




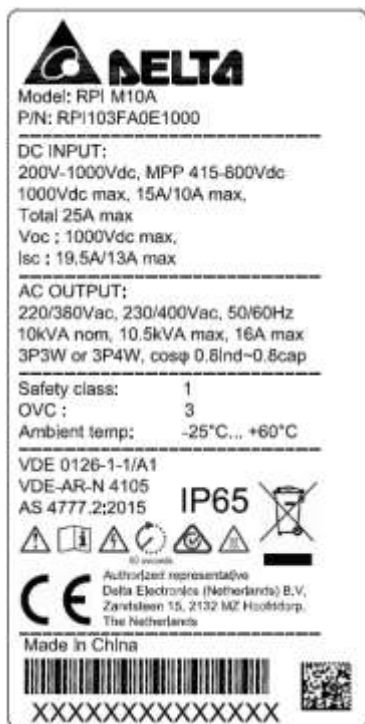


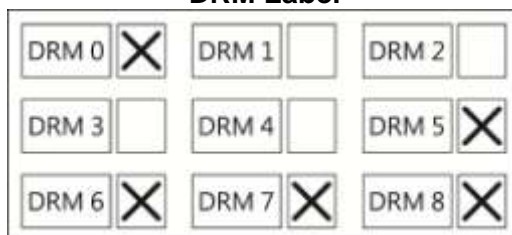
<b>Test Report No.: PVAU160613C33B</b>	
<b>Client</b>	
Name :	<b>Delta Electronics, Inc.</b>
Address :	39, Sec.2, Huandong Road, Shanhua Dist., Tainan City 74144, Taiwan
<b>Test Item :</b>	<b>Grid-tied photovoltaic inverter</b>
<b>Identification :</b>	RPI M6A, RPI M8A, RPI M10A
<b>Testing laboratory</b>	
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
<b>Test specification</b>	
<b>Standard :</b>	<b>AS/NZS 4777.2:2015</b>
<b>Test Result :</b>	<b>The test item passed.</b>
<b>Prepared By :</b>	
	2017-03-03
Signature	Date
Issac Chen	
Senior Engineer	
<b>Approved By:</b>	
	2017-03-03
Signature	Date
Edward Chiueh	
Technical Manager	
<b>Other Aspects:</b>	
The completed test report includes the following documents: AS 4777.2:2015 report (164 pages)	
 	
<p>This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification</p>	

TEST REPORT			
AS/NZS 4777.2:2015			
Grid connection of energy systems via inverters – Part 2: Inverter requirements			
Report reference No. ....	PVAU160613C33B		
Tested by (printed name and signature) .....	See cover sheet		
Approved by (printed name and signature) .....	See cover sheet		
Date of issue .....	2017-03-03		
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, Kueishan Taoyuan, Taiwan.		
Applicant's Name .....	Delta Electronics, Inc.		
Address .....	39, Sec.2, Huandong Road, Shanhua Dist., Tainan City 74144, Taiwan		
<b>Test specification</b>			
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 .....	Grid-tied photovoltaic inverter		
Trademark .....			
Model / Type .....	RPI M6A, RPI M8A, RPI M10A		
Ratings .....	RPI M6A	RPI M8A	RPI M10A
MPP DC voltage range [V] .....	315-800Vdc	415-800Vdc	
Input DC voltage range [V] .....	200-1000Vdc		
Input DC current [A] .....	10A x 2 strings		15A / 10A
Output AC voltage [V] .....	230/400Vac, 3P4W, 50Hz		
Output AC current [A] .....	9,7A max.	13A max.	16A max.
Nominal Output power [kVA] .....	6kVA	8,0kVA	10,0kVA
Maximum Output power [kVA] .....	6,3kVA	8,4kVA	10,5kVA

**Copy of marking plate:**



**DRM Label**



**History Sheet:**

Name	Date	Comment	Revision
Issac Chen	2017-02-14	Initial report was written	Rev. 0
Issac Chen	2017-02-24	Add line-line transient measurements in this report.	A
Issac Chen	2017-03-03	Re-test L-N transient voltage test	B

**Supplementary information:**

**Address of the manufacturer sites:**

**Delta Electronics (Jiang Su), Ltd.**

No. 1688, Jiangxing East Rd., Wujiang Economic Development Zone,  
Wujiang City, Jiang Su Province, 215200,  
P.R. China

<b>Particulars:</b>	
Equipment mobility .....	Permanent connection
Operating condition.....	Continuous
Class of equipment .....	Class I
Protection against ingress of water .....	IP65 according to EN 60529
<b>Test case verdicts:</b>	
Test case does not apply to the test object .....	<b>N/A</b>
Test item does meet the requirement .....	<b>P(ass)</b>
Test item does not meet the requirement .....	<b>F(ail)</b>
<b>Testing:</b>	
Date of receipt of test item .....	2016-09-02
Date(s) of performance of test .....	2016-09-03 till 2017-03-03
<p><b>General remarks:</b></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.  "(see Annex #)" refers to additional information appended to the report.  "(see appended table)" refers to a table appended to the report.  Throughout this report a comma is used as the decimal separator.</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><b>This Test Report consists of the following documents:</b></p> <ol style="list-style-type: none"> <li>1. Test Results</li> <li>2. Annex No. 1 – EMC Test Report</li> <li>3. Annex No. 2 – Pictures of the unit</li> <li>4. Annex No. 3 – Test equipment list</li> </ol>	

### General product information:

The Solar converter converts DC voltage into AC voltage.

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 in series. This assures that the opening of the output circuit will also operate in case of one error.

### Description of the electrical circuit:

The internal control is redundant built. It consists one DSP (Digital Signal Processor) and one MCU (Micro Control Unit), the master DSP (UM1) which can control one 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 slave MCU (UM9) measures the grid voltage, frequency and RCMU. Both DSP can open relays and communicate with each other.

The Slave MCU (UM9) is used for detecting the grid voltage and current, it also can open the relays independently and communicate with Master controller each other.

The unit provides to relays in series in each phase. The relays are tested before each start up. Both CPU can switch of the relays.

The grid voltage is measured between phase L1 and L2 and between phase L2 and L3 before the relays and after the relays. The voltage between phase L1 and L3 is calculated. The voltage signals are sent to both CPU. In addition this signal is used for the frequency measurement.

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.

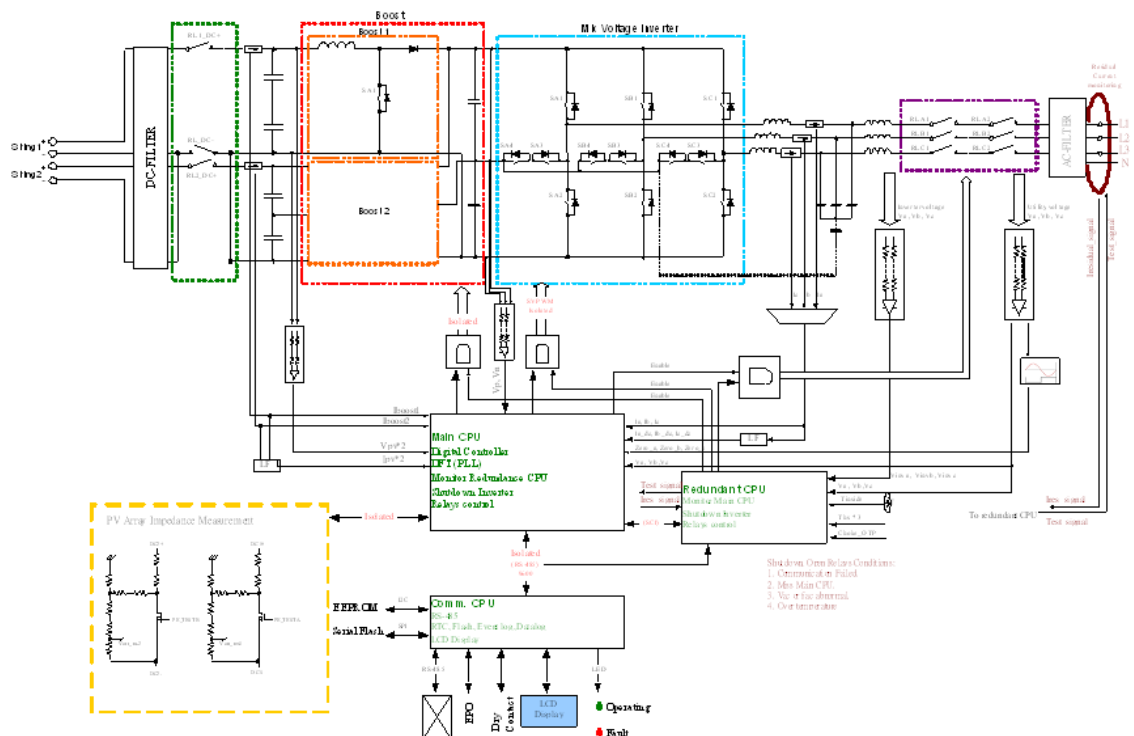


Figure 1 – Block diagram

**Differences of the models:**

The RPI M10A and RPI M8A are completely identical in software and hardware, except the boost/inverter choke, model description and rating. The RPI M8A and RPI M6A are completely identical in software and hardware, except the model description and rating.

**The product was tested on**

Hardware: MP

Software:

DSP: 1.40

RED: 1.15

COMM: 1.20

**Test condition:**

Temperature: 25°C

Relative humidity: 60%

Air pressure: 980 mba

AS/NZS 4777.2 – 2015			
Clause	Requirement – Test	Result - Remark	Verdict
<b>5</b>	<b>GENERAL REQUIREMENTS</b>		<b>P</b>
5.1	Electrical safety	See below.	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.	The inverters meet the requirements of IEC 62109-1 and IEC 62109-2. Details see Report LD141114C15B.	P
	Inverters for use in inverter energy systems that have energy storage (batteries) as the only possible energy source shall comply with the electrical safety requirements of AS 62040.1.1, and the requirements within this Standard.	No energy storage exist.	N/A
	Inverters for use in inverter energy systems that incorporate energy sources other than photovoltaic (PV) arrays or batteries shall comply with the applicable electrical safety requirements of IEC 62109-1 and IEC 62109-2, and the requirements within this Standard.	No energy storage exist.	N/A
5.2	Provision for external connections		P
	Inverters shall be used and installed as fixed equipment only.	Fixed equipment and permanent connection.	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.	Certified connectors are provided for DC input and AC output connections.	P
	All inverter ports (except communications ports) shall incorporate connection types for either -	See below.	P
	(i) permanently connected equipment; or		P
	(ii) pluggable type B equipment.	No such parts.	N/A
	Inverter source or load connections shall not incorporate connection types for pluggable type A equipment.	No connection for pluggable type A.	P
	Permanently connected inverters shall have suitable terminals for connection to fixed installation wiring.	Suitable terminals used.	P
	Pluggable type B equipment shall have one of the following means of connection:	See below.	N/A
	(A) A non-detachable cord for connection to the supply by means of a connector.	Permanent connection.	N/A
	(B) An appliance inlet suitable for	No such parts.	N/A

	connection to a matching connector.		
	Pluggable type B equipment shall not incorporate -	See below.	N/A
	(1) a connection by a connector or inlet complying with any of the dimensional sheets of AS/NZS 60320.1;	No such parts.	N/A
	(2) a connection by a plug conforming to AS/NZS 3112; or	No such parts.	N/A
	(3) a connection by a connector or inlet where hazardous voltages are accessible by the standard test finger.	No such parts.	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.	The PV array earth fault detection and residual current detection are declared in IEC 62109-1 and IEC 62109-2. Details see report LD141114C15B.	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.	Internal RCM used.	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.	N/A
	(a) open circuit the functional earth connection to the PV array;	No functional earth for PV array.	N/A
	(b) measure the resistance to earth of each conductor of the PV array;	No functional earth for PV array.	N/A
	(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	No functional earth for PV array.	N/A
	(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.	No functional earth for PV array.	N/A
5.4	Compatibility with electrical installation	See below.	P
	The inverter shall be compatible with wiring practices for LV electrical installations of AS/NZS 3000 and variations as required in AS/NZS 4777.1. The inverter a.c. voltage and frequency operation shall comply with the limits	Considered.	P

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

<b>6</b>	<b>OPERATIONAL MODES AND MULTIPLE MODE INVERTERS</b>		<b>P</b>
6.1	General		P
	Unless otherwise stated, the modes in the following Clauses are for the grid-interactive port of the inverter.	See below.	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.	The inverter support the demand response mode DRM 0, DRM 5, DRM 6, DRM 7 and DRM 8.	P
	The inverter shall detect and initiate a response to all supported demand response commands within 2 s. The inverter shall continue to respond while the mode remains asserted.	See appendix table.	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.	Terminal block used for supporting the DRMs function.	P
	The terminal block or RJ45 socket shall comply with the minimum electrical specifications in Table 6.	Terminal block used for supporting the DRMs function.	P
	The DRED asserts demand response modes by shorting together terminals or pins as specified in Table 7.	Terminal block used for supporting the DRMs function.	P
6.3	Inverter power quality response modes		P
6.3.1	General		P
	The inverter may have the capability of operating in modes which will -	See below.	P
	(a) contribute to maintaining the power quality at the point of connection with the customer installation; or	Considered.	P
	(b) provide characteristics which are outside the typical operation of an inverter for the purpose of providing support to a grid.	Considered.	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.	Considered.	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.	See 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.	The inverter has volt-watt response mode. And the function is enabled by default.	P
	The response curve required for the volt-watt response mode is defined by the volt response reference values in Table 9 and corresponding power levels. The default values are listed in Table 10 and example response modes are shown in Figure 2(A) for Australia and Figure 2(B) for New Zealand.	See appendix table.	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.	The inverter has volt-var response mode. And the function is disabled by default.	P
	The response curve required for the volt-var response is defined by the volt response reference values specified in Table 9 and corresponding var levels. The default values are listed in Table 11 and shown in Figure 3.	See appendix table.	P
6.3.2.4	Voltage balance modes		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.	No Voltage balance modes.	N/A
	If the voltage balance mode is available, the following requirements apply:	see below.	N/A
	(a) The voltage balance mode shall be disabled by default.	No Voltage balance modes.	N/A
	(b) For single-phase inverters used in a three-phase combination, the requirements of Clause 8.2 apply.	Three phase inverters.	N/A
	(c) The voltage balancing mode shall be able to -	No Voltage balance modes.	N/A
	(i) operate correctly with a single fault applied;		N/A
	(ii) detect the fault or loss of operability		N/A

	and cause the inverter to revert to injecting current into the three-phase electrical installation as a three-phase balanced current; or		
	(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.	The mode is disabled by default.	P
	If the inverter is capable of operating with reactive power mode, the maximum ratio of reactive power (vars) to rated apparent power should be 100%.	See appendix table.	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
	If this mode is available, it shall be disabled by default.	The mode is disabled by default.	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.	Considered.	P
	The inverter shall have the capability to rate limit changes in power generation through the grid-interactive port.	Considered.	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).	Not multiple mode inverters.	N/A
	The power rate limit does not apply when the inverter disconnection device is required to operate (i.e. to disconnect).	Considered.	P
6.3.5.2	Gradient of power rate limit	See below.	P
	The default setting for the power rate limit (WGra) for increase and decrease shall be 16.67% of rated power per minute which is a nominal ramp time of 6 min.	Considered.	P
	The power rate limit (WGra) shall be adjustable within the range 5% to 100% of rated power per minute.	The power rate limit (Wgra) is adjustable within 5% to 100% of rated power per minute.	P

	It is acceptable to have two separate power rate limits for increase and decrease in output power, as follows:	Only one power rate limit setting.	N/A
	(a) To rate limit an increase in power (WGr+).		N/A
	(b) To rate limit a decrease in power (WGr-).		N/A
6.3.5.3	Power rate limit modes		P
6.3.5.3.1	General		P
	The inverter power rate limit (WGr) is applicable to operate in the following modes:	see below.	P
6.3.5.3.2	Soft ramp up after connect or reconnect		P
	All inverters shall have this mode. This mode shall be enabled as per Clause 7.7 and for the increase in power required by Clause 7.5.3 after frequency decreased to the required limit.	See appendix table.	P
6.3.5.3.3	Changes in a.c. operation and control		P
	If available, this mode shall be enabled for a change in a demand response mode of Clause 6.2 (except for DRM 0).	The inverter support the demand response mode DRM 0, DRM 5, DRM 6, DRM 7 and DRM 8.	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.	N/A
	This mode only applies to multiple mode inverters with energy storage. It operates when there is a change in the energy resource available to the inverter, which causes a change in output through the grid-interactive port.	No energy source.	N/A
	For this mode the power rate limit (WGr) should apply to the increase or decrease in power generation or consumption, and to the transitions between power output levels.	No energy source.	N/A
	For this mode, the power rate limit (WGr) should be able to be enabled or disabled.	No energy source.	N/A
	The power rate limit shall be disabled by default.	No energy source.	N/A
	The increase or decrease for transitions between power output levels is contingent on external situations (such as amount of available solar energy, wind energy or discharge capacity).	No energy source.	N/A
	Only for increases or decreases in the output which are faster than the power rate limit (WGr) does a control action to	No energy source.	N/A

	limit the ramp rate apply.		
6.3.5.4	Nonlinearity of power rate limit changes		P
	The nonlinearity (NL) of the power rate limit (WGra) in response to an increase of the inverter power output, as defined by the characteristic curve depicted in Figure 5, shall be less than 10%.	See clause 6.3.5.3.2 and 6.3.5.3.3.	P
6.4	Multiple mode inverter operation		N/A
6.4.1	General	See below.	N/A
	When the multiple mode inverter is disconnected from the grid any stand-alone port shall ensure that all active conductors are also isolated from the grid-interactive port.	Not multiple mode inverters.	N/A
	Multiple mode inverters shall be arranged to ensure that the continuity of the neutral conductor to the load from the electrical installation is not interrupted when the inverter disconnects from the grid and supplies a load via the stand-alone port.	Not multiple mode inverters.	N/A
	When the multiple mode inverter is providing the stand-alone function and is disconnected from the grid, the stand-alone port shall comply with the requirements for d.c. current injection (refer to Clause 5.9) into the connected load circuits. The type of RCD compatible with and for use on the stand-alone function outputs shall be declared.	Not multiple mode inverters.	N/A
6.4.2	Sinusoidal output in stand-alone mode	See below.	N/A
	The a.c. output voltage waveform of a stand-alone port of a multiple mode inverter operating in stand-alone mode, shall comply with the requirements of this Clause (6.4.2). The a.c. output voltage waveform of a stand-alone mode shall have a voltage total harmonic distortion (THD) not exceeding of 5% and no individual harmonic at a level exceeding 5%.	No stand-alone model.	N/A
6.4.3	Volt-watt response mode for charging of energy storage	No energy storage.	N/A
	A multiple mode inverter with energy storage which can be charged from the grid shall have this volt-watt response mode.	Not multiple mode inverters.	N/A
	This volt-watt response mode is only active when power from the grid is required to charge the energy storage.	No 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	No energy storage.	N/A

	the grid through the grid-interactive port for charging energy storage. The default values are listed in Table 12 and shown in Figure 6.		
6.5	Security of operational settings	See below.	P
	The internal settings of the demand response or power quality response modes of the inverter shall be secured against inadvertent or unauthorized tampering.	Unauthorized person cannot make any setting change.	P
	Changes to the internal settings shall require the use of a tool and special instructions not provided to unauthorized personnel.	Unauthorized person cannot make any setting change.	P

<b>7</b>	<b>PROTECTIVE FUNCTIONS FOR CONNECTION TO ELECTRICAL INSTALLATIONS AND THE GRID</b>		<b>P</b>
7.1	General	See below.	P
	The automatic disconnection device shall operate -		P
	(a) if supply from the grid is disrupted;	Considered.	P
	(b) when the grid goes outside preset parameters (e.g. undervoltage/overvoltage, under-frequency/over-frequency); or	Considered.	P
	(c) when the demand response mode DRM 0 (see Clause 6.2) is asserted.	Considered.	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.	Considered.	P
7.2	Automatic disconnection device		P
	The automatic disconnection device shall provide isolation in all live conductors	The disconnection devices (relays) are provided on each phase.	P
	The automatic disconnection device shall be capable of interrupting at least the rated current.	Considered.	P
	The settings of the automatic disconnection device shall not exceed the capability of the inverter.	Considered.	P
	A semiconductor (solid-state) device shall not be used for isolation purposes.	No such parts.	P
7.3	Active anti-islanding protection	See below.	P
	The automatic disconnection device shall incorporate at least one method of active anti-islanding protection.	Considered.	P
	The method used to provide active anti-islanding protection shall be declared.	Reactive power variation	P

	To prevent islanding, the active anti-islanding protection system shall operate the automatic disconnection device (see Clause 7.2) within 2 s of disruption to the power supply from the grid.	See appendix table.	P
	Compliance shall be determined by type testing in accordance with the active anti-islanding tests specified in Appendix F or IEC 62116.	Appendix F test method used.	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.	Considered.	P
7.5.2	Sustained operation for voltage variations		P
	The inverter shall operate the automatic disconnection device (see Clause 7.2) within 3 s when the average voltage for a 10 min period exceeds the $V_{nom\_max}$ , 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.	Considered.	P
	The inverter shall be capable of supplying rated power between 45 Hz and 50.25 Hz for New Zealand.	Considered.	P
	The power level present at the time the frequency reaches or exceeds 50.25 Hz shall be held as the reference power level used to calculate the required response to	See below.	P

	the increasing frequency.		
	<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><math>P_{out}</math> = required output for a frequency between 50.25 Hz and <math>f_{stop}</math></p> <p><math>P_{ref}</math> = reference power level when the frequency reaches or exceeds 50.25 Hz</p> <p><math>f</math> = frequency between 50.25 Hz and <math>f_{stop}</math></p> <p>When the frequency exceeds <math>f_{stop}</math> the inverter power output shall be ceased (i.e. 0 W).</p> <p>The default set-point for <math>f_{stop}</math> 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.	See appendix table.	P
7.5.3.2	Response to a decrease in grid frequency	See below.	N/A
	This requirement applies only to inverters with energy storage.	No energy storage.	N/A
	The inverter shall be capable of charging the energy storage between 49.75 Hz and 52.0 Hz.	No energy storage.	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.	No energy storage. No response to a decrease in grid frequency required.	N/A
	<p>This is expressed in the equation below:</p> $P_{charge} = P_{ref} \left[ 1 - \frac{(49.75 - f)}{(49.75 - f_{stop-CH})} \right]$ <p>where</p> <p><math>P_{charge}</math> = charge rate of the storage element for a frequency between 49.75 Hz and <math>f_{stop-CH}</math></p> <p><math>P_{ref-CH}</math> = charge rate of the storage element when the frequency reaches or falls below 49.75 Hz</p> <p><math>f</math> = frequency between 49.75 Hz and <math>f_{stop-CH}</math></p> <p>CH</p> <p>When the frequency falls below <math>f_{stop-CH}</math>, the inverter should have ceased charging the storage element (i.e. 0 W). The default set-point for <math>f_{stop-CH}</math> should be 49 Hz.</p>	No response to a decrease in grid frequency required.	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		P
	The automatic disconnection device shall incorporate the ability to disconnect on an external signal.	See below.	P
	If an external signal or demand response 'DRM 0' condition is asserted, the automatic disconnection device shall operate within 2 s.	The inverter is disconnected from the grid when DRM 0 condition is asserted.	P
7.7	Connection and reconnection procedure		P
	Only after all of the following conditions have been met shall the automatic disconnection device operate to connect or reconnect the inverter to the grid -	See below.	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.	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.	P
	(c) the inverter and the grid are synchronized and in-phase with each other; and	See appendix table.	P
	(d) no external signal is present or DRM 0 asserted requiring the system to be disconnected.	See appendix table.	P
7.8	Security of protection settings		P
	The internal settings of the automatic disconnection device shall be secured against inadvertent or unauthorized tampering. Changes to the internal settings shall require the use of a tool and special instructions not provided to unauthorized personnel.	Any setting change only authorized person is allowed.	P

<b>8</b>	<b>MULTIPLE INVERTER COMBINATIONS</b>		<b>P</b>
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.	Combination is tested.	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.	Three-phase inverter.	P

8.2	Inverter current balance across multiple phases	Three-phase inverter.	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.	See appendix table.	
8.3	Grid disconnection		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.	See appendix table.	P
	This applies to all inverters used in combination for single-phase or multiple phases.	Combination for multiple phase inverters.	P
8.4	Grid connection and reconnection		P
	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.	See appendix table.	P
	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.		P
8.5	Testing combinations		N/A
8.5.1	Single-phase combinations	See below.	N/A
	Single-phase parallel combinations of inverters shall be tested for combinations with total rated current ( $I_{rated}$ ) equal to or up to the maximum of 6 A per phase.	Three-phase inverters.	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  <math>I_{rated}</math> = rating of the inverter in amperes</p> <p>If <math>N \geq 2</math>, the minimum number of inverters to be tested shall be N. If <math>N &gt; 6</math>, the maximum number of inverters to be tested in a combination shall be 6.</p>	Three-phase inverters.	N/A
8.5.2	Single-phase inverters used in three-phase combinations	See below.	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)].	Three-phase inverters.	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)].	Three-phase inverters.	N/A
8.5.3	Required tests for multiple inverter combinations	See below.	N/A
	Any single-phase inverter used in a multiple inverter combination shall be tested individually and meet all the requirements of this Standard. Any single-phase inverter which is to be used as part of a multiple inverter combination shall be tested in combination as specified in Clauses 8.5.1 and 8.5.2.	Three-phase inverters.	N/A
8.5.4	Multiple inverters with one automatic disconnection device	See below.	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.	No external automatic disconnection device.	N/A

<b>9</b>	<b>INVERTER MARKING AND DOCUMENTATION</b>		<b>P</b>
9.1	General		P
	All markings and documentation shall be in the English language.	English language marking and document provided.	P
9.2	Marking		P
9.2.1	General		P
9.2.2	Equipment ratings	See below.	P
	<b>Photovoltaic</b>		-
	V <sub>max</sub> PV (absolute maximum)	1000Vdc	P
	I <sub>sc</sub> PV (absolute maximum)	RPI M10A: 19.5 d.c.A /13 d.c.A RPI M8A, RPI M6A : 13 d.c.A x 2 strings	P
	<b>Wind (a.c. or d.c.)</b>		-
	Voltage (nominal or range)	Not such product.	N/A

	Rated current (maximum continuous)		N/A
	Frequency (nominal or range) (a.c. wind only)		N/A
	<b>Energy storage ports</b>		-
	Voltage (nominal)	No energy storage.	N/A
	Voltage (range)		N/A
	Rated current (maximum continuous)		N/A
	Storage type		N/A
	<b>Other energy sources or inputs (a.c. or d.c.)</b>		-
	Voltage (nominal or range)	No other energy sources.	N/A
	Rated current (maximum continuous)		N/A
	Power factor (range)		N/A
	Frequency (nominal or range) (a.c. sources only)		N/A
	<b>a.c. output ratings (for each port)</b>		-
	Voltage (nominal or range)	230/400 a.c.V, 3P3W or 3P4W	P
	Rated current	RPI M10A: 16 a.c.A RPI M8A: 13 a.c.A RPI M6A: 9.7 a.c. A	P
	Frequency (nominal or range)	50Hz	P
	Rated apparent power	RPI M10A: 10,5kVA RPI M8A: 8,4kVA RPI M6A: 6,3kVA	P
	Power factor range	Cosφ 0,8 ind - 0,8 cap	P
	<b>d.c. output ratings</b>		-
	Voltage (nominal or range)		N/A
	Rated current		N/A
	Inverter topology	Transformer-less	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.	Considered.	P
9.2.4	External and ancillary equipment	No such parts.	N/A
9.2.5	Residual current devices (RCDs)		N/A
	Where an external RCD is required, the inverter shall be marked with a warning along with the rating and type of RCD required. The warning shall be located in a prominent position and written in lettering at least 5 mm high. It shall contain the following or an equivalent	Internal RCM used.	N/A

	statement:  <b>WARNING: AN RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER</b>		
	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:  <b>WARNING: A TYPE B RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER</b>	No external RCD.	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.	The inverter support the demand response mode DRM 0, DRM 5, DRM 6, DRM 7 and DRM 8. 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	See below.	P
	<b>Photovoltaic</b>		-
	V <sub>max</sub> PV (absolute maximum)	1000Vdc	P
	PV input operating voltage range	200-1000Vdc	P
	Maximum operating PV input current	RPI M10A: 15 d.c.A /10 d.c.A RPI M8A, RPI M6A: 10 d.c.A x 2 strings	P
	I <sub>sc</sub> PV (absolute maximum)	RPI M10A: 19.5 d.c.A /13 d.c.A RPI M8A, RPI M6A: 13 d.c.A x 2 strings	P
	Maximum inverter backfeed current to array	0	P
	<b>Wind (a.c. or d.c.)</b>		-
	Voltage (nominal or range)	Not such product.	N/A
	Rated current (maximum continuous)		N/A
	Current (inrush)		N/A
	Frequency (nominal or range) (a.c. wind only)		N/A
	<b>Energy storage ports</b>		-
	Voltage (nominal or range)	No energy storage.	N/A
	Nominal battery voltage		N/A
	Rated current (maximum continuous) input and output		N/A

	Storage type		N/A
	<b>Other energy sources or inputs (a.c. or d.c.)</b>		-
	Voltage (nominal or range)	No other energy sources.	N/A
	Rated current (maximum continuous)		N/A
	Power factor (range)		N/A
	Frequency (nominal or range) (a.c. sources only)		N/A
	<b>a.c. output ratings (for each port)</b>		-
	Voltage (nominal or range)	230/400 a.c.V, 3P3W or 3P4W	P
	Rated current	RPI M10A: 16 a.c.A RPI M8A: 13 a.c.A RPI M6A: 9.7 a.c. A	P
	Current (inrush)	31A / 100us	P
	Frequency (nominal or range)	50Hz	P
	Rated apparent power	RPI M10A: 10,5kVA RPI M8A: 8,4kVA RPI M6A: 6,3kVA	P
	Power factor range	cosφ 0,8 ind - 0,8 cap	P
	Maximum output fault current	22.8 a.c. A	P
	Maximum output overcurrent protection	RPI M10A: 19.2 a.c.A RPI M8A: 15.6 a.c.A RPI M6A: 11.6 a.c. A	P
	<b>d.c. output ratings</b>		-
	Voltage (nominal or range)		N/A
	Rated current		N/A
	Inverter topology	Transformerless	P
	Active anti-islanding method	Reactive power injection	P
	Protective class (I, II or III)	Class I	P
	Over voltage category	III	P
	Ingress protection (IP) rating	IP65	P
	Temperature operating range	-25 ~ 60° C, full power up to 40° C	P
9.3.3	Ports	Considered.	P
9.3.4	External and ancillary equipment		P
9.3.5	RCDs	No such parts.	N/A
9.3.6	Multiple mode inverters	Not such equipment.	N/A
9.3.7	Multiple inverter combinations		P

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

# Test results

5.5 Power factor Appendix B Power factor test (RPI M10A)						P
Mode	Measurement	Rated Output Current				
		15+/-5%	25+/-5%	50+/-5%	75+/-5%	100+/-5%
Unity	Vrms (V)	230,43	230,48	230,56	230,61	230,69
	Arms (A)	2,179	3,646	7,312	10,954	14,563
	Apparent Power (kVA)	1,508	2,523	5,062	7,584	10,086
	Power (kW)	1,504	2,521	5,061	7,583	10,085
	Recative power (kVar)	0,112	0,100	0,121	0,149	0,131
	PF cos (phi)	0,9972	0,9992	0,9997	0,9998	0,9998
Lag limit	Vrms (V)	230,38	230,41	230,47	230,51	230,53
	Arms (A)	2,458	4,506	9,032	13,627	14,769
	Apparent Power (kVA)	1,702	3,119	6,250	9,430	10,220
	Power (kW)	1,342	2,505	5,024	7,513	8,115
	Recative power (kVar)	-1,047	-1,858	-3,719	-5,699	-6,214
	PF cos (phi)	0,7883	0,8032	0,8038	0,7967	0,7940
Lead limit	Vrms (V)	230,47	230,50	230,58	230,65	230,61
	Arms (A)	2,694	4,497	9,107	13,611	14,700
	Apparent Power (kVA)	1,862	3,110	6,302	9,422	10,176
	Power (kW)	1,501	2,514	5,036	7,534	8,152
	Recative power (kVar)	1,102	1,831	3,789	5,658	6,091
	PF cos (phi)	0,8060	0,8084	0,7991	0,7996	0,8011
Modes	Vrms (V)	-	-	-	-	-
	Arms (A)	-	-	-	-	-
	Apparent Power (kVA)	-	-	-	-	-
	Power (kW)	-	-	-	-	-
	Recative power (kVar)	-	-	-	-	-
	PF cos (phi)	-	-	-	-	-
<b>Note:</b> Inverter shall be connected to test circuit Figure B1 (AS/NZS 4777.2), The required accuracy for the measurement and reporting of results is $\pm 0.01$ 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						

5.5 Power factor Appendix B Power factor test (RPI M6A)						P
Mode	Measurement	Rated Output Current				
		15+/-5%	25+/-5%	50+/-5%	75+/-5%	100+/-5%
Unity	Vrms (V)	230,23	230,31	230,58	230,67	230,87
	Arms (A)	3,928	6,573	13,175	19,728	26,212
	Apparent Power (kVA)	0,904	1,514	3,038	4,551	6,052
	Power (kW)	0,902	1,512	3,036	4,550	6,051
	Recative power (kVar)	0,117	0,120	0,115	0,124	0,123
	PF cos (phi)	0,9977	0,9991	0,9995	0,9998	0,9998
Lag limit	Vrms (V)	230,80	230,91	230,99	231,12	231,11
	Arms (A)	4,833	8,096	16,279	24,397	26,320
	Apparent Power (kVA)	1,116	1,869	3,760	5,639	6,083
	Power (kW)	0,900	1,508	3,022	4,521	4,891
	Recative power (kVar)	0,659	1,104	2,238	3,370	3,616
	PF cos (phi)	0,8071	0,8068	0,8036	0,8017	0,8041
Lead limit	Vrms (V)	230,24	230,39	230,51	230,84	230,99
	Arms (A)	4,375	8,142	16,331	24,420	26,351
	Apparent Power (kVA)	1,007	1,876	3,764	5,637	6,087
	Power (kW)	0,805	1,503	3,014	4,508	4,869
	Recative power (kVar)	-0,605	-1,122	-2,255	-3,384	-3,653
	PF cos (phi)	0,7993	0,8014	0,8007	0,7997	0,7999
Modes	Vrms (V)	-	-	-	-	-
	Arms (A)	-	-	-	-	-
	Apparent Power (kVA)	-	-	-	-	-
	Power (kW)	-	-	-	-	-
	Recative power (kVar)	-	-	-	-	-
	PF cos (phi)	-	-	-	-	-
<b>Note:</b> Inverter shall be connected to test circuit Figure B1 (AS/NZS 4777.2), The required accuracy for the measurement and reporting of results is $\pm 0.01$ 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 (RPI M10A)							P
Generating Unit rating per phase (rpp)							
	At 50% of rated ouput current						
	Watts			5261			
	VA			5263			
	Vrms			230,45			
	Arms			22,838			
	PF			0,9996			
	Frequency			50			
Harmonic	Value A			% of fundamental			Limit in % of fundamental
	L1	L2	L3	L1	L2	L3	
1st	7,608	7,614	7,617	-	-	-	-
2nd	0,020	0,027	0,022	0,125	0,169	0,138	1%
3rd	0,010	0,008	0,012	0,063	0,050	0,075	4%
4th	0,005	0,005	0,003	0,031	0,031	0,019	1%
5th	0,034	0,031	0,027	0,213	0,194	0,169	4%
6th	0,004	0,003	0,002	0,025	0,019	0,013	1%
7th	0,011	0,014	0,012	0,069	0,088	0,075	4%
8th	0,004	0,002	0,001	0,025	0,013	0,006	1%
9th	0,003	0,004	0,004	0,019	0,025	0,025	2%
10th	0,005	0,003	0,003	0,031	0,019	0,019	0,5%
11th	0,016	0,015	0,013	0,100	0,094	0,081	2%
12th	0,002	0,004	0,004	0,013	0,025	0,025	0,5%
13th	0,018	0,017	0,017	0,113	0,106	0,106	2%
14th	0,004	0,004	0,003	0,025	0,025	0,019	0,5%
15th	0,003	0,003	0,005	0,019	0,019	0,031	1%
16th	0,005	0,003	0,004	0,031	0,019	0,025	0,5%
17th	0,026	0,027	0,027	0,163	0,169	0,169	1%
18th	0,003	0,004	0,005	0,019	0,025	0,031	0,5%
19th	0,027	0,027	0,028	0,169	0,169	0,175	1%
20th	0,004	0,003	0,005	0,025	0,019	0,031	0,5%
21th	0,004	0,004	0,003	0,025	0,025	0,019	0,6%
22th	0,004	0,004	0,004	0,025	0,025	0,025	0,5%
23th	0,029	0,027	0,026	0,181	0,169	0,163	0,6%
24th	0,005	0,004	0,003	0,031	0,025	0,019	0,5%
25th	0,042	0,044	0,046	0,263	0,275	0,288	0,6%
26th	0,002	0,003	0,002	0,013	0,019	0,013	0,5%
27th	0,002	0,001	0,002	0,013	0,006	0,013	0,6%
28th	0,002	0,001	0,002	0,013	0,006	0,013	0,5%
29th	0,015	0,018	0,018	0,094	0,113	0,113	0,6%
30th	0,002	0,001	0,002	0,013	0,006	0,013	0,5%
31th	0,030	0,029	0,030	0,188	0,181	0,188	0,6%
32th	0,002	0,002	0,002	0,013	0,013	0,013	0,5%
33th	0,001	0,002	0,002	0,006	0,013	0,013	0,6%
THD (to 50th)	-	-	-	0,90	0,92	0,90	5%
<b>Note:</b> 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 C Harmonic Current Limit Test (RPI M10A)							P
Generating Unit rating per phase (rpp)							
	At 100% of rated ouput current						
	Watts			10067			
	VA			10070			
	Vrms			230,80			
	Arms			43,631			
	PF			0,9997			
	Frequency			50			
Harmonic	Value A			% of fundamental			Limit in % of fundamental
	L1	L2	L3	L1	L2	L3	
1st	14,536	14,542	14,553	--	--	--	-
2nd	0,023	0,030	0,036	0,158	0,206	0,247	1%
3rd	0,009	0,016	0,019	0,062	0,110	0,131	4%
4th	0,005	0,010	0,010	0,034	0,069	0,069	1%
5th	0,039	0,034	0,032	0,268	0,234	0,220	4%
6th	0,003	0,006	0,006	0,021	0,041	0,041	1%
7th	0,011	0,014	0,013	0,076	0,096	0,089	4%
8th	0,002	0,005	0,004	0,014	0,034	0,027	1%
9th	0,003	0,006	0,005	0,021	0,041	0,034	2%
10th	0,003	0,005	0,005	0,021	0,034	0,034	0,5%
11th	0,011	0,010	0,014	0,076	0,069	0,096	2%
12th	0,003	0,005	0,005	0,021	0,034	0,034	0,5%
13th	0,019	0,020	0,020	0,131	0,138	0,137	2%
14th	0,003	0,004	0,005	0,021	0,028	0,034	0,5%
15th	0,003	0,003	0,006	0,021	0,021	0,041	1%
16th	0,005	0,004	0,007	0,034	0,028	0,048	0,5%
17th	0,030	0,027	0,023	0,206	0,186	0,158	1%
18th	0,007	0,006	0,005	0,048	0,041	0,034	0,5%
19th	0,035	0,037	0,036	0,241	0,254	0,247	1%
20th	0,006	0,005	0,004	0,041	0,034	0,027	0,5%
21th	0,003	0,004	0,004	0,021	0,028	0,027	0,6%
22th	0,005	0,005	0,004	0,034	0,034	0,027	0,5%
23th	0,025	0,024	0,024	0,172	0,165	0,165	0,6%
24th	0,005	0,005	0,005	0,034	0,034	0,034	0,5%
25th	0,038	0,041	0,041	0,261	0,282	0,282	0,6%
26th	0,003	0,004	0,005	0,021	0,028	0,034	0,5%
27th	0,003	0,002	0,003	0,021	0,014	0,021	0,6%
28th	0,002	0,002	0,004	0,014	0,014	0,027	0,5%
29th	0,022	0,027	0,027	0,151	0,186	0,186	0,6%
30th	0,002	0,003	0,002	0,014	0,021	0,014	0,5%
31th	0,030	0,032	0,031	0,206	0,220	0,213	0,6%
32th	0,002	0,002	0,002	0,014	0,014	0,014	0,5%
33th	0,001	0,003	0,002	0,007	0,021	0,014	0,6%
THD (to 50th)	-	-	-	0,67	0,71	0,71	5%
<b>Note:</b> 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 (RPI M10A)							P
Harmonic	Value V			% of fundamental			Limit in % of fundamental
	L1	L2	L3	L1	L2	L3	
2nd	0,03	0,03	0,03	0,013	0,013	0,013	0,2%
3rd	0,04	0,04	0,04	0,017	0,017	0,017	4%
4th	0,01	0,01	0,01	0,001	0,001	0,004	0,2%
5th	0,06	0,06	0,06	0,026	0,026	0,026	4%
6th	0,01	0,01	0,01	0,004	0,004	0,004	0,2%
7th	0,06	0,06	0,06	0,026	0,026	0,026	4%
8th	0,01	0,01	0,01	0,001	0,001	0,001	0,2%
9th	0,02	0,02	0,02	0,009	0,009	0,009	2%
10th	0,02	0,02	0,01	0,009	0,009	0,004	0,2%
11th	0,03	0,02	0,03	0,013	0,009	0,013	0,1%
12th	0,01	0,01	0,01	0,001	0,001	0,004	0,1%
13th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
14th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
15th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
16th	0,01	0,01	0,01	0,001	0,001	0,001	0,1%
17th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
18th	0,01	0,01	0,02	0,004	0,004	0,009	0,1%
19th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
20th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
21th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
22th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
23th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
24th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
25th	0,01	0,01	0,01	0,004	0,001	0,004	0,1%
26th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
27th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
28th	0,01	0,01	0,01	0,001	0,004	0,001	0,1%
29th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
30th	0,01	0,01	0,01	0,001	0,001	0,001	0,1%
31th	0,01	0,01	0,01	0,001	0,004	0,001	0,1%
32th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
33th	0,01	0,01	0,01	0,004	0,001	0,004	0,1%
34th	0,01	0,01	0,01	0,004	0,001	0,004	0,1%
35th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
36th	0,01	0,01	0,01	0,001	0,001	0,001	0,1%
37th	0,01	0,01	0,01	0,001	0,004	0,004	0,1%
38th	0,01	0,01	0,01	0,001	0,001	0,001	0,1%
39th	0,01	0,01	0,01	0,004	0,001	0,004	0,1%
40th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
41th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
42th	0,01	0,01	0,01	0,004	0,001	0,001	0,1%
43th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
44th	0,01	0,01	0,01	0,001	0,001	0,001	0,1%
45th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
46th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
47th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
48th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
49th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
50th	0,01	0,01	0,01	0,004	0,004	0,004	0,1%
THD	-	-	-	0,052	0,051	0,053	5%
<b>Note:</b> 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  $120 \pm 1.5^\circ$ . Via DC-input set AC-output power (VA) so that it equals to  $100 \pm 5\%$  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 C Harmonic Current Limit Test (RPI M6A)							P
Generating Unit rating per phase (rpp)							
	At 50% of rated ouput current						
	Watts			3328			
	VA			3329			
	Vrms			230,12			
	Arms			14,467			
	PF			0,9998			
	Frequency			50			
Harmonic	Value A			% of fundamental			Limit in % of fundamental
	L1	L2	L3	L1	L2	L3	
1st	4,818	4,834	4,815	-	-	-	-
2nd	0,030	0,047	0,026	0,309	0,485	0,268	1%
3rd	0,009	0,011	0,004	0,093	0,113	0,041	4%
4th	0,005	0,002	0,003	0,052	0,021	0,031	1%
5th	0,061	0,073	0,065	0,629	0,753	0,670	4%
6th	0,004	0,002	0,004	0,041	0,021	0,041	1%
7th	0,083	0,057	0,083	0,856	0,588	0,856	4%
8th	0,007	0,003	0,004	0,072	0,031	0,041	1%
9th	0,003	0,003	0,004	0,031	0,031	0,041	2%
10th	0,014	0,009	0,006	0,144	0,093	0,062	0,5%
11th	0,114	0,081	0,111	1,175	0,835	1,144	2%
12th	0,009	0,007	0,008	0,093	0,072	0,082	0,5%
13th	0,067	0,070	0,064	0,691	0,722	0,660	2%
14th	0,004	0,002	0,004	0,041	0,021	0,041	0,5%
15th	0,005	0,011	0,009	0,052	0,113	0,093	1%
16th	0,010	0,006	0,007	0,103	0,062	0,072	0,5%
17th	0,054	0,052	0,053	0,557	0,536	0,546	1%
18th	0,003	0,001	0,004	0,031	0,010	0,041	0,5%
19th	0,024	0,037	0,024	0,247	0,381	0,247	1%
20th	0,005	0,003	0,002	0,052	0,031	0,021	0,5%
21th	0,002	0,007	0,004	0,021	0,072	0,041	0,6%
22th	0,005	0,002	0,002	0,052	0,021	0,021	0,5%
23th	0,019	0,020	0,014	0,196	0,206	0,144	0,6%
24th	0,001	0,002	0,003	0,010	0,021	0,031	0,5%
25th	0,018	0,018	0,014	0,186	0,186	0,144	0,6%
26th	0,005	0,002	0,002	0,052	0,021	0,021	0,5%
27th	0,003	0,003	0,002	0,031	0,031	0,021	0,6%
28th	0,003	0,001	0,002	0,031	0,010	0,021	0,5%
29th	0,007	0,012	0,011	0,072	0,124	0,113	0,6%
30th	0,003	0,003	0,003	0,031	0,031	0,031	0,5%
31th	0,009	0,010	0,009	0,093	0,103	0,093	0,6%
32th	0,002	0,001	0,002	0,021	0,010	0,021	0,5%
33th	0,003	0,003	0,005	0,031	0,031	0,052	0,6%
THD (to 50th)	-	-	-	3,19	2,88	3,13	5%
<b>Note:</b> 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 C Harmonic Current Limit Test (RPI M6A)							P
Generating Unit rating per phase (rpp)							
	At 100% of rated ouput current						
	Watts			6008			
	VA			6010			
	Vrms			230,67			
	Arms			26,054			
	PF			0,9997			
	Frequency			50			
Harmonic	Value A			% of fundamental			Limit in % of fundamental
	L1	L2	L3	L1	L2	L3	
1st	8,681	8,699	8,674	-	-	-	-
2nd	0,031	0,049	0,025	0,320	0,505	0,258	1%
3rd	0,017	0,011	0,008	0,175	0,113	0,082	4%
4th	0,004	0,003	0,003	0,041	0,031	0,031	1%
5th	0,038	0,055	0,041	0,392	0,567	0,423	4%
6th	0,004	0,002	0,005	0,041	0,021	0,052	1%
7th	0,088	0,059	0,093	0,907	0,608	0,959	4%
8th	0,006	0,004	0,004	0,062	0,041	0,041	1%
9th	0,003	0,003	0,004	0,031	0,031	0,041	2%
10th	0,010	0,006	0,006	0,103	0,062	0,062	0,5%
11th	0,128	0,089	0,134	1,320	0,918	1,381	2%
12th	0,006	0,008	0,006	0,062	0,082	0,062	0,5%
13th	0,087	0,101	0,079	0,897	1,041	0,814	2%
14th	0,010	0,006	0,008	0,103	0,062	0,082	0,5%
15th	0,005	0,008	0,005	0,052	0,082	0,052	1%
16th	0,007	0,004	0,004	0,072	0,041	0,041	0,5%
17th	0,045	0,053	0,050	0,464	0,546	0,515	1%
18th	0,005	0,002	0,006	0,052	0,021	0,062	0,5%
19th	0,047	0,052	0,045	0,485	0,536	0,464	1%
20th	0,009	0,005	0,004	0,093	0,052	0,041	0,5%
21th	0,005	0,004	0,006	0,052	0,041	0,062	0,6%
22th	0,005	0,003	0,003	0,052	0,031	0,031	0,5%
23th	0,028	0,032	0,026	0,289	0,330	0,268	0,6%
24th	0,003	0,002	0,004	0,031	0,021	0,041	0,5%
25th	0,026	0,025	0,021	0,268	0,258	0,216	0,6%
26th	0,007	0,001	0,003	0,072	0,010	0,031	0,5%
27th	0,003	0,003	0,003	0,031	0,031	0,031	0,6%
28th	0,007	0,002	0,005	0,072	0,021	0,052	0,5%
29th	0,019	0,022	0,022	0,196	0,227	0,227	0,6%
30th	0,005	0,004	0,007	0,052	0,041	0,072	0,5%
31th	0,014	0,018	0,016	0,144	0,186	0,165	0,6%
32th	0,003	0,001	0,001	0,031	0,010	0,010	0,5%
33th	0,003	0,004	0,006	0,031	0,041	0,062	0,6%
THD (to 50th)	-	-	-	2,35	2,18	2,37	5%
<b>Note:</b> 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
Phase 1			
Limit	Pst = 1,0	Plt = 0,65	
Test value	-	-	
Phase 2			
Limit	Pst = 1,0	Plt = 0,65	
Test value	-	-	
Phase 3			
Limit	Pst = 1,0	Plt = 0,65	
Test value	-	-	
Note: The inverter shall conform to the voltage fluctuation and flicker limits specified in AS/NZS 61000.3.3 for equipment with rated current less than or equal to 16 A per phase (a.c.). For equipment with rated current greater than 16 A per phase (a.c.), if the inverter cannot meet the requirements of AS/NZS 61000.3.3, the maximum permissible connection point impedance (Zmax) shall be determined such that the voltage fluctuation and flicker limits specified in AS/NZS 61000.3.3 can be met. The impedance shall be determined in accordance with the methods given in AS/NZS 61000.3.11.  <b>For test results see Annex 1 – EMC Report.</b>			



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

**P**

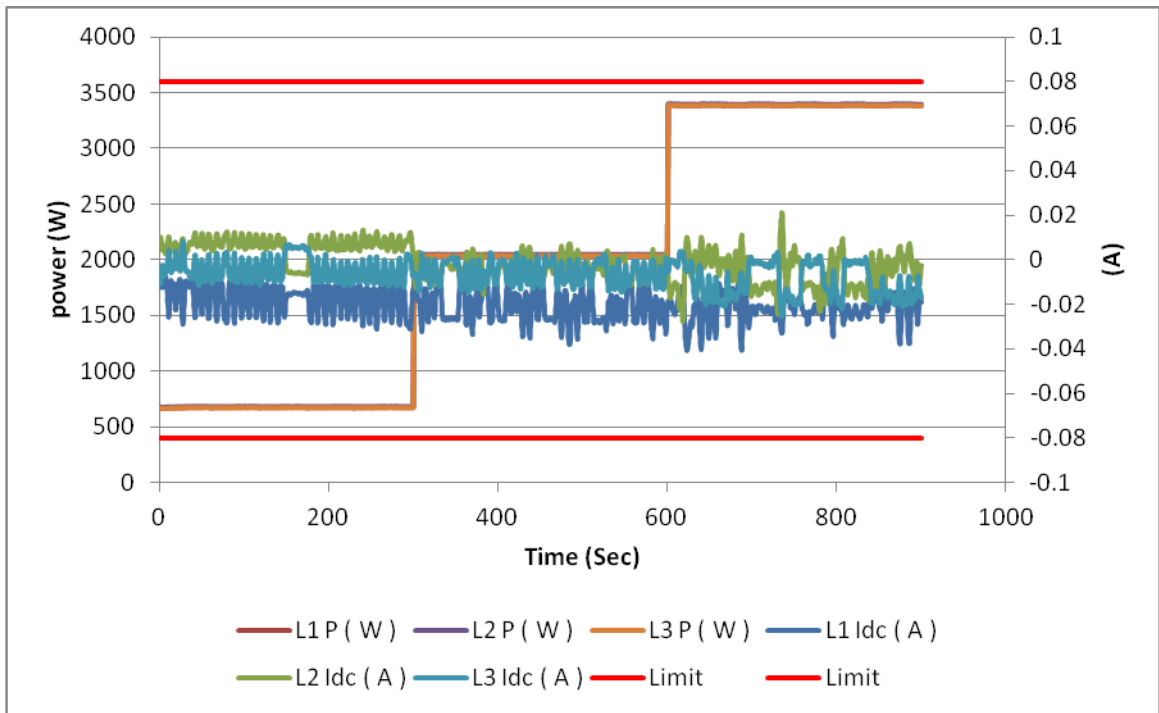
	10+/-5% Output Power (VA)		50+/-5% Output Power (VA)		100+/-5% Output Power (VA)	
	Duration (s)	Line to line (V)	Duration (s)	Line to line (V)	Duration (s)	Line to line (V)
L1-L2						
Limit	0,060	670	0,060	670	0,060	670
Test value	0	647,6	0,0013	688	0,0011	670,4
L2-L3						
Limit	0,060	670	0,060	670	0,060	670
Test value	0	643,2	0,0018	686,4	0,0014	705,6
L3-L1						
Limit	0,060	670	0,060	670	0,060	670
Test value	0	616	0,0017	700,8	0,0015	697,6

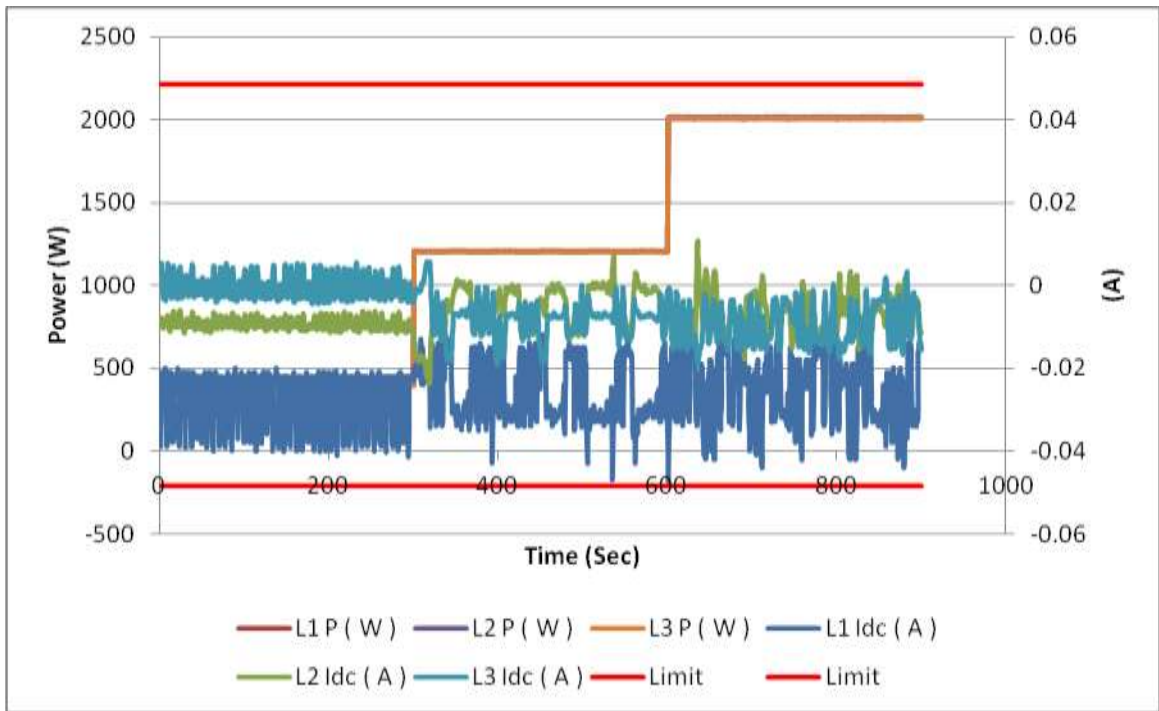
**Diagram of Transient voltage (L2-L3 50%)**



**Note:**

Results shall not exceed limits in Table 3 of AS/NZS 4777.2. Test Specifications: Inverter shall be connected to test circuit AS/NZS 4777.2 Figure D1, Appendix C. Grid nominal voltage within +/-5%, Via DC-input set AC- output power so that it equals to 10+/-5% of rated output (VA). Switch S shall be opened and the output voltage duration (Sample frequency of at least 10KHz) of the inverter shall be recorded. Test shall be repeated at 50+/-5% and 100+/-5% of rated output power.

5.9 Direct current injection Appendix E D.C. injection test RPI M10A							P
Testing at 20+/-5% Output Power							
Phases	L1-L1 (mA)	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Test value	-	-	-	-	-31	13	-13
Testing at 60+/-5% Output Power							
Phases	L1-L1 (mA)	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Test value	-	-	-	-	-38	-16	-15
Testing at 100+/-5% Output Power							
Phases	L1-L1 (mA)	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Test value	-	-	-	-	-41	-28	-26
Diagram of permanent dc-injection							
							
<p>Note:</p> <p>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.</p> <p>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.</p>							

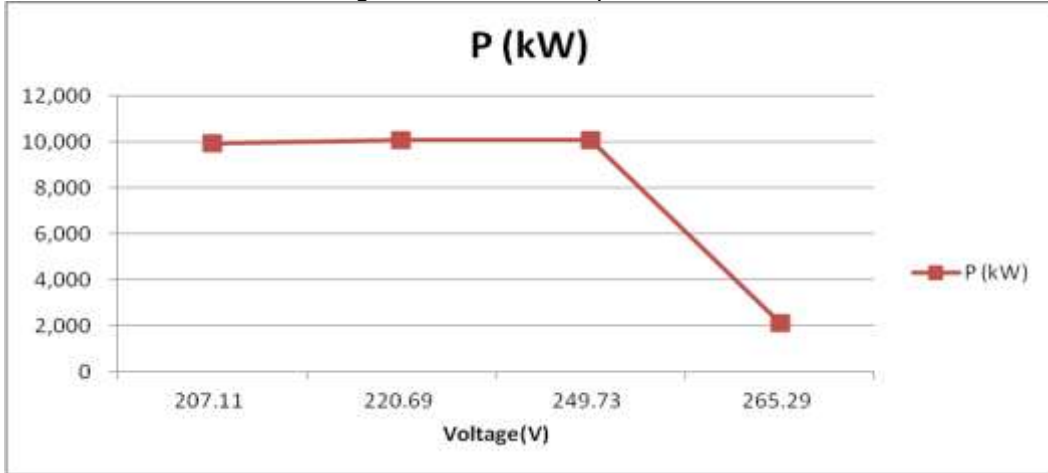
5.9 Direct current injection Appendix E D.C. injection test RPI M6A							P
Testing at 20+/-5% Output Power							
Phases	L1-L1 (mA)	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Test value	-	-	-	-	-41	-12	6
Testing at 60+/-5% Output Power							
Phases	L1-L1 (mA)	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Test value	-	-	-	-	-47	-24	-19
Testing at 100+/-5% Output Power							
Phases	L1-L1 (mA)	L1-L2 (mA)	L1-L3 (mA)	L2-L3 (mA)	L1-N (mA)	L2-N (mA)	L3-N (mA)
Test value	-	-	-	-	-44	-18	-19
Diagram of permanent dc-injection							
 <p>Power (W)</p> <p>Time (Sec)</p> <p>Legend: L1 P (W), L2 P (W), L3 P (W), L1 Idc (A), L2 Idc (A), L3 Idc (A), Limit, Limit</p>							
<p>Note:</p> <p>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.</p> <p>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.</p>							

5.10 Current balance for three-phase inverters						P
Setting values	PF cos φ = 1			Rated output current: 16 A		
Test value	L1	L2	L3	L1 – L2	L2 – L3	L3 – L1
100% of rated current	14,569	14,613	14,559	0,044	-0,054	0,010
Limit [A]: 5% of rated current	0,8 A					
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 current (A)	Reactive current (A)	Switching Time (s)	
DRM 0	Operate the disconnection device	0,278	0,001	0,059	P
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	0,596	0,599	1,3760	P
DRM 6	Do not generate at more than 50% of rated power	7,47	2,115	1,9475	P
DRM 5 and DRM 6		0,592	0,599	1,6125	P
DRM 7	Do not generate at more than 75% of rated power AND Sink reactive power if capable	11,4	2,047	1,1475	P
DRM 6 and DRM 7		7,599	2,042	1,2720	P
DRM 8	Increase power generation (subject to constraints from other active DRMs)	14,572	2,081	1,6180	P
Note: Switching time limit : 2s					

6.3.2.2 Volt-watt response mode (Australia Default Setting) RPI M10A				P
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	207,11	220,69	249,73	265,29
P (kW)	9,919	10,058	10,097	2,110
P/P <sub>rated</sub> (%)	99,19	100,58	100,97	21,10

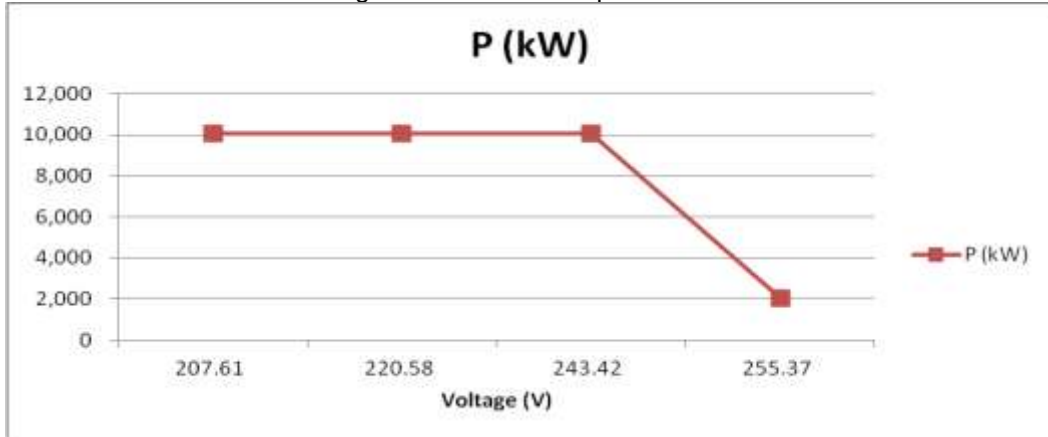
Diagram of volt-watt response mode



Note:

6.3.2.2 Volt-watt response mode (New Zealand Default Setting) RPI M10A				P
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	207,61	220,58	243,42	255,37
P (kW)	10,048	10,063	10,078	2,057
P/P <sub>rated</sub> (%)	100,48	100,63	100,78	20,57

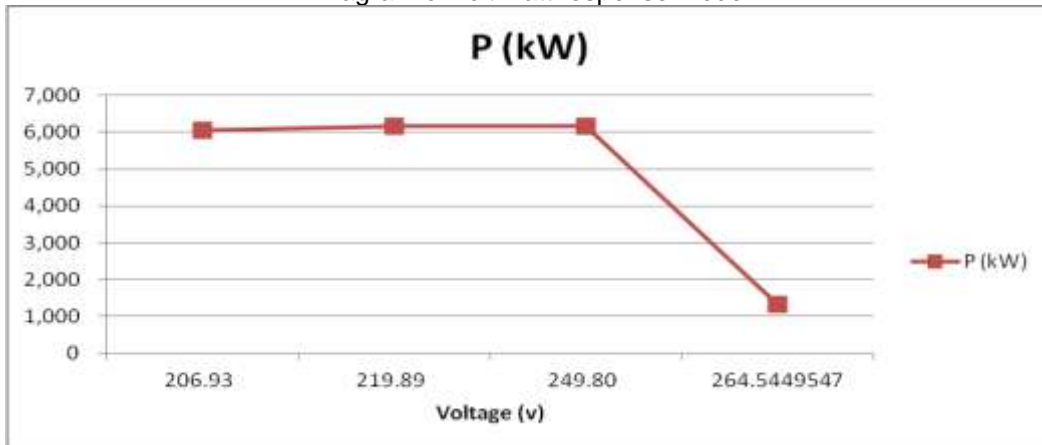
Diagram of volt-watt response mode



Note:

6.3.2.2 Volt-watt response mode (Australia Default Setting) RPI M6A				P
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	206,93	219,89	249,80	264,54
P (kW)	6,047	6,168	6,150	1,334
P/P <sub>rated</sub> (%)	100,78	102,80	102,51	22,23

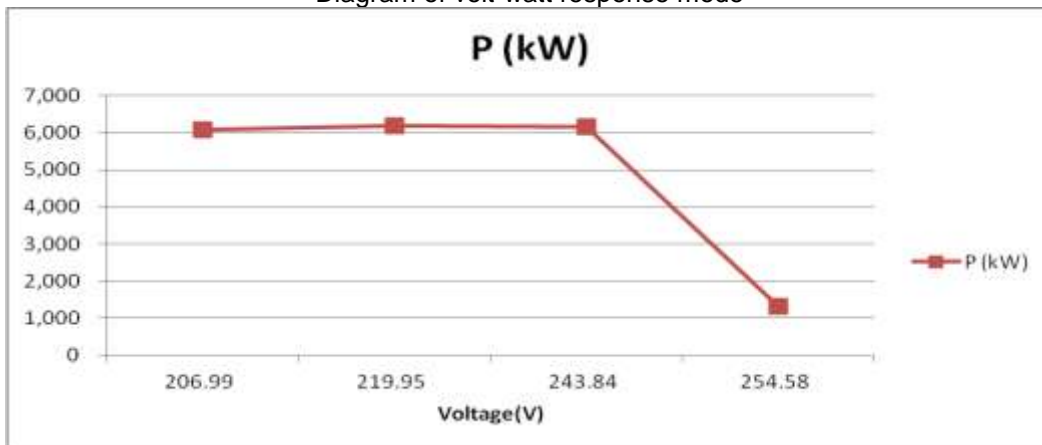
Diagram of volt-watt response mode



Note:

6.3.2.2 Volt-watt response mode (New Zealand Default Setting) RPI M6A				P
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	206.99	219.95	243.84	254.58
P (kW)	6,065	6,171	6,153	1,320
P/P <sub>rated</sub> (%)	101.08	102.86	102.54	22.00

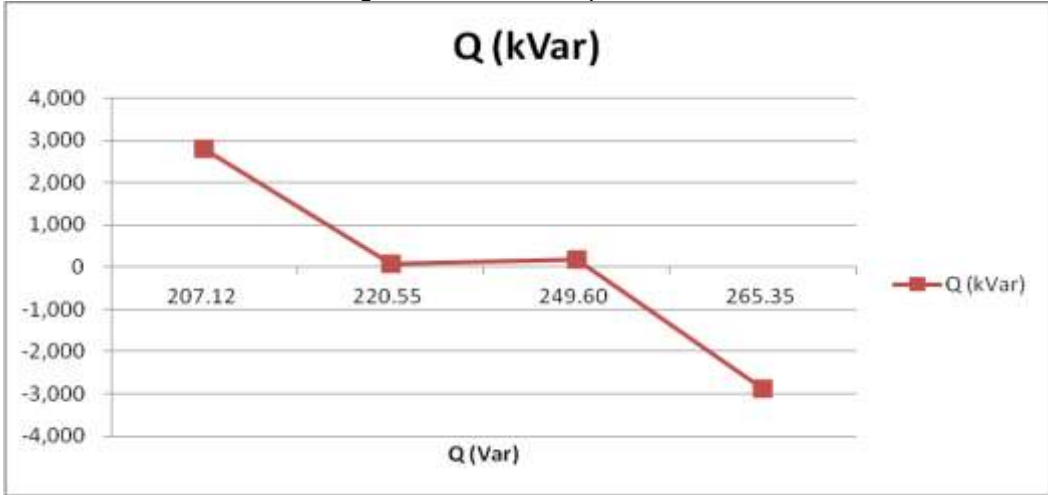
Diagram of volt-watt response mode



Note:

6.3.2.3 Volt-var response mode (Australia Default Setting) RPI M10A				P
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,12	220,55	249,60	265,35
Q (kVar)	2,805	0,074	0,174	-2,876
var / rated VA (%)	28,05	0,74	1,74	-28,76

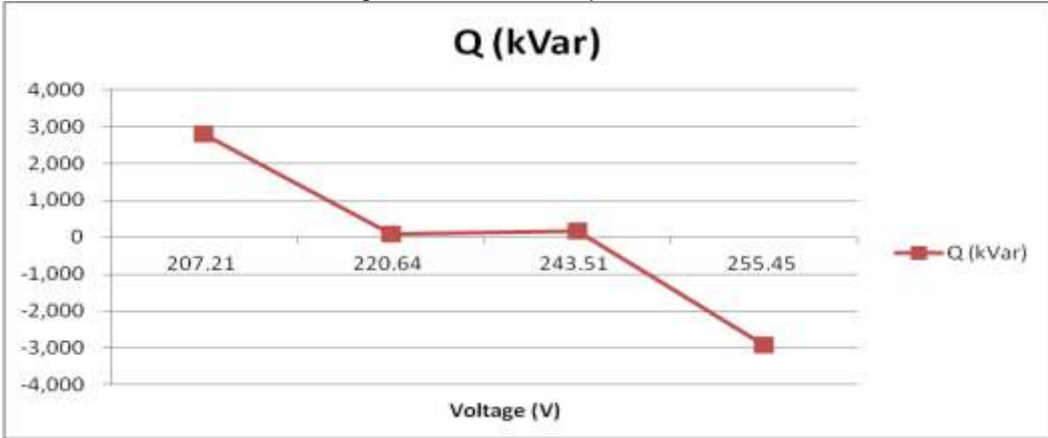
Diagram of volt-var response mode



Note:

6.3.2.3 Volt-var response mode (New Zealand Default Setting) RPI M10A				P
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,21	220,64	243,51	255,45
Q (kVar)	2,805	0,081	0,171	-2,934
var / rated VA (%)	28,05	0,81	1,71	-29,34

Diagram of volt-var response mode



Note:

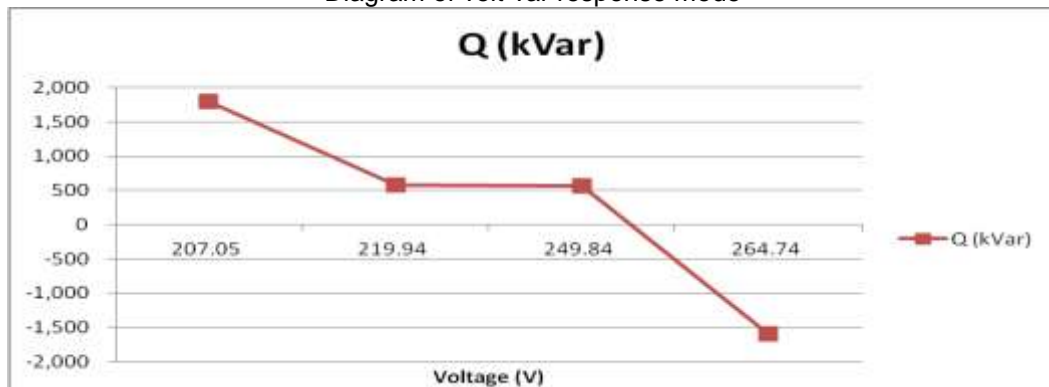
1. The percentage var/VA level leading is the inverter sourcing vars to the grid, whereas the percentage var/VA level lagging is the inverter sinking vars from the grid.
2. Inverters may provide a range up to 100% leading or lagging.
3. % of rated apparent power use for test.

### 6.3.2.3 Volt-var response mode (Australia Default Setting) RPI M6A

**P**

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,05	219,94	249,84	264,74
Q (kVar)	1,802	0,577	0,559	-1,593
var / rated VA (%)	30,03	9,62	9,32	-26,54

Diagram of volt-var response mode



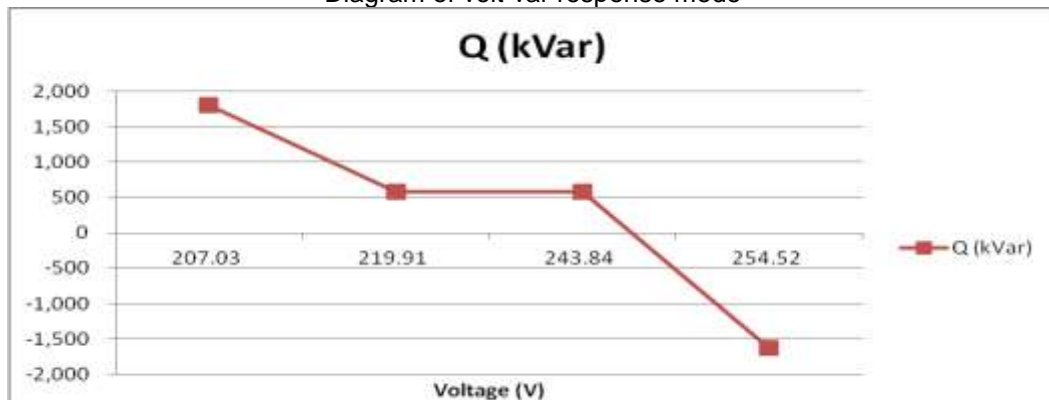
Note:

### 6.3.2.3 Volt-var response mode (New Zealand Default Setting) RPI M6A

**P**

Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V):	207,03	219,91	243,84	254,52
Q (kVar)	1,805	0,584	0,576	-1,629
var / rated VA (%)	30,09	9,73	9,60	-27,14

Diagram of volt-var response mode

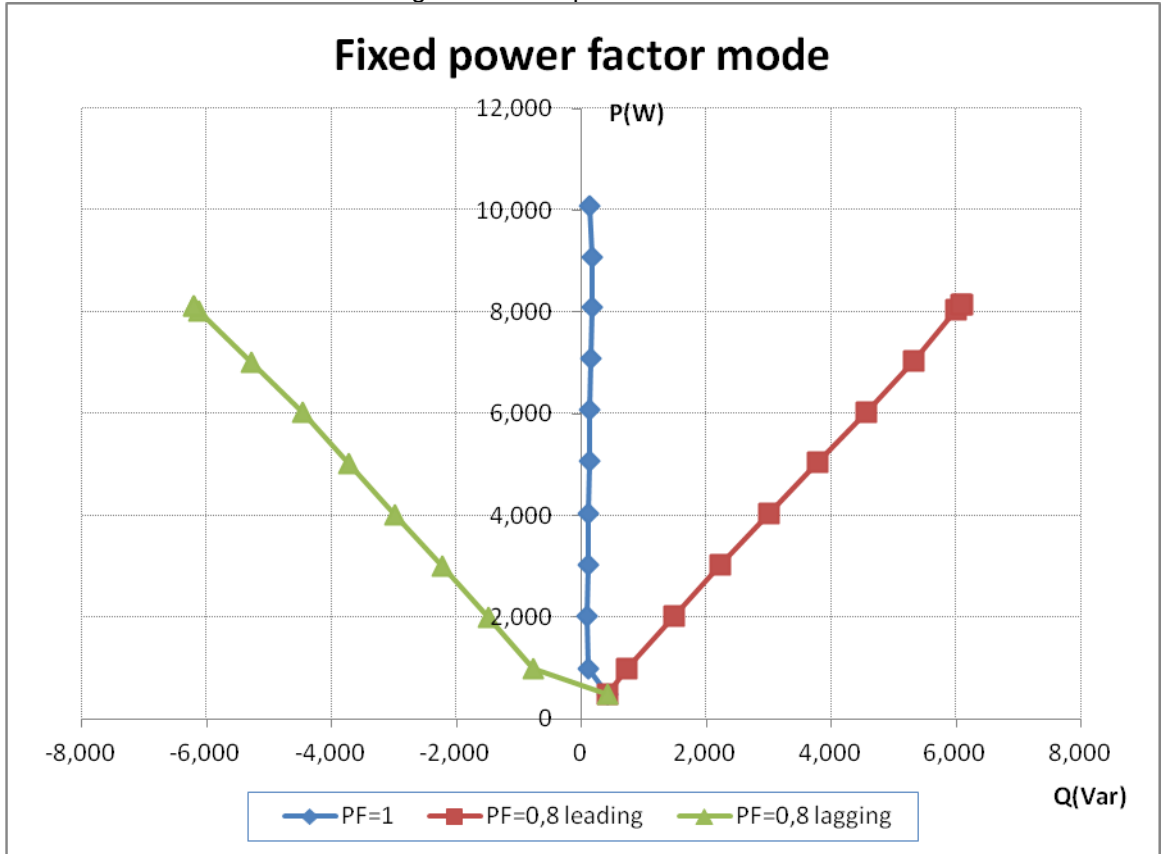


Note:

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

6.3.3 Fixed power factor mode and reactive power mode RPI M10A											P
Fixed power factor mode											
P/P <sub>rated</sub> in %	5	10	20	30	40	50	60	70	80	90	100
Setting PF cosφ = 1											
U (V)	230,4	230,4	230,4	230,4	230,5	230,5	230,5	230,6	230,6	230,6	230,6
Power (kW)	0,481	0,993	2,018	3,032	4,050	5,064	6,075	7,083	8,088	9,089	10,088
Reactive power (kvar)	0,412	0,109	0,100	0,109	0,121	0,130	0,141	0,154	0,167	0,171	0,125
Power factor	0,759	0,994	0,999	0,999	1,000	1,000	1,000	1,000	1,000	1,000	1,000
PF = 0,8 leading											
U (V)	230,4	230,4	230,5	230,5	230,5	230,5	230,6	230,6	230,6	230,6	230,6
Power (kW)	0,480	0,994	2,014	3,023	4,034	5,040	6,041	7,040	8,034	8,158	8,151
Reactive power (kVar)	0,411	0,735	1,482	2,222	3,007	3,791	4,568	5,317	6,006	6,092	6,087
Power factor	0,758	0,804	0,805	0,806	0,802	0,799	0,798	0,798	0,801	0,801	0,801
PF = 0,8 lagging											
U (V)	230,4	230,4	230,4	230,4	230,4	230,4	230,4	230,4	230,5	230,5	230,5
Power (kW)	0,481	0,989	1,999	3,014	4,023	5,028	6,029	7,024	8,013	8,117	8,116
Reactive power (kVar)	0,412	-0,767	-1,490	-2,233	-2,977	-3,719	-4,469	-5,279	-6,122	-6,211	-6,211
Power factor	0,758	0,780	0,802	0,803	0,804	0,804	0,803	0,799	0,795	0,794	0,794

Diagram of fixed power factor mode



The diagram is a scatter plot with lines connecting the points, showing the relationship between Power (W) on the y-axis and Reactive power (Var) on the x-axis. The y-axis ranges from 0 to 12,000 W, and the x-axis ranges from -8,000 to 8,000 Var. Three data series are plotted: PF=1 (blue diamonds), PF=0,8 leading (red squares), and PF=0,8 lagging (green triangles). The PF=1 series is a vertical line at 0 Var, ranging from approximately 1,000 W to 10,000 W. The PF=0,8 leading series starts at approximately (1,000 Var, 1,000 W) and goes up to (6,000 Var, 8,000 W). The PF=0,8 lagging series starts at approximately (-6,000 Var, 8,000 W) and goes down to (-1,000 Var, 1,000 W).

**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 100%.

If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.

**Reactive power mode**

Var/rated VA in %	5	10	20	30	40	50	60	70	80	90	100
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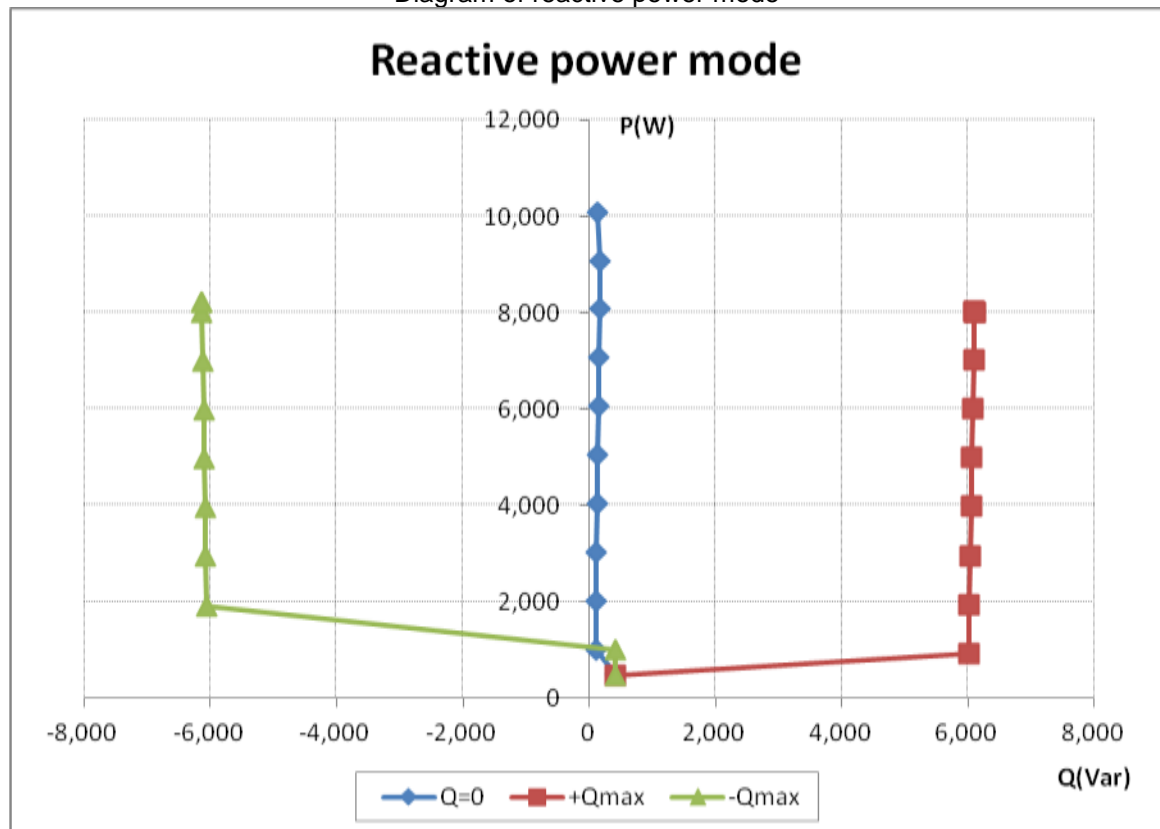
**Reactive power in leading**

U (V)	230,5	230,5	230,5	230,5	230,6	230,5	230,6	230,6	230,6	230,6	230,6
Power (kW)	0,478	0,910	1,939	2,955	3,976	4,993	6,005	7,015	8,022	8,025	8,020
Reactive power (kVar)	0,414	6,014	6,020	6,039	6,050	6,060	6,074	6,090	6,103	6,100	6,105
Power factor	0,756	0,150	0,307	0,439	0,549	0,636	0,703	0,755	0,796	0,796	0,796

**Reactive power in lagging**

U (V)	230,4	230,4	230,4	230,4	230,5	230,5	230,5	230,6	230,6	230,6	230,6
Power (kW)	0,475	0,991	1,909	2,935	3,956	4,973	5,986	6,996	8,001	8,221	8,211
Reactive power (kVar)	0,417	0,414	-6,066	-6,074	-6,080	-6,089	-6,101	-6,114	-6,130	-6,138	-6,130
Power factor	0,751	0,923	0,300	0,435	0,545	0,633	0,700	0,753	0,794	0,801	0,801

Diagram of reactive power mode


**Note:**

The grid-connected inverter of power plant type shall be evaluated.

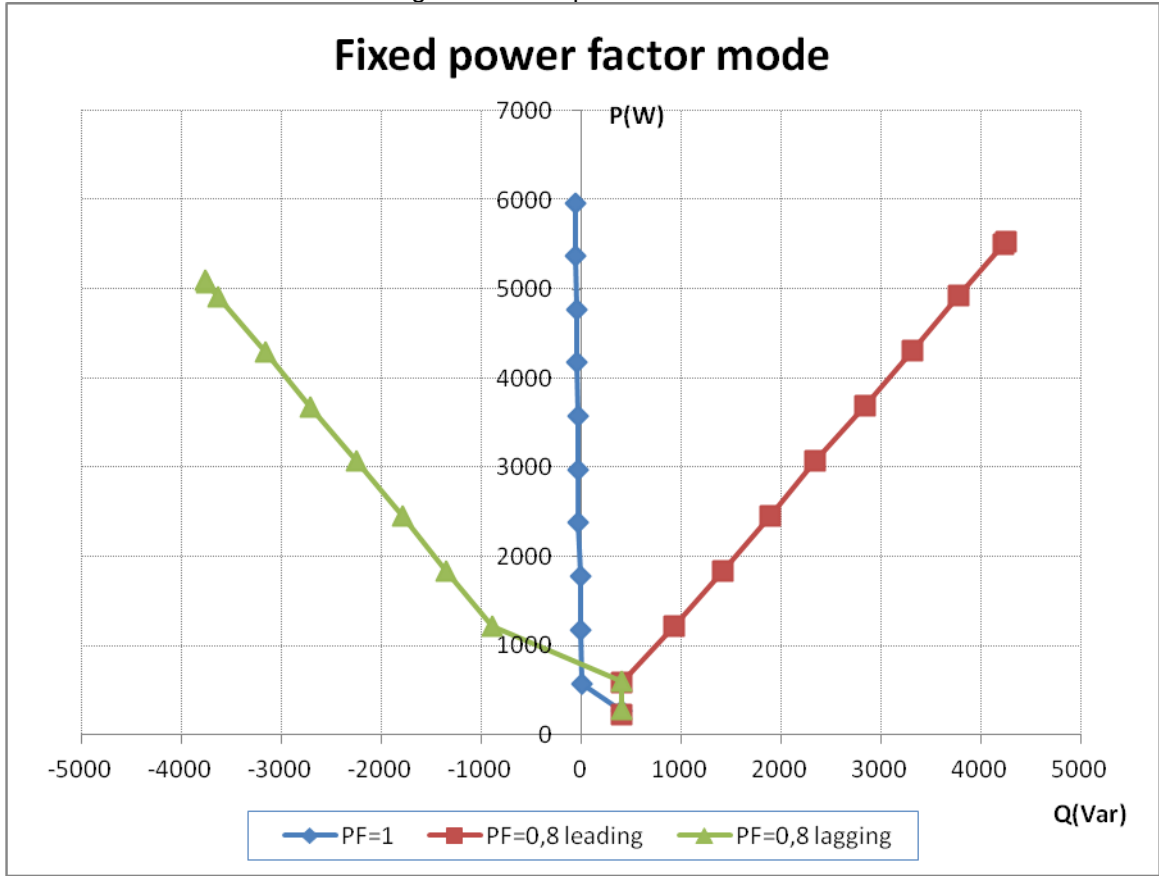
Each power-bin must be kept for at least 3 minute.

If the inverter is capable of operating with reactive power mode, the maximum ratio of reactive power (vars) to rated apparent power should be 100%.

If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.

6.3.3 Fixed power factor mode and reactive power mode RPI M6A											P
Fixed power factor mode											
P/P <sub>rated</sub> in %	5	10	20	30	40	50	60	70	80	90	100
Setting PF cosφ = 1											
U (V)	230,2	230,2	230,2	230,2	230,2	230,3	230,3	230,4	230,3	230,3	230,3
Power (kW)	269	570	1175	1779	2378	2980	3580	4179	4776	5371	5965
Reactive power (kvar)	0,408	0,004	-0,003	-0,008	-0,027	-0,033	-0,039	-0,046	-0,052	-0,058	-0,064
Power factor	0,551	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
PF = 0,8 leading											
U (V)	230,0	230,0	230,1	230,1	230,1	230,1	230,1	230,2	230,2	230,2	230,2
Power (kW)	0,226	0,584	1,218	1,843	2,462	3,080	3,695	4,309	4,922	5,500	5,537
Reactive power (kVar)	0,402	0,399	0,932	1,409	1,889	2,342	2,839	3,308	3,780	4,224	4,250
Power factor	0,491	0,826	0,794	0,794	0,793	0,796	0,793	0,793	0,793	0,793	0,793
PF = 0,8 lagging											
U (V)	230,0	230,0	230,1	230,1	230,1	230,1	230,1	230,1	230,1	230,1	230,1
Power (kW)	0,285	0,597	1,213	1,836	2,454	3,071	3,685	4,299	4,911	5,078	5,095
Reactive power (kVar)	0,400	0,398	-0,892	-1,353	-1,793	-2,252	-2,712	-3,167	-3,631	-3,757	-3,769
Power factor	0,581	0,832	0,806	0,805	0,807	0,806	0,805	0,805	0,804	0,804	0,804

Diagram of fixed power factor mode



The diagram is a scatter plot with lines connecting the points, titled 'Fixed power factor mode'. The vertical axis is labeled 'P(W)' and ranges from 0 to 7000. The horizontal axis is labeled 'Q(Var)' and ranges from -5000 to 5000. There are three data series:
 

- PF=1 (blue diamonds):** A vertical line at Q=0, starting from P=0 and going up to P=6000.
- PF=0,8 leading (red squares):** A curve starting from the origin (0,0) and extending into the first quadrant (positive P, positive Q), reaching approximately (4250, 5500).
- PF=0,8 lagging (green triangles):** A curve starting from the origin (0,0) and extending into the second quadrant (positive P, negative Q), reaching approximately (-3800, 5200).

 The legend at the bottom identifies the series: PF=1 (blue diamond), PF=0,8 leading (red square), and PF=0,8 lagging (green triangle).

**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 100%.

If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.

**Reactive power mode**

Var/rated VA in %	5	10	20	30	40	50	60	70	80	90	100
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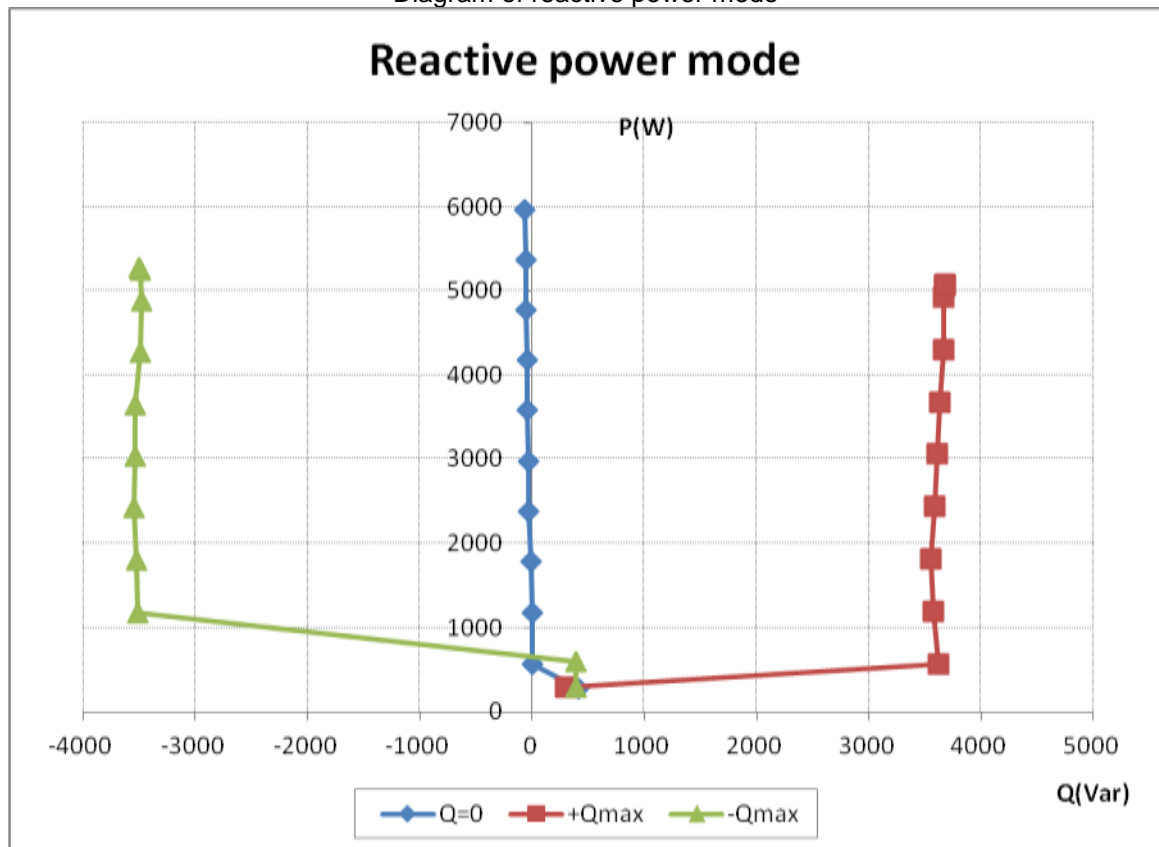
**Reactive power in leading**

U (V)	230,0	230,1	230,1	230,1	230,1	230,1	230,1	230,2	230,1	230,2	230,2
Power (kW)	0,284	0,561	1,190	1,817	2,441	3,064	3,684	4,305	4,924	5,060	5,076
Reactive power (kVar)	0,303	3,621	3,569	3,557	3,585	3,614	3,636	3,664	3,661	3,679	3,682
Power factor	0,569	0,153	0,316	0,455	0,563	0,647	0,712	0,762	0,802	0,809	0,809

**Reactive power in lagging**

U (V)	230,0	230,0	229,9	230,0	230,0	230,0	230,0	230,1	230,1	230,2	230,2
Power (kW)	0,285	0,597	1,173	1,802	2,426	3,043	3,652	4,271	4,888	5,254	5,277
Reactive power (kVar)	0,396	0,394	-3,507	-3,529	-3,548	-3,539	-3,534	-3,489	-3,482	-3,490	-3,505
Power factor	0,584	0,835	0,317	0,455	0,564	0,652	0,719	0,774	0,814	0,833	0,833

Diagram of reactive power mode

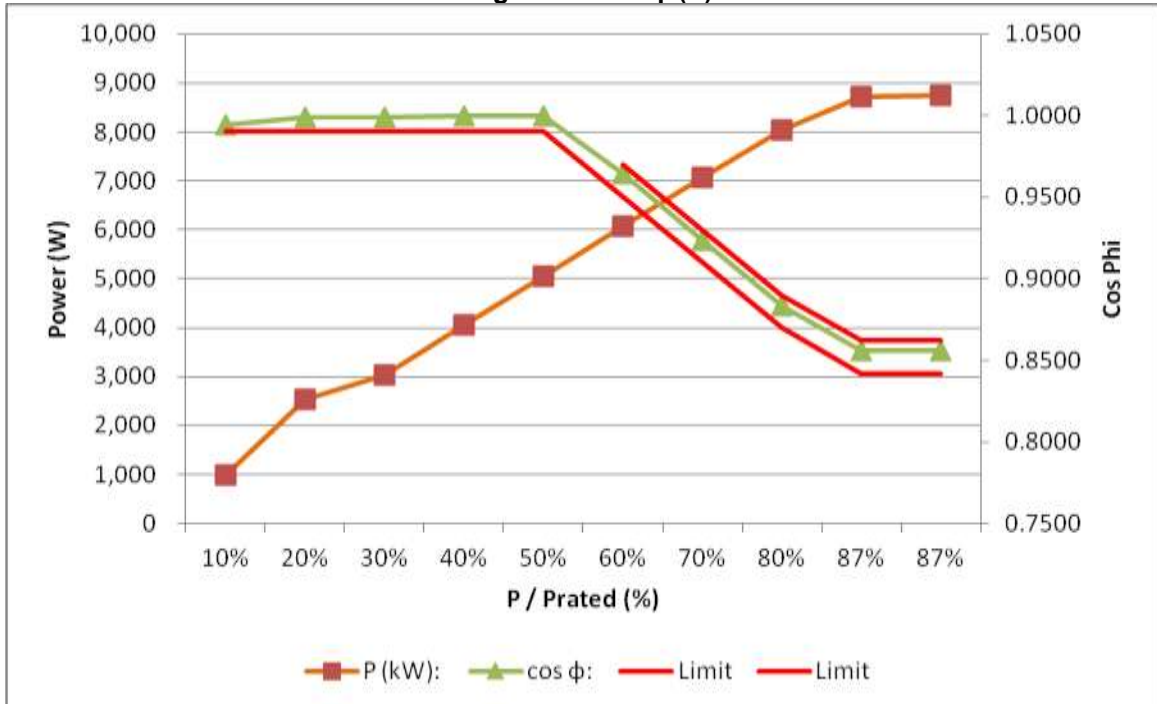

**Note:**

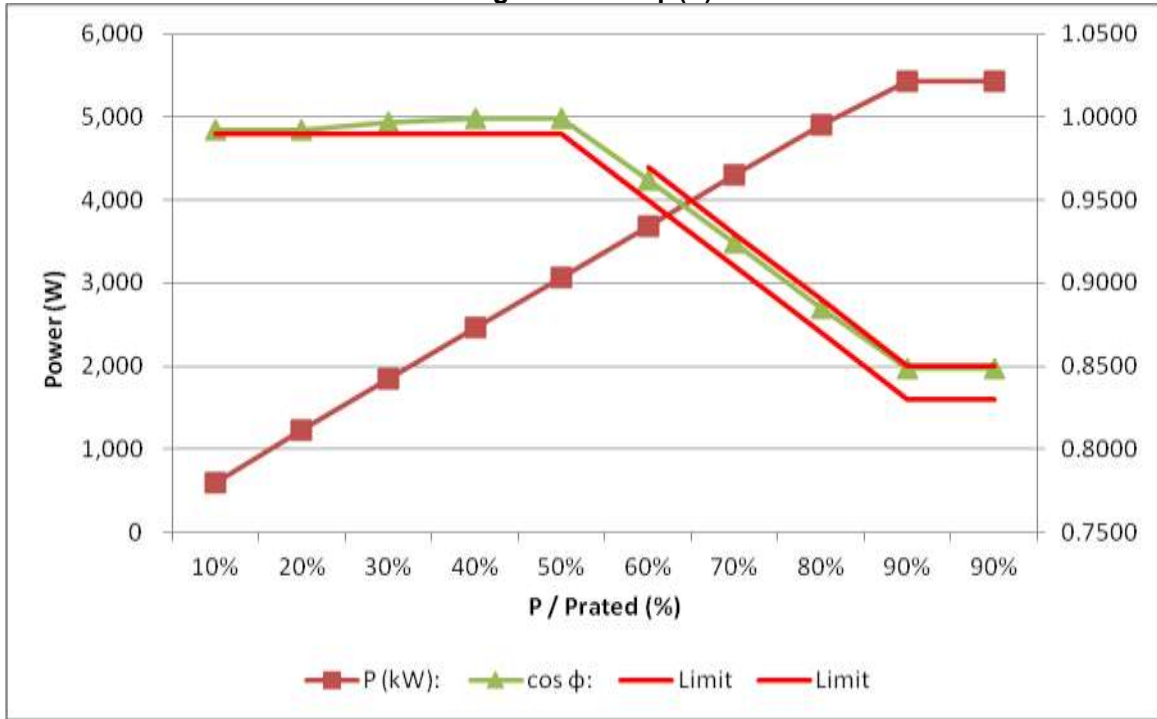
The grid-connected inverter of power plant type shall be evaluated.

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 100%.

If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.

6.3.4 characteristic power factor curve for cos φ (P) (Power response) RPI M10A										P
cos φ (P)										
P/P <sub>rated</sub> (%)	10	20	30	40	50	60	70	80	90	100
30 s mean value	10% to 100% P <sub>rated</sub>									
U (V):	230,40	230,47	230,50	230,55	230,56	230,48	230,47	230,46	230,45	230,45
P (kW):	0,992	2,521	3,031	4,049	5,062	6,064	7,059	8,047	8,722	8,733
P / P <sub>rated</sub> (%):	9,92	25,21	30,31	40,49	50,62	60,64	70,59	80,47	87,22	87,33
Q (kVar):	0,109	0,104	0,109	0,119	0,128	-1,665	-2,930	-4,276	-5,273	-5,275
cos φ:	0,9940	0,9991	0,9994	0,9996	0,9997	0,9643	0,9236	0,8831	0,8558	0,8560
cos φ <sub>setpoint</sub> of P:	1,000	1,000	1,000	1,000	1,000	0,960	0,920	0,880	0,852	0,852
Limit cos φ :	cos φ <sub>setpoint</sub> ± 0,01									
<div>Diagram of cos φ (P)</div>  <div>■ P (kW): ▲ cos φ: — Limit — Limit</div>										
<div>Note:</div> <div>The response curve required for the cos φ (P) response should be defined within displacement power factor range of 0.9 leading to 0.9 lagging.</div>										

6.3.4 characteristic power factor curve for cos φ (P) (Power response) RPI M6A										P
cos φ (P)										
P/P <sub>rated</sub> (%)	10	20	30	40	50	60	70	80	90	100
30 s mean value	10% to 100% P <sub>rated</sub>									
U (V):	229,96	229,99	230,01	230,04	230,06	230,04	230,04	230,05	230,06	230,06
P (kW):	0,597	1,222	1,846	2,467	3,073	3,685	4,296	4,903	5,424	5,424
P / P <sub>rated</sub> (%):	9,95	20,37	30,76	41,11	51,21	61,42	71,60	81,72	90,40	90,40
Q (kVar):	0,76	0,151	0,141	0,086	0,097	-1,042	-1,777	-2,581	-3,377	-3,379
cos φ:	0,9919	0,9924	0,9971	0,9994	0,9995	0,9623	0,9241	0,8849	0,8489	0,8488
cos φ <sub>setpoint</sub> of P:	1,000	1,000	1,000	1,000	1,000	0,96	0,92	0,88	0,84	0,84
Limit cos φ :	cos φ <sub>setpoint</sub> ± 0,01									
Diagram of cos φ (P)										
 <p>Power (W)</p> <p>P / Prated (%)</p> <p>—■— P (kW): —▲— cos φ: — Limit — Limit</p>										
Note: The response curve required for the cos φ (P) response should be defined within displacement power factor range of 0.9 leading to 0.9 lagging.										

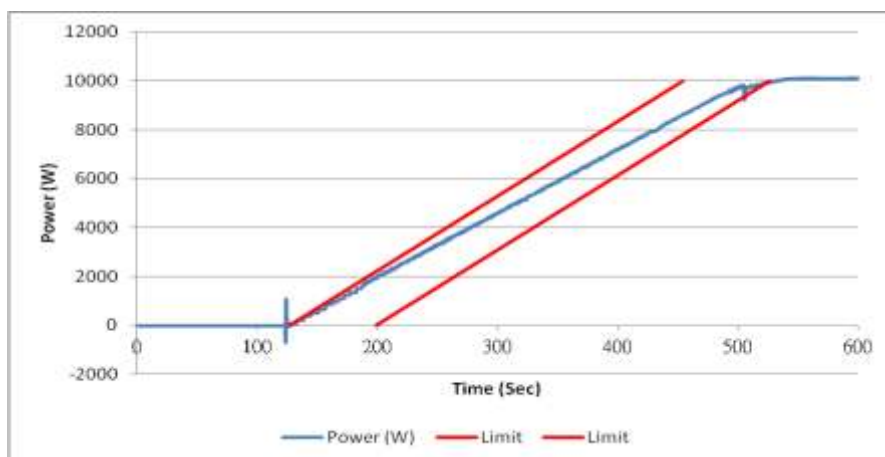
### 6.3.5 Power rate limit

**P**

#### 6.3.5.3.2 Test (a): Soft ramp up after connect or reconnect

Time measurement from 0% to 100% $P_{rated}$ (min)	6,267
$W_{Gra}$	15,95
Limit $W_{Gra}$ : (Default : 16,67%)	15,15% - 18,52%

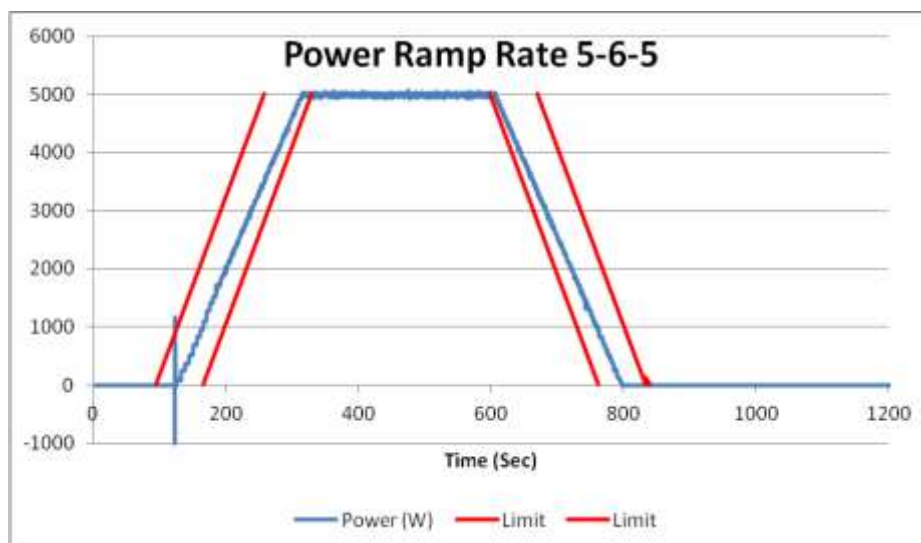
**Diagram of Soft ramp up after connect or reconnect**



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

DRM mode	DRM 5 and DRM 6	DRM 6 and DRM 5
Power change (%)	Increase: 0 % to 50 %	Decrease: 50 % to 0 %
Time measurement (min)	3,21	3,237
$W_{Gra}$	15,58	15,44
Limit $W_{Gra}$ : (Default : 16,67%)	15,15% - 18,52%	15,15% - 18,52%

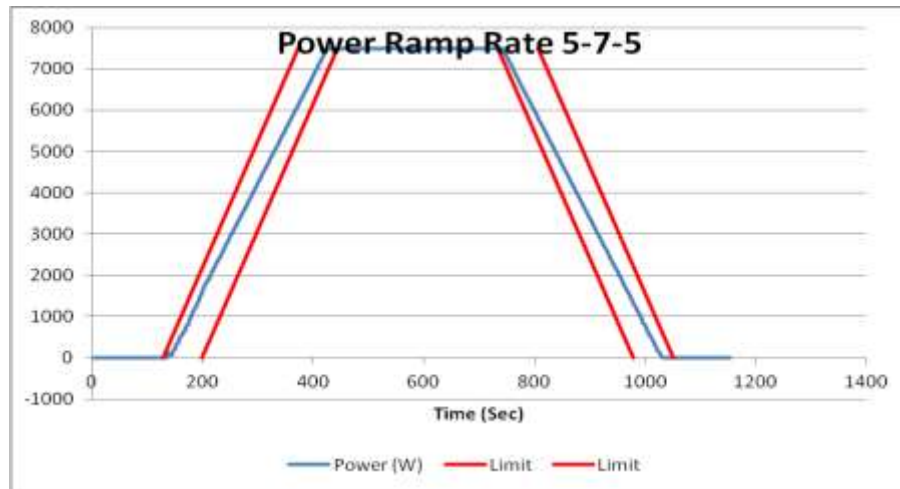
**Diagram of Change in a.c. operation and control**



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

DRM mode	DRM 5 and DRM 7	DRM 7 and DRM 5
Power change (%)	Increase: 0 % to 75 %	Decrease: 75 % to 0 %
Time measurement	4,79	4,92
$W_{Gra}$	15,65	15,24
Limit $W_{Gra}$ : (Default : 16,67%)	15,15% - 18,52%	15,15% - 18,52%

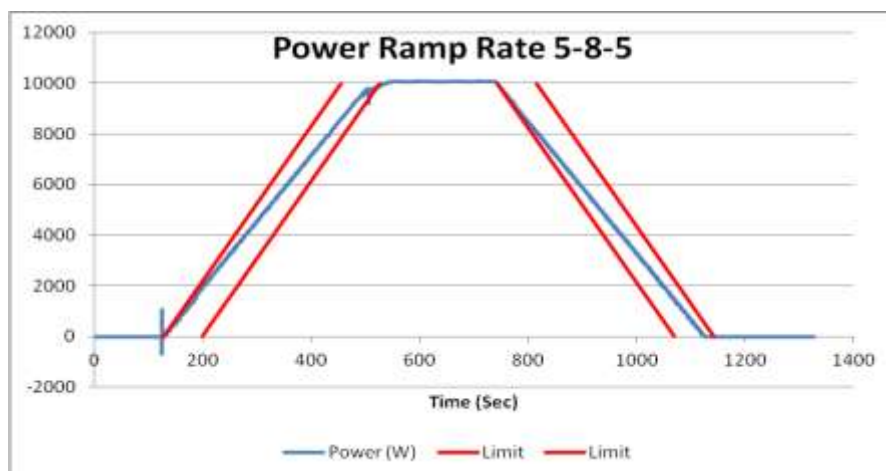
Diagram of Change in a.c. operation and control



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

DRM mode	DRM 5 and DRM 8	DRM 8 and DRM 5
Power change (%)	Increase: 0 % to 100 %	Decrease: 100 % to 0 %
Time measurement	6,267	6,283
$W_{Gra}$	15,95	15,92
Limit $W_{Gra}$ : (Default : 16,67%)	15,15% - 18,52%	15,15% - 18,52%

Diagram of Change in a.c. operation and control



**6.3.5.3.4 Test (c): Change in energy source operation (only for multiple mode inverters with energy storage)**

DRM mode	-	-
Power change	Increase: _____% to _____%	Decrease: _____% to _____%
Time measurement	-	-
$W_{Gra}$	-	-
Limit $W_{Gra}$ : (Default : 16,67%)	-	-

**Diagram of Change in energy source operation**

**6.3.5.4 Nonlinearity of power rate limit changes**

DRM mode	-	-
Power change	Increase: _____% to _____%	Decrease: _____% to _____%
Time measurement	-	-
$W_{Gra}$	-	-
Limit $W_{Gra}$ : (Default : 16,67%)	-	-

**Diagram of Nonlinearity of power rate limit changes**

6.4.2 Sinusoidal output in stand-alone mode Appendix C Harmonic Current Limit Test (stand-alone mode)							N/A
Generating Unit rating per phase (rpp)							
	At 50% of rated output current			100% of rated output currentA			
	Watts	-		Watts	-		
	VA	-		VA	-		
	Vrms	-		Vrms	-		
	Arms	-		Arms	-		
	PF	-		PF	-		
	Frequency	-		Frequency	-		
Harmonic	Value A	Angle degrees	% of fundamental	Value A	Angle degrees	% of fundamental	Limit in % of fundamental
0	-	-	-	-	-	-	0,5%
1st	-	-	-	-	-	-	100%
2nd	-	-	-	-	-	-	1%
3rd	-	-	-	-	-	-	4%
4th	-	-	-	-	-	-	1%
5th	-	-	-	-	-	-	4%
6th	-	-	-	-	-	-	1%
7th	-	-	-	-	-	-	4%
8th	-	-	-	-	-	-	1%
9th	-	-	-	-	-	-	2%
10th	-	-	-	-	-	-	0,5%
11th	-	-	-	-	-	-	2%
12th	-	-	-	-	-	-	0,5%
13th	-	-	-	-	-	-	2%
14th	-	-	-	-	-	-	0,5%
15th	-	-	-	-	-	-	1%
16th	-	-	-	-	-	-	0,5%
17th	-	-	-	-	-	-	1%
18th	-	-	-	-	-	-	0,5%
19th	-	-	-	-	-	-	1%
20th	-	-	-	-	-	-	0,5%
21th	-	-	-	-	-	-	0,6%
22th	-	-	-	-	-	-	0,5%
23th	-	-	-	-	-	-	0,6%
24th	-	-	-	-	-	-	0,5%
25th	-	-	-	-	-	-	0,6%
26th	-	-	-	-	-	-	0,5%
27th	-	-	-	-	-	-	0,6%
28th	-	-	-	-	-	-	0,5%
29th	-	-	-	-	-	-	0,6%
30th	-	-	-	-	-	-	0,5%
31th	-	-	-	-	-	-	0,6%
32th	-	-	-	-	-	-	0,5%
33th	-	-	-	-	-	-	0,6%
THD (to 50th)	-	-	-	-	-	-	5%
<b>Note:</b> 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%.							

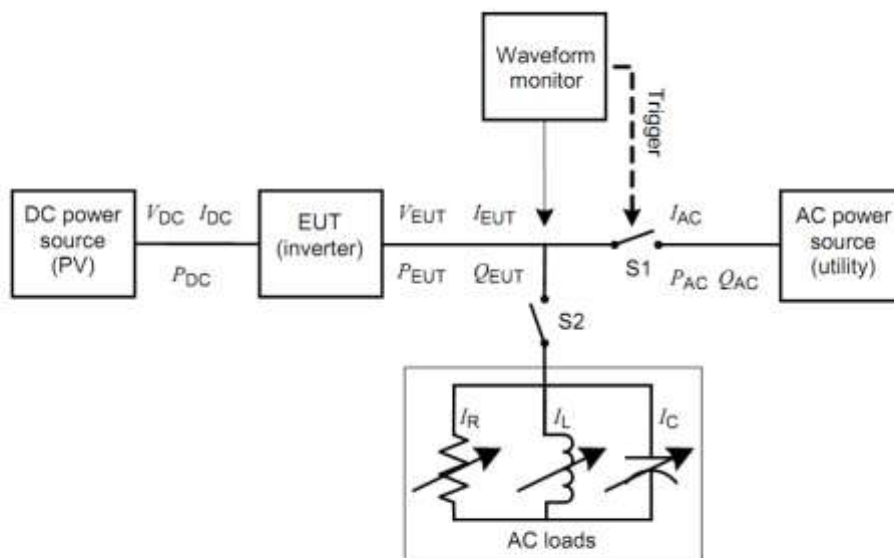
6.4.3 Volt-watt response mode for charging of energy storage				N/A
Test value	a) V1	b) V2	c) V3	d) V4
Voltage (V)	-	-	-	-
P (kW)	-	-	-	-
P/P <sub>rated</sub> (%)	-	-	-	-
Diagram of volt-watt response mode				
Note:				

### 7.3 Active anti-islanding protection

#### Test circuit and parameters

Parameter	Symbol	Units
<b>EUT DC Input</b>		
DC voltage	$V_{DC}$	V
DC Current	$I_{DC}$	A
DC Power	$P_{DC}$	W
<b>EUT AC output</b>		
AC voltage	$V_{EUT}$	V
AC current	$I_{EUT}$	A
Real power	$P_{EUT}$	W
Reactive power	$Q_{EUT}$	VA <sub>r</sub>
<b>Test Load</b>		
Resistive load current	$I_R$	A
Inductive load current	$I_L$	A
Capacitive load current	$I_C$	A
<b>AC (utility) power source</b>		
Utility real power	$P_{AC}$	W
Utility reactive power	$Q_{AC}$	VA <sub>r</sub>
Utility current	$I_{AC}$	A

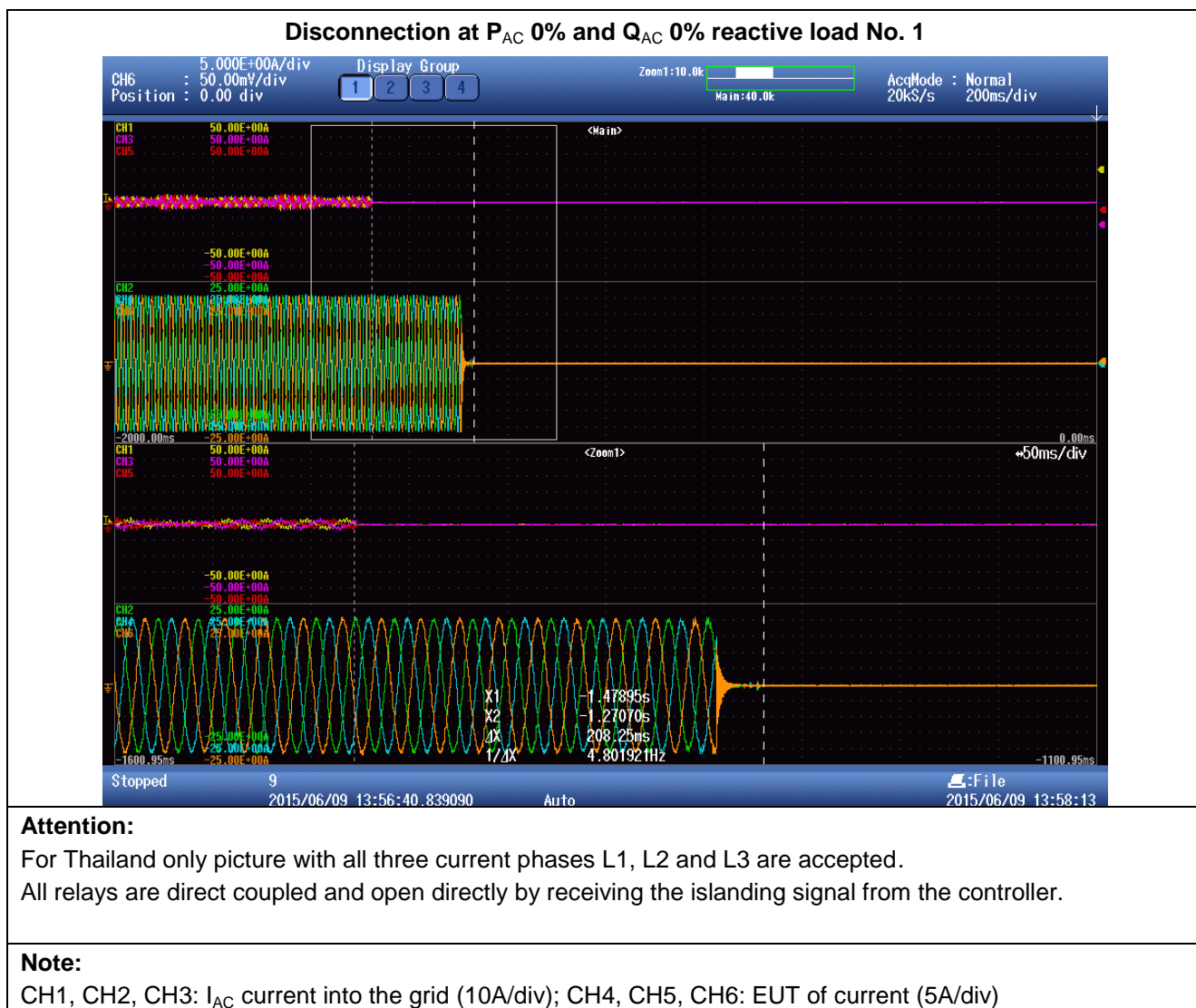
#### Block diagram test circuit IEC 62116:2008



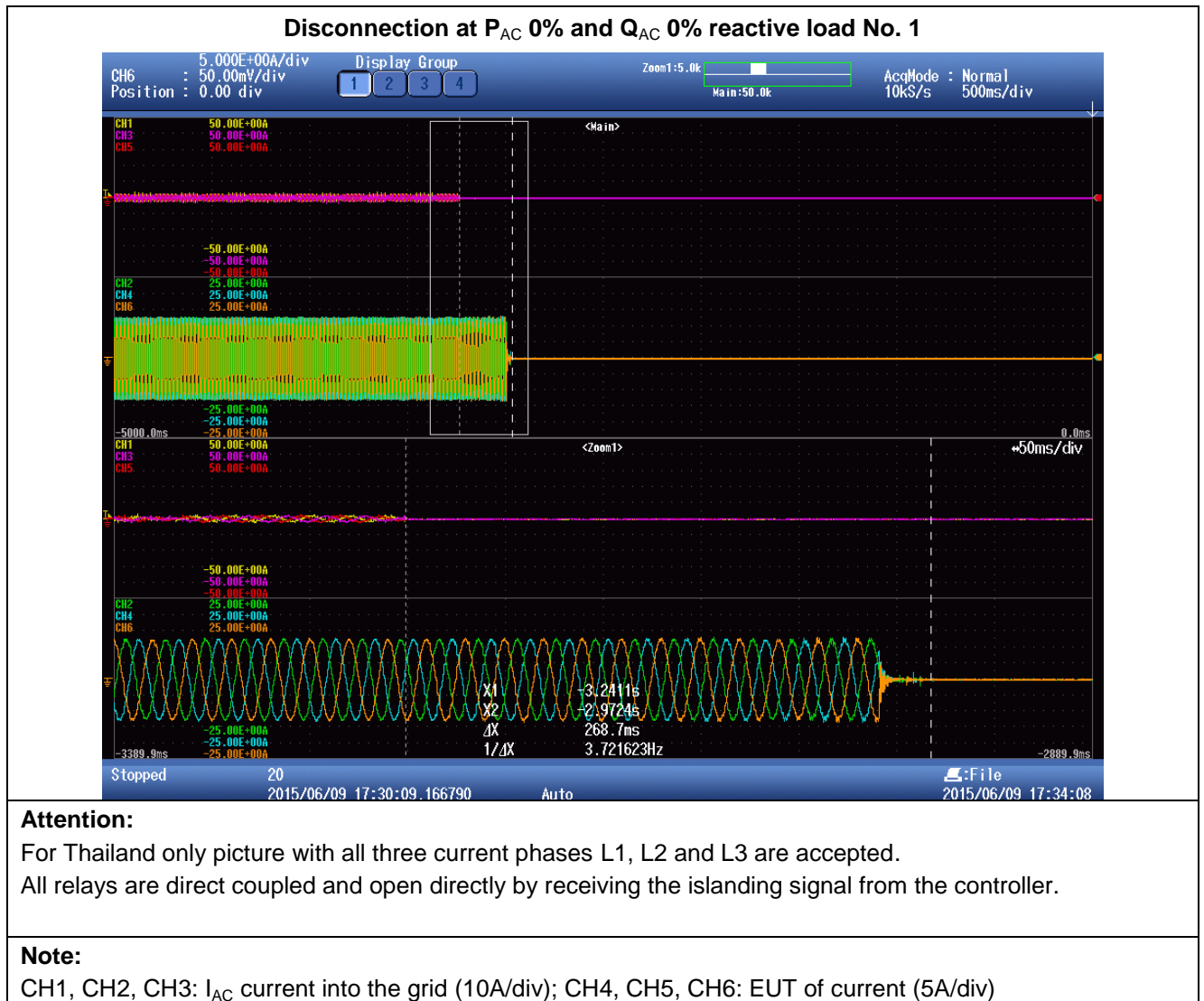
IEC 1567/08

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

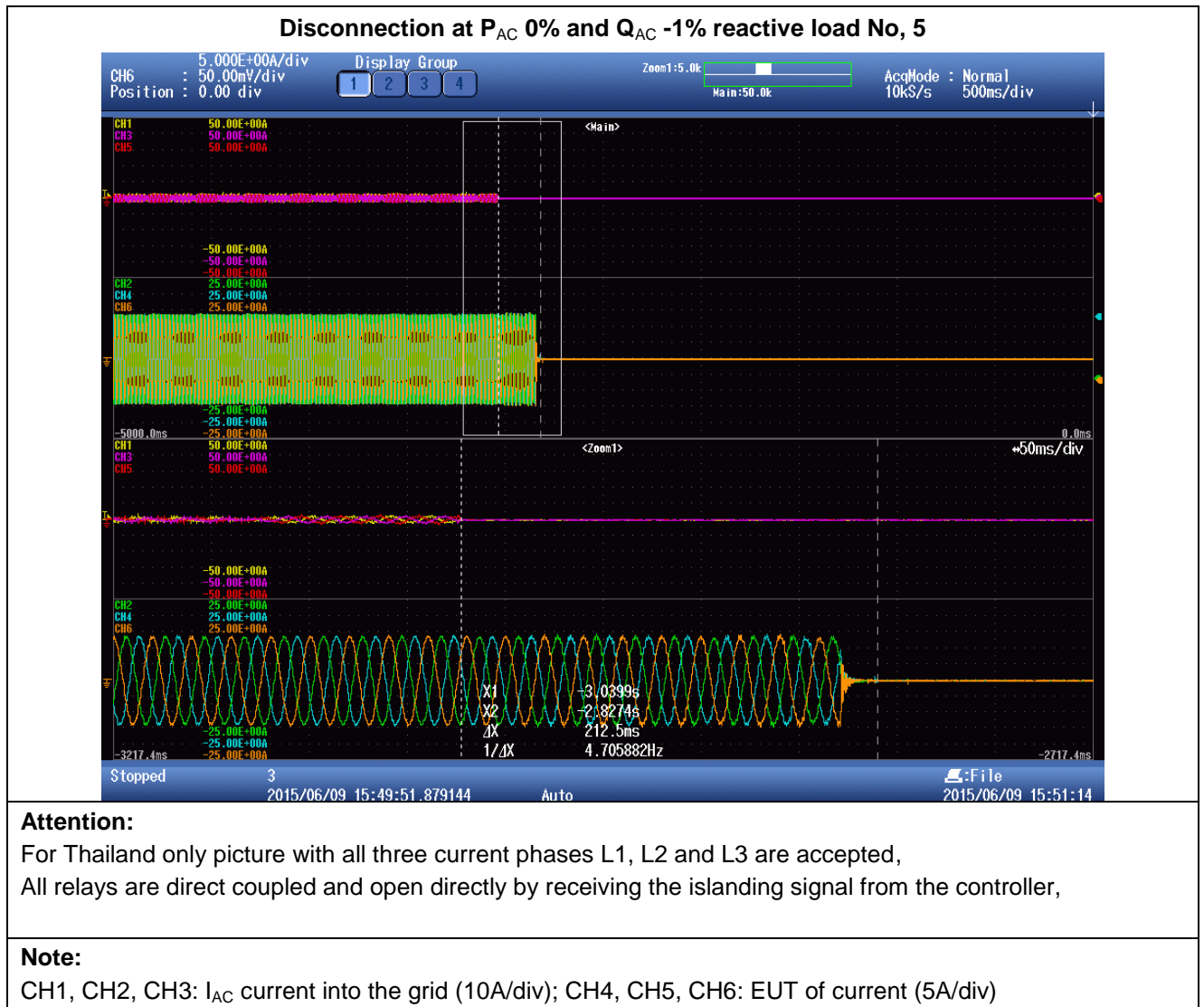
Islanding protection according table 6 - Load imbalance (real, reactive load) for test condition A (EUT output = 100%)										P
<b>Test: RPI M10A</b>										
Test conditions			Frequency: 50+/-0,1Hz U <sub>N</sub> =230 +/-3Vac Distortion factor of chokes < 2% Quality = 1							
Disconnection limit			2s (IEC 62116)							
No	P <sub>EUT</sub> <sup>1)</sup> [% of EUT rating]	Reactive load [% of Q <sub>L</sub> in 6.1.d] <sup>1)</sup>	P <sub>AC</sub> <sup>2)</sup> [% of nominal]	Q <sub>AC</sub> <sup>3)</sup> [% of nominal]	I <sub>AC</sub> <sup>4)</sup> [A]	Run on Time [ms]	P <sub>EUT</sub> [kW per phase]	Actual Q <sub>f</sub>	V <sub>DC</sub> [V]	Remarks <sup>5)</sup>
1	100	100	0	0	0.12	208	3,333	1,000	762	Test A at BL
8	100	100	-5	-5	0.83	172	3,333	1,026	762	Test A at IB
9	100	100	-5	0	0.85	190	3,333	1,053	762	Test A at IB
10	100	100	-5	+5	0.83	166	3,333	1,079	762	Test A at IB
13	100	100	0	-5	0.14	184	3,333	0,975	762	Test A at IB
14	100	100	0	+5	0.14	178	3,333	1,025	762	Test A at IB
17	100	100	+5	-5	0.86	164	3,333	0,928	762	Test A at IB
18	100	100	+5	0	0.85	180	3,333	0,953	762	Test A at IB
19	100	100	+5	+5	0.86	148	3,333	0,976	762	Test A at IB
Parameter at 0% per phase			L=	50,4	mH	R=	16,2	Ω	C=	200,5 μF
<b>Note:</b> RLC is adjusted to min. +/-1% of the inverter rated output power <sup>1)</sup> P <sub>EUT</sub> : EUT output power <sup>2)</sup> P <sub>AC</sub> : Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>3)</sup> Q <sub>AC</sub> : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>4)</sup> Fundamental of I <sub>AC</sub> when RLC is adjusted <sup>5)</sup> BL: Balance condition, IB: Imbalance condition.  Condition A: EUT output power P <sub>EUT</sub> = Maximum <sup>5)</sup> EUT input voltage <sup>6)</sup> = >90% of rated input voltage range <sup>6)</sup> Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output. <sup>7)</sup> Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range = X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range. Test Data refers to report No "PV150512C16"										



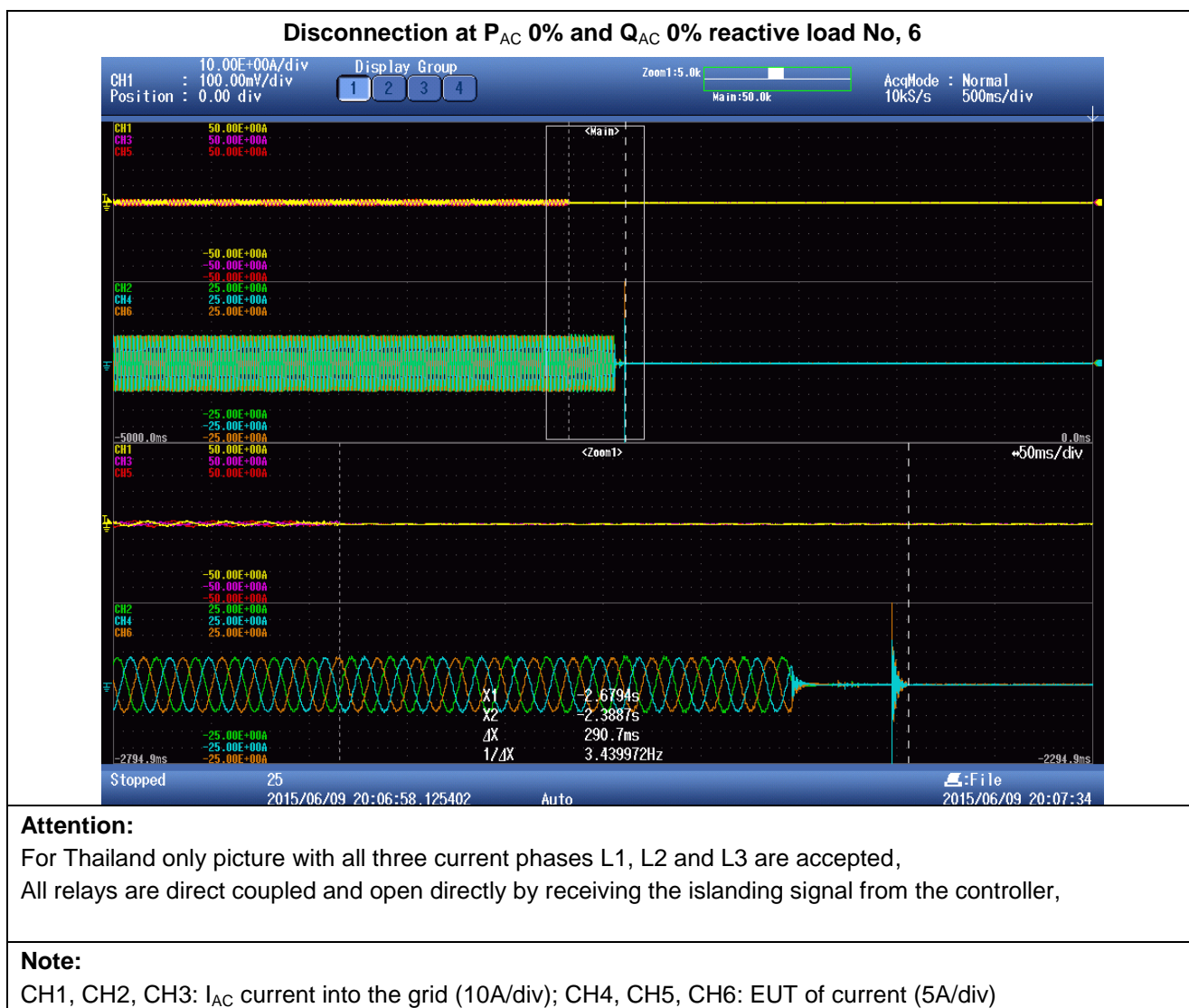
Test: RPI M6A										
Test conditions			Frequency: 50+/-0,1Hz $U_N=230 \pm 3V_{ac}$ Distortion factor of chokes < 2% Quality = 1							
Disconnection limit			2s (IEC 62116)							
No	$P_{EUT}^{1)}$ [% of EUT rating]	Reactive load [% of $Q_L$ in 6.1.d] <sup>1)</sup>	$P_{AC}^{2)}$ [% of nominal]	$Q_{AC}^{3)}$ [% of nominal]	$I_{AC}^{4)}$ [A]	Run on Time [ms]	$P_{EUT}$ [kW per phase]	Actual $Q_f$	$V_{DC}$ [V]	Remarks <sup>5)</sup>
1	100	100	0	0	0,09	269	2,000	1,000	752	Test A at BL
8	100	100	-5	-5	0,51	184	2,000	1,026	752	Test A at IB
9	100	100	-5	0	0,52	216	2,000	1,053	752	Test A at IB
10	100	100	-5	+5	0,51	191	2,000	1,079	752	Test A at IB
13	100	100	0	-5	0,10	219	2,000	0,975	752	Test A at IB
14	100	100	0	+5	0,10	208	2,000	1,025	752	Test A at IB
17	100	100	+5	-5	0,53	178	2,000	0,928	752	Test A at IB
18	100	100	+5	0	0,52	208	2,000	0,952	752	Test A at IB
19	100	100	+5	+5	0,53	166	2,000	0,976	752	Test A at IB
Parameter at 0% per phase			L=	84,2	mH	R=	26,6	$\Omega$	C=	120,4 $\mu F$
<b>Note:</b> RLC is adjusted to min. +/-1% of the inverter rated output power <sup>1)</sup> $P_{EUT}$ : EUT output power <sup>2)</sup> $P_{AC}$ : Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>3)</sup> $Q_{AC}$ : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>4)</sup> Fundamental of $I_{AC}$ when RLC is adjusted <sup>5)</sup> BL: Balance condition, IB: Imbalance condition.  Condition A: EUT output power $P_{EUT} = \text{Maximum}$ <sup>5)</sup> EUT input voltage <sup>6)</sup> = >90% of rated input voltage range <sup>6)</sup> Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output. <sup>7)</sup> Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range = $X + 0,9 \times (Y - X)$ . Y shall not exceed $0,8 \times$ EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range. Test Data refers to report No "PV150512C16"										



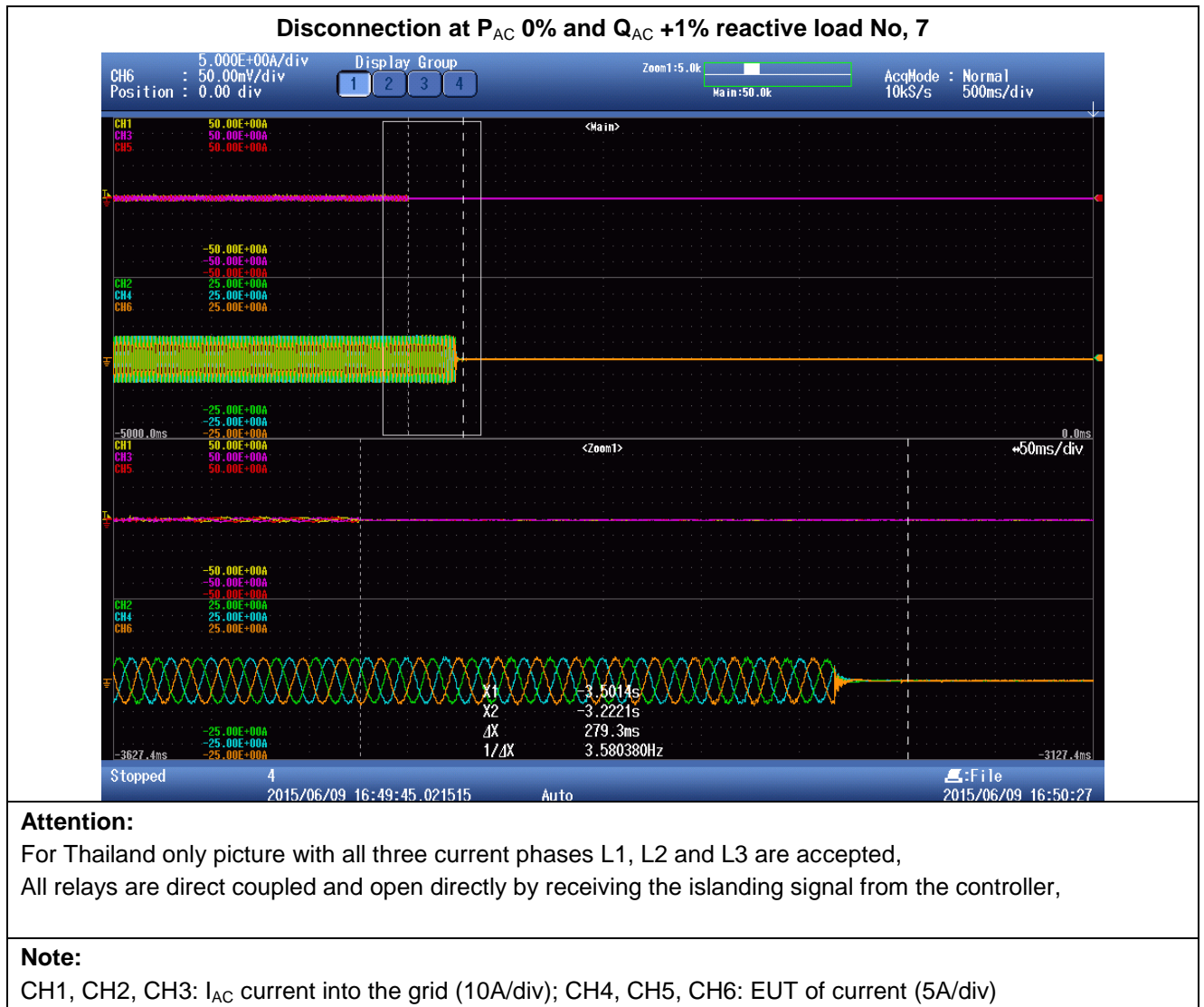
Islanding protection according table 6 - Load imbalance (real, reactive load) for test condition B (EUT output = 50% – 66%)										P
Test: RPI M10A										
Test conditions			Frequency: 50+/-0,1Hz U <sub>N</sub> =230 +/-3Vac Distortion factor of chokes < 2% Quality = 1							
Disconnection limit			2s (IEC 62116)							
No	P <sub>EUT</sub> <sup>1)</sup> [% of EUT rating]	Reactive load [% of Q <sub>L</sub> in 6.1.d] <sup>1)</sup>	P <sub>AC</sub> <sup>2)</sup> [% of nominal]	Q <sub>AC</sub> <sup>3)</sup> [% of nominal]	I <sub>AC</sub> <sup>4)</sup> [A]	Run on Time [ms]	P <sub>EUT</sub> [kW per phase]	Actual Q <sub>f</sub>	V <sub>DC</sub> [V]	Remarks <sup>5)</sup>
1	66	66	0	-5	0,13	173	2,200	0,975	608	Test B at IB
2	66	66	0	-4	0,13	196	2,200	0,980	608	Test B at IB
3	66	66	0	-3	0,12	204	2,200	0,985	608	Test B at IB
4	66	66	0	-2	0,12	210	2,200	0,990	608	Test B at IB
5	66	66	0	-1	0,12	213	2,200	0,995	608	Test B at IB
6	66	66	0	0	0,12	211	2,200	1,000	608	Test B at BL
7	66	66	0	+1	0,12	208	2,200	1,005	608	Test B at IB
8	66	66	0	+2	0,12	200	2,200	1,010	608	Test B at IB
9	66	66	0	+3	0,12	199	2,200	1,015	608	Test B at IB
10	66	66	0	+4	0,13	183	2,200	1,020	608	Test B at IB
11	66	66	0	+5	0,13	175	2,200	1,025	608	Test B at IB
Parameter at 0% per phase			L=	76,5	mH	R=	24,2	Ω	C=	133 μF
<b>Note:</b> RLC is adjusted to min, +/-1% of the inverter rated output power <sup>1)</sup> P <sub>EUT</sub> : EUT output power <sup>2)</sup> P <sub>AC</sub> : Real power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value, <sup>3)</sup> Q <sub>AC</sub> : Reactive power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value, <sup>4)</sup> Fundamental of I <sub>AC</sub> when RLC is adjusted <sup>5)</sup> BL: Balance condition, IB: Imbalance condition,  Condition B: EUT output power P <sub>EUT</sub> = 50 % – 66 % of maximum EUT input voltage <sup>5)</sup> = 50 % of rated input voltage range, ±10 % <sup>6)</sup> Based on EUT rated input operating range, For example, If range is between X volts and Y volts, 50 % of range =X + 0,5 × (Y – X), Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage), In any case, the EUT should not be operated outside of its allowable input voltage range. Test Data refers to report No “PV150512C16”										



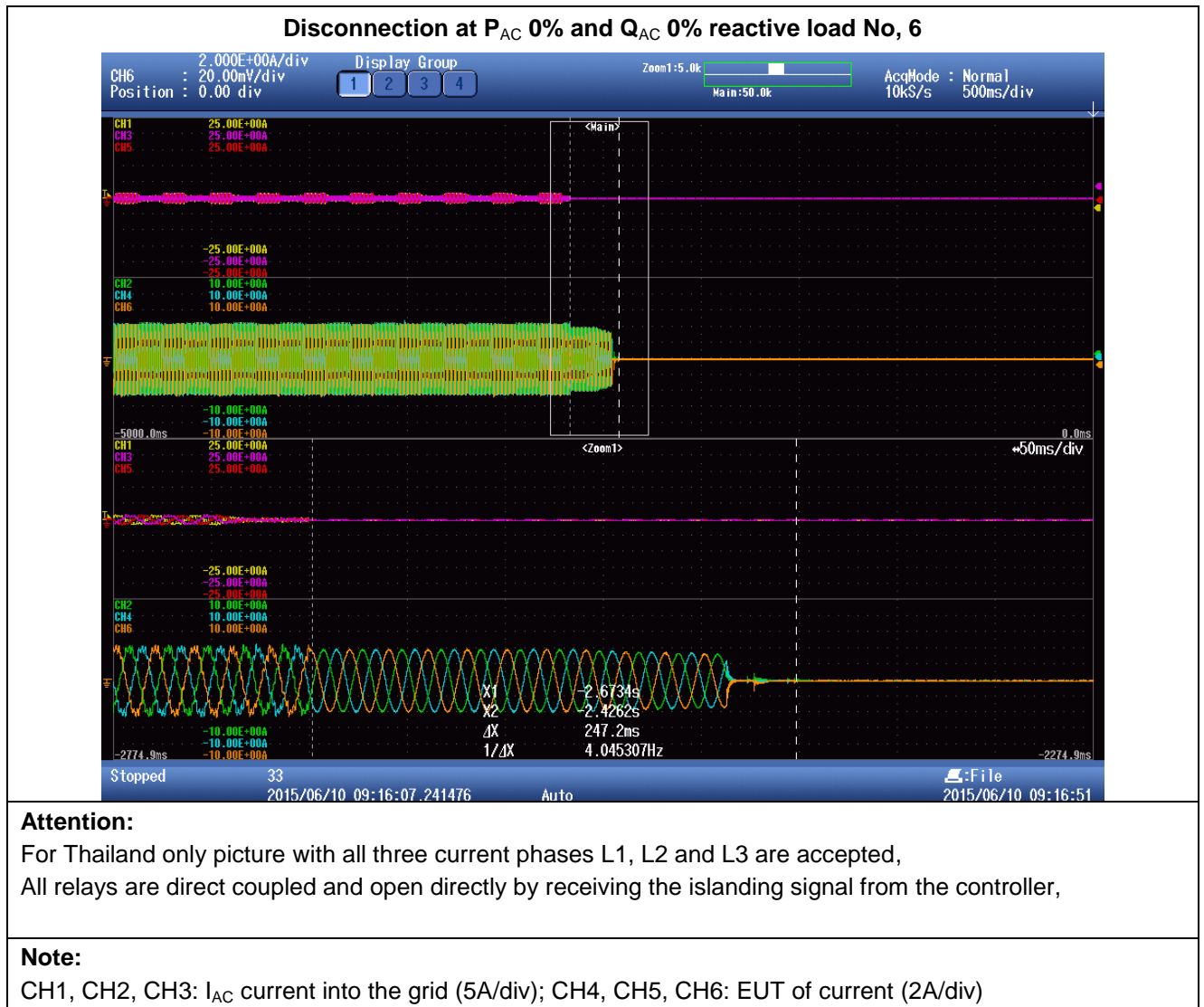
Test: RPI M6A										
Test conditions			Frequency: 50+/-0,1Hz $U_N=230 \pm 3V_{ac}$ Distortion factor of chokes < 2% Quality = 1							
Disconnection limit			2s (IEC 62116)							
No	$P_{EUT}^{1)}$ [% of EUT rating]	Reactive load [% of $Q_L$ in 6.1.d] <sup>1)</sup>	$P_{AC}^{2)}$ [% of nominal]	$Q_{AC}^{3)}$ [% of nominal]	$I_{AC}^{4)}$ [A]	Run on Time [ms]	$P_{EUT}$ [kW per phase]	Actual $Q_f$	$V_{DC}$ [V]	Remarks <sup>5)</sup>
1	66	66	0	-5	0,08	178	1,320	0,975	558	Test B at IB
2	66	66	0	-4	0,08	189	1,320	0,980	558	Test B at IB
3	66	66	0	-3	0,08	188	1,320	0,985	558	Test B at IB
4	66	66	0	-2	0,07	205	1,320	0,990	558	Test B at IB
5	66	66	0	-1	0,07	287	1,320	0,995	558	Test B at IB
6	66	66	0	0	0,07	291	1,320	1,000	558	Test B at BL
7	66	66	0	+1	0,07	282	1,320	1,005	558	Test B at IB
8	66	66	0	+2	0,07	250	1,320	1,010	558	Test B at IB
9	66	66	0	+3	0,08	233	1,320	1,015	558	Test B at IB
10	66	66	0	+4	0,08	204	1,320	1,020	558	Test B at IB
11	66	66	0	+5	0,08	172	1,320	1,025	558	Test B at IB
Parameter at 0% per phase			L=	127,6	mH	R=	40,1	$\Omega$	C=	79,5 $\mu F$
<p><b>Note:</b>  RLC is adjusted to min, +/-1% of the inverter rated output power  <sup>1)</sup> <math>P_{EUT}</math>: EUT output power  <sup>2)</sup> <math>P_{AC}</math>: Real power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value,  <sup>3)</sup> <math>Q_{AC}</math>: Reactive power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value,  <sup>4)</sup> Fundamental of <math>I_{AC}</math> when RLC is adjusted  <sup>5)</sup> BL: Balance condition, IB: Imbalance condition,</p> <p>Condition B:  EUT output power <math>P_{EUT} = 50 \% - 66 \%</math> of maximum  EUT input voltage <sup>5)</sup> = 50 % of rated input voltage range, <math>\pm 10 \%</math>  <sup>6)</sup> Based on EUT rated input operating range, For example, If range is between X volts and Y volts, 50 % of range = <math>X + 0,5 \times (Y - X)</math>, Y shall not exceed <math>0,8 \times</math> EUT maximum system voltage (i.e., maximum allowable array open circuit voltage), In any case, the EUT should not be operated outside of its allowable input voltage range.  Test Data refers to report No "PV150512C16"</p>										



Islanding protection according Table 7 – Load imbalance (reactive load) for test condition C (EUT output = 25% – 33%)										P
Test: RPI M10A										
Test conditions			Frequency: 50+/-0,1Hz U <sub>N</sub> =230 +/-3Vac Distortion factor of chokes < 2% Quality = 1							
Disconnection limit			2s (IEC 62116)							
No	P <sub>EUT</sub> <sup>1)</sup> [% of EUT rating]	Reactive load [% of Q <sub>L</sub> in 6.1.d] <sup>1)</sup>	P <sub>AC</sub> <sup>2)</sup> [% of nominal]	Q <sub>AC</sub> <sup>3)</sup> [% of nominal]	I <sub>AC</sub> <sup>4)</sup> [A]	Run on Time [ms]	P <sub>EUT</sub> [kW per phase]	Actual Q <sub>f</sub>	V <sub>DC</sub> [V]	Remarks <sup>5)</sup>
1	33	33	0	-5	0,10	188	1,100	0,975	454	Test B at IB
2	33	33	0	-4	0,09	200	1,100	0,980	454	Test B at IB
3	33	33	0	-3	0,09	216	1,100	0,985	454	Test B at IB
4	33	33	0	-2	0,09	239	1,100	0,990	454	Test B at IB
5	33	33	0	-1	0,09	248	1,100	0,995	454	Test B at IB
6	33	33	0	0	0,09	262	1,100	1,000	454	Test B at BL
7	33	33	0	+1	0,09	279	1,100	1,005	454	Test B at IB
8	33	33	0	+2	0,09	252	1,100	1,010	454	Test B at IB
9	33	33	0	+3	0,09	249	1,100	1,015	454	Test B at IB
10	33	33	0	+4	0,09	221	1,100	1,020	454	Test B at IB
11	33	33	0	+5	0,10	181	1,100	1,025	454	Test B at IB
Parameter at 0% per phase			L=	154	mH	R=	48,0	Ω	C=	67,0 μF
<b>Note:</b> RLC is adjusted to min. +/-1% of the inverter rated output power <sup>1)</sup> P <sub>EUT</sub> : EUT output power <sup>2)</sup> P <sub>AC</sub> : Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>3)</sup> Q <sub>AC</sub> : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>4)</sup> Fundamental of I <sub>AC</sub> when RLC is adjusted <sup>5)</sup> BL: Balance condition, IB: Imbalance condition.  Condition C: EUT output power P <sub>EUT</sub> = 25 % – 33 % <sup>5)</sup> of maximum EUT input voltage <sup>6)</sup> = <10 % of rated input voltage range <sup>6)</sup> Or minimum allowable EUT output level if greater than 33 %. <sup>7)</sup> Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range. Test Data refers to report No “PV150512C16”										

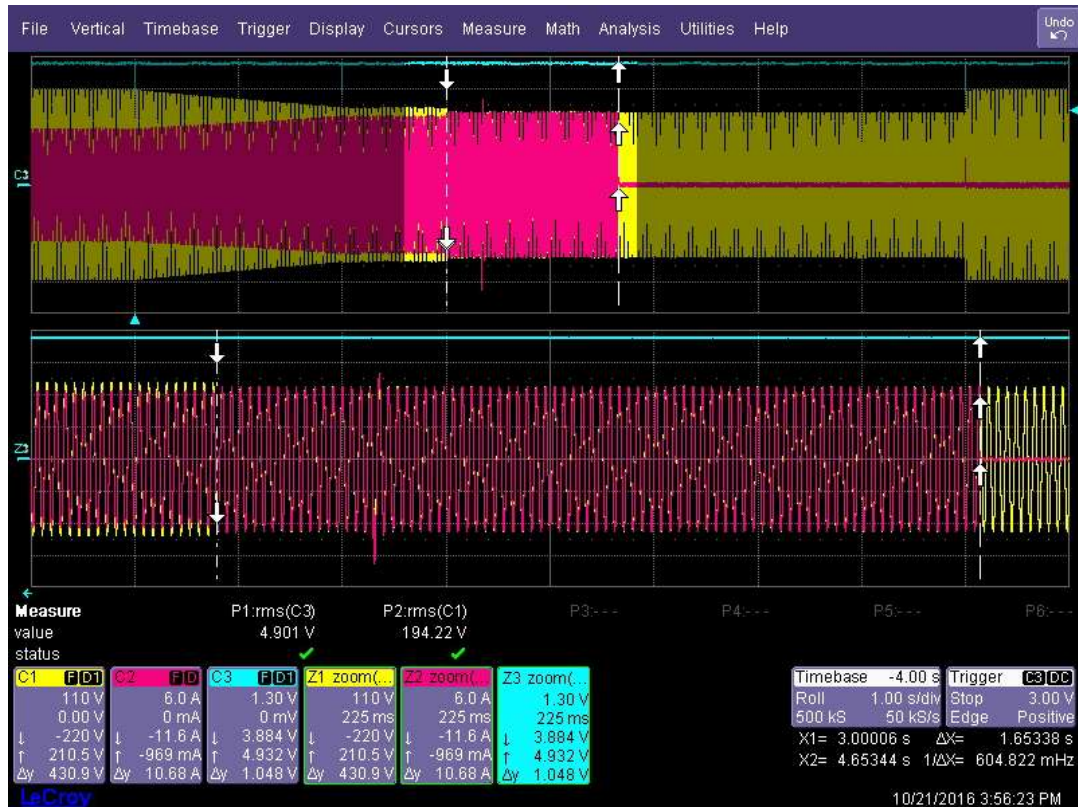


Test: RPI M6A										
Test conditions			Frequency: 50+/-0,1Hz U <sub>N</sub> =230 +/-3Vac Distortion factor of chokes < 2% Quality = 1							
Disconnection limit			2s (IEC 62116)							
No	P <sub>EUT</sub> <sup>1)</sup> [% of EUT rating]	Reactive load [% of Q <sub>L</sub> in 6.1.d] <sup>1)</sup>	P <sub>AC</sub> <sup>2)</sup> [% of nominal]	Q <sub>AC</sub> <sup>3)</sup> [% of nominal]	I <sub>AC</sub> <sup>4)</sup> [A]	Run on Time [ms]	P <sub>EUT</sub> [kW per phase]	Actual Q <sub>f</sub>	V <sub>DC</sub> [V]	Remarks <sup>5)</sup>
1	33	33	0	-5	0,06	196	0,660	0,975	364	Test B at IB
2	33	33	0	-4	0,06	202	0,660	0,980	364	Test B at IB
3	33	33	0	-3	0,06	224	0,660	0,985	364	Test B at IB
4	33	33	0	-2	0,06	233	0,660	0,990	364	Test B at IB
5	33	33	0	-1	0,06	243	0,660	0,995	364	Test B at IB
6	33	33	0	0	0,06	247	0,660	1,000	364	Test B at BL
7	33	33	0	+1	0,06	240	0,660	1,005	364	Test B at IB
8	33	33	0	+2	0,06	231	0,660	1,010	364	Test B at IB
9	33	33	0	+3	0,06	226	0,660	1,015	364	Test B at IB
10	33	33	0	+4	0,06	197	0,660	1,020	364	Test B at IB
11	33	33	0	+5	0,06	183	0,660	1,025	364	Test B at IB
Parameter at 0% per phase			L= 255,2 mH		R= 80,16 Ω		C= 39,8 μF			
<b>Note:</b> RLC is adjusted to min. +/-1% of the inverter rated output power <sup>1)</sup> P <sub>EUT</sub> : EUT output power <sup>2)</sup> P <sub>AC</sub> : Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>3)</sup> Q <sub>AC</sub> : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. <sup>4)</sup> Fundamental of I <sub>AC</sub> when RLC is adjusted <sup>5)</sup> BL: Balance condition, IB: Imbalance condition.  Condition C: EUT output power P <sub>EUT</sub> = 25 % – 33 % <sup>5)</sup> of maximum EUT input voltage <sup>6)</sup> = <10 % of rated input voltage range <sup>6)</sup> Or minimum allowable EUT output level if greater than 33 %. <sup>7)</sup> Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range. Test Data refers to report No “PV150512C16”										

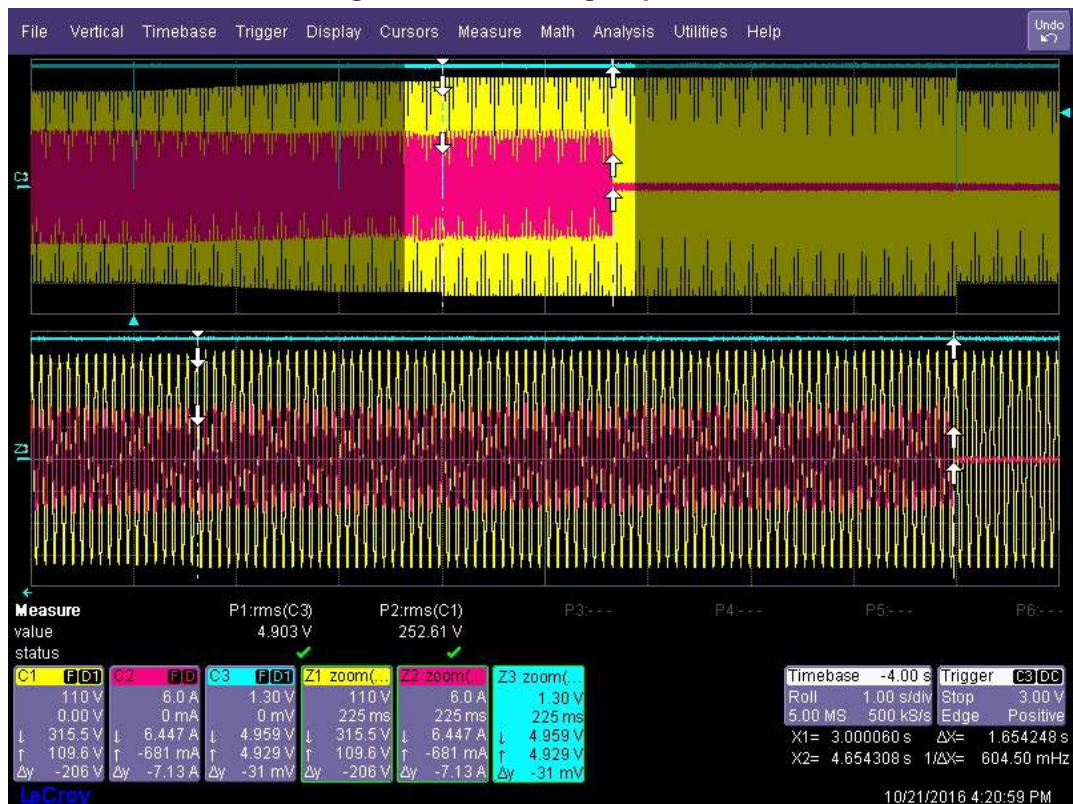


7.4 Voltage and frequency limits (passive anti-islanding protection) Appendix G2 Under- and over-voltage trip settings and reconnection test							P
Output Current level: 50+/-5% rated current							
Test	Under Voltage (V)			Time to disconnect (s) (Trip delay 1s)			Time to reconnect (s)
Limit	< 180 V			<=2s			>=60s
Actual setting	180,0			1,7			60
	L1	L2	L3	L1	L2	L3	
Trip value	180,0	180,0	180,0	1,653	1,653	1,653	67,14
	180,0	180,0	180,0	1,653	1,653	1,653	67,27
	180,0	180,0	180,0	1,653	1,653	1,653	67,40
Test	Over Voltage 1 (V)			Time to disconnect (s) (Trip delay 1s)			Time to reconnect (s)
Limit	> 260 V			<=2s			>=60s
Actual setting	260,0			1,7			60
	L1	L2	L3	L1	L2	L3	
Trip value	260,0	260,0	260,0	1,653	1,653	1,654	66,88
	260,0	260,0	260,0	1,653	1,653	1,653	67,01
	260,0	260,0	260,0	1,653	1,653	1,653	67,14
Test	Over Voltage 2 (V)			Time to disconnect (s)			Time to reconnect (s)
Limit	> 265 V			<=0,2s			>=60s
Actual setting	265,0			0,2			60
	L1	L2	L3	L1	L2	L3	
Trip value	265,0	265,0	265,0	0,033	0,033	0,033	69,21
	265,0	265,0	265,0	0,034	0,033	0,033	67,27
	265,0	265,0	265,0	0,033	0,033	0,033	67,14
<b>Note:</b> Actual settings are the settings of the inverter. The Trip value the measured value. It has to be in the range of $\pm 2V$ 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.							

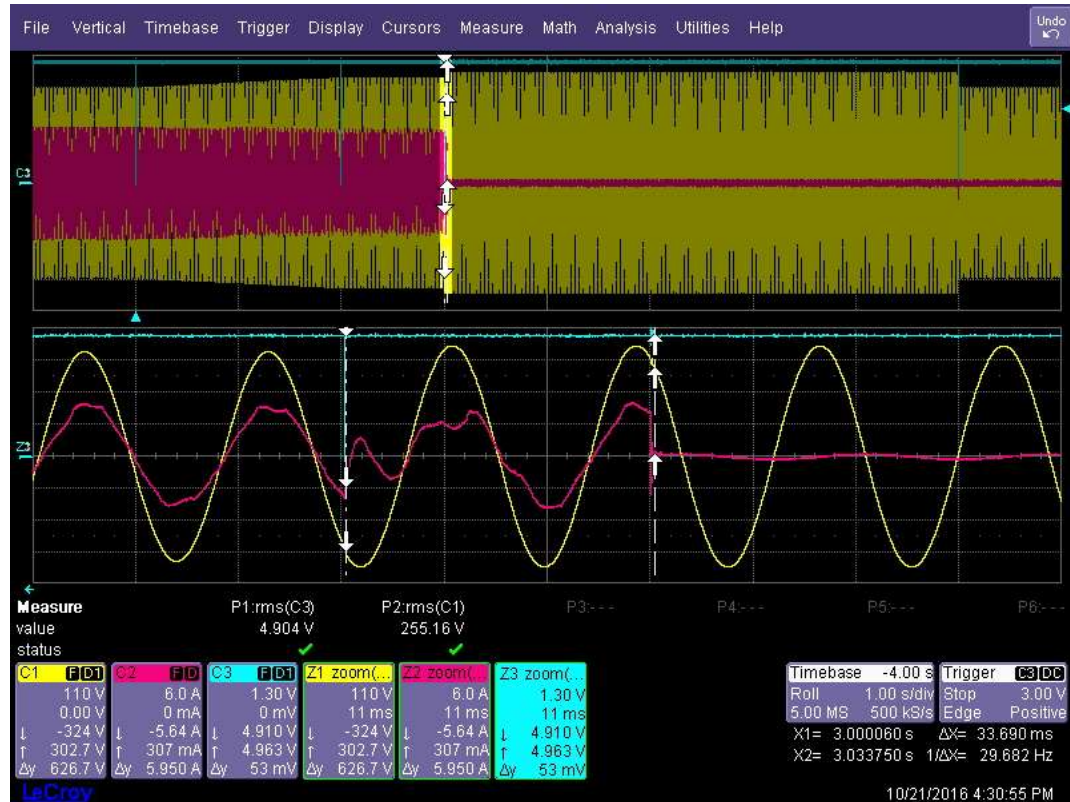
### Diagram of under-voltage protection



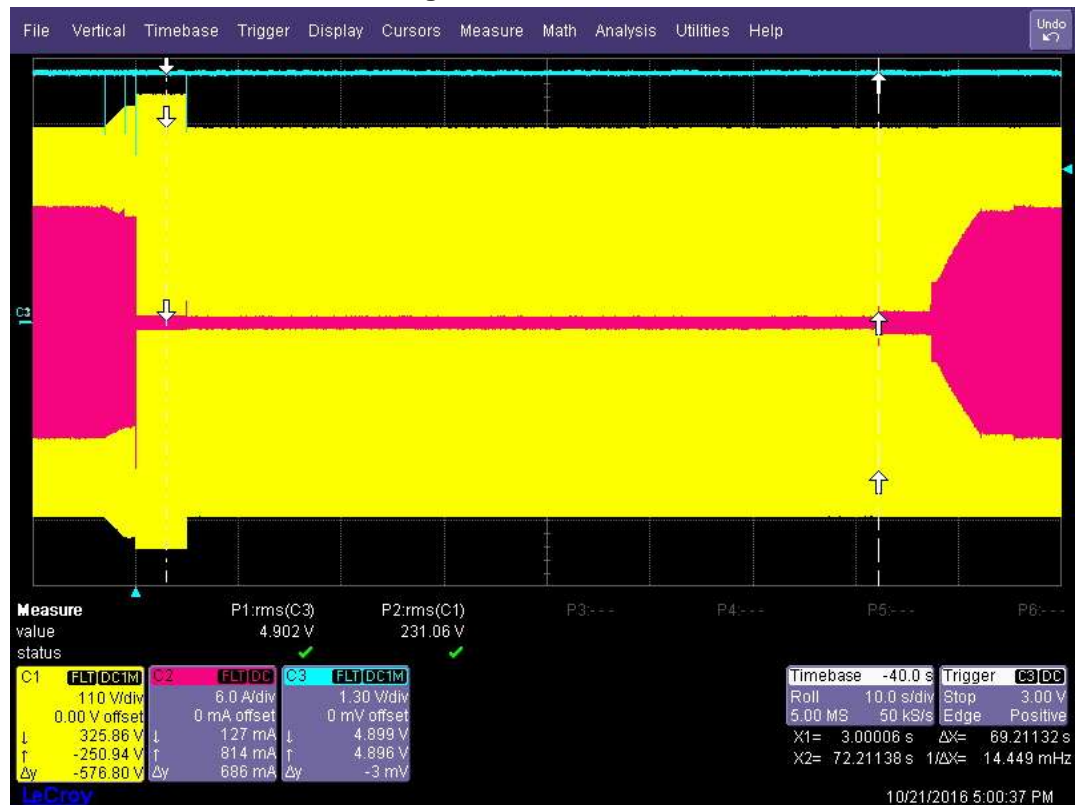
### Diagram of over-voltage 1 protection



### Diagram of over-voltage 2 protection

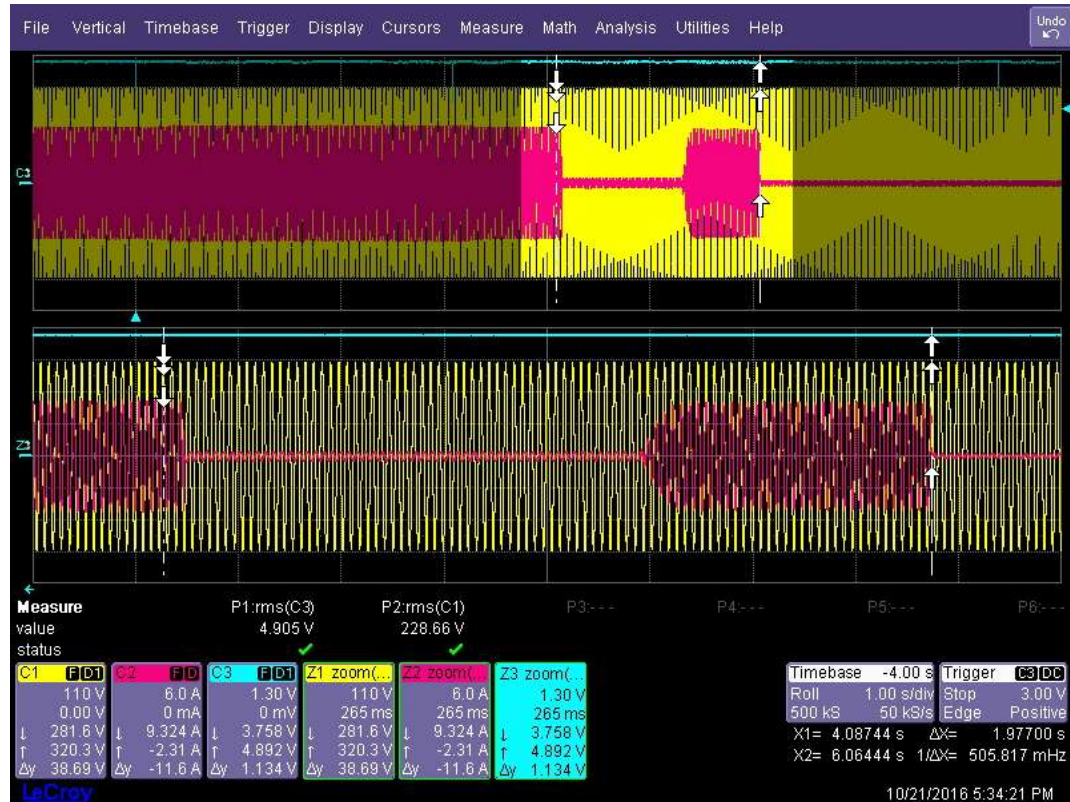


### Diagram of reconnection

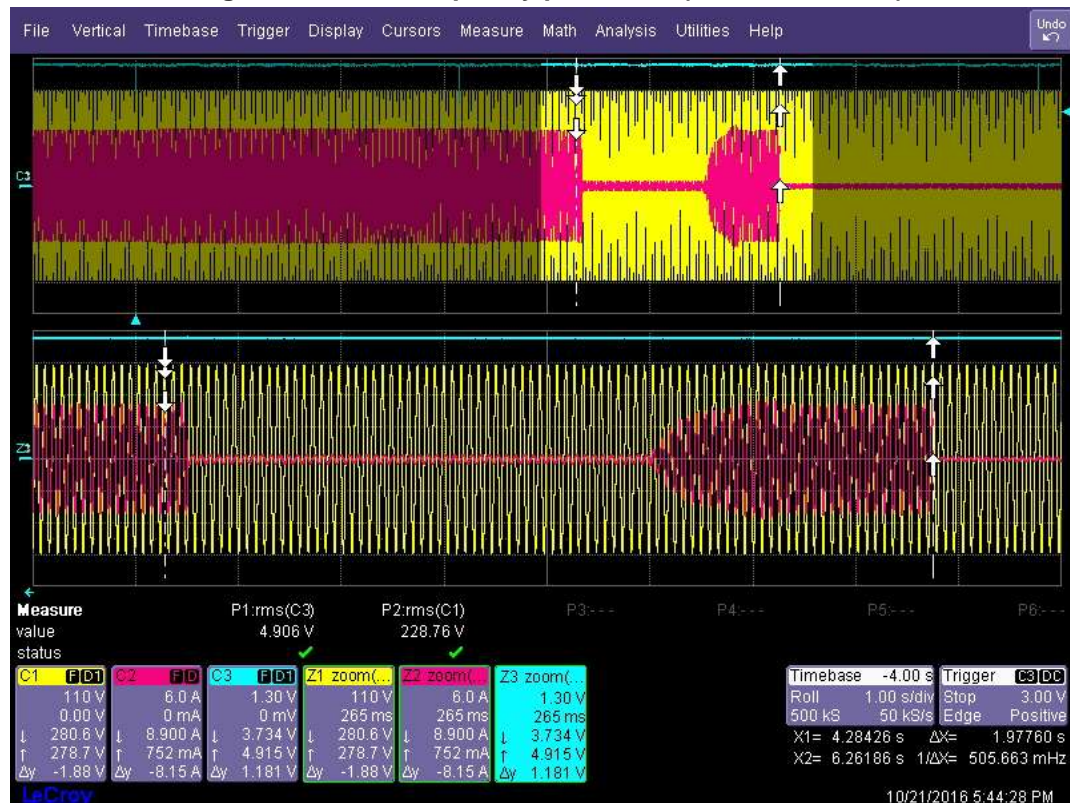


7.4 Voltage and frequency limits (passive anti-islanding protection) Appendix G3 Under- and over-frequency trip settings and reconnection test			P
	Output Current level: 50+/-5% rated current or 10A (whichever is the lesser)		
Test	Under Frequency (Hz)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)
<b>Australia</b> Limit	$\geq 47\text{Hz}$	$\leq 2\text{s}$	$\geq 60\text{s}$
Actual setting	47,00	2	60
Trip value	47,00	1,974	68
	47,00	1,975	68
	47,00	1,977	68
Test	Under Frequency (Hz)	Time to disconnect (s) (Trip delay 1s)	Time to reconnect (s)
<b>New Zealand</b> Limit	$\geq 45\text{Hz}$	$\leq 2\text{s}$	$\geq 60\text{s}$
Actual setting	45,00	2	60
Trip value	45,00	1,978	68
	45,00	1,978	68
	45,00	1,970	68
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	52,00	0,2	60
Trip value	52,00	0,055	68
	52,00	0,055	68
	52,00	0,065	68
<b>Note:</b> Actual settings are the settings of the inverter. The trip value is the measured value. It has to be in the range of <u><math>\pm 0.1\text{Hz}</math></u> 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.			

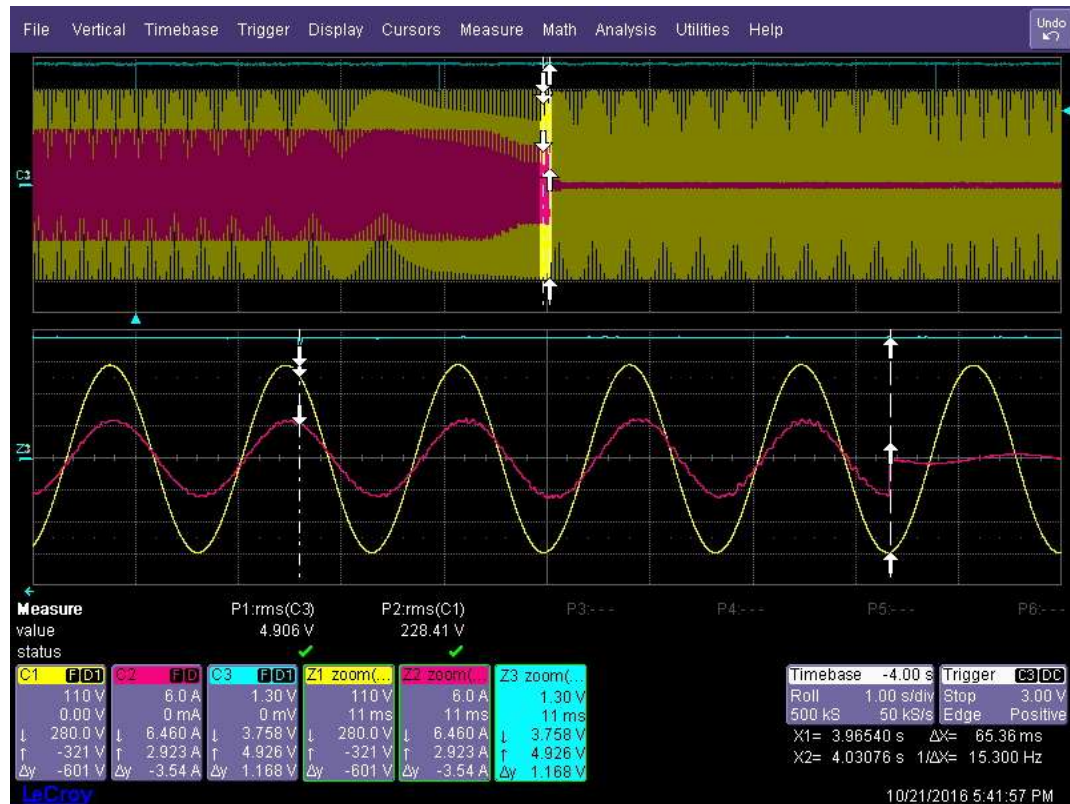
### Diagram of under-frequency protection (for Australia)



### Diagram of under-frequency protection (for New Zealand)



### Diagram of over-frequency protection

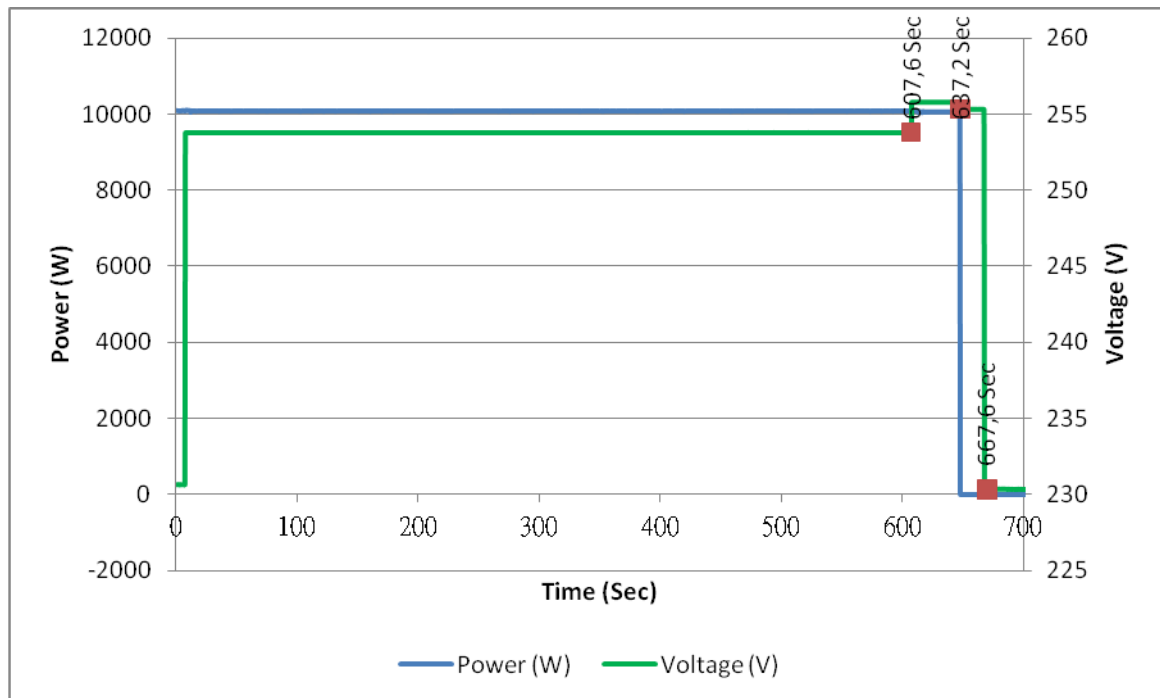


### Diagram of reconnection



7.5.2 Limits for sustained operation Appendix H2 Sustained operation for voltage variations				P
Australia		Output power level: 50+/-5% Apparent Power		
Setting values		Setting Vnom_max [V]	255	
		Setting T <sub>disconnection</sub> [s]	20	
Test:				
a)	Step 1. The voltage is set to Vnom_max – 1 V. Maintained for 5 min. Step 2. The voltage increase to Vnom_max + 1 V and proceeding 10 min. Step 3. The 10 min average voltage shall be recorded.			
		Average Voltage (V)		Limit
	Phase 1	1 <sup>st</sup> time	254,81	1. Disconnection should take place.  2. Voltage within +/-1 % of the set-point.
		2 <sup>nd</sup> time	254,81	
		3 <sup>rd</sup> time	254,81	
	Phase 2	1 <sup>st</sup> time	254,96	
		2 <sup>nd</sup> time	254,97	
		3 <sup>rd</sup> time	254,96	
	Phase 3	1 <sup>st</sup> time	256,93	
		2 <sup>nd</sup> time	256,93	
		3 <sup>rd</sup> time	256,93	
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	29,6		Disconnection time < 30s
	Phase 2	29,4		
	Phase 3	29,6		
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	71,8		Reconnection time > 60s
	Phase 2	71,8		
	Phase 3	71,8		

Diagram

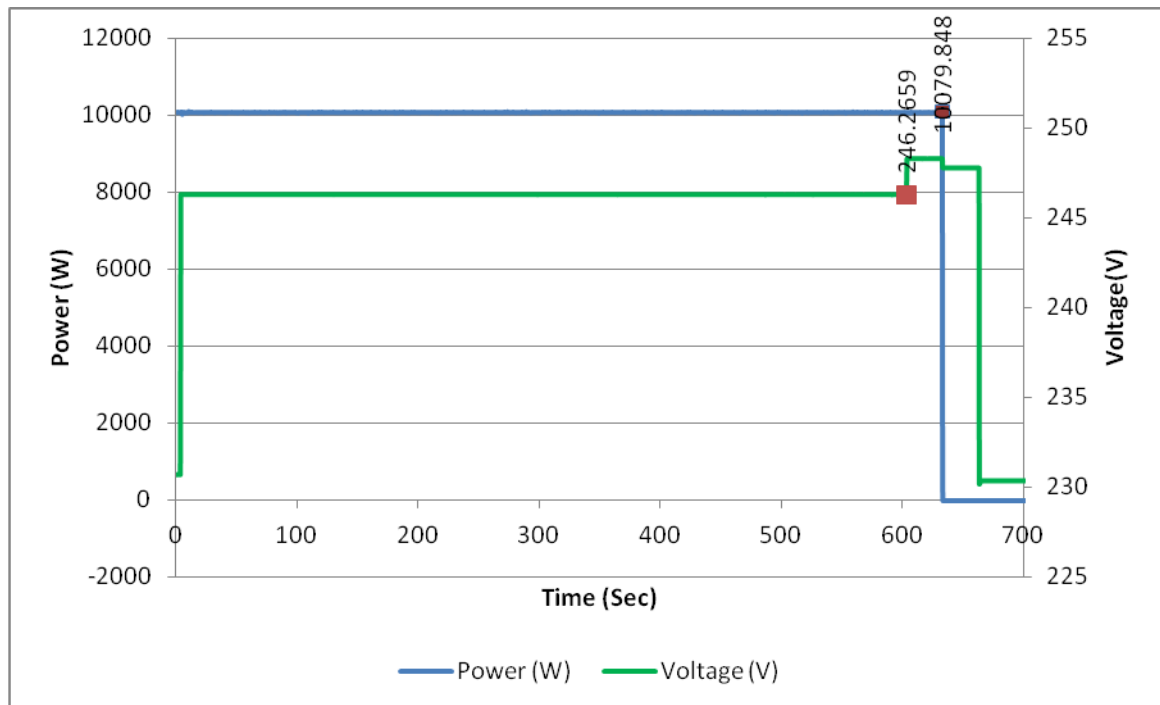


**Note:**

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.

7.5.2 Limits for sustained operation Appendix H2 Sustained operation for voltage variations				P
New Zealand		Output power level: 50+/-5% Apparent Power		
Setting values		Setting V <sub>nom_max</sub> [V]	244	
		Setting T <sub>disconnection</sub> [s]	20	
Test:				
a)	Step 1. The voltage is set to V <sub>nom_max</sub> – 1 V. Maintained for 5 min. Step 2. The voltage increase to V <sub>nom_max</sub> + 1 V and proceeding 10 min. Step 3. The 10 min average voltage shall be recorded.			
			Average Voltage (V)	Limit
	Phase 1	1 <sup>st</sup> time	248,21	1. Disconnection should take place.  2. Voltage within +/-1 % of the set-point.
		2 <sup>nd</sup> time	248,21	
		3 <sup>rd</sup> time	248,21	
	Phase 2	1 <sup>st</sup> time	247,86	
		2 <sup>nd</sup> time	247,86	
		3 <sup>rd</sup> time	247,86	
	Phase 3	1 <sup>st</sup> time	249,92	
		2 <sup>nd</sup> time	249,92	
		3 <sup>rd</sup> time	249,93	
b)	Step 1. The voltage is set to V <sub>nom_max</sub> 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		28,6	Disconnection time < 30s
	Phase 2		28,6	
	Phase 3		28,2	
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		73,2	Reconnection time > 60s
	Phase 2		73,2	
	Phase 3		73,2	

Diagram



**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.

7.5.3.1 Response to an increase in frequency Appendix H3.2 Test procedure Test: RPI M10A							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	50,25	50,35	50,45	50,55	50,65	50,75
P <sub>setpoint</sub> [kW]:	5,000	5,113	4,821	4,529	4,237	3,945	3,652
P [kW]:	5,113	5,113	4,800	4,509	4,212	3,932	3,637
$\Delta P/P_n$ [%]:	1,13%	0,00%	0,21%	0,20%	0,24%	0,13%	0,16%
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 <sub>setpoint</sub> [kW]:	3,360	3,068	2,776	2,484	2,191	1,899	1,607
P [kW]:	3,342	3,051	2,764	2,479	2,185	1,894	1,611
$\Delta P/P_n$ [%]:	0,18%	0,17%	0,12%	0,05%	0,07%	0,05%	0,04%
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 <sub>setpoint</sub> [kW]:	1,315	1,023	0,730	0,438	0,146	0	0
P [kW]:	1,318	1,023	0,730	0,434	0,141	0,005	0,003
$\Delta P/P_n$ [%]:	0,03%	0,01%	0,00%	0,04%	0,05%	0,05%	0,03%
<p>The frequency shall be decreased every 30 s in 0.2 Hz decrements from 52,25Hz until less than 50,15Hz.  Maintained for 10 min or until the inverter reaches the maximum output power available.  After frequency decreased to less than 50,15Hz, adjust output power to 100% rated power.</p>							
30s mean value	v) 52,25Hz	->	w) 50,05Hz				
Frequency [Hz]:	52,25	-	50,05	-	-	-	-
P <sub>setpoint</sub> [kW]:	0	-	0	-	-	-	-
P [kW]:	0,001	-	0,002	-	-	-	-
$\Delta P/P_{Setpoint}$ [%]:	0,01%	-	0,02%	-	-	-	-
Limit W <sub>Gra</sub> :	+ 16,67 % (default value)						

Diagram of Response to an increase in frequency

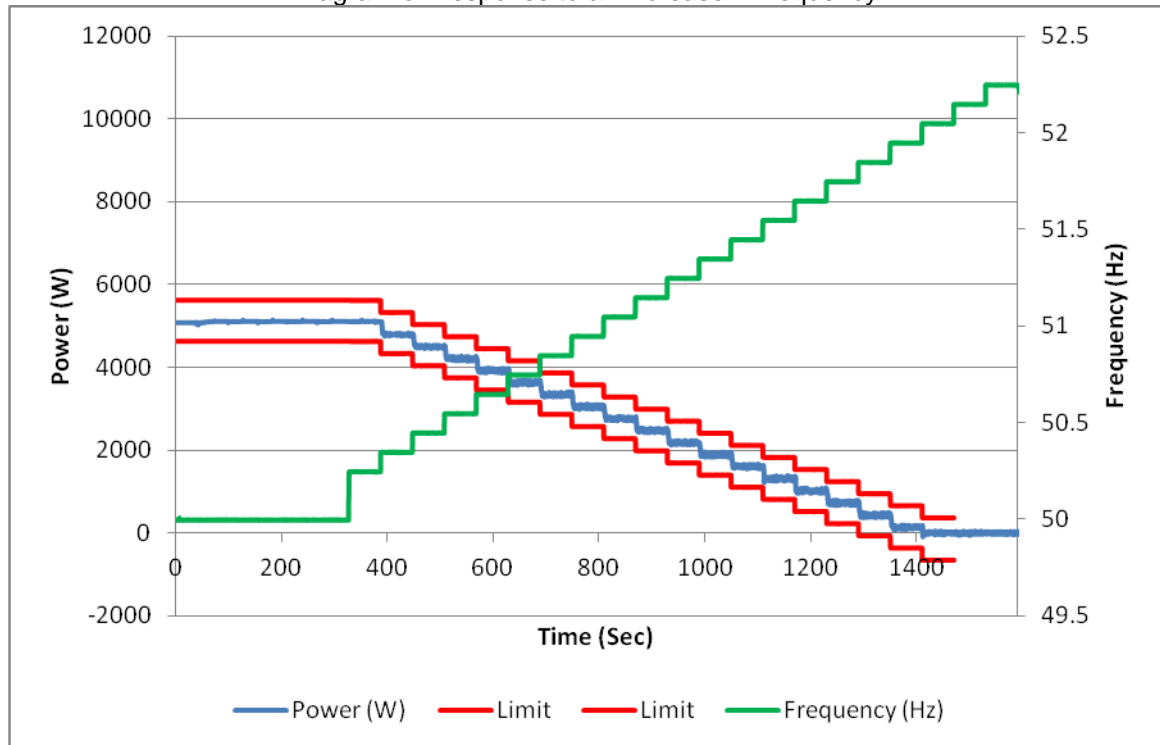


Diagram of Frequency from 52,25Hz to 50,05Hz

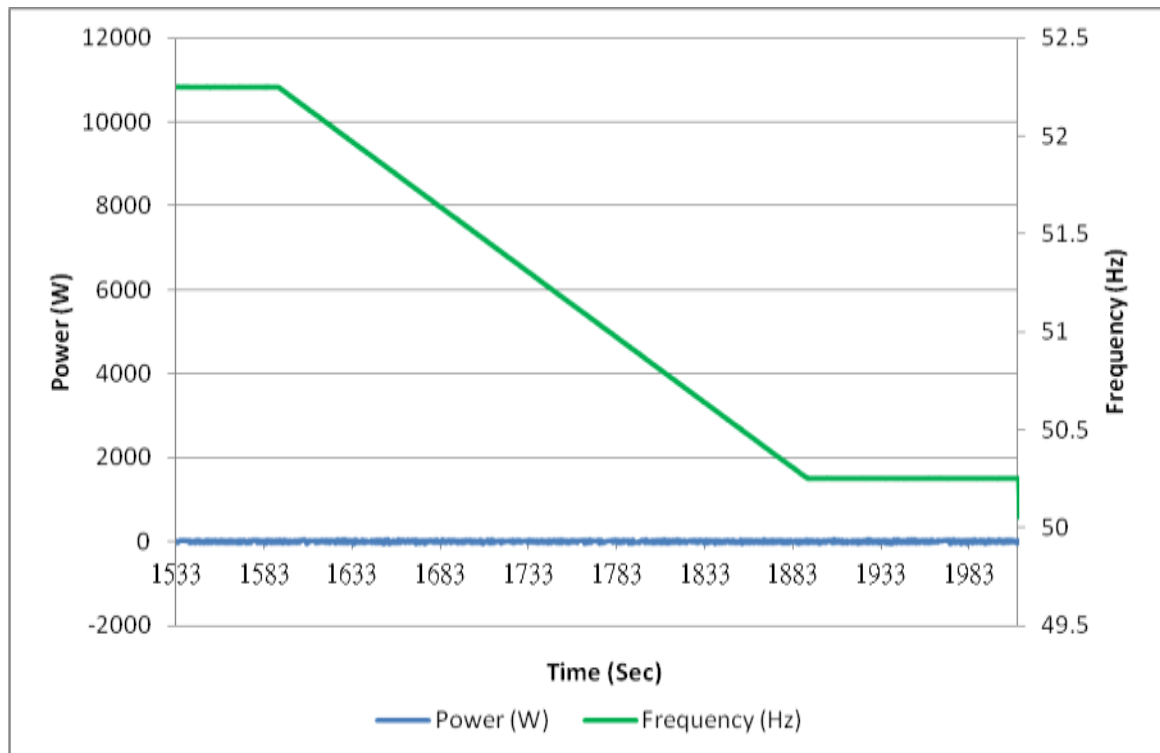
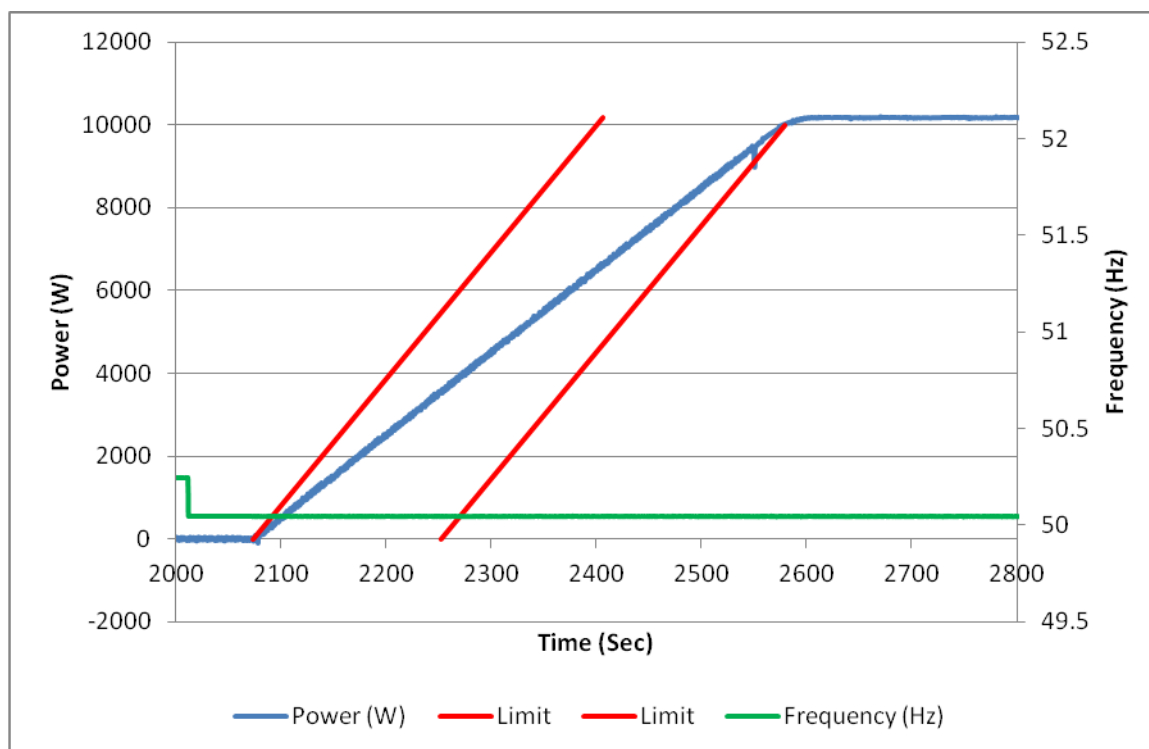


Diagram of Power ramp up


**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.

7.5.3.1 Response to an increase in frequency (continued) Appendix H3.2 Test procedure (continued) Test: RPI M10A							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	50.25	50.35	50.45	50.55	50.65	50.75
P <sub>setpoint</sub> [kW]:	5,000	5,113	4,820	4,528	4,236	3,944	3,652
P [kW]:	5,111	5,113	4,813	4,520	4,223	3,938	3,643
$\Delta P/P_n$ [%]:	1.11%	0.00%	0.07%	0.09%	0.13%	0.06%	0.09%
30s mean value	h) 50,85Hz	i) 50,95Hz	j) 51,05Hz				
Frequency [Hz]:	50.85	50.95	51.05	-	-	-	-
P <sub>setpoint</sub> [kW]:	3,360	3,068	2,775	-	-	-	-
P [kW]:	3,351	3,063	2,784	-	-	-	-
$\Delta P/P_n$ [%]:	0.09%	0.05%	0.08%	-	-	-	-
<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		
Frequency [Hz]:	50.85	50.65	50.45	50.25	50.05	-	-
P <sub>setpoint</sub> [kW]:	2,775	2,775	2,775	2,775	10,000	-	-
P [kW]:	2,778	2,768	2,770	2,775	10,183	-	-
$\Delta P/P_{Setpoint}$ [%]:	0.03%	0.07%	0.05%	0.00%	1.83%	-	-
Limit W <sub>Gra</sub> :	+ 16,67 % (default value)						

Diagram of Response to an increase in frequency

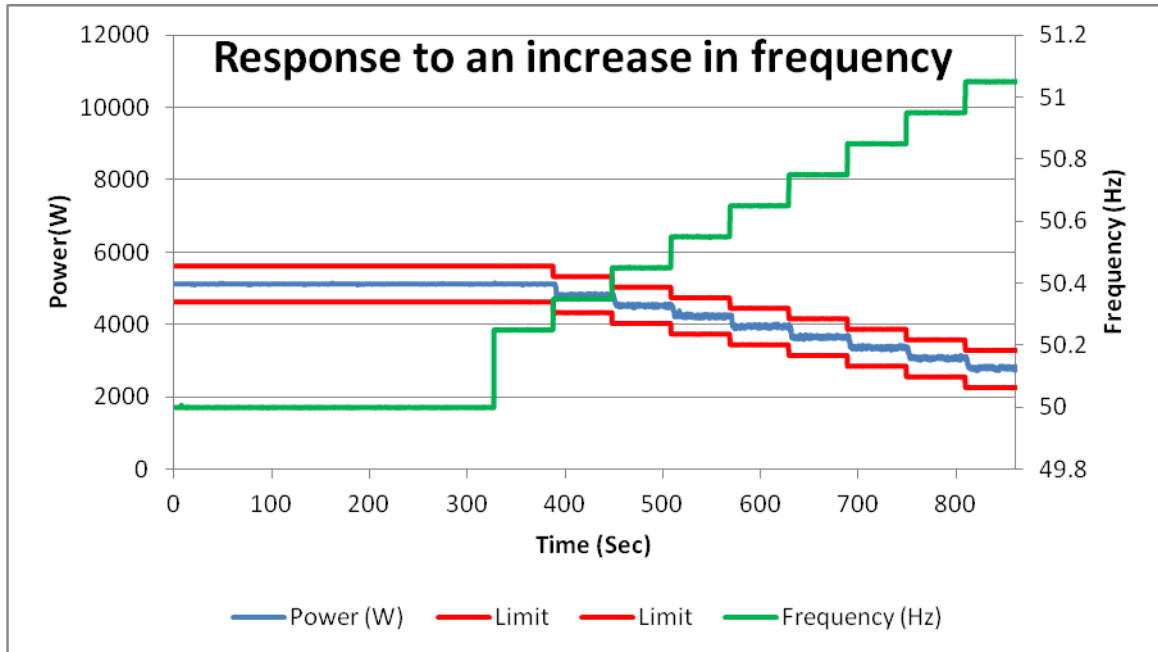


Diagram of Frequency from 51,05Hz to 50,05Hz

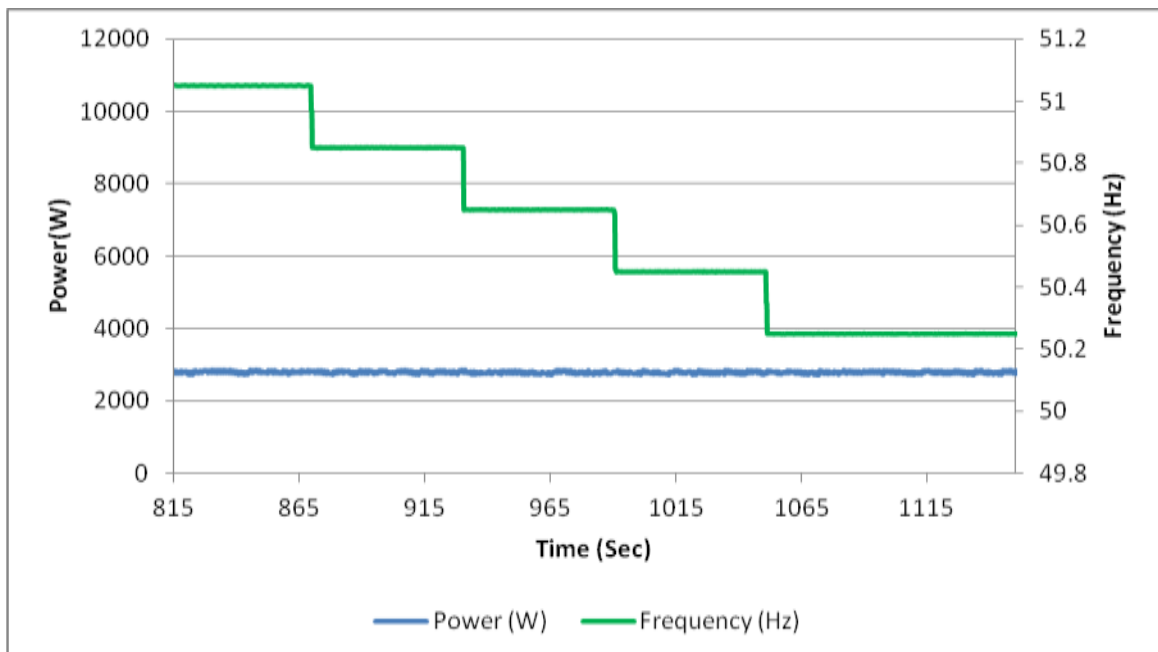
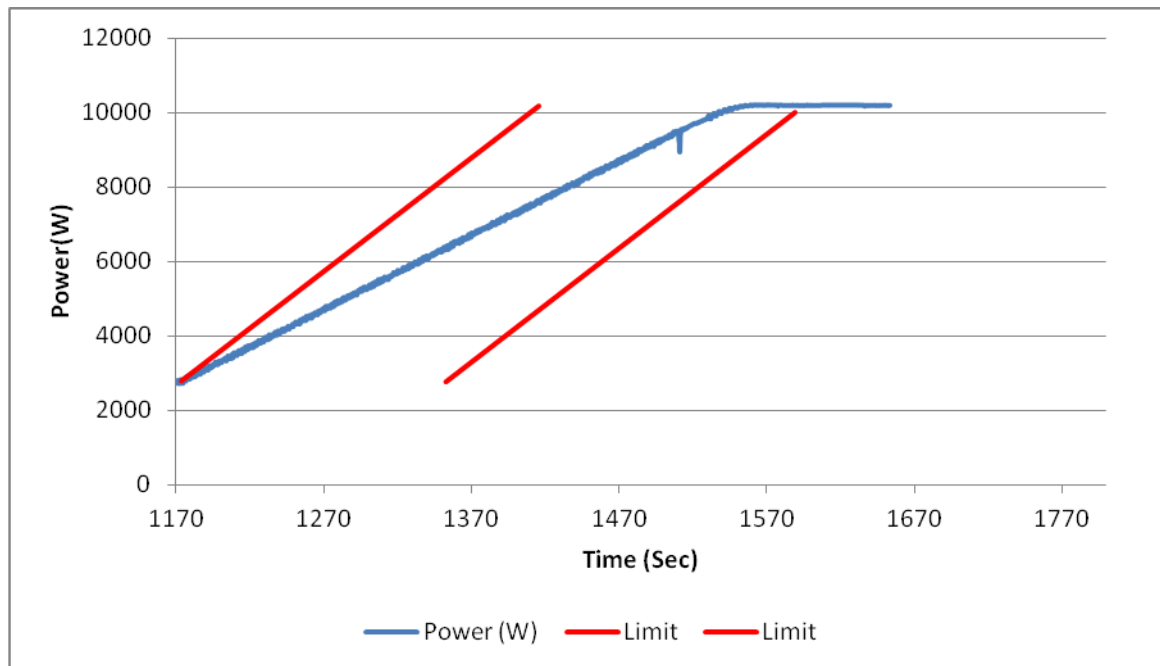


Diagram of Power ramp up


**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.

8.3 Grid disconnection 8.4 connection and reconnection 7.4 Voltage and frequency limits (passive anti-islanding protection) Appendix G2 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	180V	2s		60s	
		t	△t		
Trip value	EUT 1	--	--	--	
	EUT 2	--	--		
Test	Over Voltage 1 (V)	Time to disconnect (s)		Time to reconnect (s)	
Limit	> 260 V	<=2s		>=60s	
Actual setting	260	2		60s	
		t	△t		
Trip value	EUT 1	--	--	--	
	EUT 2	--	--		
Test	Over Voltage 2 (V)	Time to disconnect (s)		Time to reconnect (s)	
Limit	> 265 V	<=0,2s		>=60s	
Actual setting	265	0,2		60s	
		t	△t		
Trip value	EUT 1	--	--	--	
	EUT 2	--	--		
<b>Note:</b> 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. Accorcing to CH 8.5.1, if I <sub>rated</sub> is above 6A, then only one EUT should be under test. These two models are all aboved 6A and the test result for one inverter is in Ch 7.4.					

8.3 Grid disconnection 8.4 connection and reconnection 7.4 Voltage and frequency limits (passive anti-islanding protection) Appendix G3 Under- and over-frequency trip settings and reconnection test				N/A	
		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		2s		60s	
		t	△t		
Trip value	EUT 1	--	--	--	
	EUT 2	--	--		
Test	Under Frequency (Hz)	Time to disconnect (s) (Trip delay 1s)		Time to reconnect (s)	
New Zealand Limit	>=45Hz	<=2s		>=60s	
Actual setting		2s		60s	
		t	△t		
Trip value	EUT 1	--	--	--	
	EUT 2	--	--		
Test	Over Frequency (Hz)	Time to disconnect (s)		Time to reconnect (s)	
Limit	<=52Hz	<=0,2s		>=60s	
Actual setting	52,00Hz	0,2s		60s	
		t	△t		
Trip value	EUT 1	--	--	--	
	EUT 2	--	--		
<b>Note:</b> Actual settings are the settings of the inverter. The trip value is the measured value. It has to be in the range of <u>+/- 0.1Hz</u> of the actual setting. According to CH 8.5.1, if I <sub>rated</sub> is above 6A, then only one EUT should be under test. These two models are all aboved 6A and the test result for one inverter is in Ch 7.4.					

# **Annex 1**

## **EMC report**

**Intertek**Report No.: TS14020005-EME  
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## EMC TEST REPORT

Report No: TS14020005-EME

Model No: RPI M10A\_1xx, RPI M10A\_0xx, RPI M8A\_1xx,  
RPI M8A\_0xx, RPI M6A\_1xx, RPI M6A\_0xx

Issued Date: Mar. 28, 2014


**Applicant:** Delta Electronics, Inc.  
**Address:** 39 Sec. 2 Huandong Road, Shanhua Dist., Tainan City 74144, Taiwan  
**Test Methods/ Standards:** EN 61000-6-3: 2007+A1: 2011 / EN 61000-6-4: 2007+A1: 2011  
IEC 61000-6-3: 2007+A1: 2010  
IEC 61000-6-4: 2006+A1: 2010  
EN 61000-3-3: 2008 / IEC 61000-3-3: 2008  
EN 61000-6-2: 2005 / EN 61000-6-1: 2007  
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 61000-3-2: 2006+A1: 2009+A2: 2009  
IEC 61000-3-2: 2005+A1: 2008+A2: 2009  
EN 61000-4-11:2004 / IEC 61000-4-11:2004  
IEC 61000-3-2:2005+A1:2008+A2: 2009  
IEC 61000-6-3: 2007+A1: 2011 / IEC 61000-6-4: 2006+A1: 2011  
EN 61000-3-3: 2013 / IEC 61000-3-3: 2013  
**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  
Anson Lee / Engineer

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

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## 1. General Information

### 1.1 Identification of the EUT

Product:	PV Inverter
Model No.:	RPI M10A_1xx
Software Version:	DSP:V1.20 RED:V1.10 Comm:V1.05
Hardware Version:	Prototype
Rated Power:	I/P: 200-1000V, Max. 25A O/P: 3 phase 230V, 50/60Hz, 16A, 10500 W Max. output power: 10500VA Max. output current: 16A
Power Cord:	2C wires 3 meters cable 3-Phase/5-Wire 5 meter cable
Sample receiving date:	Feb. 24, 2014
Sample condition:	Workable
Testing date:	Feb. 25, 2014 ~ Mar. 25, 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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## 1.2 Additional information about the EUT

The customer confirmed the models listed as below were series model to model RPI M10A\_1XX (EUT), the difference between main model and series model are listed as below.

Model Number	Difference
RPI M10A_1xx, RPI M10A_0xx	I/P: 200-1000V, Max. 25A O/P: 3 phase 230V, 50/60Hz, 16A, 10500 W Max. output power: 10500VA Max. output current: 16A
RPI M8A_1xx, RPI M8A_0xx	I/P: 200-1000V, Max. 20A O/P: 3 phase 230V, 50/60Hz, 13A, 8400 W Max. output power: 8400VA Max. output current: 13A
RPI M6A_1xx, RPI M6A_0xx	I/P: 200-1000V, Max. 20A O/P: 3 phase 230V, 50/60Hz, 9.7A, 6300 W Max. output power: 6300VA Max. output current: 9.7A

Model Number	Difference
RPI M10A_1xx, RPI M8A_1xx, RPI M6A_1xx	W/DC Switch W/O AC Switch
RPI M10A_0xx, RPI M8A_0xx, RPI M6A_0xx	W/O DC Switch W/AC Switch

For more detail features, please refer to user's Manual.



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## 2. Test Summary

### 2.1 Test requirements

Standard	Test Type	Enclosure	AC side	DC side	Signal port
EN 61000-6-3: 2007 +A1: 2011	Conducted Test	×	√	×	×
	Radiated Test	√	×	×	×
EN 61000-3-2: 2006+A1: 2009+A2: 2009	Harmonic current emissions	×	√	×	×
EN 61000-3-3: 2008	Voltage fluctuation & flicker	×	√	×	×
EN 61000-4-2: 2009 IEC 61000-4-2: 2008	ESD test	√	×	×	×
EN 61000-4-3: 2006 +A1: 2008+A2: 2010 IEC 61000-4-3: 2010	RS test	√	×	×	×
EN 61000-4-4: 2012 IEC 61000-4-4: 2012	EFT test	×	√	√	√
EN 61000-4-5: 2006 IEC 61000-4-5: 2005	Surge test	×	√	√	√
EN 61000-4-6: 2009 IEC 61000-4-6: 2008	CS test	×	√	×	×
EN 61000-4-8: 2010 IEC 61000-4-8: 2009	Magnetic Field test	√	×	×	×
EN 61000-4-11: 2004 IEC 61000-4-11: 2004	Dip test	×	√	×	×

√: Applicable    ×: Not applicable    \*: Require by client



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## 2.2 Test results

Emission (EN 61000-6-3: 2007+A1: 2011)			
Standard	Test Type	Result	Remarks
EN 61000-6-3: 2007 +A1: 2011	Conducted Test	PASS	Meet the requirements
	Radiated Test	PASS	Meet the requirements
EN 61000-3-12: 2005	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)				
Standard	Test Type	Minimum Criteria	Result	Test Judgment
EN 61000-4-2: 2009 IEC 61000-4-2: 2008	ESD test	Criterion B	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-3: 2006 +A1: 2008+A2: 2010 IEC 61000-4-3: 2010	RS test	Criterion A	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-4: 2012 IEC 61000-4-4: 2012	EFT test	Criterion B	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-5: 2006 IEC 61000-4-5: 2005	Surge test	Criterion B	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-6: 2009 IEC 61000-4-6: 2008	CS test	Criterion A	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-8: 2010 IEC 61000-4-8: 2009	Magnetic Field test	Criterion A	PASS	Meets the requirements of Performance Criterion A
EN 61000-4-11: 2004 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 B 3. 30 % reduction- Performance Criterion B 4. 100 % reduction- Performance Criterion B



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### 3. Test Specifications

#### 3.1 Standards

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

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

**EN 61000-6-3: 2007+A1: 2011** Generic standards—Emission standard for residential, commercial and light-industrial environments

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

#### 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 External port

Items	Specifications
DC input port	+,-
AC mains output port	3-Phase/5-Wire(L1, L2, L3, N, PE)
Communication	CNC104(RS-485)

### 3.4 Performance verification



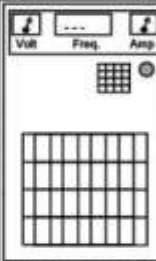
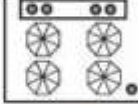

The EUT has been monitored based on manufacturer's specification; the performance fulfilled the requirements of standard.

### 3.5 Mode of operation during the test

The input power port of EUT is connected with DC source, the output power port of EUT is connected with AC source and load. After EUT joining with AC source, when the output power of EUT raises, the AC source power will decline but not to zero. The margin of EUT raised power is the same as the margin of AC source declined power.


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### 3.6 Peripheral equipment

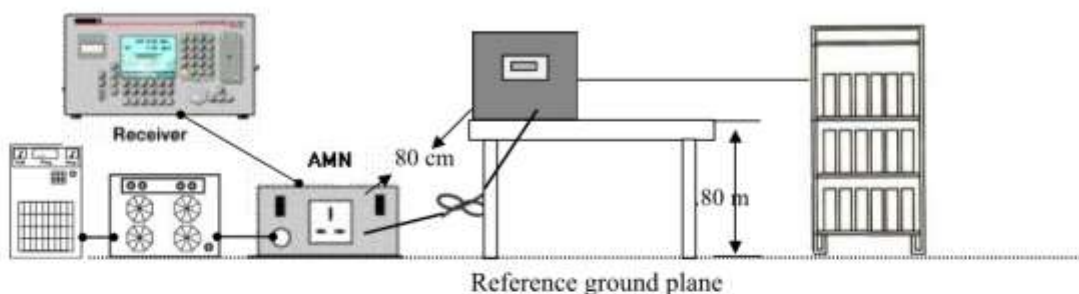
Peripherals	Brand	Model No.	Serial No.	Description of cable length	Symbol
DC power	Chroma	62150H-1000S	N/A	N/A	
Batteries frame	YUASA& GS	UXH90-12& GPL 121000	N/A	N/A	
AC Converter	APC	AFC-33030J	F311040038	N/A	
Load	N/A	N/A	N/A	N/A	
Notebook PC	IBM	2609	BA-ZHNHN	RS 232 Cable 1 meter	
RS232 to RS-485 Coverter*	TryCon	TRP-C06	NA	N/A	N/A

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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 an 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  $\Omega$ .
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.



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#### 4.4 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration
EMI Test Receiver	Rohde&schwarz	ESCS30	833364/011	2013/6/11	2014/6/11
200-A Four -Line V-Network	Rohde&schwarz	ENV4200	848411/012	2013/10/09	2014/10/08
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 mains port

Freq. (MHz)	Maximum RF Line Voltage	
	Class B (dBμV)	
	Q.P.	Ave.
0.15~0.50	66-56	56-46
0.50~5.00	56	46
5~30.00	60	50

#### 4.6 Uncertainty of Conducted Emission

Expanded uncertainty ( $k=2$ ) of conducted emission measurement is 2.08 dB.

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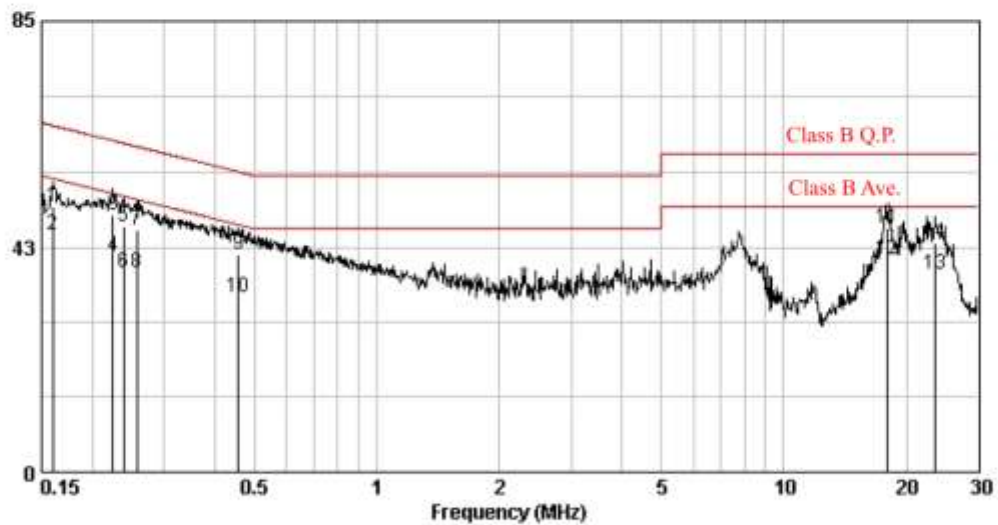
#### 4.7 Test Result: Pass

Phase:	Line 1			
Temperature:	21	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	60	%	Test Date:	Feb. 25, 2014
Atmospheric Pressure:	1008	hPa	Remark:	N/A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
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)	Margin (dB)	
						Qp	Av
0.160	9.88	50.10	65.47	44.92	55.47	-15.37	-10.55
0.224	9.88	48.66	62.66	40.89	52.66	-13.99	-11.76
0.239	9.88	46.25	62.13	37.60	52.13	-15.87	-14.53
0.258	9.88	45.66	61.51	37.53	51.51	-15.85	-13.98
0.456	9.87	41.23	56.76	32.95	46.76	-15.53	-13.81
17.910	10.18	45.94	60.00	40.27	50.00	-14.06	-9.73
23.511	10.36	43.37	60.00	37.51	50.00	-16.63	-12.49

Remark:

1. Q.P. stands for Quasi-peak.
2. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



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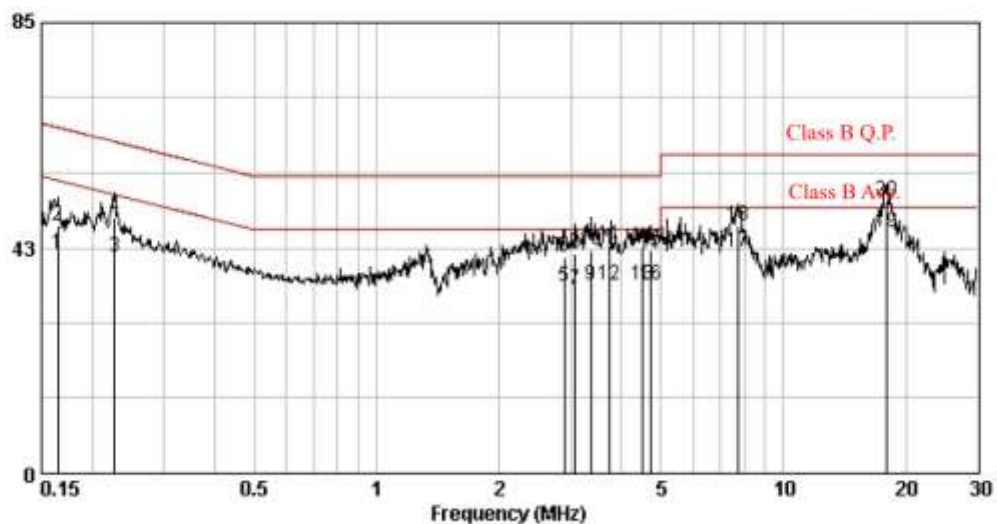
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Phase:	Line 2			
Temperature:	21	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	60	%	Test Date:	Feb. 25, 2014
Atmospheric Pressure:	1008	hPa	Remark:	N/A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB) Qp	Av
0.164	9.89	46.68	65.25	41.46	55.25	-18.57	-13.80
0.227	9.89	48.34	62.57	40.76	52.57	-14.23	-11.81
2.900	9.93	40.86	56.00	35.09	46.00	-15.14	-10.91
3.074	9.93	41.49	56.00	34.66	46.00	-14.51	-11.34
3.364	9.94	42.17	56.00	35.50	46.00	-13.83	-10.50
3.719	9.94	42.97	56.00	35.45	46.00	-13.03	-10.55
4.501	9.96	42.54	56.00	35.35	46.00	-13.46	-10.65
4.696	9.96	42.18	56.00	35.51	46.00	-13.82	-10.49
7.728	10.03	46.86	60.00	41.73	50.00	-13.14	-8.27
17.902	10.18	51.40	60.00	45.47	50.00	-8.60	-4.53

Remark:

1. Q.P. stands for Quasi-peak.
2. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



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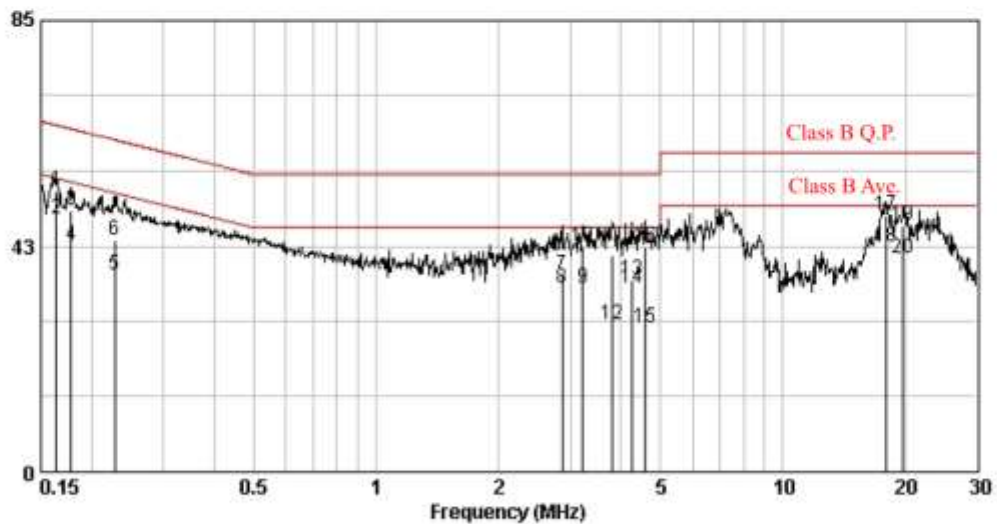
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Phase:	Line 3			
Temperature:	21	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	60	%	Test Date:	Feb. 25, 2014
Atmospheric Pressure:	1008	hPa	Remark:	N/A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB)	
						Qp	Av
0.163	9.87	52.97	65.30	47.62	55.30	-12.32	-7.68
0.178	9.87	49.14	64.59	42.74	54.59	-15.45	-11.85
0.228	9.87	43.61	62.52	36.97	52.52	-18.91	-15.55
2.869	9.91	37.04	56.00	34.53	46.00	-18.96	-11.47
3.224	9.91	42.43	56.00	34.69	46.00	-13.57	-11.31
3.820	9.92	40.84	56.00	27.81	46.00	-15.16	-18.19
4.247	9.93	36.16	56.00	34.63	46.00	-19.84	-11.37
4.598	9.94	42.35	56.00	27.04	46.00	-13.65	-18.96
17.944	10.11	48.16	60.00	42.37	50.00	-11.84	-7.63
19.740	10.13	46.53	60.00	40.16	50.00	-13.47	-9.84

Remark:

1. Q.P. stands for Quasi-peak.
2. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



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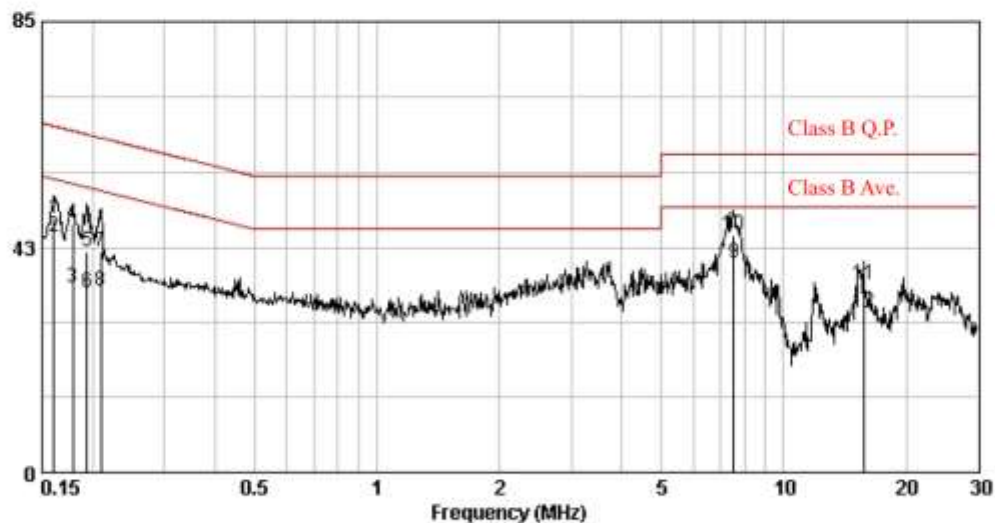
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Phase:	Neutral			
Temperature:	21	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	60	%	Test Date:	Feb. 25, 2014
Atmospheric Pressure:	1008	hPa	Remark:	N/A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
Frequency range:	0.15 MHz to 30 MHz			

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Δv (dBuV)	Limit Δv (dBuV)	Margin (dB)	
						Qp	Δv
0.161	9.90	47.94	65.43	44.63	55.43	-17.48	-10.80
0.179	9.90	47.11	64.55	34.82	54.55	-17.44	-19.72
0.193	9.90	41.70	63.89	33.94	53.89	-22.18	-19.95
0.209	9.89	41.85	63.23	34.15	53.23	-21.38	-19.08
7.526	9.99	44.68	60.00	39.69	50.00	-15.32	-10.31
15.718	10.09	35.61	60.00	30.06	50.00	-24.39	-19.94

Remark:

1. Q.P. stands for Quasi-peak.
2. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



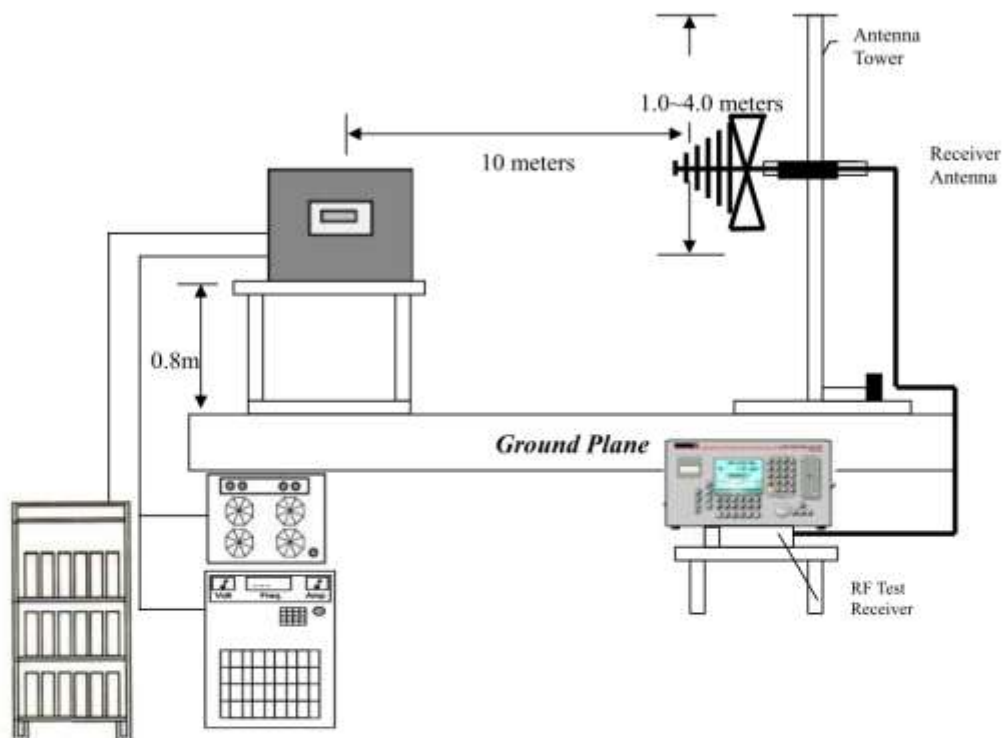
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## 5. Radiated Emission Test

### 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 Test Receiver	Rohde&schwarz	ESCS30	825788/015	2013/06/05	2014/06/05
Antenna (Bi Log Type)	Schaffner	CBL6112B	2836	2012/05/22	2014/05/22
OATS_1	Intertek	N/A	N/A	2013/05/18	2014/05/17

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

#### 5.5 Radiated Emission Limit

Frequency (MHz)	Distance(m)	dB( $\mu$ 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.

#### 5.6 Uncertainty of Radiated Emission

Vertical: Expanded uncertainty ( $k=2$ ) of radiated emission measurement is 4.13 dB.

Horizontal: Expanded uncertainty ( $k=2$ ) of radiated emission measurement is 3.85 dB.

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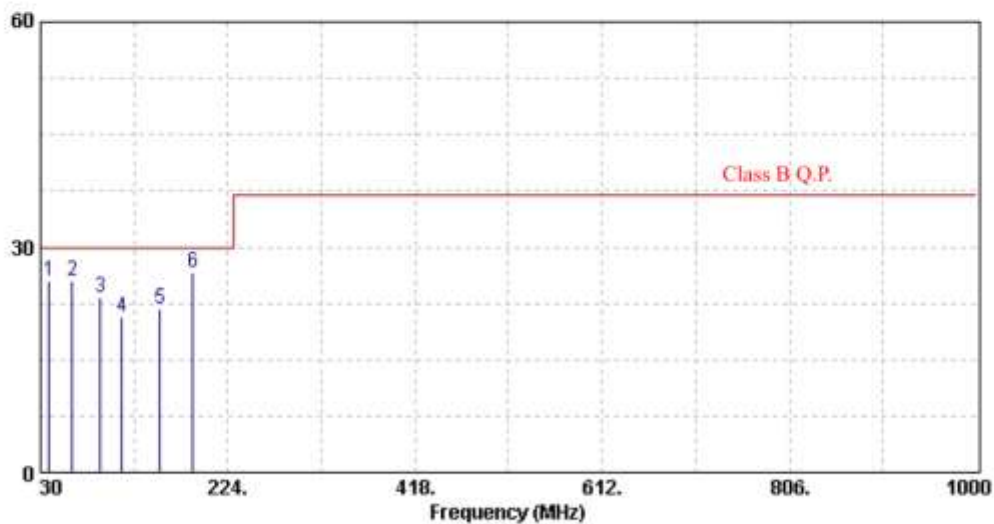
### 5.7 Test Result: Pass

Phase:	Vertical			
Temperature:	26	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	53	%	Test Date:	Feb. 25, 2014
Atmospheric Pressure:	1008	hPa	Remark:	N/A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
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	
39.16	VERTICAL	14.82	10.70	25.52	30.00	-4.48	QP
63.00	VERTICAL	7.65	17.90	25.55	30.00	-4.46	QP
92.08	VERTICAL	10.87	12.50	23.37	30.00	-6.63	QP
114.14	VERTICAL	13.72	6.90	20.62	30.00	-9.38	QP
153.94	VERTICAL	12.46	9.30	21.76	30.00	-8.24	QP
187.50	VERTICAL	11.21	15.30	26.51	30.00	-3.49	QP

Remark:

1. Q.P. stands for Quasi-peak.
2. Factor = Antenna Factor (dB/m) + Cable Loss (dB)
3. Level (dBμV/m) = Factor (dB/m) + Read Level (dBμV)
4. Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)



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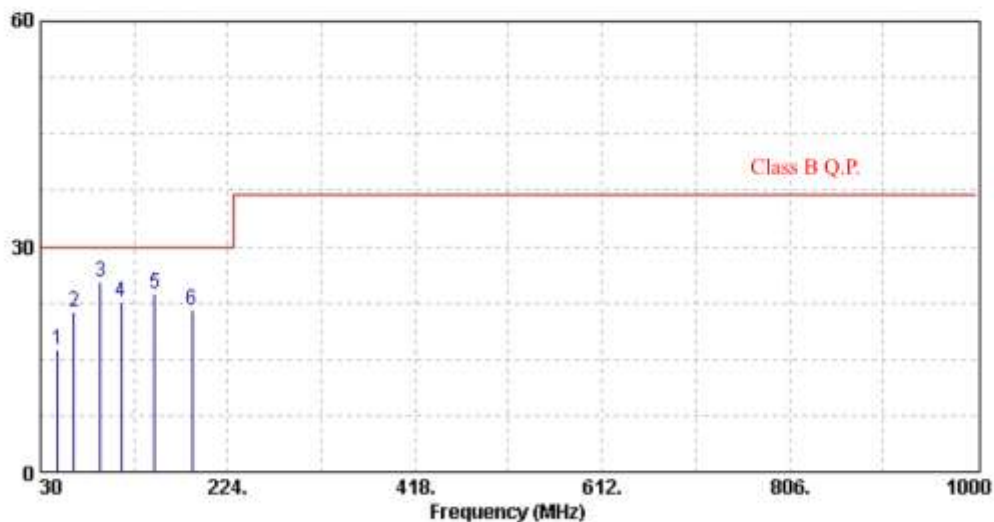
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Phase:	Horizontal			
Temperature:	26	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	53	%	Test Date:	Feb. 25, 2014
Atmospheric Pressure:	1008	hPa	Remark:	N/A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
Frequency range:	30 MHz to 1000 MHz			

Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
47.46	HORIZONTAL	10.45	5.75	16.20	30.00	-13.80	QP
64.92	HORIZONTAL	7.61	13.69	21.30	30.00	-8.71	QP
92.08	HORIZONTAL	10.87	14.50	25.37	30.00	-4.63	QP
113.42	HORIZONTAL	13.71	9.01	22.72	30.00	-7.28	QP
148.34	HORIZONTAL	12.77	11.01	23.78	30.00	-6.22	QP
187.14	HORIZONTAL	11.22	10.23	21.45	30.00	-8.55	QP

Remark:

1. Q.P. stands for Quasi-peak.
2. Factor = Antenna Factor (dB/m) + Cable Loss (dB)
3. Level (dBuV/m) = Factor (dB/m) + Read Level (dBuV)
4. Over Limit (dB) = Level (dBuV/m) – Limit Line (dBuV/m)



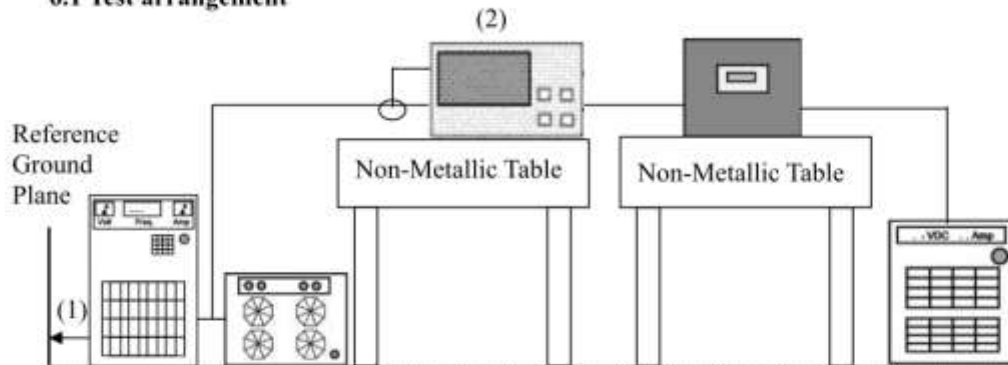
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## 6. Harmonic Test

### 6.1 Test arrangement



Note: (1) Connected to mains supply system

(2) Power Analyzer

### 6.2 Photographs of the test arrangement

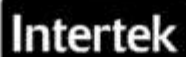
Please refer to the appendix B3 of the present report.

### 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	Newtons4th	PPA2530	520	2013/06/27	2014/06/27
DC source	Chroma	62150H-1000S	N/A	N/A	N/A

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

### 6.6 Uncertainty of Harmonic

Expanded uncertainty ( $k=2$ ) of harmonics measurement is 0.58.

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### 6.7 Test Result: Pass

Phase:	Line 1			
Temperature:	23	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	50	%	Test Date:	Mar. 25, 2014
Atmospheric Pressure:	1008	hPa	Classification:	Class A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)

V<sub>rms</sub> (Volts): 230.27V

I<sub>rms</sub> (Amperes): 14.350A

Freq: 50.003Hz

THDi: 1.18%

THDu: 0.093%

Active input power: 3.304KVA

P.F.: 0.999

Note: THDi stands for current total harmonic distortion

#### Harmonic Current Results

Order	Av. Current [A] Frame: 2.5min	Limit	In/11 (%)	Result	Order	Av. Current [A] Frame: 2.5min	Limit	In/11 (%)	Result
1	14.350	0.0000	NA	NA	21	0.1071	0.1071	0.058%	PASS
2	0.0131	1.0800	0.091%	PASS	22	0.0836	0.0836	0.050%	PASS
3	0.0226	2.3000	0.157%	PASS	23	0.0978	0.0978	0.061%	PASS
4	0.0039	0.4300	0.027%	PASS	24	0.0767	0.0767	0.045%	PASS
5	0.1216	1.1400	0.847%	PASS	25	0.0900	0.0900	0.031%	PASS
6	0.0043	0.3000	0.030%	PASS	26	0.0708	0.0708	0.029%	PASS
7	0.0502	0.7700	0.350%	PASS	27	0.0833	0.0833	0.026%	PASS
8	0.0061	0.2300	0.043%	PASS	28	0.0657	0.0657	0.049%	PASS
9	0.0045	0.4000	0.031%	PASS	29	0.0776	0.0776	0.034%	PASS
10	0.0040	0.1840	0.028%	PASS	30	0.0613	0.0613	0.040%	PASS
11	0.0739	0.3300	0.515%	PASS	31	0.0726	0.0726	0.047%	PASS
12	0.0040	0.1533	0.028%	PASS	32	0.0575	0.0575	0.042%	PASS
13	0.0553	0.2100	0.385%	PASS	33	0.0682	0.0682	0.049%	PASS
14	0.0035	0.1314	0.024%	PASS	34	0.0542	0.0542	0.014%	PASS
15	0.0051	0.1500	0.036%	PASS	35	0.0643	0.0643	0.040%	PASS
16	0.0025	0.1150	0.017%	PASS	36	0.0511	0.0511	0.015%	PASS
17	0.0378	0.1324	0.263%	PASS	37	0.0608	0.0608	0.040%	PASS
18	0.0010	0.1022	0.007%	PASS	38	0.0484	0.0484	0.017%	PASS
19	0.0162	0.1184	0.113%	PASS	39	0.0577	0.0577	0.040%	PASS
20	0.0013	0.0920	0.009%	PASS	40	0.0460	0.0460	0.015%	PASS

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Phase:	Line 2			
Temperature:	23	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	50	%	Test Date:	Mar. 25, 2014
Atmospheric Pressure:	1008	hPa	Classification:	Class A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)

V<sub>rms</sub> (Volts): 229.82V

I<sub>rms</sub> (Amperes): 14.402A

Freq: 50.003Hz

THDi: 1.14%

THDu: 0.096%

Active input power: 3.309KVA

P.F.: 0.999

Note: THDi stands for current total harmonic distortion

#### Harmonic Current Results

Order	Av. Current [A] Frame: 2.5min	Limit	In/11 (%)	Result	Order	Av. Current [A] Frame: 2.5min	Limit	In/11 (%)	Result
1	14.402	0.0000	NA	NA	21	0.0056	0.1071	0.039%	PASS
2	0.0166	1.0800	0.115%	PASS	22	0.0014	0.0836	0.010%	PASS
3	0.0179	2.3000	0.124%	PASS	23	0.0119	0.0978	0.083%	PASS
4	0.0105	0.4300	0.073%	PASS	24	0.0014	0.0767	0.010%	PASS
5	0.1103	1.1400	0.766%	PASS	25	0.014	0.0900	0.097%	PASS
6	0.0047	0.3000	0.033%	PASS	26	0.0016	0.0708	0.011%	PASS
7	0.0523	0.7700	0.363%	PASS	27	0.0016	0.0833	0.011%	PASS
8	0.0085	0.2300	0.059%	PASS	28	0.0015	0.0657	0.010%	PASS
9	0.0037	0.4000	0.026%	PASS	29	0.0029	0.0776	0.020%	PASS
10	0.0094	0.1840	0.065%	PASS	30	0.0006	0.0613	0.004%	PASS
11	0.0798	0.3300	0.554%	PASS	31	0.0065	0.0726	0.045%	PASS
12	0.0033	0.1533	0.023%	PASS	32	0.002	0.0575	0.014%	PASS
13	0.0476	0.2100	0.331%	PASS	33	0.0046	0.0682	0.032%	PASS
14	0.0065	0.1314	0.045%	PASS	34	0.0017	0.0542	0.012%	PASS
15	0.0042	0.1500	0.029%	PASS	35	0.0078	0.0643	0.054%	PASS
16	0.0036	0.1150	0.025%	PASS	36	0.0008	0.0511	0.006%	PASS
17	0.0422	0.1324	0.293%	PASS	37	0.0048	0.0608	0.033%	PASS
18	0.0015	0.1022	0.010%	PASS	38	0.0013	0.0484	0.009%	PASS
19	0.0144	0.1184	0.100%	PASS	39	0.0046	0.0577	0.032%	PASS
20	0.0018	0.0920	0.012%	PASS	40	0.0022	0.0460	0.015%	PASS

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Phase:	Line 3			
Temperature:	23	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	50	%	Test Date:	Mar. 25, 2014
Atmospheric Pressure:	1008	hPa	Classification:	Class A
Input voltage:	800	Vdc	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)

V<sub>rms</sub> (Volts): 229.69V

I<sub>rms</sub> (Amperes): 14.329A

Freq: 50.03Hz

THDi: 1.27%

THDu: 0.094%

Active input power: 3.291KVA

P.F.: 0.999

Note: THDi stands for current total harmonic distortion

#### Harmonic Current Results

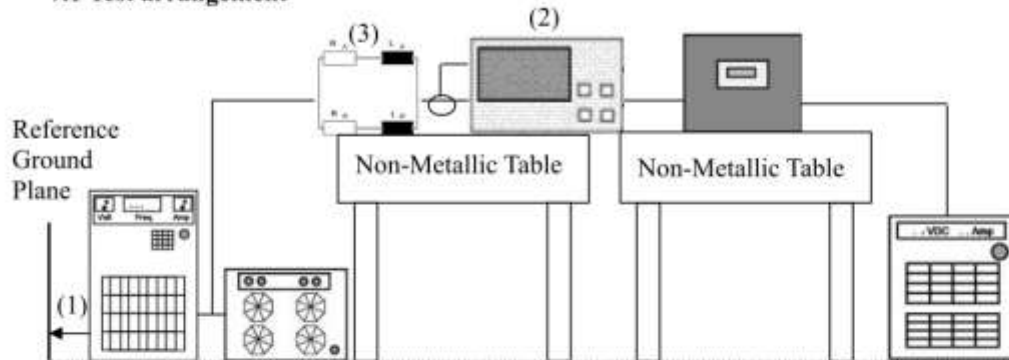
Order	Av. Current [A] Frame: 2.5min	Limit	In/11 (%)	Result	Order	Av. Current [A] Frame: 2.5min	Limit	In/11 (%)	Result
1	14.329	0.0000	NA	NA	21	0.0015	0.1071	0.010%	PASS
2	0.01	1.0800	0.070%	PASS	22	0.0015	0.0836	0.010%	PASS
3	0.0292	2.3000	0.204%	PASS	23	0.0159	0.0978	0.111%	PASS
4	0.0067	0.4300	0.047%	PASS	24	0.0017	0.0767	0.012%	PASS
5	0.1238	1.1400	0.864%	PASS	25	0.02	0.0900	0.140%	PASS
6	0.0014	0.3000	0.010%	PASS	26	0.002	0.0708	0.014%	PASS
7	0.0535	0.7700	0.373%	PASS	27	0.0009	0.0833	0.006%	PASS
8	0.0082	0.2300	0.057%	PASS	28	0.0015	0.0657	0.010%	PASS
9	0.0096	0.4000	0.067%	PASS	29	0.0045	0.0776	0.031%	PASS
10	0.0096	0.1840	0.067%	PASS	30	0.0005	0.0613	0.003%	PASS
11	0.082	0.3300	0.572%	PASS	31	0.0063	0.0726	0.044%	PASS
12	0.003	0.1533	0.021%	PASS	32	0.0017	0.0575	0.012%	PASS
13	0.0599	0.2100	0.418%	PASS	33	0.0034	0.0682	0.024%	PASS
14	0.0049	0.1314	0.034%	PASS	34	0.0013	0.0542	0.009%	PASS
15	0.0071	0.1500	0.050%	PASS	35	0.0149	0.0643	0.104%	PASS
16	0.005	0.1150	0.035%	PASS	36	0.0018	0.0511	0.013%	PASS
17	0.0417	0.1324	0.291%	PASS	37	0.0101	0.0608	0.070%	PASS
18	0.0015	0.1022	0.010%	PASS	38	0.0015	0.0484	0.010%	PASS
19	0.0144	0.1184	0.100%	PASS	39	0.0039	0.0577	0.027%	PASS
20	0.0015	0.0920	0.010%	PASS	40	0.0023	0.0460	0.016%	PASS

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## 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  $P_R$ ,  $T_P = 2 \text{ h}$

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.

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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	Newton's4th	PPA2530	520	2013/06/27	2014/06/26
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 above equipments are within the valid calibration period.

#### 7.5 Uncertainty of Flicker

Expanded uncertainty ( $k=2$ ) of flicker measurement is 0.86.

#### 7.6 Test result: Pass

Phase:	Line 1			
Temperature:	23	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	55	%	Test Date:	Mar. 25, 2014
Atmospheric Pressure:	1008	hPa	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
Input voltage:	800	Vdc	Remark:	230Vac / 50Hz

	EUT DATA	LIMIT	RESULT	TEST ENABLED
<b>Pst max</b>	<b>0.182</b>	<b>1.00</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>Plt max</b>	<b>0.189</b>	<b>0.65</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>c</sub> %</b>	<b>-0.590</b>	<b>3.30</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>max</sub> %</b>	<b>-0.820</b>	<b>4.00</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>(t)</sub> Sec.</b>	<b>0.000</b>	<b>0.50</b>	<b>PASS</b>	<input checked="" type="checkbox"/>

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Phase:	Line 2			
Temperature:	23	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	55	%	Test Date:	Mar. 25, 2014
Atmospheric Pressure:	1008	hPa	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
Input voltage:	800	Vdc	Remark:	230Vac / 50Hz

	EUT DATA	LIMIT	RESULT	TEST ENABLED
<b>Pst max</b>	<b>0.188</b>	<b>1.00</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>Plt max</b>	<b>0.173</b>	<b>0.65</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>c</sub> %</b>	<b>0.550</b>	<b>3.30</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>max</sub> %</b>	<b>-0.960</b>	<b>4.00</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>(t)</sub> Sec.</b>	<b>0.000</b>	<b>0.50</b>	<b>PASS</b>	<input checked="" type="checkbox"/>

Phase:	Line 3			
Temperature:	23	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	55	%	Test Date:	Mar. 25, 2014
Atmospheric Pressure:	1008	hPa	Output voltage:	3-Phase/5-Wire(L1, L2, L3, N, PE)
Input voltage:	800	Vdc	Remark:	230Vac / 50Hz

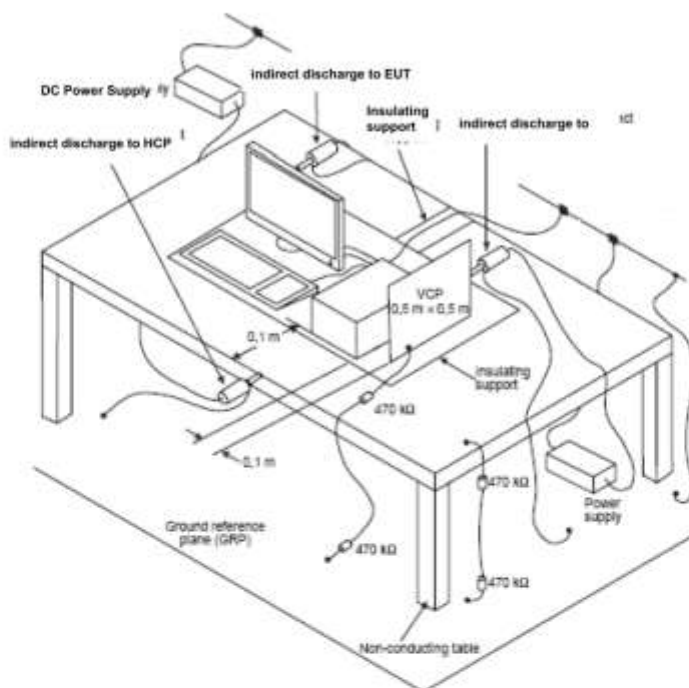
	EUT DATA	LIMIT	RESULT	TEST ENABLED
<b>Pst max</b>	<b>0.162</b>	<b>1.00</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>Plt max</b>	<b>0.187</b>	<b>0.65</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>c</sub> %</b>	<b>0.730</b>	<b>3.30</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>max</sub> %</b>	<b>0.920</b>	<b>4.00</b>	<b>PASS</b>	<input checked="" type="checkbox"/>
<b>d<sub>(t)</sub> Sec.</b>	<b>0.000</b>	<b>0.50</b>	<b>PASS</b>	<input checked="" type="checkbox"/>



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## 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.



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### 8.5 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Electrostatic Discharge System	NoiseKen	ESS-2002	ESS0291088	2013/10/07	2014/10/06

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

### 8.6 Requirement

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

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

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

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### 8.7 Test Result: Pass

Temperature:	24	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	53	%	Test Date:	Mar 18, 2014
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

Type of discharge	Applied Voltage (kV)	Total No. of Discharge (Each Point)	Minimum requirement	Result	
Contact (Red points)	±2	20	Criterion B	Criterion A	PASS
	±4	20	Criterion B	Criterion A	PASS
	±8	20	Criterion B	Criterion A	PASS
Air (Yellow points)	±2	20	Criterion B	Criterion A	PASS
	±4	20	Criterion B	Criterion A	PASS
	±8	20	Criterion B	Criterion A	PASS
	±15	20	Criterion B	Criterion A	PASS
VCP (4 sides)	±2	50	Criterion B	Criterion A	PASS
	±4	50	Criterion B	Criterion A	PASS
	±8	50	Criterion B	Criterion A	PASS
HCP (4 sides)	±2	20	Criterion B	Criterion A	PASS
	±4	20	Criterion B	Criterion A	PASS
	±8	20	Criterion B	Criterion A	PASS

### Description of Discharge Point

Contact Discharge 25 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

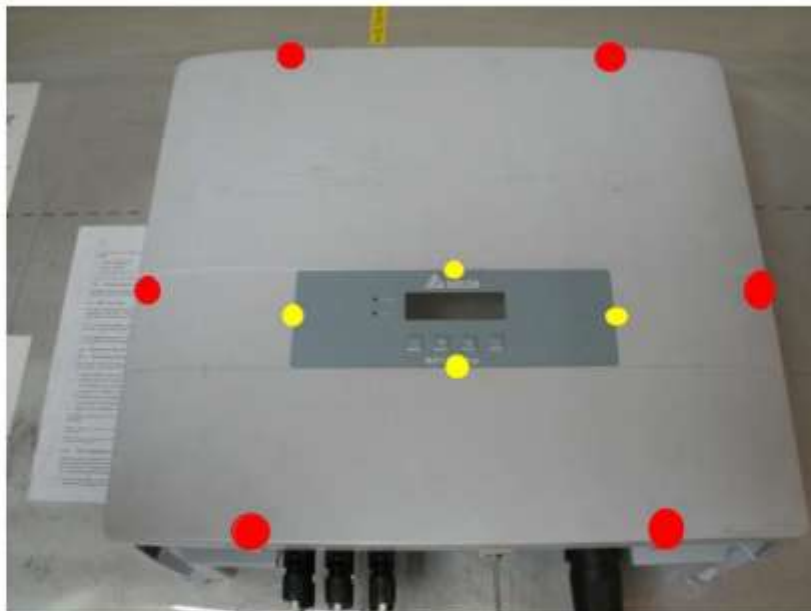
### Criteria description:

- 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.  
☐

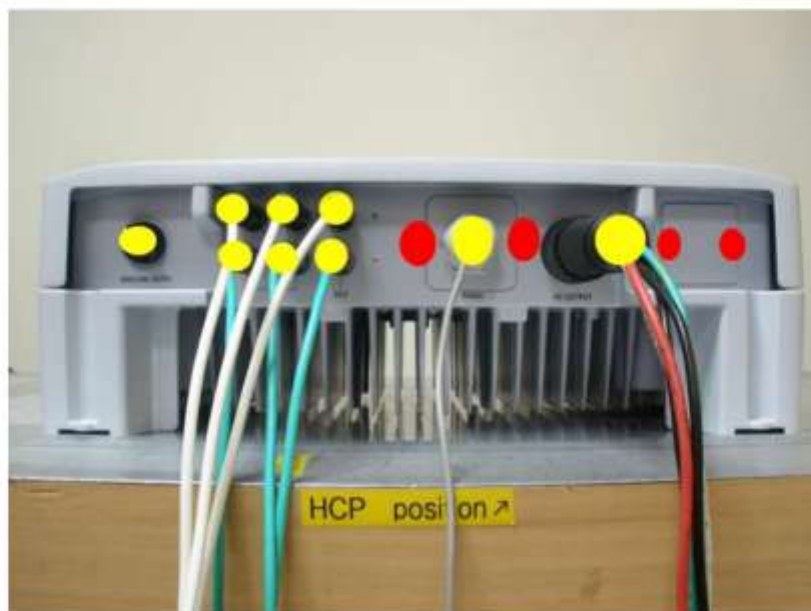
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**The tested point of EUT (Face side)**



**The tested point of EUT (Front side)**



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**The tested point of EUT (Right side)**



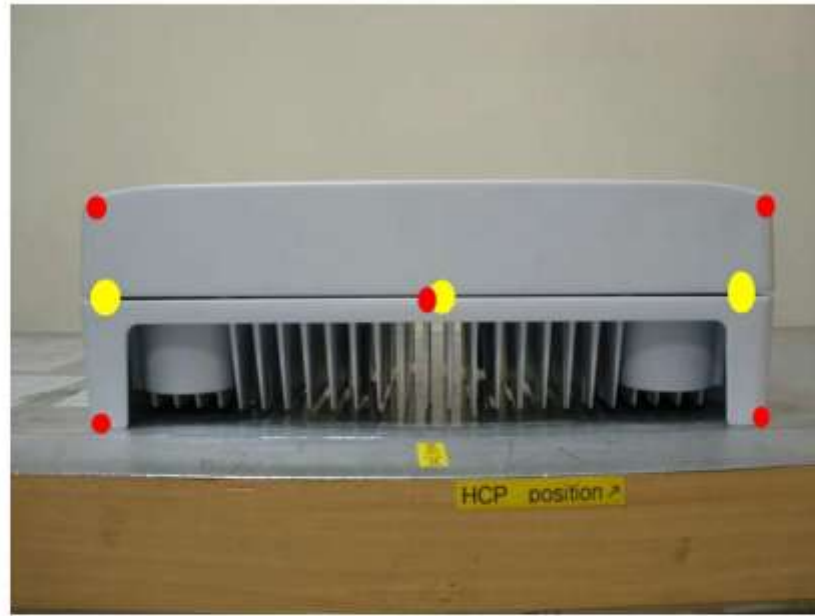
**The tested point of EUT (Left side)**



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**The tested point of EUT (Back side)**

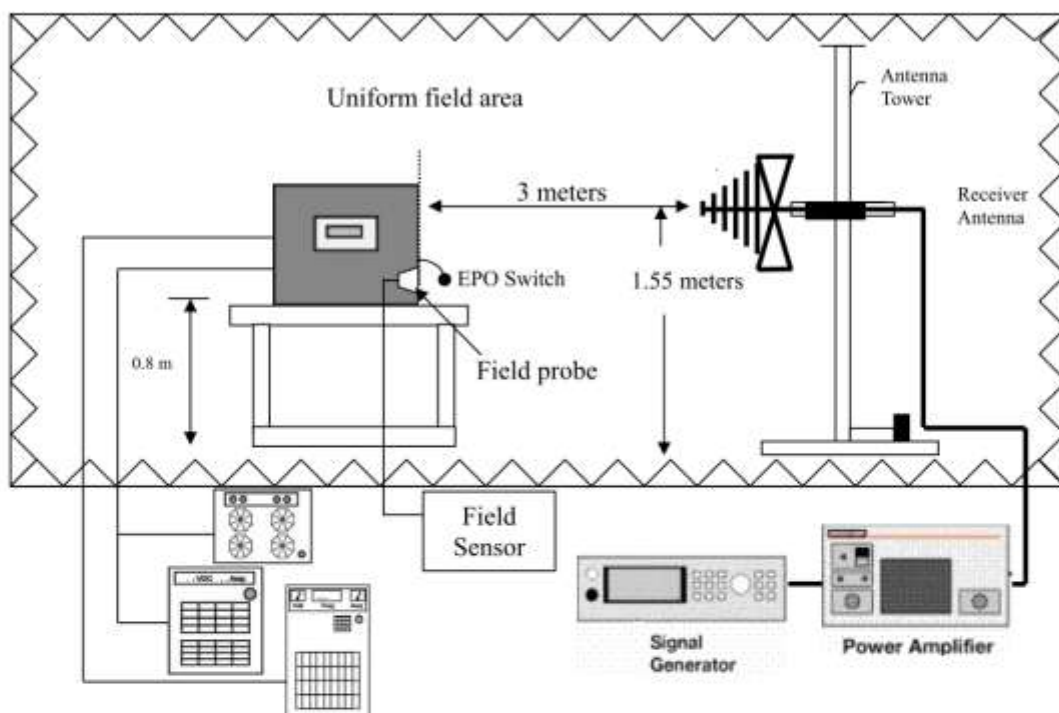


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## 9. Radiated Susceptibility Immunity Test

### 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.



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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
RS test system	Frankonia	RIS 3000	N/A	2013/08/30	2014/08/30

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



## 9.6 Requirement

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

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

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

## 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 M10A_1xx
Relative Humidity:	55	%	Test Date:	Mar 19, 2014
Atmospheric Pressure:	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

Exposed Side: ☒ Front ☒ Left ☒ Rear ☒ Right

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

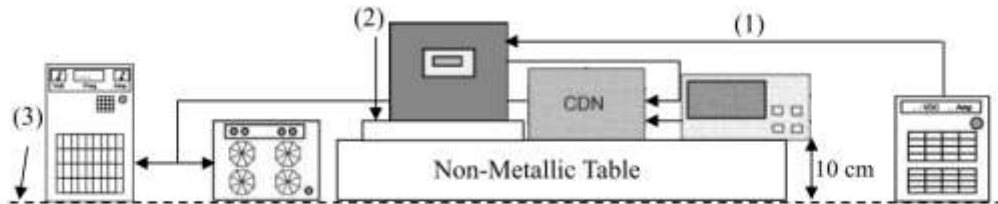
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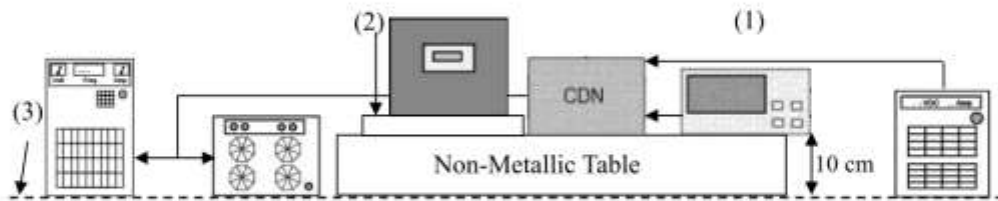
## 10. Electrical Fast Transient/Burst Immunity Test

### 10.1 Test arrangement (for Main power)



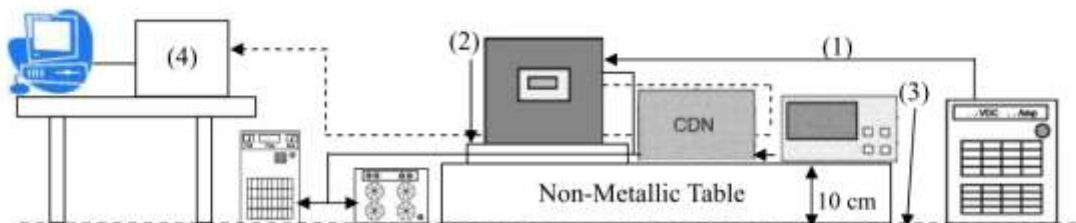
Note: (1) EFT/Burst Signal Generator  
(2) 10cm insulating support  
(3) Reference ground plane

### 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 RS-485 port)



Note: (1) EFT/Burst Signal Generator  
(2) 10cm insulating support  
(3) Reference ground plane  
(4) RS232 to RS-485 Converter



#### 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	4*, 3, 2
Voltage peak	$\pm 4\text{kV(AC)}$ ; $\pm 4\text{kV(DC)}$ ; $\pm 4\text{kV(RS-232 \& RS-485)}$
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. The level of 4kV for electrical fast transient/burst immunity test was required by client



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### 10.7 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMC Test System	Teseq	NSG 3060	1366	2013/11/04	2014/11/03
CDN 3063	Teseq	CDN 3063	1992	2013/11/04	2014/11/03
CDN 3425	Teseq	CDN 3425	1682	N/A	N/A

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

### 10.8 Requirement

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

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

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



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### 10.9 Test Results

Temperature:	25	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	55	%	Test Date:	Mar 18, 2014
Atmospheric Pressure:	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

Coupling line	Voltage peak	Signal Line & Control Line (see Note 1)	Minimum requirement	Result	
Signal power port	±4 kV	RS-232 & RS-485	Criterion B	Criterion A	Pass
DC port	±4 kV	-	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 port

#### 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.

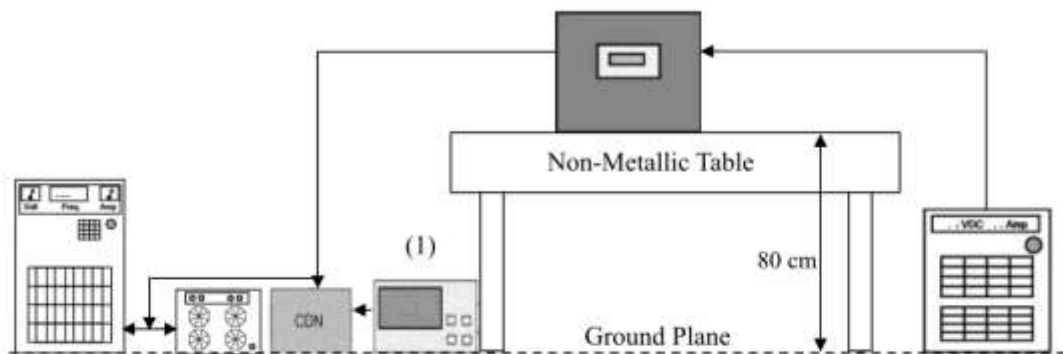
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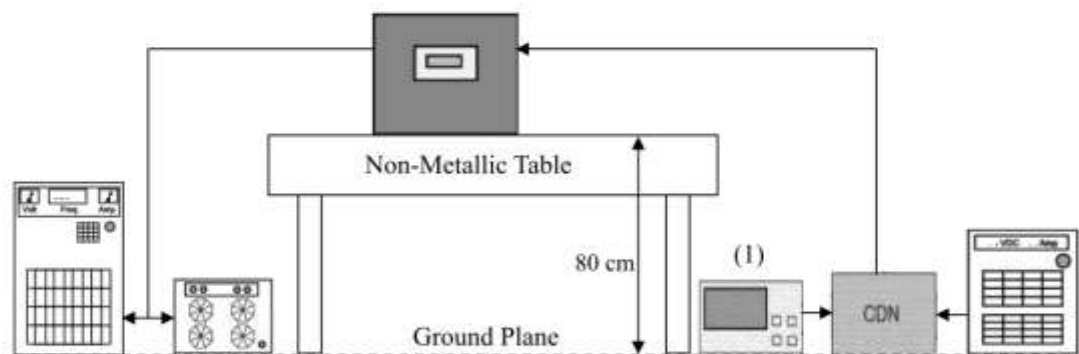
## 11. Surge Immunity Test

### 11.1 Test arrangement (AC side)



Note: (1) Surge Signal Generator

### 11.2 Test arrangement (DC side)

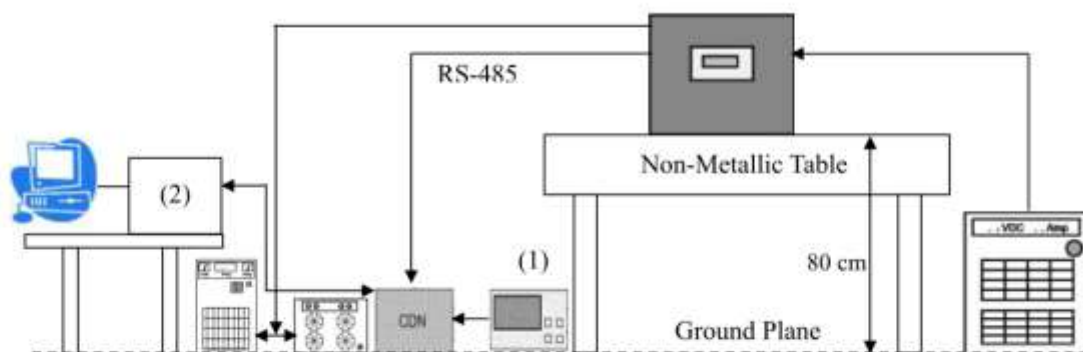


Note: (1) Surge Signal Generator

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### 11.3 Test arrangement (Signal port)



Note: (1) Surge Signal Generator  
(2) RS232 to RS-485 Converter

### 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	*3, 2, 1,
Open-circuit test voltage	$\pm 4$ kV, $\pm 2$ kV, $\pm 1$ kV, $\pm 0.5$ kV (AC Only); $\pm 0.5$ kV (DC Only) $\pm 6$ kV, $\pm 1$ kV, $\pm 0.5$ kV (RS-485)
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-485

### 11.7 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMC Test System	Teseq	NSG 3060	1366	2013/11/04	2014/11/03
CDN 3063	Teseq	CDN 3063	1992	2013/11/04	2014/11/03
Signal Line Coupling Decoupling Network	EMC- Partner AG	CDN-UTP8	033	N/A	N/A

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

### 11.8 Requirement

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

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

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

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### 11.9 Test Results: Pass

#### 11.9.1 Main power port

Phase	Line 1					
Temperature:	25	°C	Model No.:	RPI M10A_1xx		
Relative Humidity:	55	%	Test Date:	Mar 18, 2014		
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)		

Test 5 times for each voltage

Open-circuit test voltage	Mode	Minimum requirement	Angle			
			0°	90°	180°	270°
±0.5 kV	L1 to L2	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	L1 to L3	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	L1 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L1 to L2	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L1 to L3	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L1 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±2 kV	L1 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±2 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L1 to L2	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L1 to L3	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L1 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	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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Phase	Line 2					
Temperature:	25	°C	Model No.:	RPI M10A 1xx		
Relative Humidity:	55	%	Test Date:	Mar 18, 2014		
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)		

Test 5 times for each voltage

Open-circuit test voltage	Mode	Minimum requirement	Angle			
			0°	90°	180°	270°
±0.5 kV	L2 to L1	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	L2 to L3	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	L2 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L2 to L1	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L2 to L3	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L2 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±2 kV	L2 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±2 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L2 to L1	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L2 to L3	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L2 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	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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Phase	Line 3					
Temperature:	25	°C	Model No.:	RPI M10A 1xx		
Relative Humidity:	55	%	Test Date:	Mar 18, 2014		
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)		

Test 5 times for each voltage

Open-circuit test voltage	Mode	Minimum requirement	Angle			
			0°	90°	180°	270°
±0.5 kV	L3 to L1	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	L3 to L2	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	L3 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±0.5 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L3 to L1	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L3 to L2	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	L3 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±1 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±2 kV	L3 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±2 kV	N to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L3 to L1	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L3 to L2	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	L3 to Gnd	Criterion B	Criterion A	Criterion A	Criterion A	Criterion A
±4 kV	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
±0.5 kV	+ to -	Criterion B	Criterion A
±0.5 kV	+ to Gnd	Criterion B	Criterion A
±0.5 kV	- to Gnd	Criterion B	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.

☐

### 11.9.3 Signal port

Phase		Result	Criteria Level	Remark
Volt	Mode			
±0.5KV	Line to Ground	Pass	A	RS-485 port
±1KV	Line to Ground	Pass	A	RS-485 port
±6KV	Line to Ground	Pass	A	RS-485 port

#### 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.

☐

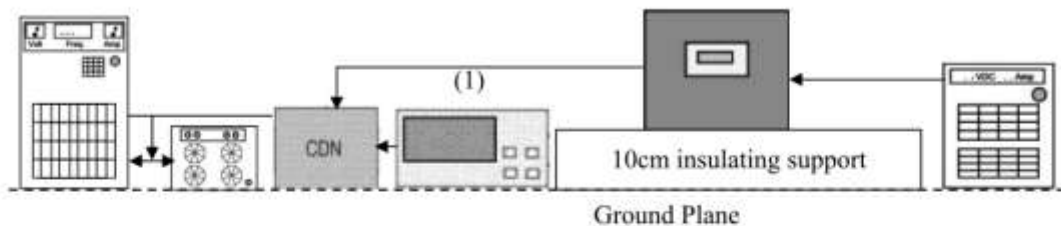
**Intertek**

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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	2013/11/05	2014/11/04
Mainsnetwork	COMTEST	4413-016	9818	2013/11/06	2014/11/05
Coupling And Decoupling Network	Schaffner	CDN M016	21272	2013/05/04	2014/05/04

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

#### 12.6 Requirement

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

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

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



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### 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.

### 12.8 Test Results: Pass

Temperature:	25	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	55	%	Test Date:	Mar 18, 2014
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

Measurement at power port:

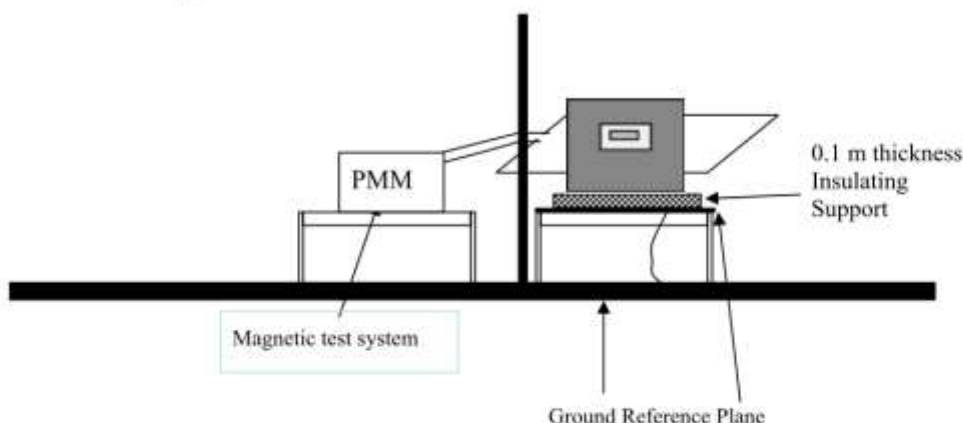
Frequency range	Minimum requirement	Result	
0.15 MHz to 80 MHz	Criterion A	Criterion A	Pass

#### 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.  
☐ \_\_\_\_\_

### 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	2012/11/30	2014/11/30

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

### 13.6 Requirement

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

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

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



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**13.7 Test Result: Pass**

Temperature:	25	°C	Model No.:	RPI M10A_1xx
Relative Humidity:	55	%	Test Date:	Mar 18, 2014
Atmospheric Pressure:	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

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:**

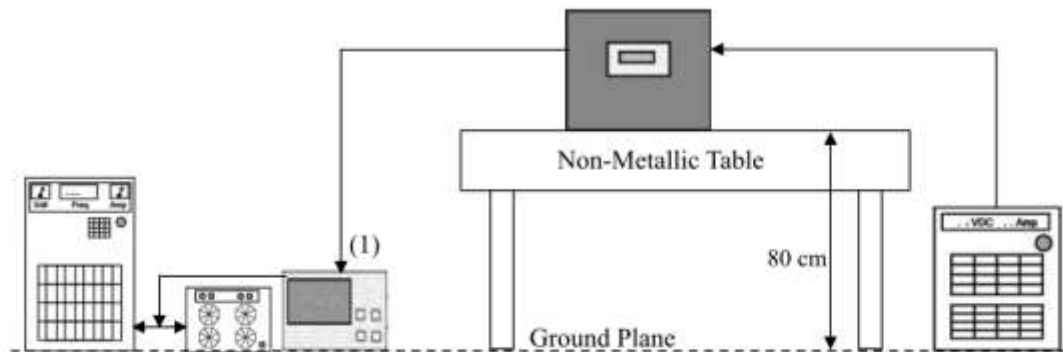
- Criterion A: ☒ Function is operated as intended during and after the test  
☐ \_\_\_\_\_
- Criterion B: ☐ Function is temporary degradation and operated as intended after the test.  
☐ \_\_\_\_\_
- Criterion C: ☐ Function is degradation or loss, requires operator intervention or system reset occurs.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

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## 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 B8 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.



#### 14.4 Test Specification

##### Voltage dips & short interruptions

Test level	3
Time at reduced voltage	0% residual voltage dips with 1 cycle 40% residual voltage dips with 10 cycles 70% residual voltage dips with 25 cycles 0 % during 250 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	2013/11/21	2014/11/20

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

#### 14.6 Requirement

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

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

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

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**14.7 Test Result: Pass**

Phase	Line 1			
Temperature:	25	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	55	%	Test Date:	Mar 18, 2014
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

**Voltage Dips**

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

**Voltage Interruption**

Test level (% residual voltage)	cycle	Minimum requirement	Result	
0	250	Criterion C	Criterion B	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.

☐



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Phase	Line 2			
Temperature:	25	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	55	%	Test Date:	Mar 18, 2014
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

#### Voltage Dips

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

#### Voltage Interruption

Test level (% residual voltage)	cycle	Minimum requirement	Result	
0	250	Criterion C	Criterion B	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.  
☐ \_\_\_\_\_



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Phase	Line 3			
Temperature:	25	°C	Model No.:	RPI M10A 1xx
Relative Humidity:	55	%	Test Date:	Mar 18, 2014
Atmospheric	1008	hPa	Remark:	3-Phase/5-Wire(L1, L2, L3, N, PE)

#### Voltage Dips

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

#### Voltage Interruption

Test level (% residual voltage)	cycle	Minimum requirement	Result	
0	250	Criterion C	Criterion B	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**

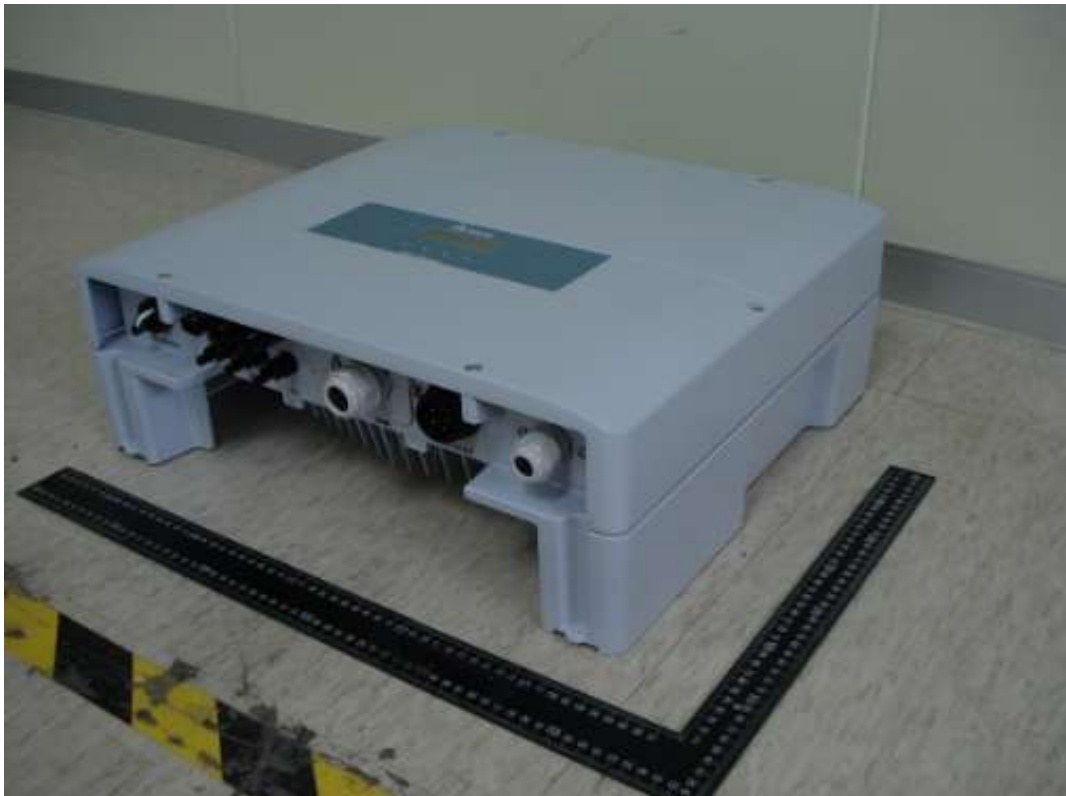
**Inverter  
Enclosure front side**



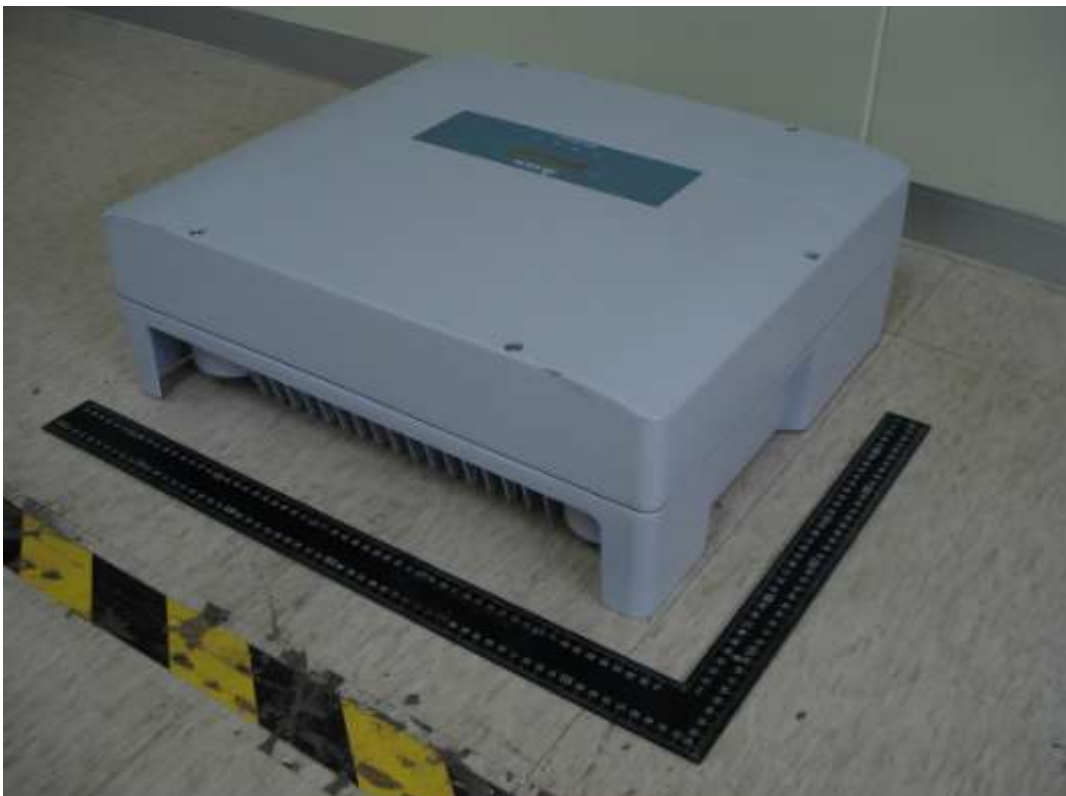
**Inverter  
Enclosure rear side**



**Enclosure – Bottom / Right side**



**Enclosure – Top / Left side**



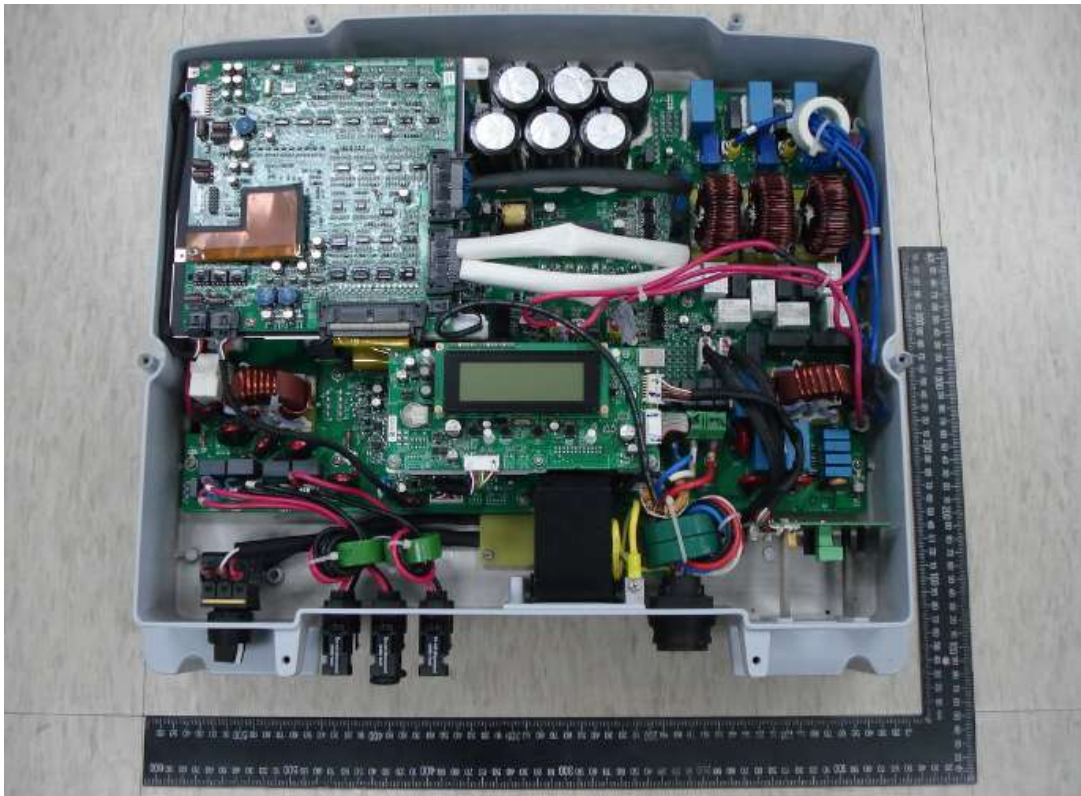
**Enclosure – Top side**



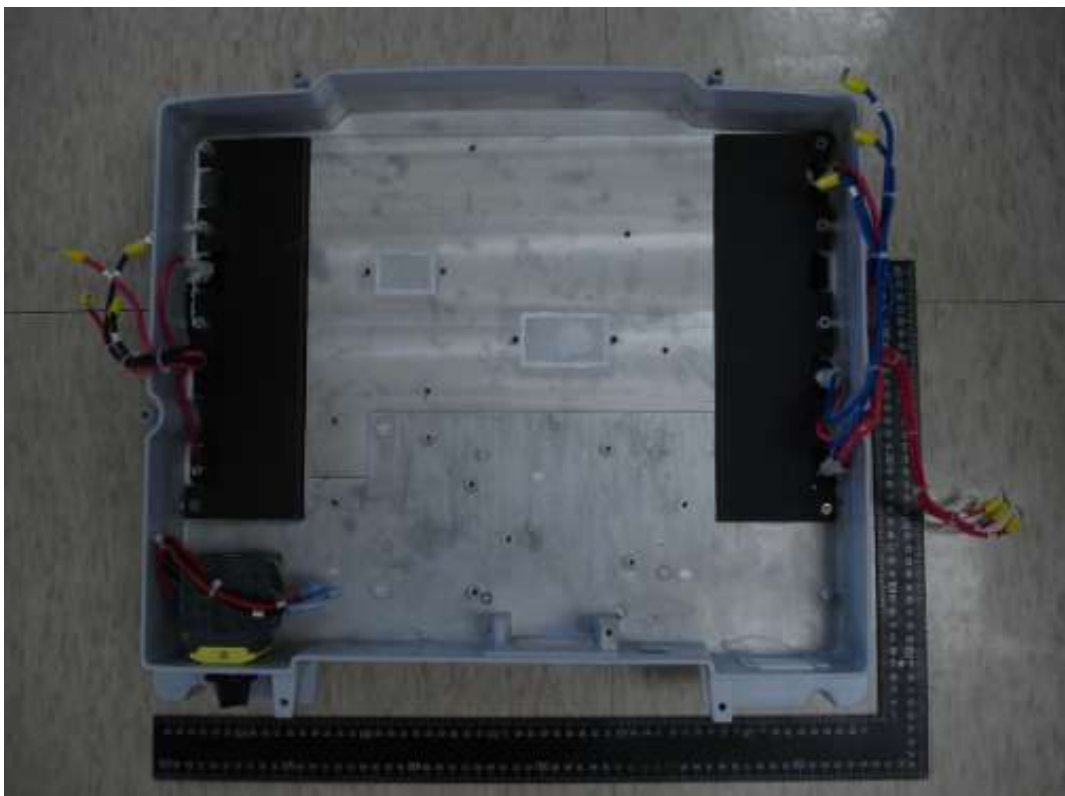
**Enclosure – Bottom side**



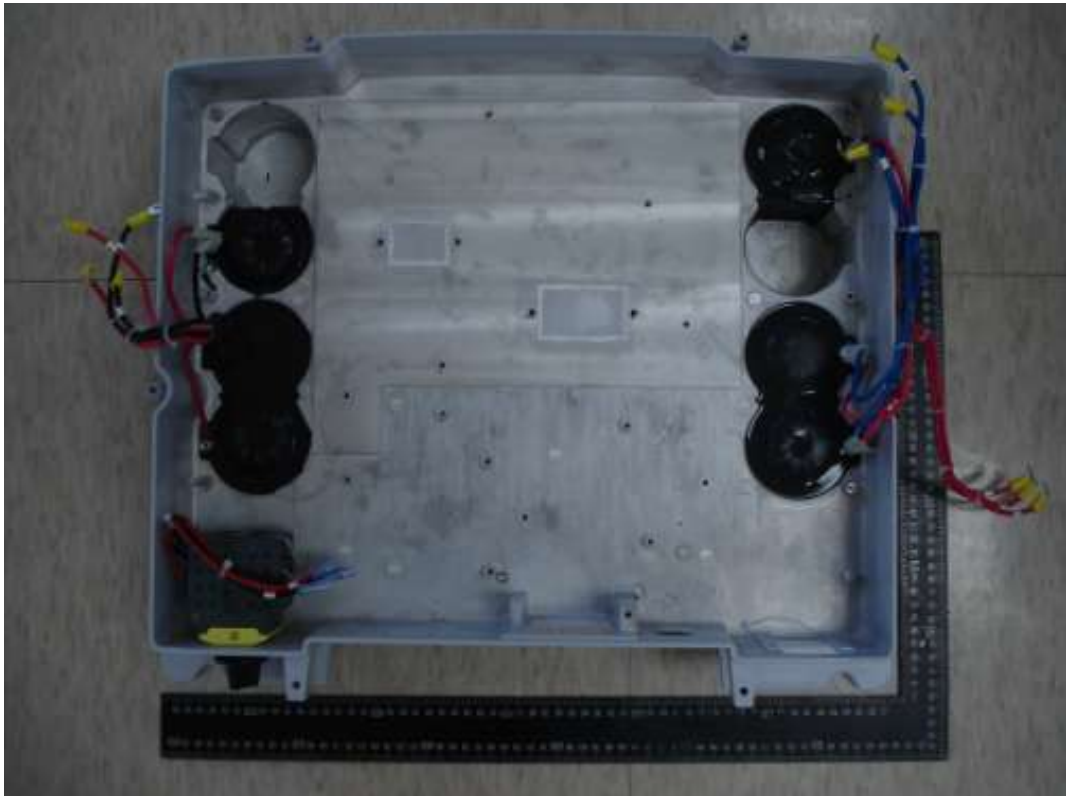
**Interior view**



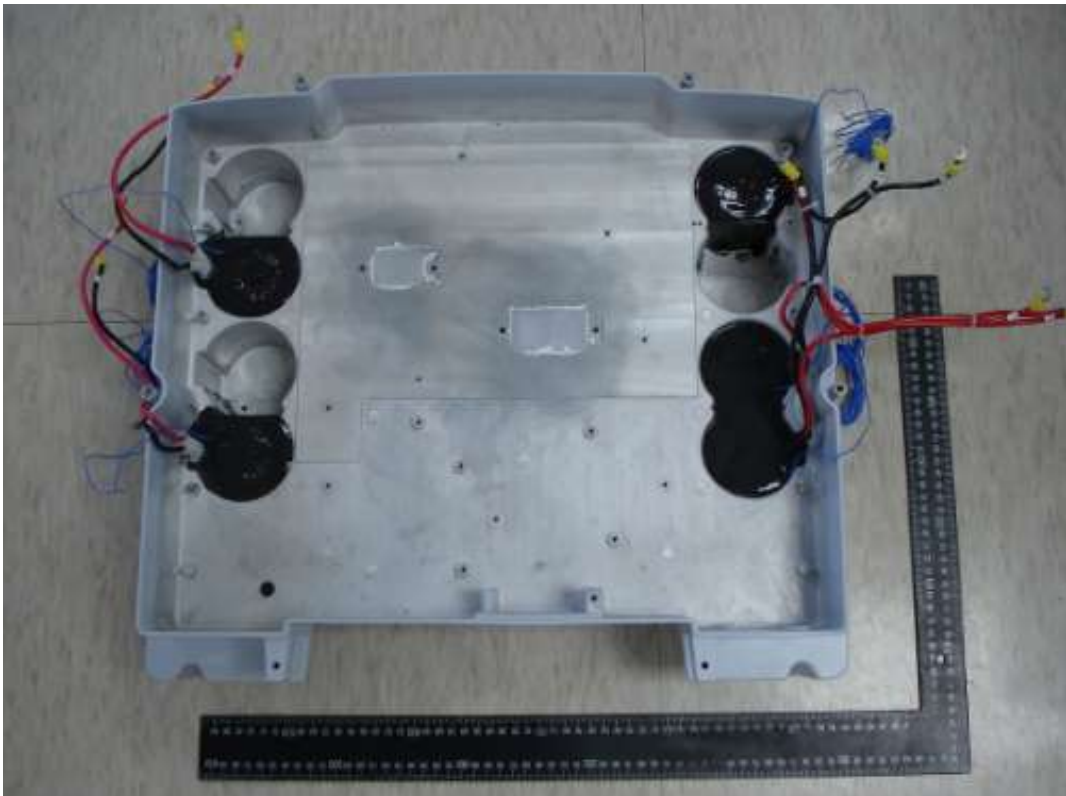
**Interior view**



**Interior view (RPI M10A)**



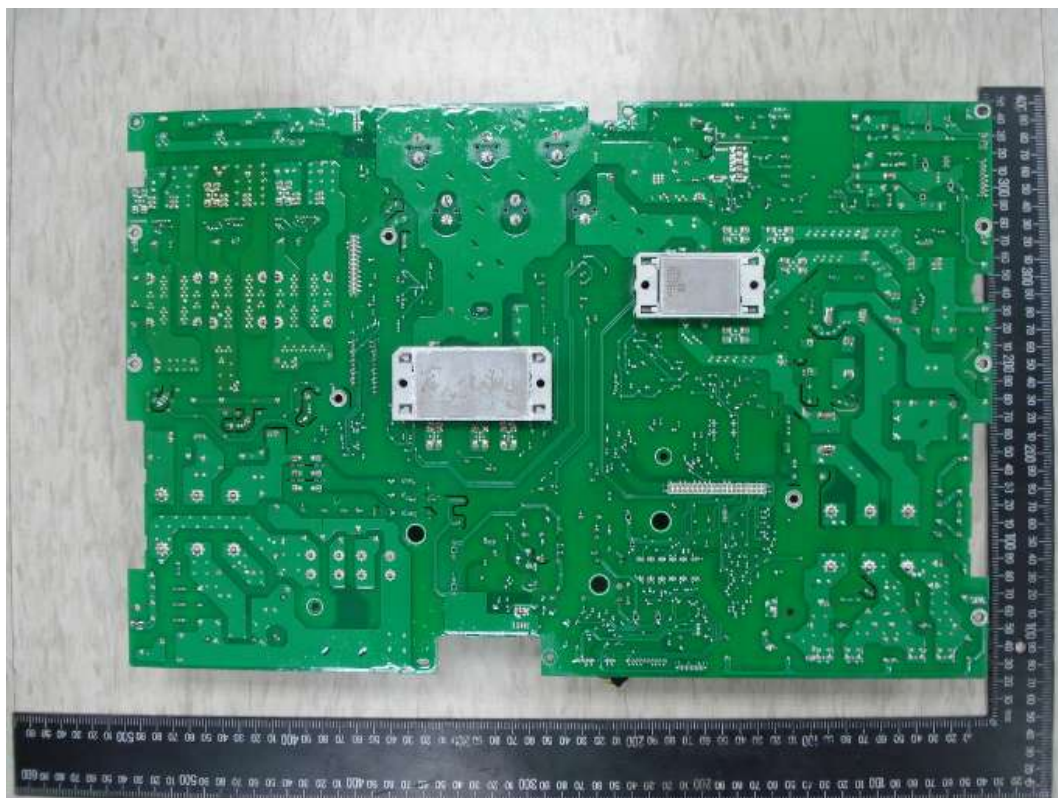
**Interior view (RPI M8A, RPI M6A)**



**Power board\_component side view**



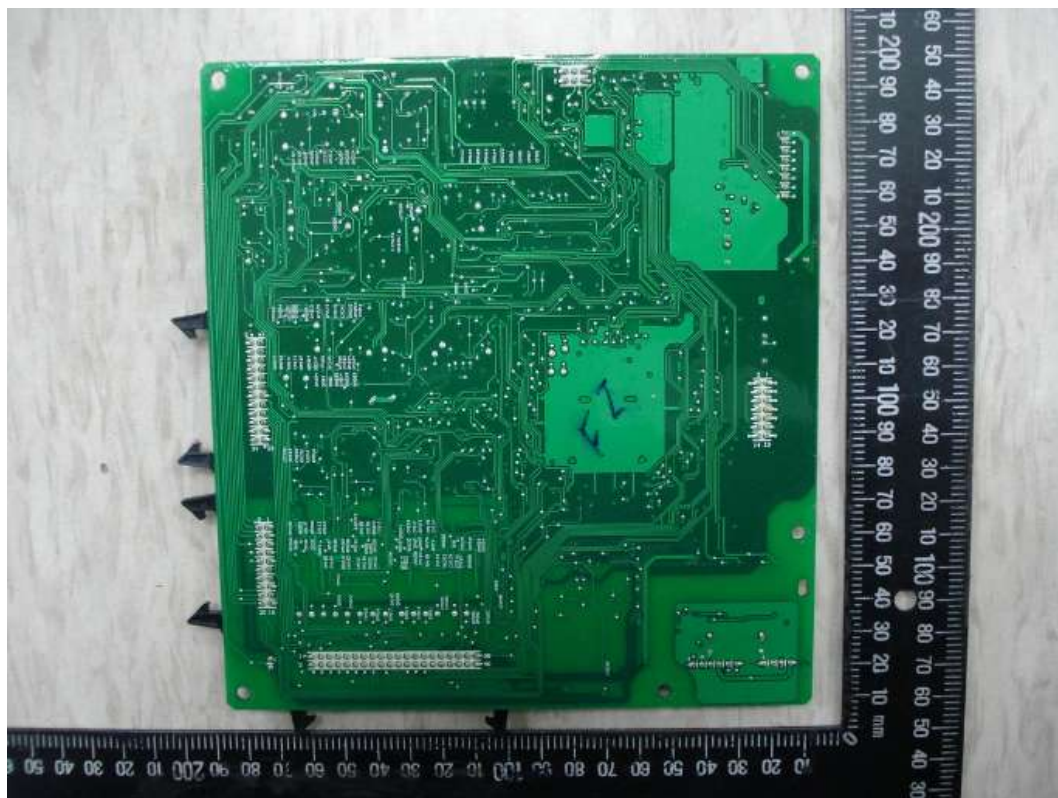
**Power board\_solder side view**



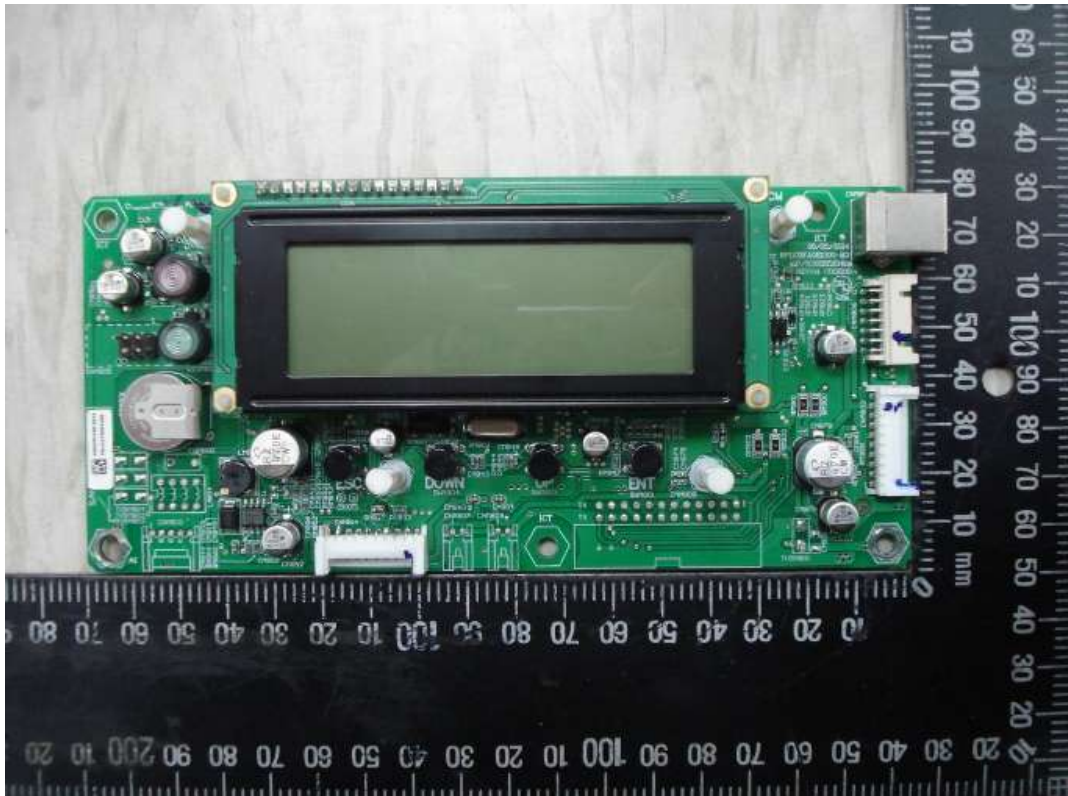
**Control board\_component side view**



**Control board\_solder side view**



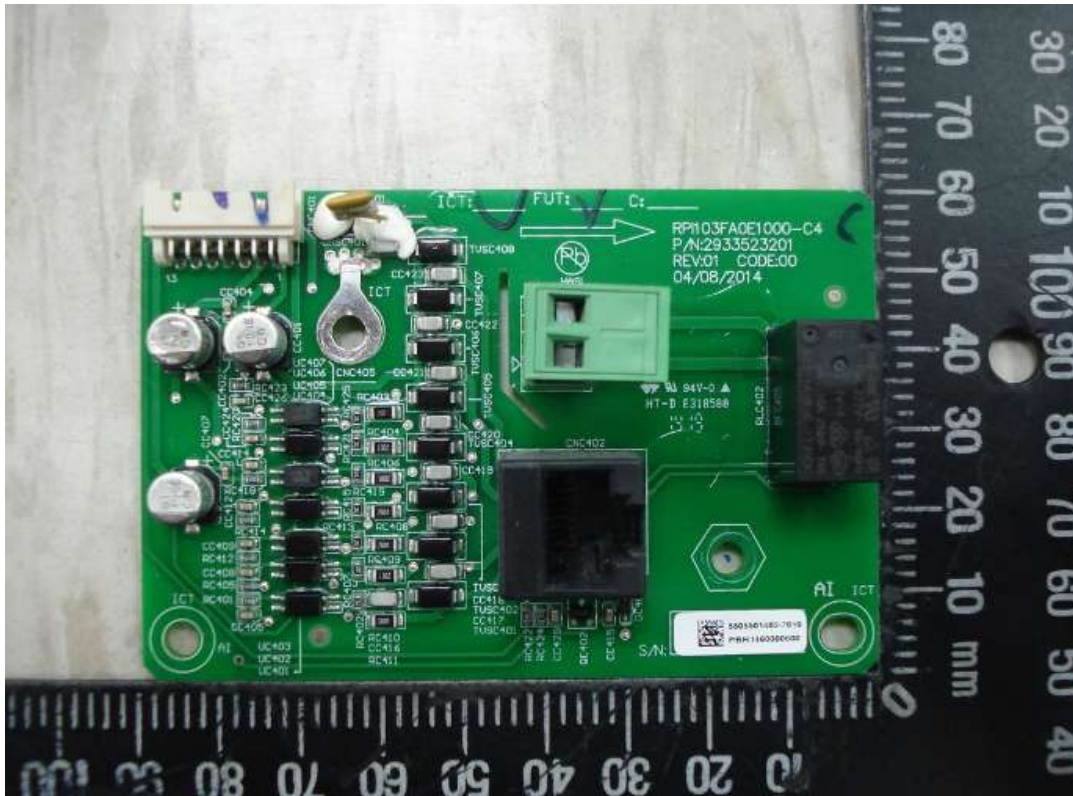
**Display board\_component side view**



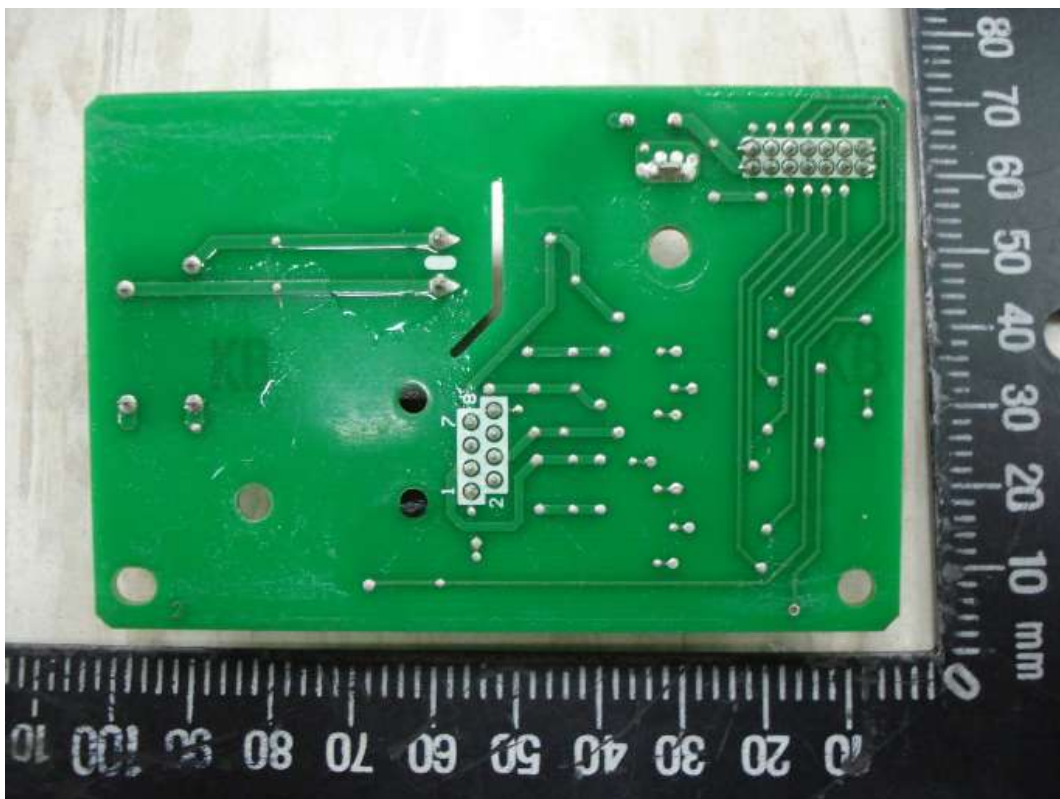
**Display board\_solder side view**



**Communication board\_component side view**



**Communication board\_solder side view**



# **Annex 3**

## **Test equipment list**

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Thermo-Hygro Grapg	50	Isuzs	3-3122	70860282	2016-12-02
Impulse tester	118	Prostar	IEC-950	1990741	2016-09-14
LCR Meter	137	Motech	MT4090/I-S1	40905090004	2017-01-22
Precision Power Analyzer	157	YOKOGAWA	WT-1600	91JA10617	2016-11-04
Digital Oscilloscope	158	LECROY	WS-44XS	LCRY0310M22703	2016-05-25
Electric strength	163	EXTECH	7451	1310408	2016-12-08
Programable DC Source	183	CHROMA	62150H-1000S	62150EF00169	Monitor by Power Analyzer
Programable DC Source	184	CHROMA	62150H-1000S	62150EF00143	
Programable AC Source	185	CHROMA	61512	615120000263	
Precision Power Analyzer	215	YOKOGAWA	WT-3000	91M534527	2016-06-01
SCOPE CORDER	216	YOKOGAWA	DL850	91M534532	2017-02-03
Programable AC Source	217	CHROMA	61512	615120000372	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	511	39108378	2016-06-08