. Connect the EUT's power source to the appropriate power through the test generator and perform the specified test level.
8. Record the performance of the EUT.



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14.4 Test Specification

Voltage dips & short interruptions

Test level	3
Time at reduced voltage	0% residual voltage dips with 0.5, 1 cycle 40% residual voltage dips with 10/12 cycles 0% residual voltage dips with 1 cycle 70% residual voltage dips with 25/30 cycles 0 % during 250/300 cycles
Rated voltage	230V/50Hz
Time interval	10 s minimum (between each test event)
Test Duration	A sequence of three dips/interruptions
Phase Angle	45°, 90°, 135°, 180°, 225°, 270° and 315°
Test port	AC side

14.5 Test Equipment.

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Advanced EMC Immunity Test System	Keytek	EMC Pro	9807103	2014/11/27	2015/11/26

Note: The above equipments are within the valid calibration period.



14.6 Requirement

Performance table

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance(Note1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance(Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance(Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance(Note 2)
<p>Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.</p> <p>If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		



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14.7 Test Result: Pass

Phase	Line			
Temperature:	23	°C	Model No.:	RPI E5
Relative Humidity:	50	%	Test Date:	Dec. 04, 2014
Atmospheric Pressure:	1008	hPa	Remark:	1-Phase/5-Wire(L Grid, N Grid, PE, L Load, N Load)

Voltage Dips for EN 61000-6-2: 2005

Test level (% residual voltage)	cycle	Minimum requirement	Result	
0	1	Criterion B	Criterion A	Pass
40	10	Criterion C	Criterion A	Pass
70	25	Criterion C	Criterion A	Pass

Voltage Interruption

Test level (% residual voltage)	cycle	Minimum requirement	Result	
0	250	Criterion C	Criterion A	Pass

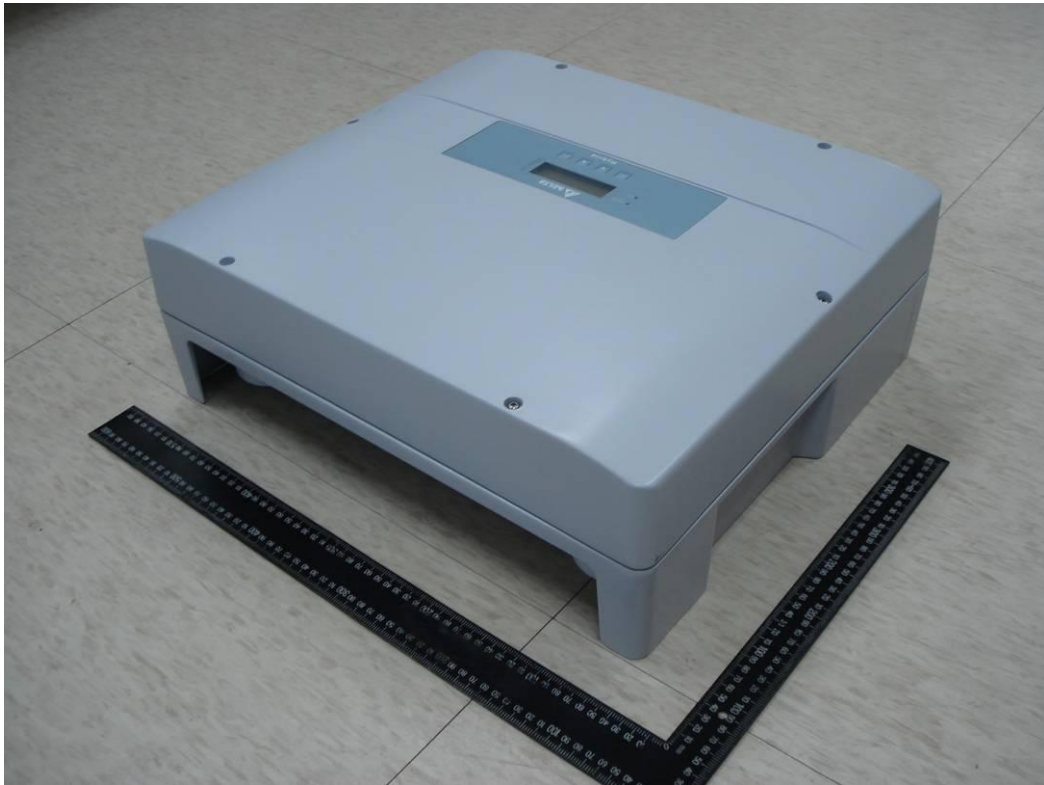
Criteria description:

- Criterion A: ☒ Function is operated as intended during and after the test
☐ _____
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.
☐ _____
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.
☐ _____

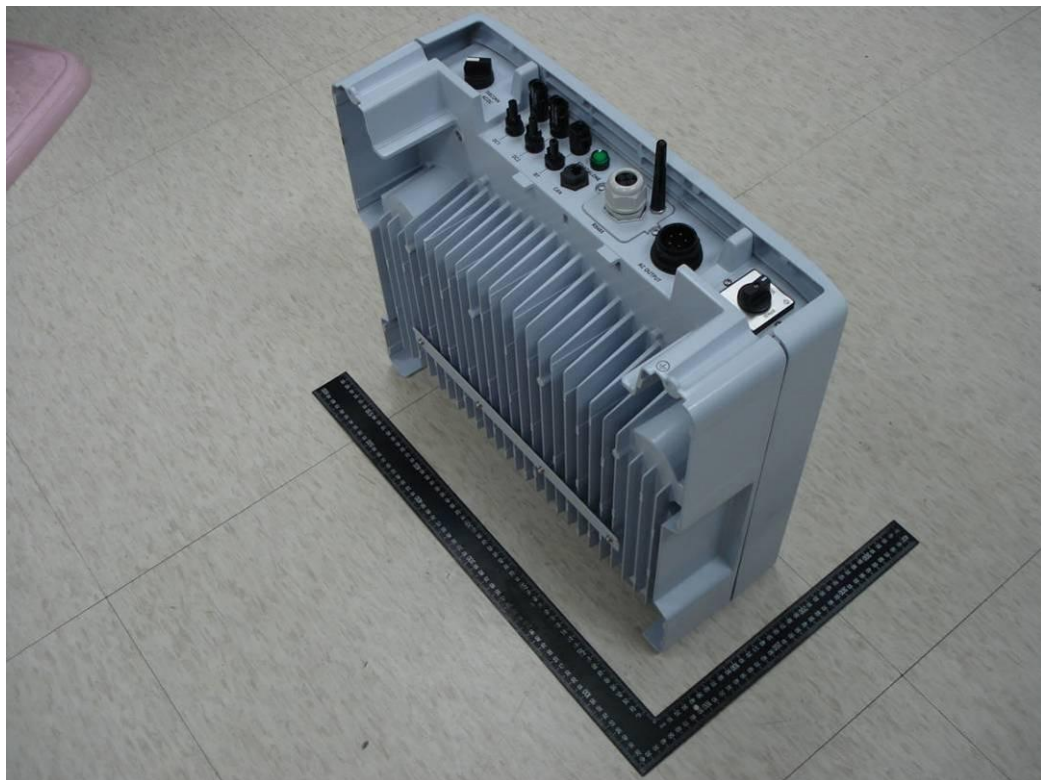
Annex 2

Pictures of the unit

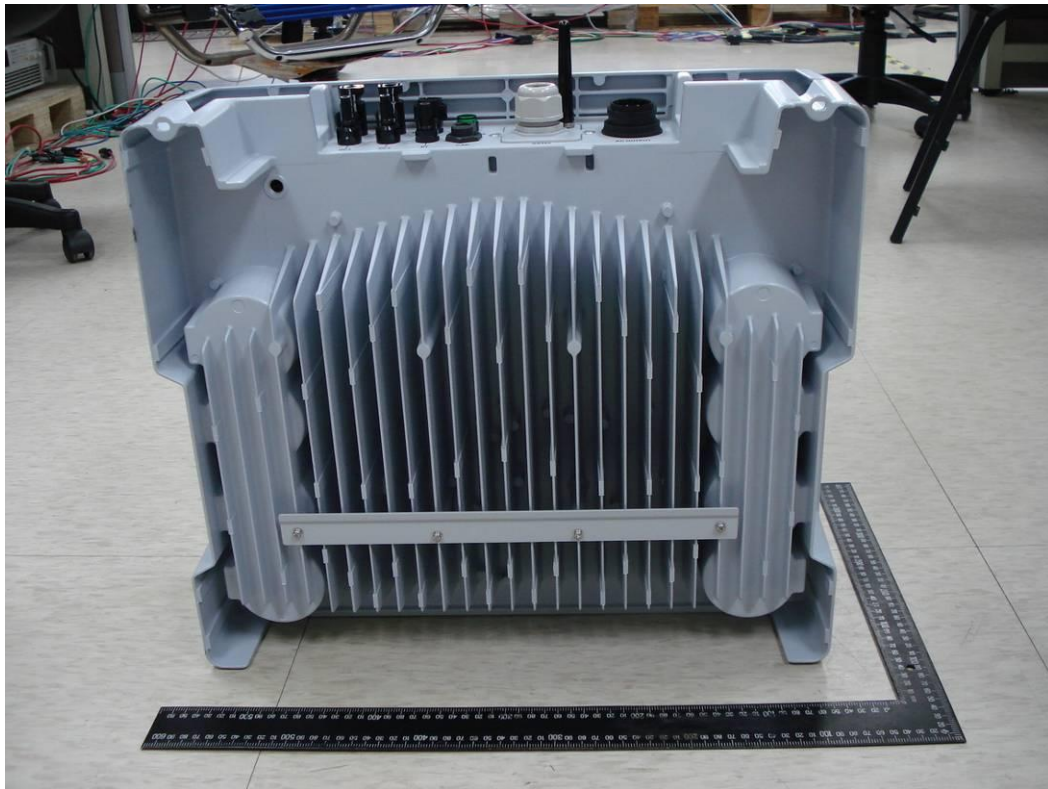
Inverter Enclosure



Enclosure



Enclosure Rear



Enclosure bottom



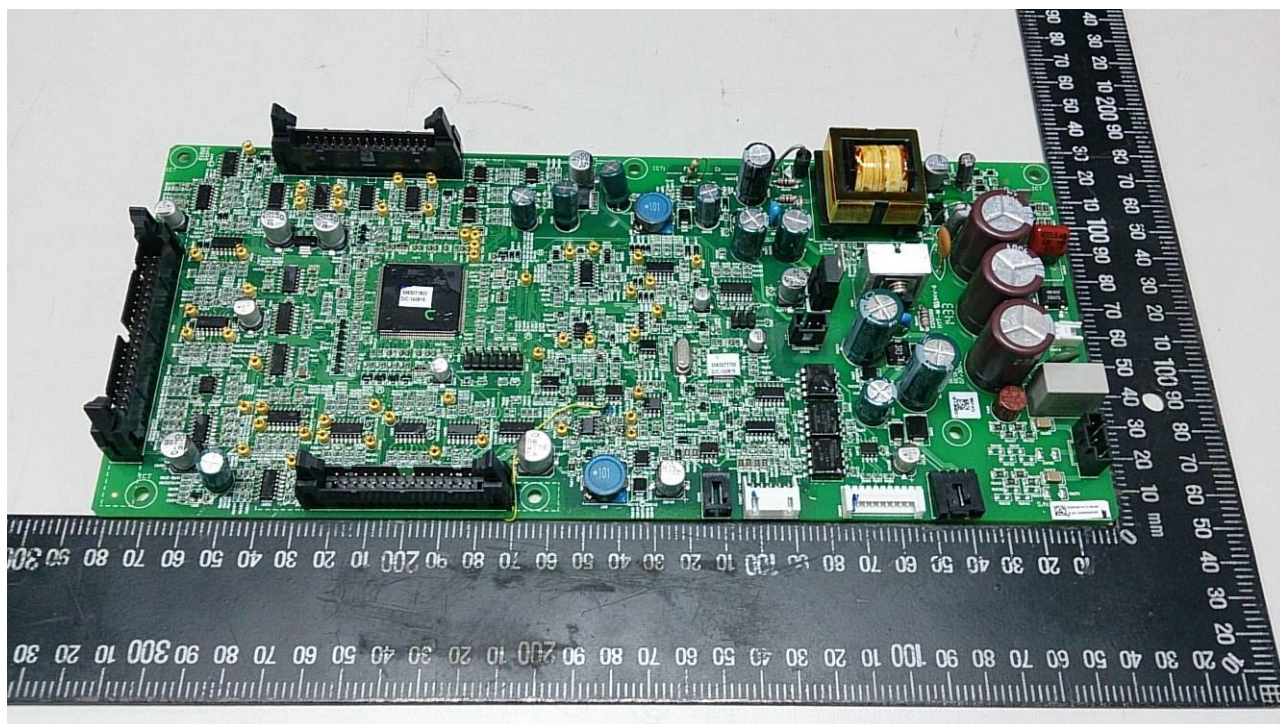
Interior view



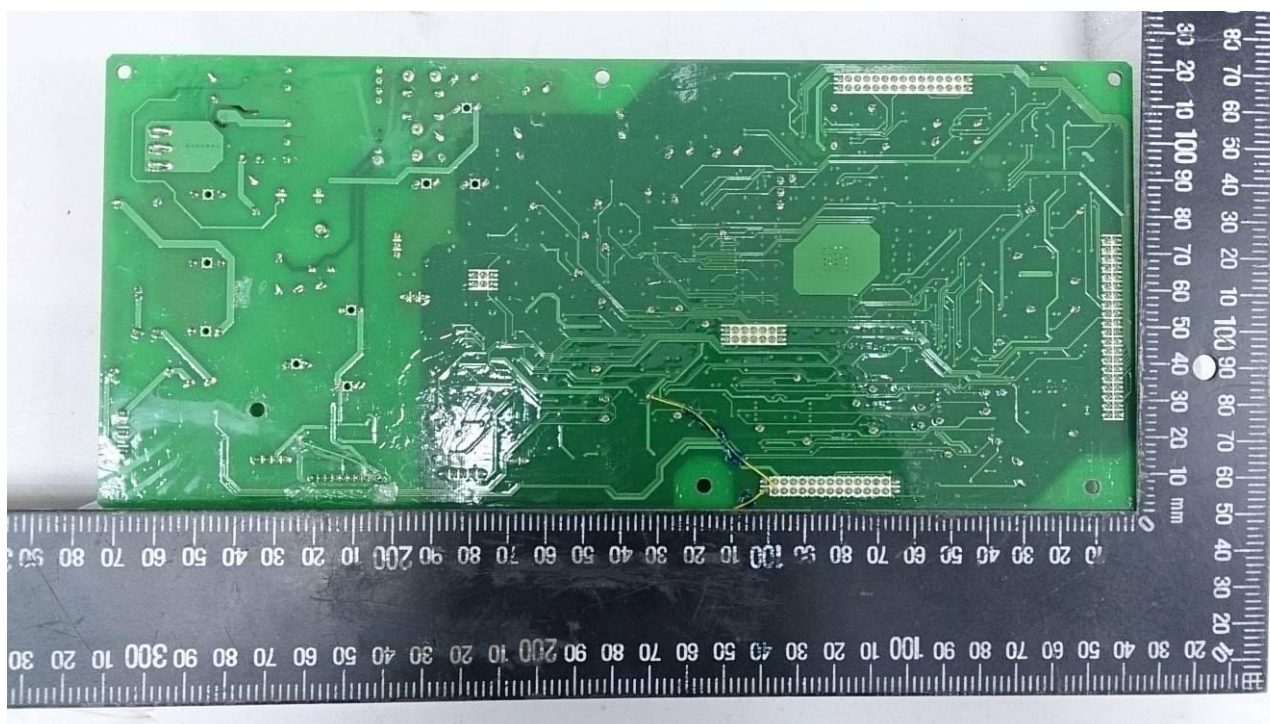
Interior view



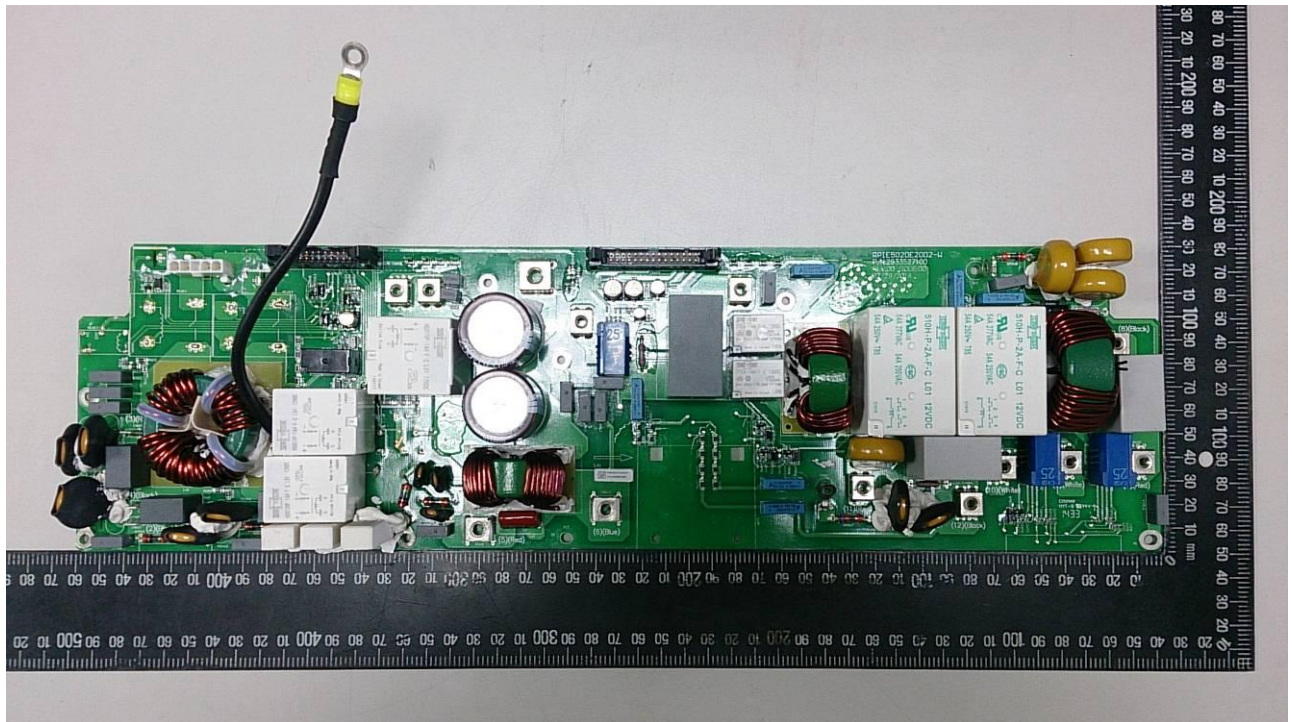
Control Board_component side view



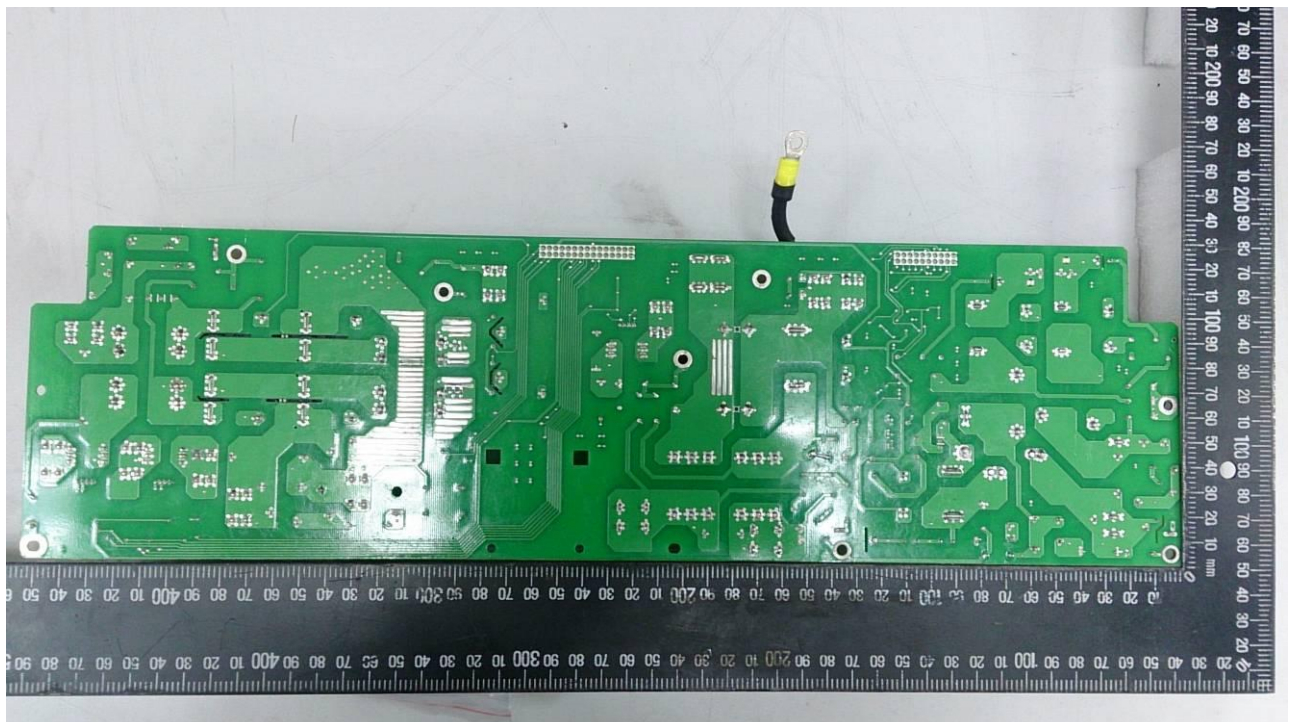
Control Board_Solder side view



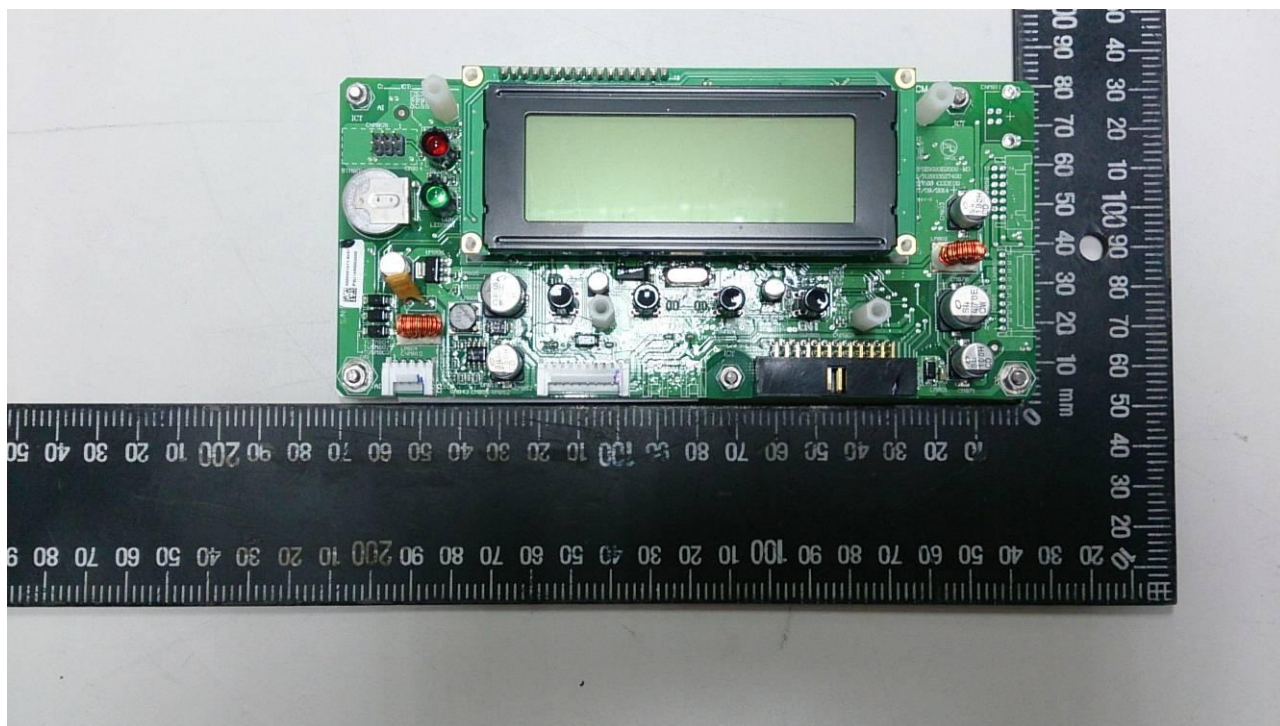
DC Input / AC Output Board _component side view



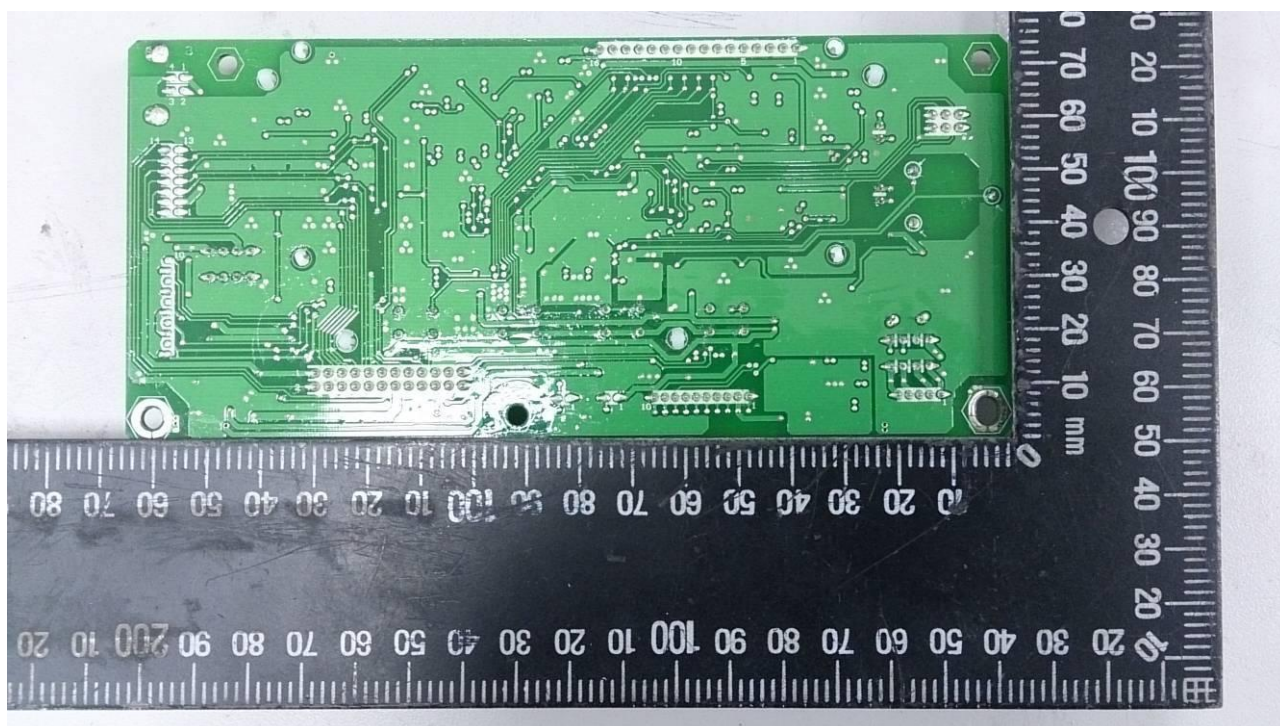
DC Input / AC Output Board _Solder side view



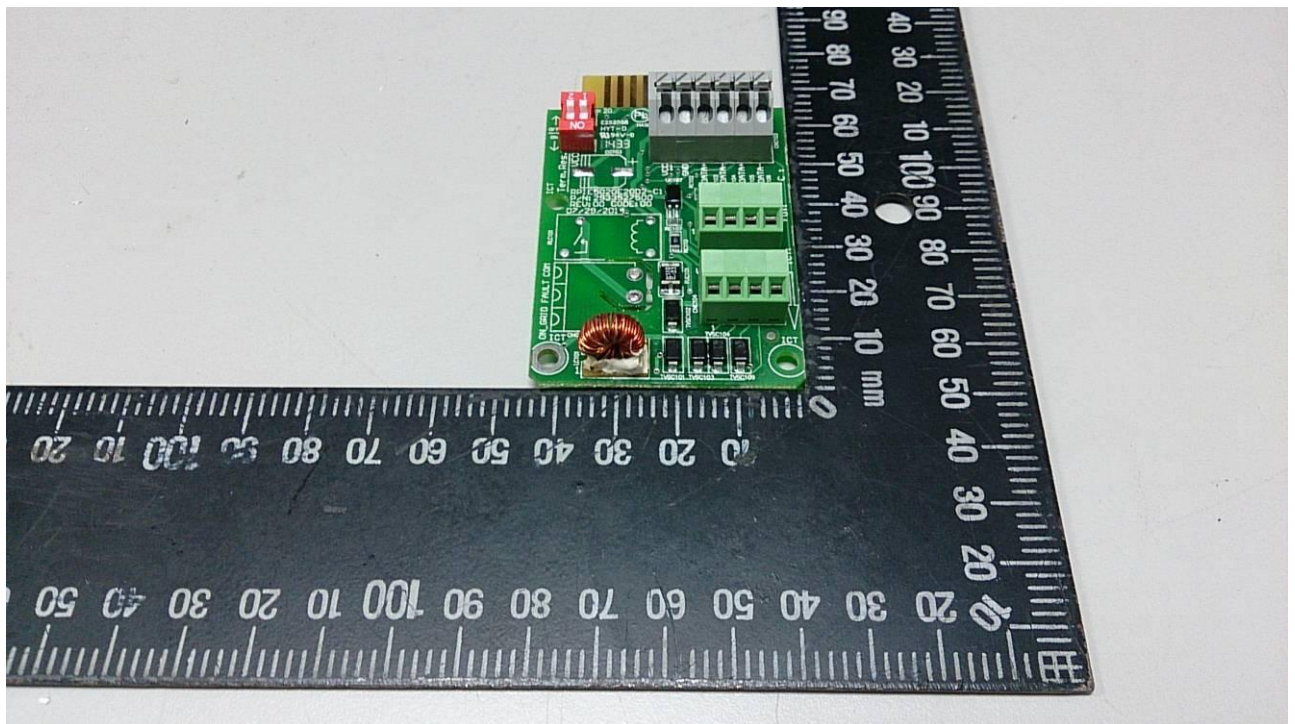
LCD Display Board_component side view



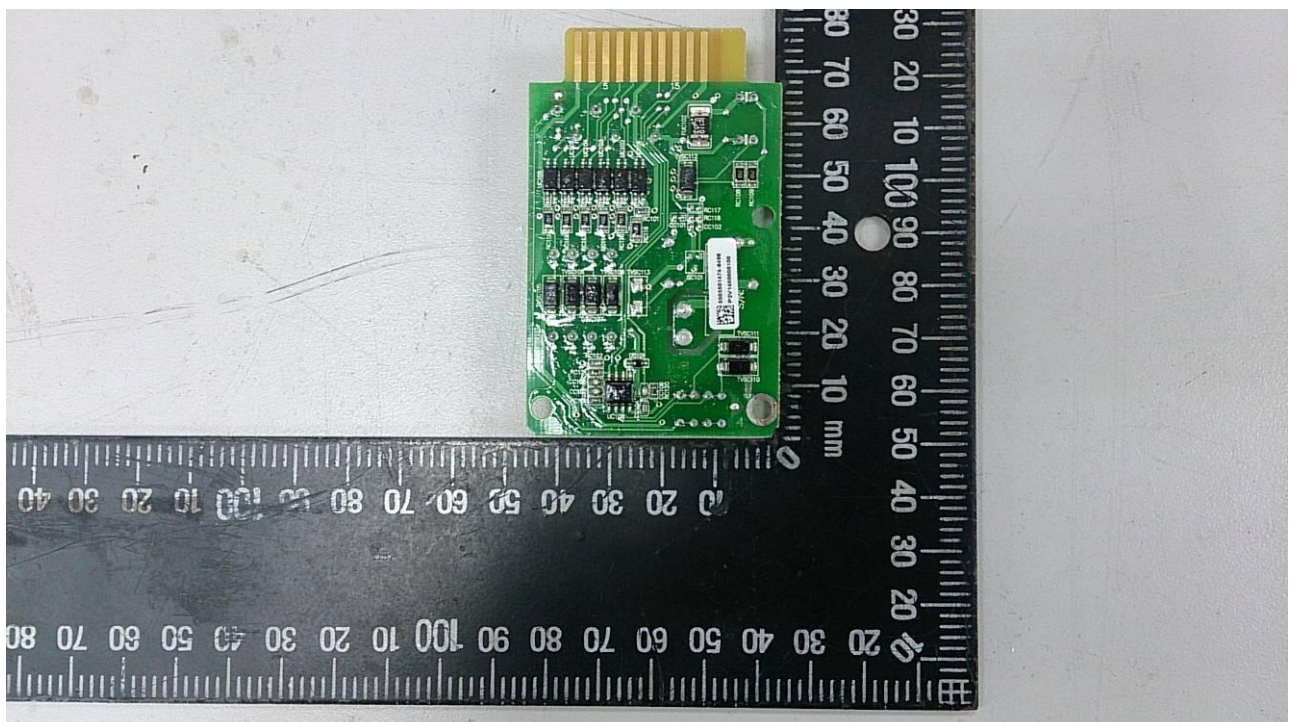
LCD Display driver Board_Solder side view



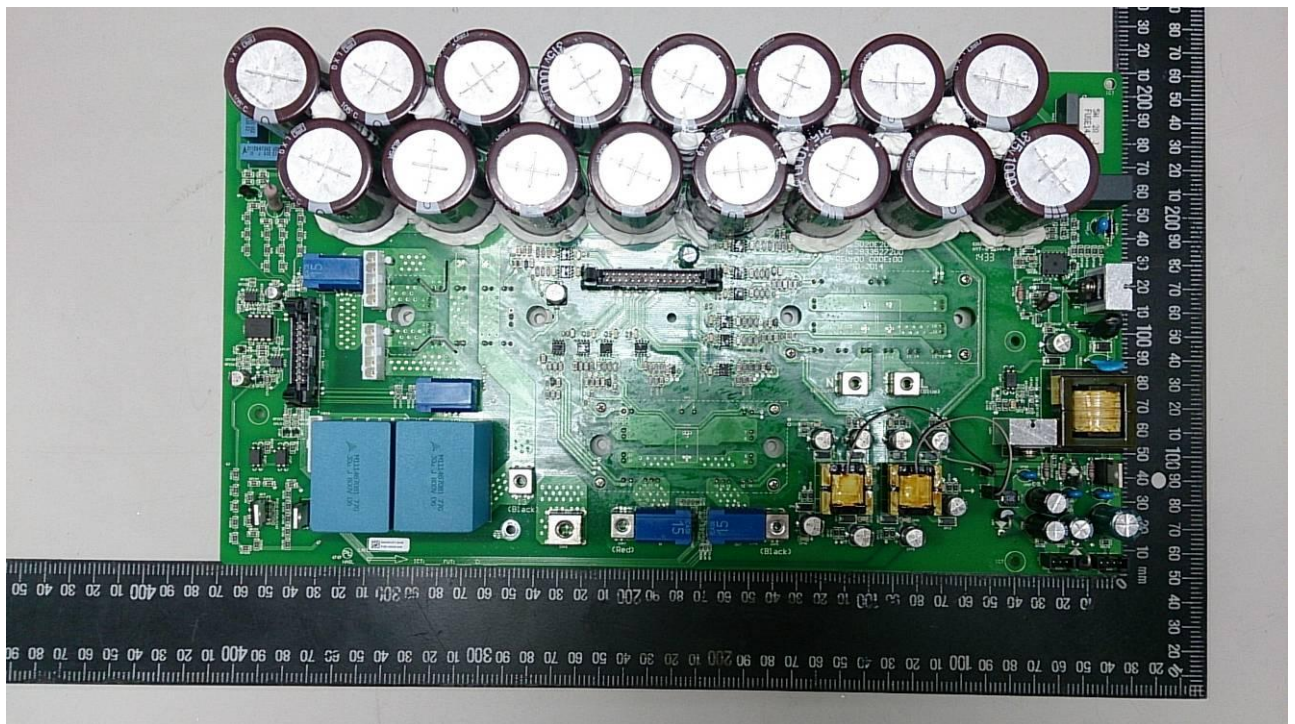
Communication Board_component side view



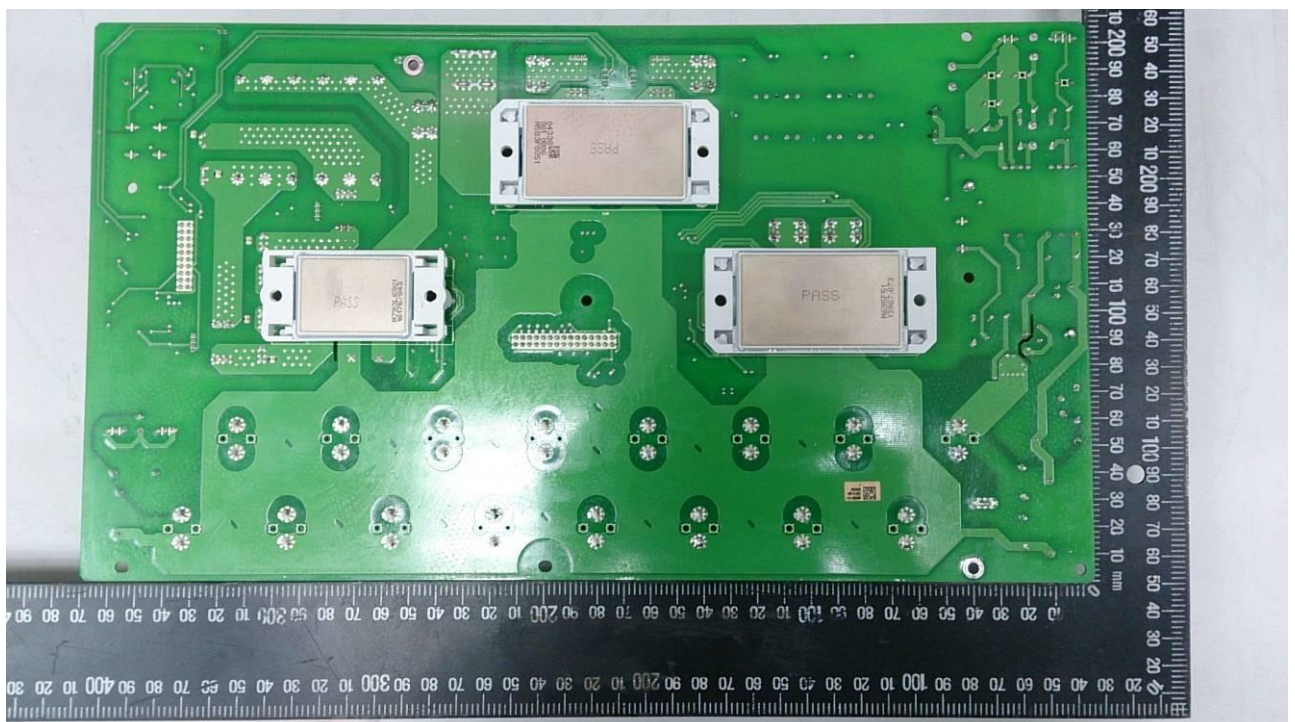
Communication Board_Solder side view



Boost / Inverter Board_component side view



Boost / Inverter Board_Solder side view



Annex 3

Test equipment list

Testing Location: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

Date(s) of performance test: 2016-07-15 to 2016-09-01

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Thermo-Hygro Grapg	50	Isuzs	3-3122	70860282	2015-11-10
LCR Meter	137	Motech	MT4090/I-S1	40905090004	2016-01-22
Digital Oscilloscope	158	LECROY	WS-44XS	LCRY0310M22703	2016-05-25
Programable DC Source	183	Chroma	62150H-1000S	62150EF00169	Monitor by Power Analyzer
Power Analyzer	215	YOKOGAWA	WT3000	91M534527	2016-06-01
SCOPE CORDER	216	YOKOGAWA	DL850	91M534532	2016-02-03
Programable AC Source	217	Chroma	61512	615120000263	Monitor by Power Analyzer
Programable DC Source	218	CHROMA	62150H-1000S	62150EF00455	
Current Sensor	219	YOKOGAWA	CT200	9121070097	2016-06-01
Atmospheric pressure gauge	226	TESTO	TESTO 511	39108378	2016-06-08