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TEST REPORT
NRS 097-2-1:2017
GRID INTERCONNECTION OF EMBEDDED GENERATION
PART 2: SMALL-SCALE EMBEDDED GENERATION
SECTION 1: UTILITY INTERFACE

Report Reference No…… ...:	210800495TPE-001
Date of issue……:	2021-11-24
Total number of pages……:	113 pages

Testing Laboratory ..... :	Intertek Testing Services Taiwan Ltd.
Address..... :	5F, No. 423, Ruiguang Rd., Neihu District, Taipei 114, Taiwan
Testing location/ address..... :	Same as above
Tested by (name + signature)……:	Ted Wu Project handler
Approved by (+ signature).....:	Hans Yang Reviewer

Applicant's name ..... :	VOLTRONIC POWER TECHNOLOGY CORP.
Address..... :	No.406, Xinhu 1st Rd., Neihu Dist., Taipei, Taiwan

Test specification:

Standard ..... :	NRS 097-2-1:2017
Test procedure..... :	Type approval
Non-standard test method……..:	N/A

Test Report Form No. ..... :	NRS 097-2-1a
Test Report Form(s) Originator ..... :	Intertek Guangzhou
Master TRF..... :	Dated 2019-05

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Test item description ..... :	HYBRID MPPT SOLAR INVERTER
Trade Mark..... :	--
Manufacturer..... :	VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP. 1-5F, Building 5 & 1F Building7 & 1F Building9, RunDongSheng Industrial Park, No.467, Section Xixiang, National Highway 107, LongZhu Community, Xixiang, Bao An District, Shenzhen, China
Model/Type reference..... :	INFINI WP 8KW, INFINI WP 10KW, INFINI WP 12KW, INFINI WP 15KW

Ratings..... :	INFINI WP 8KW	INFINI WP 10KW	INFINI WP 12KW	INFINI WP 15KW
MPP DC voltage range [V]..... :	350-950Vdc			
Input DC voltage range [V]..... :	320-1000Vdc			
Maximum Input DC current [A] .... :	13A/13A	26A/13A	26A/26A	
Output AC voltage [V]..... :	3/N/PE, 230/400Vac			
Output AC current [A]..... :	3*11.6A	3*14.5A	3*17.4A	3*21.5A
Maximum Output power [W]..... :	8000W	10000W	12000W	15000W
Input AC voltage [V] ..... :	3/N/PE, 230/400Vac			
Input AC current [A]..... :	40A per phase			
Battery voltage [V] ..... :	40-62Vdc			
Maximum Battery current [A] ..... :	200A	250A	300A	375A

Summary of testing:

Tests performed (name of test and test clause):

NRS 097-2-1	Test Description
4.1.2 & 4.1.9	Normal voltage operating range Normal frequency operating range
4.1.5	Flicker and voltage changes
4.1.7	Commutation notches
4.1.8	DC injection
4.1.10	Harmonics and waveform distortion
4.1.11	Power factor
4.1.12 & 4.2.4	Synchronization Response to utility recovery
4.1.13*	Electromagnetic compatibility (EMC)
4.2.2.3.2	Overvoltage and undervoltage
4.2.2.3.3	Over-frequency and under-frequency
4.2.2.4	Prevention of islanding

Remark:

Other than special notice, the model INFINI WP 15KW is type tested and valid for other models.

Testing location:

Intertek Testing Services Taiwan Ltd.

5F, No. 423, Ruiguang Rd., Neihu District, Taipei 114, Taiwan

Copy of marking plate

Model No. : INFINI WP 8KW

Serial No. : 96161406100001

PV INPUT	Nominal operating voltage 720Vdc
	Vmax PV 1000Vdc
	PV input voltage range 320-1000Vdc
	Isc PV 2*13A
	MPPT voltage range 350 ~ 950Vdc
GRID/AC OUTPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Nominal output current 11.6A per phase
	Nominal operating frequency 50Hz
	Maximum power 8000W
	Power factor range 0.9 lead-0.9lag
AC INPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Maximum input current 40A per phase
	Nominal operating frequency 50Hz
BATTERY	Battery voltage range 40~62Vdc
	Maximum battery current 200A

Ambient temperature:-25~+60°C
Enclosure:IP 65
Safety class I
VDE0126-1-1 VDE-AR-N 4105

CE

WARNING:FIRE HAZARD.
SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY
CAUTION:THE DC AND AC BREAKER MUST HAVE BEEN TURNED OFF BEFORE SERVICING
MADE IN CHINA
VOLTRONIC POWER TECHNOLOGY CORP.

Model No. : INFINI WP 10KW

Serial No. : 96161406100001

PV INPUT	Nominal operating voltage 720Vdc
	Vmax PV 1000Vdc
	PV input voltage range 320-1000Vdc
	Isc PV 26+13A
	MPPT voltage range 350 ~ 950Vdc
GRID/AC OUTPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Nominal output current 14.5A per phase
	Nominal operating frequency 50Hz
	Maximum power 10000W
	Power factor range 0.9 lead-0.9lag
AC INPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Maximum input current 40A per phase
	Nominal operating frequency 50Hz
BATTERY	Battery voltage range 40~62Vdc
	Maximum battery current 250A

Ambient temperature:-25~+60°C
Enclosure:IP 65
Safety class I
VDE0126-1-1 VDE-AR-N 4105

CE

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CAUTION:THE DC AND AC BREAKER MUST HAVE BEEN TURNED OFF BEFORE SERVICING
VOLTRONIC POWER TECHNOLOGY CORP.

Model No. : INFINI WP 12KW

Serial No. : 96161406100001

PV INPUT	Nominal operating voltage 720Vdc
	Vmax PV 1000Vdc
	PV input voltage range 320-1000Vdc
	Isc PV 2*26A
	MPPT voltage range 350 ~ 950Vdc
GRID/AC OUTPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Nominal output current 17.4A per phase
	Nominal operating frequency 50Hz
	Maximum power 12000W
	Power factor range 0.9 lead-0.9lag
AC INPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Maximum input current 40A per phase
	Nominal operating frequency 50Hz
BATTERY	Battery voltage range 40~62Vdc
	Maximum battery current 300A

Ambient temperature:-25~+60°C
Enclosure:IP 65
Safety class I
VDE0126-1-1 VDE-AR-N 4105

CE

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CAUTION:THE DC AND AC BREAKER MUST HAVE BEEN TURNED OFF BEFORE SERVICING.
VOLTRONIC POWER TECHNOLOGY CORP.

Model No. : INFINI WP 15KW

Serial No. : 96161406100001

PV INPUT	Nominal operating voltage 720Vdc
	Vmax PV 1000Vdc
	PV input voltage range 320-1000Vdc
	Isc PV 2*26A
	MPPT voltage range 350 ~ 950Vdc
GRID/AC OUTPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Nominal output current 21.7A per phase
	Nominal operating frequency 50Hz
	Maximum power 15000W
	Power factor range 0.9 lead-0.9lag
AC INPUT	Nominal operating voltage 3/N/PE, 230/400 Vac
	Maximum input current 40A per phase
	Nominal operating frequency 50Hz
BATTERY	Battery voltage range 40~62Vdc
	Maximum battery current 375A

Ambient temperature:-25~+60°C
Enclosure:IP 65
Safety class I
VDE0126-1-1 VDE-AR-N 4105

CE

WARNING:FIRE HAZARD.
SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY
CAUTION:THE DC AND AC BREAKER MUST HAVE BEEN TURNED OFF BEFORE SERVICING.
MADE IN CHINA
VOLTRONIC POWER TECHNOLOGY CORP.

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation
3. The other model labels are identical with label above, except the model name and rating.

Test item particulars.....:	
Temperature range .....:	-25 ~ +60℃; >+45℃ derating
AC Overvoltage category.....:	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
DC Overvoltage category .....:	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
IP protection class .....:	IP 65
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A (Not applicable)
- test object does meet the requirement .....:	P (Pass)
- test object does not meet the requirement .....:	F (Fail)
Testing.....:	
Date of receipt of test item.....:	2021-08-26
Date (s) of performance of tests.....:	2021-08-30 – 2021-11-12

General remarks:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

When determining for test conclusion, measurement uncertainty of tests has been considered.
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The test report only allows to be revised only within the report defined retention period unless standard or regulation was withdrawn or invalid.

Throughout this report a ☒ comma / ☐ point is used as the decimal separator.

General product information:

The Hybrid inverter is a three phases type, converts DC voltage, generated by batteries and PV array, into AC voltage. Battey can also be charged from the AC grid and PV array.

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

The internal control is redundant built. It consists of Microcontroller Main DSP (U3) and slave DSP (U6).

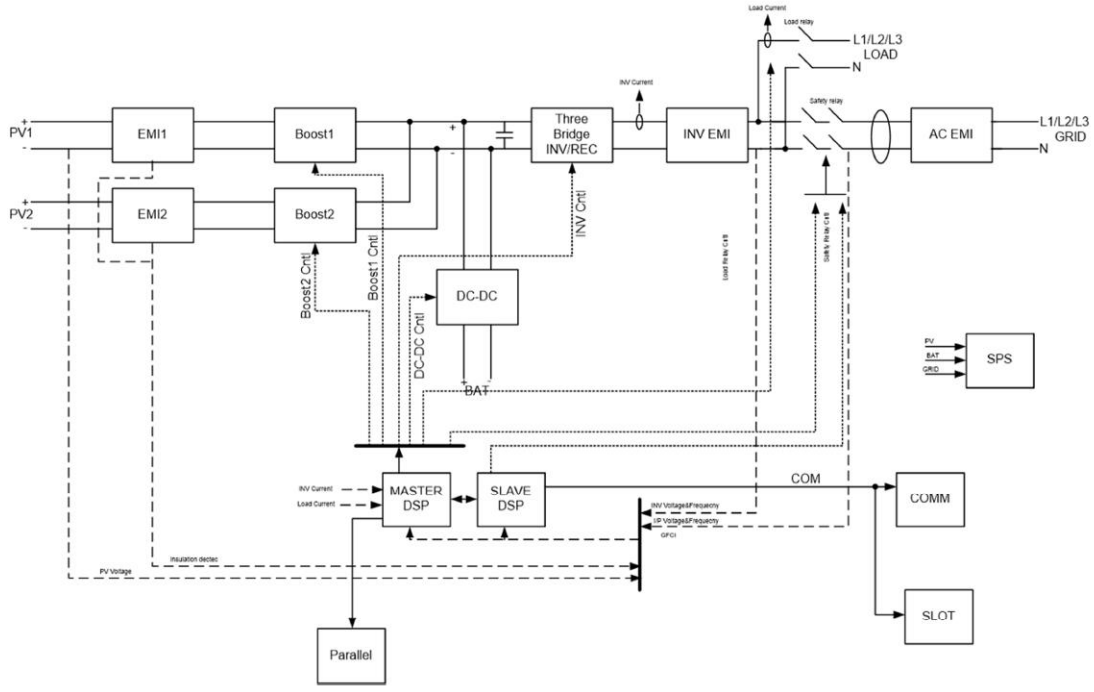
The Main DSP (U3) control the relays by switching signals; measures the battery voltage, battery current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition, it tests the current sensors and the RCMU circuit before each start up

The slave DSP (U6) measures the grid voltage, grid frequency and residual current, also can switch off the relays independently, and communicate with Main DSP (U3) each other.

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the Main DSP(U6). The Main DSP(U3) tests and calibrates before each start up all current sensors.

The unit provides two relays in series in all output conductors. When single fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the battery and the mains. All the relays are tested before each start up.

The topology diagram as following:



Model differences:

The models INFINI WP 8KW and INFINI WP 10KW, INFINI WP 12KW, INFINI WP 15KW are completely identical except for the INV inductor, the output power derated by software.

The product was tested on:
Hardware version: V00
Software version: V00

Factory information:
VOLTRONIC POWER TECHNOLOGY (SHENZHEN) CORP.
1-5F, Building 5 & 1F Building7 & 1F Building9, RunDongSheng Industrial Park, No.467, Section Xixiang, National Highway 107, LongZhu Community, Xixiang, Bao An District, Shenzhen, China.

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4	**Requirements**		P
4.1	**Utility compatibility (Performance aspects)**		P
4.1.1	General		P
4.1.1.1	This clause describes the technical issues and the responsibilities related to interconnecting an embedded generator to a utility network.	Noticed.	P
4.1.1.2	The quality of power provided by the embedded generator in the case of the on-site a.c. loads and the power delivered to the utility is governed by practices and standards on voltage, flicker, frequency, harmonics and power factor. Deviation from these standards represents out-of-bounds conditions. The embedded generator is required to sense the deviation and might need to disconnect from the utility network.	Noticed.	P
4.1.1.3	All power quality parameters (voltage, flicker, frequency and harmonics) shall be measured at the POC, unless otherwise specified (see annex A).	See appended table	P
	The power quality to be supplied to customers and influenced by SSEG shall comply with NRS 048-2. This implies that the combined voltage disturbances caused by the specific EG and other customers, added to normal background voltage disturbances, may not exceed levels stipulated by NRS 048-2. The maximum emission levels that may be contributed by SSEG are provided in this document (see 4.1.5 to 4.1.10).	Noticed.	P
	The customer can expect power quality at the POC in line with NRS 048-2. As such, the generator may not contribute significant disturbances to the voltage supplied at the POC. Typical contributions for small customer installations (total installation) are provided in Annex D of NRS 048-4. NOTE 1 The frequency cannot be changed by a SSEG. NOTE 2 The utility is responsible for the power quality at the POC, however, the EG is responsible to mitigate power quality exceedances should it be shown to cause excessive power quality levels.	Must be taken under consideration for the installation.	N/A
4.1.1.4	The embedded generator's a.c. voltage, current and frequency shall be compatible with the utility at the POC.	Noticed.	P
4.1.1.5	The embedded generator shall be type approved, unless otherwise agreed upon with the utility (see annex A).	Complied to type test.	P
4.1.1.6	The maximum size of the embedded generator is limited by the rating of the supply point on the premises. NOTE Also see NRS097-2-3.	Noticed.	P

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict
4.1.1.7	The utility will approve the size of the embedded generator and will decide on the connection point and conditions. In some cases it may be required to create a separate supply point.	Must be taken under consideration for the installation.	N/A
4.1.1.8	Embedded generators larger than 13,8 kVA shall be of the balanced three-phase type unless only a single-phase network supply is available, in which case NRS 097-2-3 recommendations can be applied based on the NMD. NOTE 1 This value refers to the maximum export potential of the generation device/system. NOTE 2 In the case of long feeder spurs the maximum desired capacity of the EG might require approval by the utility and might result in the requirement for a three-phase connection for smaller units.	Balanced three phase type of SSEG.	P
4.1.1.9	A customer with a multiphase connection shall split the embedded generator in a balanced manner over all phases if the EG is larger than 4,6 kVA. NOTE Balancing phases in a multiphase embedded generator is deemed desirable.	Must be taken under consideration for the installation.	N/A
4.1.1.10	Embedded generators or generator systems larger than 100 kVA may have additional requirements, for example, they must be able to receive communication signals for ceasing generation/disconnection from the utility supply, if the utility requires such. Communication facilities shall be provided to utility at no charge for integration with SCADA or other system when required. See Annex G (G.1). NOTE The RPP Grid Code requires category A3 units to be able to interface with the utility in order to receive stop and start signals.	Must be taken under consideration for the installation.	N/A
4.1.1.11	In line with the current Renewable Power Plant Grid Code, embedded generators smaller than 1000 kVA connected to low-voltage form part of Category A generators, with the following subcategories:	See below.	P
	a) Category A1: 0 – 13,8 kVA; This sub-category includes RPPs of Category A with rated power in the range from 0 to 13,8 kVA, inclusive of 13,8 kVA.	Considered.	P
	b) Category A2: 13,8 kVA – 100 kVA; and This sub-category includes RPPs of Category A with rated power in the range greater than 13,8 kVA but less than 100 kVA.	Considered.	P

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict
	c) Category A3: 100 kVA – 1 MVA. This sub-category includes RPPs of Category A with rated power in the range from 100 kVA but less than 1 MVA. NOTE 1 These sub-categories must be cross-checked with the Renewable Power Plant Grid Code (or other part of the Grid Code where applicable); where applicable, requirements will apply per sub-category and not per sizes defined here. NOTE 2 Until a separate Grid Code for non-renewable technologies have been compiled and published, relevant categories from this document will apply to non-renewable SSEG.		N/A
4.1.1.12	In accordance with SANS 10142-1, all generators shall be wired permanently. NOTE 1 Some international companies are distributing so-called "plug-in" generators, where a small PV panel and inverter is connected to the supply circuit via a standard (load) plug. At present such installations are not regarded as safe and in contravention of SANS 10142-1. NOTE 2 This option will be reviewed when internationally accepted norms are finalised to ensure plugs and plug points are safe when feeding power into the grid as well as additional requirements for such generators or plugs.	Permanent and fixed connection type of unit. Must be taken under consideration for the installation.	N/A
4.1.1.13	Any UPS/generating device that operates in parallel with the grid may only connect to the grid when it complies fully with the requirements of this part of NRS 097. This includes UPS configurations with or without EG. NOTE The requirement is applicable irrespective of the duration of parallel operation.	No such type of SSEG.	P
4.1.1.14	Standby-generators are covered by SANS 10142-1.	Grid interactive type	N/A
4.1.1.15	All generators larger than 100 kVA will be controllable, i.e. be able to control the active output power dependent on network conditions/abnormal conditions. This includes several smaller units that totals more than 100 kVA at a single POC	Noticed.	P
4.1.1.16	Maximum DC Voltage may not exceed 1000V. This is the voltage on the DC side of the inverter, for example when no load is taken and maximum source energy is provided, e.g. peak solar radiation occurs on the solar panels.	V_{DC} =1000V max.	P

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict
4.1.2	**Normal voltage operating range**		P
4.1.2.1	In accordance with IEC 61727, utility-interconnected embedded generators do not normally regulate voltage, they inject current into the utility. Therefore the voltage operating range for embedded generators is designed as protection which responds to abnormal utility network conditions and not as a voltage regulation function.	Derived from tests.	P
4.1.2.2	The embedded generator shall synchronise (see 4.1.12) with the utility network before a connection is established. The embedded generator shall not control the voltage, unless agreed to by the utility (see annex A).	See appended table.	P
4.1.2.3	An embedded generator that operates in parallel with the utility system shall operate within the voltage trip limits defined in 4.2.2.3.2.	See appended table.	P
4.1.3	**Reference source impedance and short-circuit levels (fault levels)**		P
4.1.3.1	The impact of the generator on the network voltage and quality of supply levels is directly linked to the (complex) source impedance and short-circuit level. The minimum short-circuit level to which a generator can be connected should be based on the size of the generator as well as the design criteria.	Noticed.	P
4.1.3.2	For general purposes of testing and design for potential worst case conditions, a minimum network strength of the following may be assumed: Z_source = 1,05 + j 0,32 ohm, i.e. I_SC = 210 A and S_SC = 146 kVA (three-phase). NOTE This does not imply a guarantee that the fault level will be more than this at all times. Fault levels less than this may be sufficient for small loads in certain applications.	Noticed.	P
4.1.3.3	The maximum network strength will be assumed to be no more than 33 times the rated active power of the generator. The R/X ratio will be assumed between 0,33 to 3. NOTE 1 In practice, the generators will connect to the network at a wide range of short-circuit ratios. The assumption of a maximum ratio of 33 will allow safe connection of the SSEG in most practical situations. NOTE 2 The minimum fault level at which the generator may be connected is at the discretion of the manufacturer, provided that the requirements of this specification is met at the specified fault level.	Noticed.	P
4.1.3.4	The relevant utility will advise whether equipment may be connected at other network characteristics, i.e. for weaker parts of the network.	Must be taken under consideration for the installation.	N/A

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict
4.1.3.5	The generator documentation and nameplate shall state the reference impedance (complex impedance) and fault level that was used for design and certification and that it is not intended to connect the generator to a network with a higher network impedance than specified for the certification. NOTE See Annex C (Network Impedance), for more information.	Must be taken under consideration for the installation.	N/A

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict
4.1.4	**General QOS requirements**		N/A
4.1.4.1	Embedded generators can expect QOS levels on networks to be in line with NRS 048-2. It is expected that the embedded generator will be able to operate continuously under worst-case conditions.	Noticed.	P
4.1.4.2	Notwithstanding this, the embedded generator must protect itself from potential excursions beyond NRS 048-2 and ensure fail-safe conditions. Should the embedded generator be unable to operate according to requirements of this document for such excursions, it shall disconnect and cease generation onto the network.	Noticed.	P
4.1.5	**Flicker and voltage changes**		
4.1.5.1	When connected to a network impedance equal to the reference impedance used during certification, no SSEG may generate flicker levels higher than the following: a) short-term flicker severity (Pst) = 0,35; and b) long-term flicker severity (Plt) = 0,30.	See appended table	P
4.1.5.2	It is anticipated that the utility will plan the connections in line with acceptable flicker limits, i.e. the ratio of the size of the generator to the network strength at the point of connection.	Noticed.	P
4.1.5.3	According to VDE-AR-N 4105, no generator shall be connected to a system where generation rejection (i.e. tripping of SSEG while generating at full capacity, regardless of reason) will lead to a voltage change of 3 % or more at the PCC, thereby minimising the potential to exceed rapid voltage change limits. NOTE 1 A voltage change of 3 % aligns to a ratio of the network fault level to generator size of 33 (ignoring network impedance angle and load power factor). NOTE 2 Standard connection conditions for customers typically include a maximum flicker contribution in line with annex D of NRS 048-4. Should these flicker levels be exceeded, the customer will be required to put mitigating measures in place as and when required by the utility.	Noticed.	P
4.1.6	**Voltage unbalance**		P
4.1.6.1	Under normal circumstances, for single and dual-phase EG, the unbalanced generation may not exceed 4,6 kVA connected between any two or different phases at an installation. Units larger than 4,6 kVA will be split evenly over the available phase connections so that this can be maintained.	Balanced three phase type of unit. See appended table	P

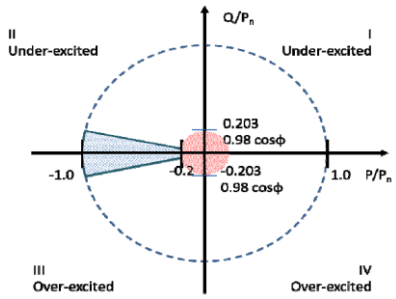
NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict
4.1.6.2	Three-phase generators may not contribute more than 0,2 % voltage unbalance when connected to a network with impedance equal to the reference impedance. NOTE Standard connection conditions for customers typically include a maximum voltage unbalance contribution in line with NRS 048-4, Annex D. Should a three-phase customer exceed these voltage unbalance levels, the customer will be required to put mitigating measures in place as and when required by the utility.	Balanced three phase type of unit. See appended table	P
4.1.7	**Commutation notches**		P
	The relative depth of commutation notches due to line-commutated inverters shall not exceed 5 % of nominal voltage at the POC for any operational state.	(See appended table)	P
4.1.8	**DC injection**		P
4.1.8.1	The average d.c. current injected by the embedded generator shall not exceed 0,5 % of the rated a.c. output current over any 1-minute period, into the utility a.c. interface under any operating condition.	See appended table	P
4.1.8.2	According to section 4.2.2.5, the generator(s) must disconnect within 500 ms when the d.c. current exceeds this value.	See appended table	P
4.1.9	**Normal frequency operating range**		P
	An embedded generator that operates in parallel with the utility system shall operate within the frequency trip limits defined in 4.2.2.3.3.	See appended table	P
4.1.10	**Harmonics and waveform distortion**		P
4.1.10.1	Only devices that inject low levels of current and voltage harmonics will be accepted; the higher harmonic levels increase the potential for adverse effects on connected equipment.	See appended table	P
4.1.10.2	Acceptable levels of harmonic voltage and current depend upon distribution system characteristics, type of service, connected loads or apparatus, and established utility practice.	See appended table	P
4.1.10.3	The embedded generator output shall have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system.	See appended table	P
4.1.10.4	The harmonic and inter-harmonic current distortion shall comply with the relevant emission limits in accordance with IEC 61727, reproduced in table 1.	See appended table	P

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.1.10.5	The harmonic and inter-harmonic distortion applies up to 3 kHz (50th harmonic). NOTE The harmonic limits above 2,5 kHz and all inter-harmonic limits refer to limits measured in accordance with IEC 61000-4-7.	See appended table	P

1	2	3	4	5	6
Harmonic order (h)	**h<11**	**11≤h<17**	**17≤h<23**	**23≤h<35**	**35≤h**
Percentage of rated current (Odd harmonics)	4,0	2,0	1,5	0,6	0,3
Percentage of rated current (Even harmonics)	1,0	0,5	0,38	0,15	0,08
Percentage of rated current (Inter-harmonics)	0,1	0,25	0,19	0,08	0,03
Total Demand Distortion = 5%					

NOTE 1 Even harmonics are limited to 25 % of the odd harmonic limits
NOTE 2 Inter-harmonic are limited to 25 % of the odd harmonic limits and adjusted for the 200 Hz band measurement required by IEC 61000-4-7, except for the lower frequencies where the flicker contribution is more likely.
NOTE 3 Total Demand Distortion = Total Harmonic Distortion

4.1.11	**Power factor**		**P**
4.1.11.1	Irrespective of the number of phases to which an embedded generator is connected, it shall comply with the power factor requirements in accordance with 4.1.11.2 to 4.1.11.12 on each phase for system normal conditions when the output power exceeds 20 % of rated active power:	See below	P
4.1.11.2	For static power converter embedded generators and synchronous embedded generators of sub-categories A1 and A2, the power factor shall remain above 0,98 as shown in Figure 1. The embedded generator shall operate anywhere in the shaded area of figure 1.  **Figure 1 — Power factor operating requirements for SSEG categoried A1 and A2 (using the load-reference arrows system)**	(See appended table)	P
4.1.11.3	For asynchronous embedded generators of sub-categories A1 and A2, which cannot control the power factor over any range, the power factor shall reach the shaded area of figure 1 within 60 s. The power factor shall remain above 0,98 as shown in figure 1. The embedded generator shall operate anywhere in the shaded area.	No such type of SSEG	N/A

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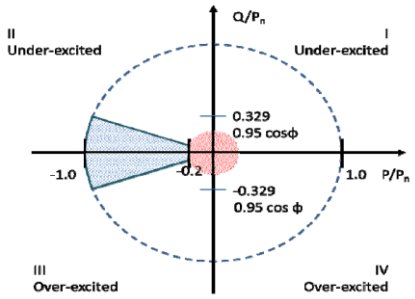
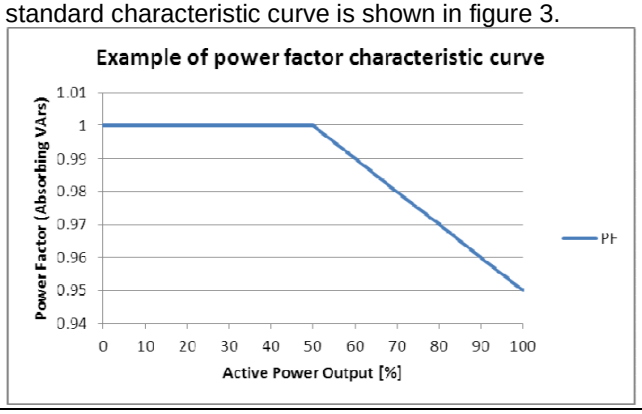
Clause	Requirement - Test	Result - Remark	Verdict
4.1.11.4	For static power converter embedded generators and synchronous embedded generators of sub-category A3, the power factor shall remain above 0,95 as shown in Figure 2. The embedded generator shall operate anywhere in the shaded area of Figure 2.  Figure 2 — Power factor operating requirements for SSEG categoried A3 (using the load-reference arrows system)	No such type of SSEG.	N/A
4.1.11.5	For asynchronous embedded generators of sub-category A3, which cannot control the power factor over any range, the power factor shall reach the shaded area of Figure 2 within 60 s. The power factor shall remain above 0,95 as shown in Figure 2. The embedded generator shall operate anywhere in the shaded area.	No such type of SSEG.	N/A
4.1.11.6	Where the EG is capable of controlling the power factor at the POC, the EG should improve the power factor at the POC towards unity.	No such function.	N/A
4.1.11.7	Unless otherwise agreed with the utility, the standard power factor setting shall be unity for the full power output range.	Noticed.	P
4.1.11.8	The maximum tolerance on the reactive power setting is 5 % of the rated active power.	Noticed.	P
4.1.11.9	For embedded generators of sub-category A3, the power factor shall be settable to operate according to a characteristic curve provided by the utility, if required by the utility, within the range 0,95 leading and 0,95 lagging; An example of a standard characteristic curve is shown in figure 3.  	No such type of SSEG.	N/A
4.1.11.10	These limits apply, unless otherwise agreed upon with the utility (see annex A).	Must be taken under consideration for the installation.	N/A

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Clause	Requirement - Test	Result - Remark	Verdict
4.1.11.11	Equipment for reactive power compensation shall either: a) be connected or disconnected with the embedded generator, or b) operated via automatic control equipment for disconnection when not required.		N/A
4.1.12	**Synchronization**		P
4.1.12.1	All embedded generators shall synchronize with the utility network before the parallel connection is made. This applies to all embedded generators where a voltage exists at the generator terminals before connection with the utility network.	Noticed.	P
4.1.12.2	Automatic synchronization equipment shall be the only method of synchronization.	The method of synchronization is integrated in unit.	P
4.1.12.3	For a synchronous generator, the limits for the synchronizing parameters for each phase are: a) frequency difference: 0,3 Hz, b) voltage difference: 5 % of nominal voltage per phase, and c) phase angle difference: 20 ° (degrees).	Static power converters	N/A
4.1.12.4	Mains excited generators do not need to synchronise when the generator is started as a motor before generation starts.	Static power converters	N/A
4.1.12.5	Mains excited generators may require soft-starting when the start-up voltage change is anticipated to be more than 3 %.	Static power converters	N/A
4.1.12.6	The start-up current for static power converters shall not exceed the full-power rated current of the generator.	Noticed.	P
4.1.12.7	Also refer to 4.2.4 for re-synchronising conditions.	Noticed.	P
4.1.12.8	The embedded generator shall synchronize with the utility network only when the voltage and frequency has been stable within the ranges provided in 4.2.2.3 for at least 60 seconds. NOTE Some utilities may require this to be longer than 60 seconds.	See appended table	P

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Clause	Requirement - Test	Result - Remark	Verdict
4.1.13	**Electromagnetic compatibility (EMC)**		**P**
4.1.13.1	Electromagnetic compatibility (EMC) refers to the ability of equipment or a system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment. EMC comprises two components, namely a radiated and conducted component. Significant attention is given to radiated EMC due to the potential impact over larger distances. However, with advances in smart grids and business management systems, the potential impacts from conducted EMI must be considered. The conditions in 4.1.13.2 and 4.1.13.6 below apply to conducted unintentional signals, while clause 4.1.13.7 applies to radiated unintentional emissions from generating equipment.	See the EMC Test Report	P
4.1.13.2	All unintentional conducted emissions from generating equipment, in the frequency band 30 kHz to 150 kHz, shall be 9 dBµV lower than the compatibility levels specified in clause 4.12.3 of *IEC 61000-2-2:2000+A2:2019* when measured in unsymmetrical voltage mode (i.e. between any phase or neutral and the earth) using a quasi-peak detector. An illustration of the limits is provided in Figure 4, below.	See the EMC Test Report	P
4.1.13.3	The test method and set up for verifying compliance with 4.1.13.1, herein, shall be according to clause 7 of *CISPR 16-2-1*. The test receiver used for verification shall comply with clauses 4 and 5 of *CISPR 16-1-1:2019*, and the AMN or LISN used for verification shall comply with clause 4 of *CISPR 16-1-2*. NOTE When measuring conducted emissions at high currents, for example at ≥ 25 A, during testing, the AMN or LISN can be connected as a voltage probe. See clause A.5 in Annexure A of CISPR 16-1-1.	See the EMC Test Report	P
4.1.13.4	All unintentional conducted emissions from generating equipment, in the frequency band above 150 kHz to 30 MHz, shall comply with SANS 211 (CISPR11), in particular limits for Class A group 1 (< 20 kVA).	Inverters are tested according to IEC/EN 61000-6-2 Immunity standard for industrial environment and IEC/EN 61000-6-3 Emission standard for residential, commercial and light-industrial environments.	P
4.1.13.5	The conducted emission requirement applies to all ports or connections to the utility supply, whether the connection is intended for monitoring, communication, power transfer or any other reason for connecting to the utility supply.	Inverters are tested according to IEC/EN 61000-6-2 Immunity standard for industrial environment and IEC/EN 61000-6-3 Emission standard for residential, commercial and light-industrial environments.	P

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Clause	Requirement - Test	Result - Remark	Verdict
4.1.13.6	In the event of susceptibility to electromagnetic interference, the unit shall be fail-safe, i.e. any deviation from intended performance must comply with all relevant specifications, both in terms of safety (i.e. disconnection) and impact on the network.	Inverters are tested according to IEC/EN 61000-6-2 Immunity standard for industrial environment and IEC/EN 61000-6-3 Emission standard for residential, commercial and light-industrial environments.	P
4.1.13.7	Notwithstanding this, should any interference be experienced to existing or new ripple control, building management system equipment and/or other PLC-based communication, the owner of the embedded generator should take the necessary remedial action to prevent further interference as will be agreed with the utility or the other affected party.	Inverters are tested according to IEC/EN 61000-6-2 Immunity standard for industrial environment and IEC/EN 61000-6-3 Emission standard for residential, commercial and light-industrial environments.	P
4.1.13.8	All radiated emissions from generating equipment shall comply with ICASA requirements.	Inverters are tested according to IEC/EN 61000-6-3 Emission standard for residential, commercial and light-industrial environments. Measurement procedure and limits are identical to the radiated emissions according to EN 55032 : 2012 (CISPR 32).	P
4.1.14	**Mains signalling (e.g. PLC and ripple control)**	No such device	N/A
4.1.14.1	Mains signalling refers to intentional signals induced into the utility supply network, where the intention is to facilitate data transfer from one component to another.		N/A
4.1.14.2	All intentional emissions (communication signals) from generating equipment shall comply with limits for intentional emissions in SANS 50065-1, limited to an acceptable band as prescribed by SANS 50065-1.		N/A
4.1.14.3	Notwithstanding this, should any interference be experienced to existing or new ripple control, building management system equipment and/or other PLC-based communication, the owner of the embedded generator shall take the necessary remedial action to prevent further interference as will be agreed with the utility or the other affected party.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict

SECTION 4.2: Safety protection and control			
4.2.1	**General** The safe operation of the embedded generator in conjunction with the utility network shall be ensured at all times. Safe operation includes people and equipment safety	Noticed.	P

4.2.2	**Safety disconnect from utility network**		P
4.2.2.1	**General**	Derived from tests.	P
4.2.2.1.1	All SSEG shall comply with the safety requirements in accordance with SANS/IEC 62109-1 and IEC 62109-2. NOTE In principle, IEC 62109 documents only apply to PV inverters. However, other SSEG shall prove compliance to these safety requirements to the satisfaction of the utility.	The inverters meet the requirements of IEC 62109-1 and IEC 62109-2. Details see reports No. WT213201650, issued by Shenzhen Academy of Metrology & Quality Inspection.	P
	The embedded generator shall automatically and safely disconnect from the grid in the event of an abnormal condition. Abnormal conditions include:	See below.	P
	a) network voltage or frequency out-of-bounds conditions,	See appended table	P
	b) loss-of-grid conditions,	See appended table	P
	c) d.c. current injection threshold exceeded (per phase),.	See appended table	P
	d) and residual d.c. current (phase and neutral currents summated).	The inverters meet the requirements of IEC 62109-1 and IEC 62109-2. Details see reports No. WT213201650, issued by Shenzhen Academy of Metrology & Quality Inspection.	P
4.2.2.2	**Disconnection device (previously disconnection switching unit)**		P
4.2.2.2.1	The embedded generator shall be equipped with a disconnection device, which separates the embedded generator from the grid due to abnormal conditions. The disconnection unit may be integrated into one of the components of the embedded generator (for example the PV utility interconnected inverter) or may be an independent device installed between the embedded generator and the utility interface.	The transformer less inverter provides two relays in series for each line.	P
4.2.2.2.2	The disconnection switching unit shall be able to operate under all operating conditions of the utility network. NOTE It is the responsibility of the embedded generator owner to enquire about the operating conditions of the utility network, e.g. fault levels for the foreseeable future.	The disconnection switching unit was tested according the single fault safety of the IEC 62109-2. See appended table.	P

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Clause	Requirement - Test	Result - Remark	Verdict
4.2.2.2.3	A failure within the disconnection device shall lead to disconnection of the generator from the utility supply and indication of the failure condition.	The disconnection switching unit was tested according the single fault safety of the IEC 62109-2. See appended table.	P
4.2.2.2.4	A single failure within the disconnection switching unit shall not lead to failure to disconnect. Failures with one common cause shall be taken into account and addressed through adequate redundancy.	The disconnection switching unit was tested according the single fault safety of the IEC 62109-2. See appended table.	P
4.2.2.2.5	The disconnection device shall disconnect the generator from the network by means of two series connected robust automated load disconnect switches.	The disconnection switching unit was tested according the single fault safety of the IEC 62109-2. See appended table.	P
4.2.2.2.6	Both switches shall be electromechanical switches.	Complied.	P
4.2.2.2.7	Each electromechanical switch shall disconnect the embedded generator on the neutral and the live wire(s). NOTE The switching unit need not disconnect its sensing circuits.		P
4.2.2.2.8	All rotating generating units, e.g. synchronous or asynchronous generating units shall have adequate redundancy in accordance with 4.2.2.2.5.	Not such type of SSEG.	N/A
4.2.2.2.9	A static power converter without simple separation shall make use of two series connected electromechanical disconnection switches.	The output is switched off redundant by two relays in series.	P
4.2.2.2.10	The current breaking capacity of each disconnecting switch shall be appropriately sized for the application. In cases where the disconnecting device is an electromechanical switching device such as a contactor, this requires suitable coordination with the upstream short circuit protection device (circuit breaker).	See Annex No. 1 – Datasheet of the relay.	P
4.2.2.2.11	Any programmable parameters of the disconnection switching unit shall be protected from interference by third-parties, i.e. password protected or access physically sealed.	Protected by password.	P
4.2.2.2.12	In order to allow customers to supply their own load in isolated operation (islanded) where this is feasible and required, the disconnection device may be incorporated upstream of part of or all of a customers' loads, provided that none of the network disconnection requirements in this document are violated.	Rely in the responsibility of the installer.	N/A

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Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.2.13	All EG installations larger than 30 kVA shall have a central disconnection device. NOTE 1 This requirement may be amended by the utility, i.e. the utility may require a central disconnection switch unit for any size and type of generator. NOTE 2 This requirement may be amended by the utility. The central disconnection switch unit will typically be waived only when a lockable disconnection switch, accessible to the utility, is installed. NOTE 3 This is an interim requirement based on requirements of VDE AR 4105 and will be revisited as more information becomes available.	Rely in the responsibility of the installer.	N/A
4.2.2.2.14	The network and system grid protection voltage and frequency relay for the central disconnection device will be type-tested and certified on its own (stand-alone tested). All clauses of 4.2.2, except 4.2.2.4 (anti-islanding) apply.	Rely in the responsibility of the installer.	N/A
4.2.2.3.1	**General**		P
	The accuracy for voltage trip values shall be within 0 % to +1 % of the nominal voltage from the upper boundary trip setting, and within -1% to 0% of the nominal voltage from the lower boundary trip setting.	Noticed.	P
	The accuracy for frequency trip values shall be within 0 to +0,1 % of the fundamental frequency from the upper boundary trip setting, and within -0,1 % to 0 % of the fundamental frequency from the lower boundary the trip setting.	Noticed.	P
4.2.2.3.2	**Overvoltage and undervoltage**		P
	The embedded generator in sub-category A1 and A2 shall cease to energize the utility distribution system should the network voltage deviate outside the conditions specified in table 2. The following conditions shall be met, with voltages in r.m.s. and measured at the POC. NOTE 1 All discussions regarding system voltage refer to the nominal voltage. NOTE 2 At the time of publication, these settings are in contradiction to the RPP Grid Code. These may only be applied with exemption to the relevant clause or after the RPP Grid Code has been suitably amended. NOTE 3 Measurements at the generator terminals will generally be sufficient for the overvoltage settings. If the expected voltage drop across the cable connecting the EG to the POC is too high, undervoltage settings might have to be adjusted.	See appended table.	P
	The purpose of the allowed time delay is to ride through short-term disturbances to avoid excessive nuisance tripping. The generator does not have to cease to energize if the voltage returns to the normal utility continuous operating condition within the specified trip time. NOTE Induction/synchronous generators need to be mindful of synchronisation issues and may have to apply faster trip times.	Noticed.	P

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Clause	Requirement - Test	Result - Remark	Verdict
	A customer with a multiphase connection shall monitor all phases for out-of-bounds voltage conditions. The EG shall be disconnected if an out-of-bounds voltage condition is detected on any of the phases.	Noticed.	P
	In line with NRS 048-2, it is recommended that A1 and A2 SSEG be able to ride through at least Y and X1 type dips, i.e. not disconnect for these events. The purpose is to avoid excessive nuisance tripping.	The SSEG have LVRT function. See appended table.	P
	Category A3 SSEG shall be able to ride through low and/or high voltage events in accordance with the RPP Grid Code.	Not such type of SSEG.	N/A
	The generator shall maintain the pre-dip current during any dip event for which it remains connected.	Noticed.	P
	The ride-through and trip times are shown graphically in figure 4.	Noticed.	P
4.2.2.3.3	**Over-frequency and under-frequency**		P
	This requirement is in line with the RPP Grid Code (version 2.8) and applies to all EG in category A.		P
	The embedded generation system shall cease to energize the utility network when the utility frequency deviates outside the specified conditions. Both over- and under-frequency conditions indicate system abnormal conditions and all generators are expected to assist in stabilising the system during such periods.	Noticed.	P
	When the utility frequency is less than 47 Hz, the embedded generator shall disconnect from the utility network within 0,2 s.	See appended table.	P
	While the utility frequency is in the range of 47 Hz and 50,5 Hz, the system shall operate normally. In order to prevent hysteresis switching (on-off toggling) during over-frequency conditions, the output power shall be reduced as follows: When the utility frequency exceeds 50,5 Hz, the active power available at the time shall be stored as the maximum power value PM; this value PM shall not be exceeded until the frequency has stabilized below 50,5 Hz for at least 4 seconds. The EG system shall control the output power as a function of PM at a gradient of 50 % per Hertz as illustrated in figure 5. The power generation shall follow the curve shown in figure 5 up and down while the system frequency is in the range 50,5 Hz to 52 Hz. When the utility frequency is more than 52 Hz for longer than 4 seconds, the embedded generator shall cease to energise the utility line within 0,5 s.	See appended table.	P
4.2.2.3.3.1	**Relaxation for non-controllable generators**	No such type of SSEG.	N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	Non-controllable generators may disconnect randomly within the frequency range 50.5 Hz to 52 Hz. The disconnect frequency for non-controllable generators will each be set at a random value by the manufacturer, with the option of changing this to a utility provided setting. The random disconnect frequency shall be selected so that all generators from any specific manufacturer will disconnect uniformly over the range with 0,1 Hz increments.		N/A
	When the utility frequency is more than the non-controllable generator over-frequency setpoint for longer than 4 seconds, the non-controllable generator shall cease to energise the utility line within 0,5 s. NOTE At the time of publication, this is in contradiction with the RPP Grid Code.		N/A
4.2.2.4	**Prevention of islanding**		P
4.2.2.4.1	A utility distribution network can become de-energized for several reasons: for example, a substation breaker that opens due to a fault condition or the distribution network might be switched off for maintenance purposes. Should the load and (embedded) generation within an isolated network be closely matched, then the voltage and frequency limits may not be triggered. If the embedded generator control system only made use of passive voltage and frequency out-of-bounds detection, this would result in an unintentional island that could continue beyond the allowed time limits.	See appended table.	P
4.2.2.4.2	In order to detect an islanding condition, the embedded generator shall make use of at least one active islanding detection method. An active islanding detection method intentionally varies an output parameter and monitors the response or it attempts to cause an abnormal condition at the utility interface to trigger an out-of-bounds condition. If the utility supply is available, the attempt to vary an output parameter or cause an abnormal condition will fail and no response will be detected. However, if the utility supply network is de-energized, there will be a response to the change which can be detected. This signals an island condition to the embedded generator upon detection of which the embedded generator shall cease to energize the utility network within a specific time period.	See appended table.	P
4.2.2.4.3	Active island detection shall be used in all cases where the EG interfaces with the utility network.	Noticed.	P

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Clause	Requirement - Test	Result - Remark	Verdict
4.2.2.4.4	An islanding condition shall cause the embedded generator to cease to energize the utility network within 2 s, irrespective of connected loads or other embedded generators. The embedded generator employing active islanding detection shall comply with the requirements of IEC 62116 (ed.1). NOTE Prevention of islanding measures is only considered on the embedded generator side, i.e. no utility installed anti-islanding measures are considered.	See appended table.	P
4.2.2.4.5	All rotating generators shall use a minimum of two islanding detection methods (e.g. rate of- change-of-frequency and voltage vector shift detection due to the dead bands (slow detection) of islands in both methods). NOTE It is possible for a condition to exist, where a mains-excited generator becomes self-excited due to capacitance of the network (either cable capacitance or power factor correction). Under such conditions, the mains-excited generator will not disconnect from an island, hence effective islanding detection is required for all rotating generators.	Not such type of SSEG.	N/A
4.2.2.4.6	Passive methods of islanding detection shall not be the sole method to detect an island condition. When used, passive methods of islanding detection shall be done by three-phase voltage detection and shall be verified by an AC voltage source.	Both methods of active and passive island detection are used.	P
4.2.2.4.7	The embedded generator shall physically disconnect from the utility network in accordance with the requirements in 4.2.2.2.	See 4.2.2.2.	P
4.2.2.5	**DC current injection**		P
	The embedded generator shall not inject d.c. current greater than 0,5 % of the rated a.c. output current into the utility interface under any operating condition, measured over a 1-minute interval. The EG shall cease to energize the utility network within 500 ms if this threshold is exceeded.	See appended table.	P
4.2.3	No requirements for emergency personnel safety (e.g. fire brigade) existed at the time of publication. It is expected that such issues will be dealt with in other documents, e.g. OHS Act, SANS 10142-1.	Rely in the responsibility of the installer.	N/A
4.2.4	**Response to utility recovery**		P
4.2.4.1	The embedded generator shall ensure synchronisation before re-energizing at all times in accordance with 4.1.12.	Complied.	P
4.2.4.2	After a voltage or frequency out-of-range condition that has caused the embedded generator to cease energizing the utility network, the generator shall not re-energize the utility network until the utility service voltage and frequency have remained within the specified ranges for a continuous and uninterrupted period of 60 s. The reconnection shall commence as follows:	See appended table.	P

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Clause	Requirement - Test	Result - Remark	Verdict
4.2.4.2.1	Non-controllable generators may connect randomly within the 1 minute to 10 minute period after voltage and frequency recovery (period includes the 60 s to confirm recovery). The delay for non-controllable generators will each be set at a random value by the manufacturer, with the option of changing this to a utility provided setting. The random value shall be selected so that no more than 2 % of generators from any specific manufacturer will reconnect within 10s of each other.	Not such type of SSEG.	N/A
4.2.4.2.2	Controllable generators may reconnect immediately after the 60 s delay confirming recovery of the system voltage and frequency at a maximum rate of 10 % of rated power per minute, i.e. full power output will only be reached after 10 minutes. This ramp rate may be modified at the request of the utility or in consultation with the utility.	See appended table.	P
4.2.5	**Isolation**		N/A
4.2.5.1	In line with SANS 10142-1 (as amended), each energy source should have its own, appropriately rated, isolation device.		N/A
4.2.5.2	It is expected that isolation requirements will be dealt with in more detail in future in e.g. SANS 10142-1/3. Such requirements shall supersede 4.2.5.		N/A
4.2.5.3	The embedded generator shall provide a means of isolating from the utility interface in order to allow for safe maintenance of the EG. The disconnection device shall be a double pole for a single-phase EG, a three-pole for a three-phase delta-connected EG, and a four-pole for a three-phase star-connected EG. The grid supply side shall be wired as the source.	Disconnecting device is not integral part of the unit. The installation instructions specify a disconnection device for the final installation. The correct assembling is part of the installer.	N/A
4.2.5.4	The breaking capacity of the isolation circuit-breaker closest to the point of utility connection shall be rated appropriately for the installation point in accordance with SANS 60947-2. This disconnection device does not need to be accessible to the utility.	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
4.2.5.5	For dedicated supplies, a means shall be provided of isolating from the point of supply in order to allow for safe maintenance of the utility network. The disconnection device shall be a double pole for a single-phase EG, a three-pole for a three-phase delta-connected EG, and a four-pole for a three-phase star-connected EG. This disconnection device shall be lockable and accessible to the utility. NOTE 1 A device inside a lockable box is deemed a lockable device. NOTE 2 This disconnection device may become the new point of control as defined by SANS10142-1.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
4.2.5.6	The requirement for the utility accessible disconnection device may only be waived by the utility where the risk to the network is deemed acceptable to the utility. Such permission shall be provided in writing. NOTE Full verification form to be signed off and accepted by the utility.		N/A
4.2.6	**Earthing**		P
4.2.6.1	The electrical installation shall be earthed in accordance with SANS 10142-1 (as applicable). The earthing requirements for different embedded generation configurations in conjunction with the customer network are described in annex B for the most common earthing systems. NOTE SANS 10142-1 applies to EG feeding a UPS and no connection to the utility supply (see table B5).	Rely in the responsibility of the installer.	N/A
4.2.6.2	Installations with utility-interconnected inverters without simple separation shall make use of earth leakage protection which are able to respond to d.c. fault currents including smooth d.c. fault currents (i.e. without zero crossings) according to IEC 62109-2 unless the inverter can exclude the occurrence of d.c. earth fault currents on any phase, neutral or earth connection through its circuit design1). This function may be internal or external to the inverter. NOTE IEC 62109-2, Edition 2011, section 4.8.3.5 gives selection criteria for RCD sensitivities.	The inverter was tested according IEC 62109-2 for the residual current device (RCD) or monitoring (RCM). Therefore The unit can be provided with an external RMCU type A, based on the construction and internal protection (the unit provides a galvanic basic insulation between PV and DC-Link): - insulation measurement detection fault current of 1mA - single faults could not cause residual direct current between 6mA and 300mA	P
4.2.6.3	Where an electrical installation includes a PV power supply system without at least simple separation between the AC side and the DC side, an integrated RCD function shall be present to provide fault protection by automatic disconnection of supply shall be type B according to IEC/TR 60755, amendment 2. Where the PV inverter by construction is not able to feed DC fault currents into the electrical installation, an RCD of type B according to IEC/TR 60755 amendment 2 is not required. NOTE 1 Consideration must also be given to ensure that any d.c. currents do not impair the effectiveness of any other RCD'S installed throughout the a.c. system. NOTE 2 The earth leakage unit may also fulfil the requirement of the all-pole disconnection device as stated in 4.2.6. NOTE 3 The function of this RCD is not to provide protection against circulating d.c. currents in the inverter and a.c. supply, i.e. does not override 4.1.8.	The RCD protection is provided integral to the unit. The inverter was tested according to IEC 62109-2.	P

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Clause	Requirement - Test	Result - Remark	Verdict
4.2.7	**Short-circuit protection**		N/A
4.2.7.1	The embedded generator shall have suitably rated short-circuit protection at the connection to the AC mains in accordance with SANS 10142-1 and 3.	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
4.2.7.2	The short-circuit characteristics for the SSEG shall be supplied to the utility.		N/A
4.2.8	**Maximum short-circuit contribution**		P
	Embedded generators have the potential to increase the fault level of the network to which it is connected. In order to limit the fault level changes in low voltage networks and allow coordination of fault levels with the utility, no generator will exceed the following fault level contribution: NOTE At the time of installation, the short-circuit capacity of all existing equipment should be confirmed and upgraded where necessary. Suitable fault current limiting devices may be required to ensure a safe installation. The potential impact on neighbouring installations should also be considered to ensure that those installations remain safe.	See below.	P
	a) for synchronous generators: 8 times the rated current;		N/A
	b) for asynchronous generators: 6 times the rated current; and		N/A
	c) for generators with inverters: 1 times the rated current.	The SSEG is specified 16 A r.m.s..	P
4.2.9	**Labelling**		N/A
4.2.9.1	A label on the distribution board of the premises where the embedded generator is connected shown in figure 6, shall state: “WARNING: ON-SITE EMBEDDED GENERATION . DO NOT WORK ON THIS EQUIPMENT UNTIL IT IS ISOLATED FROM BOTH MAINS AND ON-SITE GENERATION SUPPLIES.” or similar warning. Disconnection points for all supplies shall be indicated.	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
4.2.9.2	The label shall be permanent with lettering of height at least 8 mm.		N/A
4.2.9.3	The label shall comply to requirements of SABS 1186-1.		N/A
4.2.9.4	The absence of emergency shutdown capabilities will be indicated on signage in accordance with 4.2.2.		N/A
4.2.10	**Robustness requirements**		P
	According to 4.2.2.1 all SSEG shall comply with safety requirements in accordance to SANS/IEC 62109-1 and IEC 62109-2. NOTE This section will be expanded in future revisions.	See 4.2.2.1.	P

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Clause	Requirement - Test	Result - Remark	Verdict

Metering			
4.3	**Metering**	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A

Annex			
Annex A	**Notes to purchase**	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
Annex B	**Earthing system**	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
Annex C	**Network impedance**	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
Annex D	**(Annex A of VDE-AR-N 4105) Explanations** (normative)	Noticed.	P
Annex E	**(Annex B of VDE-AR-N 4105) Connection examples** (normative)	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
Annex F	**(Annex C of VDE-AR-N 4105) Example of meter panel configurations** (normative)	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer.	N/A
Annex G	**Generation management network security management** (normative)	Noticed.	P

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Clause	Requirement - Test	Result - Remark	Verdict

Appended Table - Testing Result

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Clause	Requirement - Test	Result - Remark	Verdict

1.	**Response to protection operation - fault condition tests**		**P**
	ambient temperature (°C):	24,9	--
	model/type of power supply:	AC: 61860 DC: 62150h-1000s	--
	manufacturer of power supply:	Chroma	--
	rated markings of power supply:	AC: 0-300V, 60kw DC: 0-1000V,15A	--

Component No.	Fault	Test condition		Test time	Fuse No.	Test condition		Test time
		AC	DC			AC	DC	
Relay defect RY7 pin1-pin4	Short before start up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID07” (RelayFail). Do not connect to AC mains. No damage,no hazards.
Relay defect RY9 pin1-pin4	Short before start up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID07” (RelayFail). Do not connect to AC mains. No damage,no hazards.
Relay defect RY18 pin1-pin4	Short before start up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID07” (RelayFail). Do not connect to AC mains. No damage,no hazards.
Relay defect RY22 pin1-pin4	Short before start up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID07” (RelayFail). Do not connect to AC mains. No damage,no hazards.
Relay defect RY17 pin1-pin4	Short before start up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID07” (RelayFail). Do not connect to AC mains. No damage,no hazards.
Relay defect RY21 pin1-pin4	Short before start up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID07” (RelayFail). Do not connect to AC mains. No damage,no hazards.
Grid	Open	230V	720V	10min.	--	230V	720V	Indicate error code

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Clause	Requirement - Test	Result - Remark	Verdict

voltage monitoring R74		21,7A	20,8A			0,05A	0,10A	“ID07” (RelayFail). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R76	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID01” (Line voltage high loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R84	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R91	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID01” (Line voltage high loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R97	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R101	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID01” (Line voltage high loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R94	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R79	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID01” (Line voltage high loss). Do not connect to AC mains. No damage,no

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Clause	Requirement - Test	Result - Remark	Verdict

								hazards.
Grid voltage monitoring R88	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R102	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID01” (Line voltage high loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R 99	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Frequency measurement defect C133	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID04” (Line frequency low loss). Do not connect to AC mains. No damage,no hazards.
Frequency measurement defect C151	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID04” (Line frequency low loss). Do not connect to AC mains. No damage,no hazards.
Monitoring BUS voltage defect C178	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID02” (BUS voltage under). Do not connect to AC mains. No damage,no hazards.
Monitoring BUS voltage defect C182	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID02” (BUS voltage under). Do not connect to AC mains. No damage,no hazards.
Monitoring PV voltage	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate solar icon flashing (Solar low voltage). No

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Clause	Requirement - Test	Result - Remark	Verdict

defect R49								damage,no hazards.
Monitoring PV voltage defect R48	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate solar icon flashing (Solar low voltage). No damage,no hazards.
PV Current measurement defect R29	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID01” (BUS voltage over). Do not connect to AC mains. No damage,no hazards.
PV Current measurement defect R28	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID01” (BUS voltage over). Do not connect to AC mains. No damage,no hazards.
GFCI detect defect C52	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID12” (GFCI fault). Do not connect to AC mains. No damage,no hazards.
GFCI detect defect R33	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID12” (GFCI fault). Do not connect to AC mains. No damage,no hazards.
GFCI detect defect R24	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID12” (GFCI fault). Do not connect to AC mains. No damage,no hazards.
GFCI detect defect R23	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID12” (GFCI fault). Do not connect to AC mains. No damage,no hazards.
Current sensor defect C70	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID14” (INV DC current over). Do not connect to AC mains. No damage,no hazards.

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Clause	Requirement - Test	Result - Remark	Verdict

Current sensor defect C54	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID14” (INV DC current over). Do not connect to AC mains. No damage,no hazards.
Current sensor defect C52	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID14” (INV DC current over). Do not connect to AC mains. No damage,no hazards.
Current sensor defect R192	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID01” (BUS OVER VOLTAGE). Do not connect to AC mains. No damage,no hazards.
Current sensor defect R195	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID01” (BUS OVER VOLTAGE). Do not connect to AC mains. No damage,no hazards.
Current sensor defect R202	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID01” (BUS OVER VOLTAGE). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R94	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R104	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring R109	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to

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Clause	Requirement - Test	Result - Remark	Verdict

								AC mains. No damage,no hazards.
Grid voltage monitoring C126	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring C136	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Grid voltage monitoring C141	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
ISO detect defect R184	Short before start-up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID13” (PV ISO fault). Do not connect to AC mains. No damage,no hazards.
ISO detect defect C198	Short before start-up	230V 0,05A	720V 0,10A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID13” (PV ISO fault). Do not connect to AC mains. No damage,no hazards.
DSP communication defect R528	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID17” (M&S communication loss). Do not connect to AC mains. No damage,no hazards.
DSP communication defect R530	Open	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate error code “ID17” (M&S communication loss). Do not connect to AC mains. No damage,no hazards.
Loss of	Short	230V	720V	10min.	--	230V	720V	Indicate warning

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control C305		21,7A	20,8A			0,05A	0,10A	code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Loss of control C306	Short	230V 21,7A	720V 20,8A	10min.	--	230V 0,05A	720V 0,10A	Indicate warning code “ID02” (Line voltage low loss). Do not connect to AC mains. No damage,no hazards.
Addendum – Shutdown device								
Each active phase can be switched. (L and N)								Two relays in series on each L have built in EUT.
If no galvanic separation between AC and DC (PV): Two relays in series on each active phase are necessary to fulfil the basic insulation or simple separation based on the PV working voltage.								
Note: The errors in the control circuit simulate that the safety is even under one error ensured. The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.								

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Clause	Requirement - Test	Result - Remark	Verdict

4.1.5	Voltage fluctuation and flicker			P
Test conditions:	Maximum permissible voltage fluctuation (expressed as a percentage of nominal voltage at 100 % power) and flicker as per EN 61000-3-3			
	Starting	**Stopping**	**Running**	
Limit	3,3%	3,3%	P_{st}=1,0	P_{lt}=0,65
Test value	*	*	*	*
inverter <=16A				
Limit	dc% = 3,3		P_{st}=1,0	P_{lt}=0,65
Test value	See below			

L1 phase (INFINI WP 8KW)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
2	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
3	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
4	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
5	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
6	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
7	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
8	0.00 Pass	0.56 Pass	0 Pass	0.23 Pass	
9	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
10	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
11	0.00 Pass	0.56 Pass	0 Pass	0.24 Pass	
12	0.00 Pass	0.56 Pass	0 Pass	0.23 Pass	
Result	Pass	Pass	Pass	Pass	0.24 Pass

L2 phase (INFINI WP 8KW)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
2	0.00 Pass	0.59 Pass	0 Pass	0.28 Pass	
3	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
4	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
5	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
6	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
7	0.00 Pass	0.59 Pass	0 Pass	0.28 Pass	
8	0.00 Pass	0.59 Pass	0 Pass	0.28 Pass	
9	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
10	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
11	0.00 Pass	0.59 Pass	0 Pass	0.28 Pass	
12	0.00 Pass	0.59 Pass	0 Pass	0.29 Pass	
Result	Pass	Pass	Pass	Pass	0.29 Pass

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Clause	Requirement - Test	Result - Remark	Verdict

L3 phase (INFINI WP 8KW)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
2	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
3	0.00 Pass	0.64 Pass	0 Pass	0.27 Pass	
4	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
5	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
6	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
7	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
8	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
9	0.00 Pass	0.64 Pass	0 Pass	0.28 Pass	
10	0.00 Pass	0.64 Pass	0 Pass	0.27 Pass	
11	0.00 Pass	0.64 Pass	0 Pass	0.27 Pass	
12	0.00 Pass	0.64 Pass	0 Pass	0.27 Pass	
Result	Pass	Pass	Pass	Pass	0.28 Pass

Note:
*The stationary deviance of dc% is more relevant than the dynamic deviance of d_{max} at starting and stopping.

Mains Impedance according EN61000-3-3: **R_{max} = 0,24Ω; jX_{max}= 0,15Ω @50Hz ($|Z_{max}|$ = 0,283 Ω)**
for single phase inverter use also **R_n = 0,16Ω; jX_n= 0,1Ω**

Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c:
$Z_{max} = Z_{ref} * 3,3\% / d_c(P_n)$

The tests should be based on the limits of the EN 61000-3-3 for less than 16A.

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Clause	Requirement - Test	Result - Remark	Verdict

inverter >16A			
Limit	dc% = 3,3	P_{st}=1,0	P_{lt}=0,65
Test value	See below		

L1 phase (INFINI WP 15KW)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.29 Pass	0.33 Pass	0 Pass	0.18 Pass	
2	0.27 Pass	0.33 Pass	0 Pass	0.18 Pass	
3	0.28 Pass	0.34 Pass	0 Pass	0.18 Pass	
4	0.30 Pass	0.34 Pass	0 Pass	0.19 Pass	
5	0.30 Pass	0.38 Pass	0 Pass	0.19 Pass	
6	0.27 Pass	0.33 Pass	0 Pass	0.19 Pass	
7	0.28 Pass	0.35 Pass	0 Pass	0.19 Pass	
8	0.29 Pass	0.33 Pass	0 Pass	0.19 Pass	
9	0.28 Pass	0.31 Pass	0 Pass	0.19 Pass	
10	0.28 Pass	0.33 Pass	0 Pass	0.19 Pass	
11	0.29 Pass	0.33 Pass	0 Pass	0.19 Pass	
12	0.27 Pass	0.38 Pass	0 Pass	0.19 Pass	
Result	Pass	Pass	Pass	Pass	0.19 Pass

L2 phase (INFINI WP 15KW)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.31 Pass	0.36 Pass	0 Pass	0.14 Pass	
2	0.32 Pass	0.37 Pass	0 Pass	0.15 Pass	
3	0.30 Pass	0.37 Pass	0 Pass	0.15 Pass	
4	0.45 Pass	0.54 Pass	0 Pass	0.16 Pass	
5	0.35 Pass	0.46 Pass	0 Pass	0.17 Pass	
6	0.28 Pass	0.38 Pass	0 Pass	0.16 Pass	
7	0.26 Pass	0.38 Pass	0 Pass	0.16 Pass	
8	0.28 Pass	0.43 Pass	0 Pass	0.15 Pass	
9	0.30 Pass	0.34 Pass	0 Pass	0.15 Pass	
10	0.32 Pass	0.39 Pass	0 Pass	0.15 Pass	
11	0.28 Pass	0.34 Pass	0 Pass	0.15 Pass	
12	0.33 Pass	0.36 Pass	0 Pass	0.15 Pass	
Result	Pass	Pass	Pass	Pass	0.15 Pass

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Clause	Requirement - Test	Result - Remark	Verdict

L3 phase (INFINI WP 15KW)

	dc[%]	dmax[%]	d(t)[ms]	Pst	Plt
Limit	3.30	4.00	500 3.30(%)	1.00	0.65 N:12
No. 1	0.21 Pass	0.22 Pass	0 Pass	0.15 Pass	
2	0.19 Pass	0.23 Pass	0 Pass	0.15 Pass	
3	0.17 Pass	0.21 Pass	0 Pass	0.16 Pass	
4	0.20 Pass	0.24 Pass	0 Pass	0.16 Pass	
5	0.20 Pass	0.26 Pass	0 Pass	0.17 Pass	
6	0.22 Pass	0.25 Pass	0 Pass	0.17 Pass	
7	0.22 Pass	0.24 Pass	0 Pass	0.17 Pass	
8	0.25 Pass	0.28 Pass	0 Pass	0.16 Pass	
9	0.19 Pass	0.22 Pass	0 Pass	0.16 Pass	
10	0.18 Pass	0.21 Pass	0 Pass	0.16 Pass	
11	0.20 Pass	0.23 Pass	0 Pass	0.15 Pass	
12	0.18 Pass	0.22 Pass	0 Pass	0.15 Pass	
Result	Pass	Pass	Pass	Pass	0.16 Pass

Note:
*The stationary deviance of dc% is more relevant than the dynamic deviance of d_{max} at starting and stopping.

Mains Impedance according EN61000-3-11: **R_{max} = 0,24 Ω; jX_{max}= 0,15 Ω @50Hz ($|Z_{max}|$ = 0,472 Ω)**
for single phase inverter use also **R_n = 0,16 Ω; jX_n= 0,1 Ω**

Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c:
$Z_{max} = Z_{ref} * 3,3\% / d_c(P_n)$

The tests should be based on the limits of the EN 61000-3-3 for more than 16A.

The test had been performed on the model INFINI WP 15KW and INFINI WP 8KW the test results are valid for the INFINI WP 12KW and INFINI WP 10KW since it is identical in hardware and just power derated by software.

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Clause	Requirement - Test	Result - Remark	Verdict

4.1.5.3	**Rapid voltage changes**	**P**

The purpose of the test is to determine k_i and k_{imax}.

The following three cases must be tested to VDE-AR-N 4105, Annex F.3 (where applicable).
- Switch-on for any capacity
- Unfavourable case when switching the generator step
- Switch-on for nominal capacity

  Note: For PV-plants the inverter is the generator

Switch-off for nominal capacity (no emergency shutdown, but operative shutdown)

Test conditions:

Frequency: 50 Hz ± 0,5%

THD of the voltage supply: ≤ 3 %

Voltage rise of the PGU at 100 P_{Emax} %: ≤ 3 %

Switch-on for any capacity (10% P_{Emax})

	Measurement 1			Measurement 2			Measurement 3		
phase	L1	L2	L3	L1	L2	L3	L1	L2	L3
Single period effective values of the current [A]	230,7	230,5	228,9	230,9	228,9	230,2	229,2	229,8	231,1
Single period effective values of the voltage [V]	1,369	1,437	1,332	1,498	1,545	1,391	1,563	1,656	1,545
k_i value	0,063	0,066	0,061	0,069	0,071	0,064	0,072	0,076	0,071
k_{imax} value	0,076								

Switch-on for nominal capacity

	Measurement 1			Measurement 2			Measurement 3		
phase	L1	L2	L3	L1	L2	L3	L1	L2	L3
Single period effective values of the current [A]	229,7	231,3	229,3	229,0	230,2	230,8	229,1	230,0	231,0
Single period effective values of the voltage [V]	1,413	1,564	1,389	1,716	1,820	1,642	1,620	1,818	1,526
k_i value	0,065	0,072	0,064	0,079	0,084	0,076	0,075	0,084	0,070
k_{imax} value	0,084								

Switch-off for nominal capacity

	Measurement 1			Measurement 2			Measurement 3		
phase	L1	L2	L3	L1	L2	L3	L1	L2	L3
Single period effective values of the current [A]	228,8	229,0	229,6	229,5	228,8	299,4	228,8	229,4	229,4
Single period effective values of the voltage [V]	5,050	4,316	1,569	2,180	6,070	3,246	3,793	1,834	2,351
k_i value	0,232	0,199	0,072	0,100	0,279	0,149	0,174	0,084	0,108
k_{imax} value	0,279								

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Highest k_{imax} value for all switching operations
0,279
Note: The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

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Clause	Requirement - Test	Result - Remark	Verdict

4.1.6	**Voltage unbalance**						**P**
Setting values	cos φ = 1:			1			
	cos φ over-excited:			/			
	cos φ under-excited:			/			
Test:							
1-min mean value	L1	L2	L3	L1 – L2	L2 – L3	L3 – L1	
a) cos φ = 1 at 100 % P_n ± 5 % P_n							
S_{E60} [kVA]:	4,960	4,950	4,964	0,010	-0,014	0,004	
	4,959	4,950	4,963	0,009	-0,013	0,004	
	4,958	4,949	4,963	0,009	-0,014	0,005	
	4,960	4,950	4,965	0,009	-0,015	0,005	
	4,958	4,949	4,964	0,009	-0,015	0,006	
cos φ_{E60}:	0,999						
max. asymmetry [kVA]:	-0,015						
U_{60} [V]:	230,12	230,03	230,07	0,086	-0,033	-0,053	
	230,12	230,03	230,05	0,086	-0,018	-0,068	
	230,12	230,03	230,03	0,085	0,003	-0,088	
	230,12	230,04	230,07	0,082	-0,034	-0,048	
	230,12	230,03	230,07	0,090	-0,035	-0,054	
max. asymmetry [V]:	0,090						
max. asymmetry [%]:	0,039						
b) cos φ = 1 at 50 % P_n ± 5 % P_{Emax}							
S_{E60} [kVA]:	2,532	2,533	2,500	-0,001	0,033	-0,032	
	2,531	2,532	2,499	-0,001	0,033	-0,032	
	2,532	2,533	2,500	-0,001	0,033	-0,032	
	2,532	2,533	2,500	-0,001	0,033	-0,032	
	2,531	2,532	2,500	-0,001	0,032	-0,031	
cos φ_{E60}:	0,999						
max. asymmetry [kVA]:	0,033						
U_{60} [V]:	230,06	230,02	230,01	0,035	0,015	-0,050	
	230,07	230,00	230,03	0,066	-0,029	-0,037	
	230,07	230,03	230,01	0,047	0,012	-0,059	
	230,06	230,00	230,05	0,059	-0,046	-0,013	
	230,07	229,94	230,09	0,123	-0,150	0,027	

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max. asymmetry [V]:	-0,150
max. asymmetry [%]:	0,065
Power Limit [kVA]:	4,6
Voltage Limit [%]:	0,2

Test:

The maximum absolute difference between the apparent powers of the three phases is determined for each of the five measurements (1-min means) in the respective operating point. The maximum of these five values is again determined.

Assessment criterion:

The test is passed if the maximum value from the above measurements does not exceed 4,6 kVA for apparent power imbalance and 0,2% for voltage unbalance.

Note:

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

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Clause	Requirement - Test	Result - Remark	Verdict

4.1.8	**DC-Injection**				**P**
Test conditions:		U_N = 230Vac; Rated Power: 100%			
Test result:					
DC Injection (A)		**Limits**	**Trip Time (ms)**		
L1					
+ 108 mA		I_{DC}:>0,5%I_{rated} than disconnection within 0,5 sec	207	363	148
- 108 mA		I_{DC}:>0,5%I_{rated} than disconnection within 0,5 sec	231	269	276
L2					
+ 108 mA		I_{DC}:>0,5%I_{rated} than disconnection within 0,5 sec	231	106	275
- 108 mA		I_{DC}:>0,5%I_{rated} than disconnection within 0,5 sec	310	347	392
L3					
+ 108 mA		I_{DC}:>0,5%I_{rated} than disconnection within 0,5 sec	218	261	239
- 108 mA		I_{DC}:>0,5%I_{rated} than disconnection within 0,5 sec	342	282	303

Note:
A dc-current of greater than 0,5% of Iac nom cause a disconnection time of max. 0,5s

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

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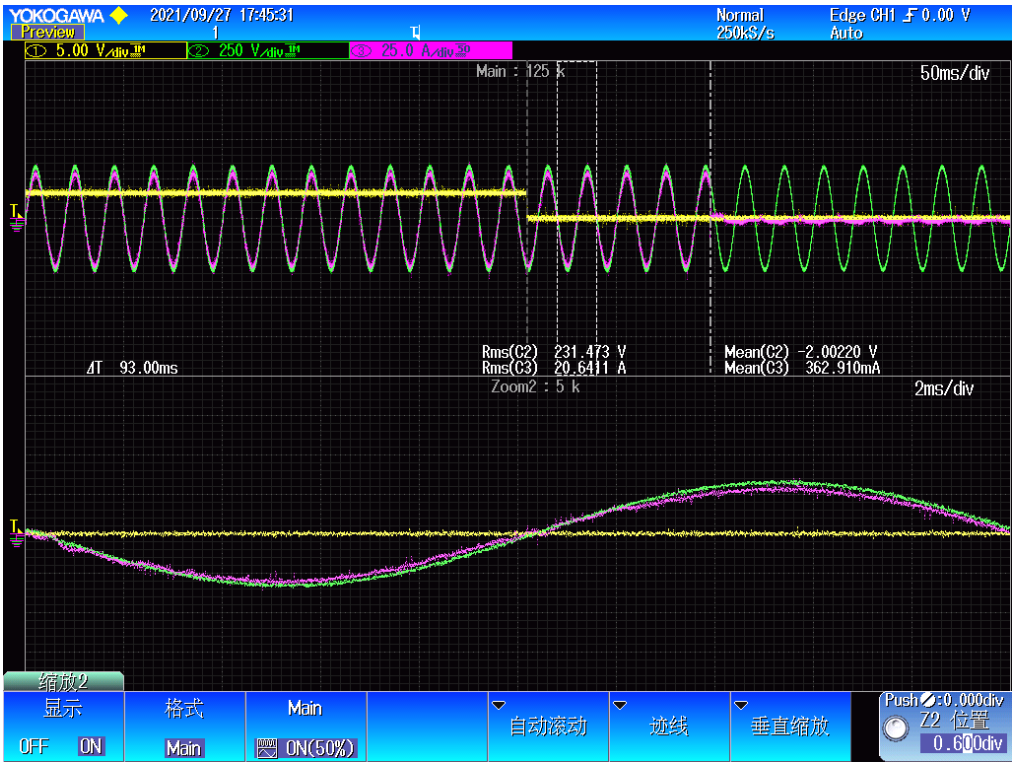
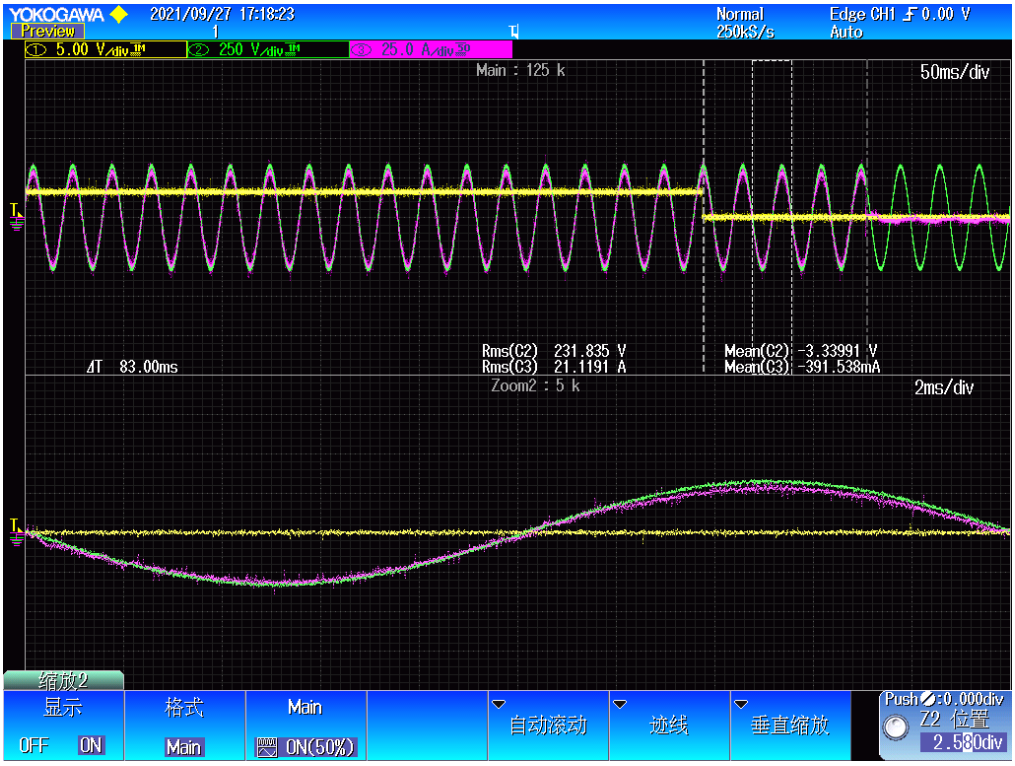
Clause	Requirement - Test	Result - Remark	Verdict

Negative DC-Injection:



Positive DC-Injection:



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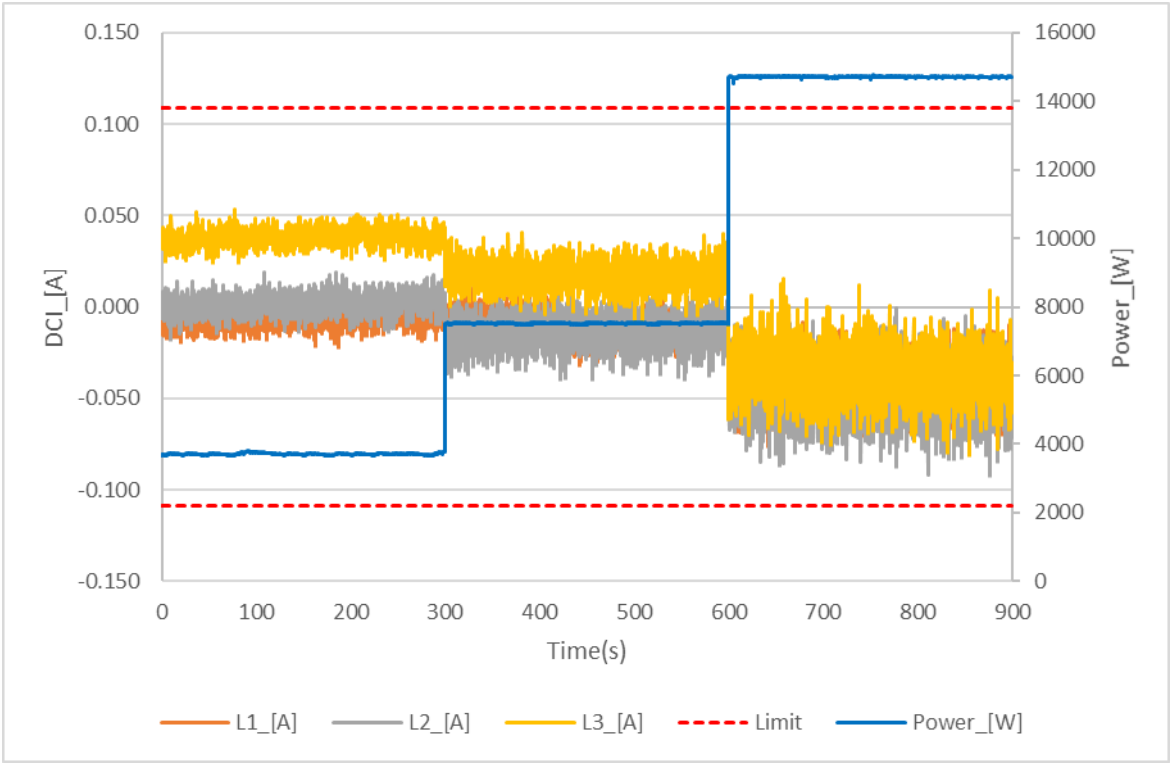
Clause	Requirement - Test	Result - Remark	Verdict

4.1.8	DC-Injection (Monitoring)	P

Test result: (INFINI WP 8KW)

IEC61727 Limit:	0,5% of Inom (58mA)		
Output power:	25%	50%	100%
max test value: (L1)	22	31	35
max test value: (L2)	24	22	35
max test value: (L3)	31	54	42



Note:
Testing must be performed according to WI 10.4.-03.doc rev D. The internal temperature of the EUT must be stabilized. No temperature drift of more than 2K within 1 hour is allowed.

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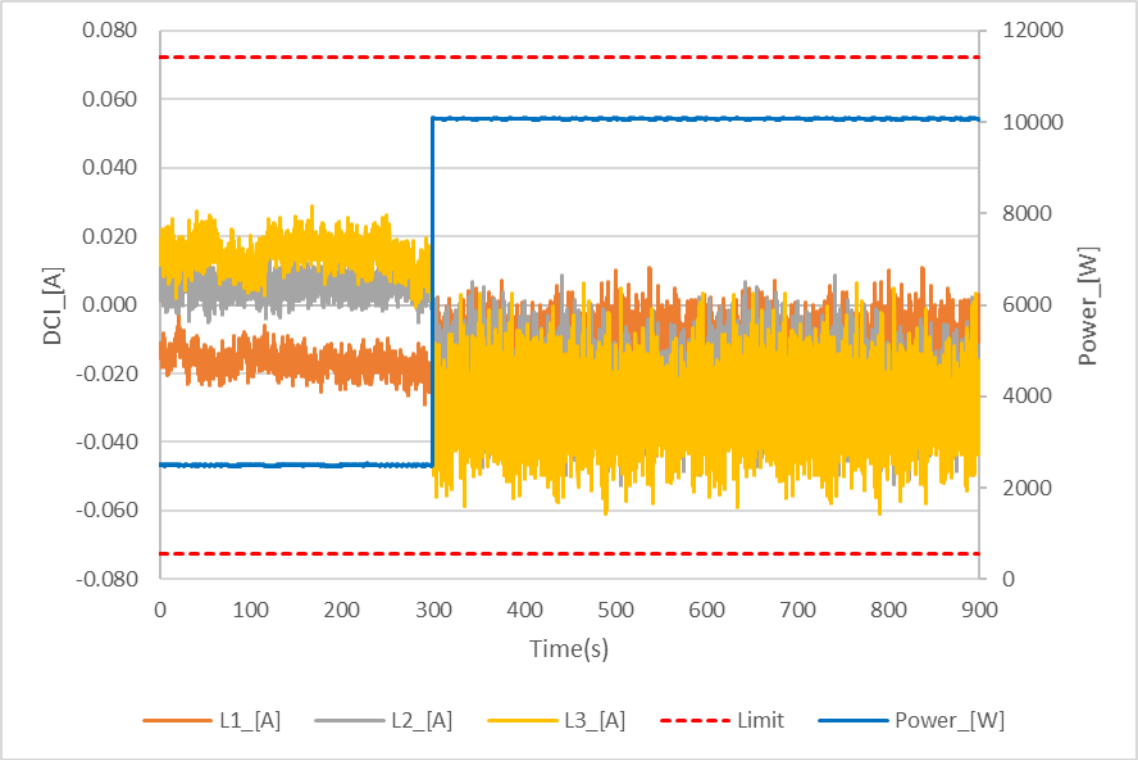
Clause	Requirement - Test	Result - Remark	Verdict

Test result: (INFINI WP 10KW)			
IEC61727 Limit:	0,5% of Inom (72mA)		
Output power:	25%	50%	100%
max test value: (L1)	29	35	35
max test value: (L2)	17	52	52
max test value: (L3)	29	61	61



Note:
Testing must be performed according to WI 10.4.-03.doc rev D. The internal temperature of the EUT must be stabilized. No temperature drift of more than 2K within 1 hour is allowed.

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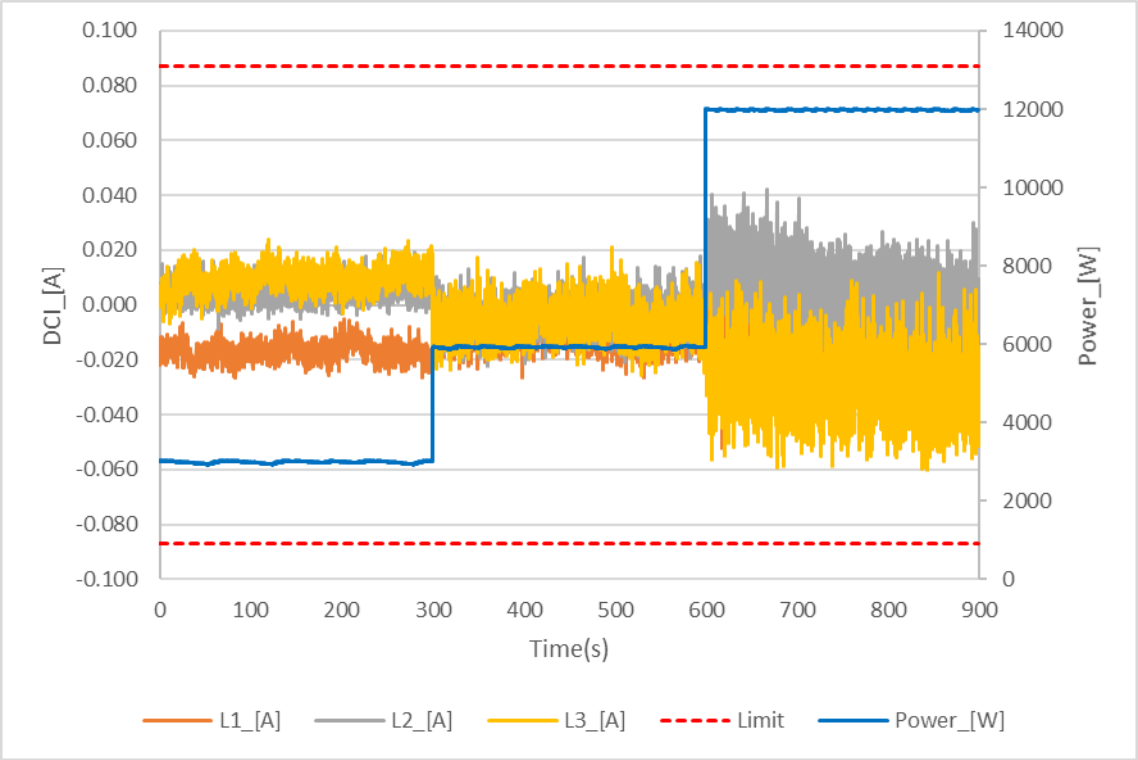
Clause	Requirement - Test	Result - Remark	Verdict

Test result: (INFINI WP 12KW)			
IEC61727 Limit:	0,5% of Inom (87mA)		
Output power:	25%	50%	100%
max test value: (L1)	27	26	52
max test value: (L2)	19	22	42
max test value: (L3)	24	26	60



Note:
Testing must be performed according to WI 10.4.-03.doc rev D. The internal temperature of the EUT must be stabilized. No temperature drift of more than 2K within 1 hour is allowed.

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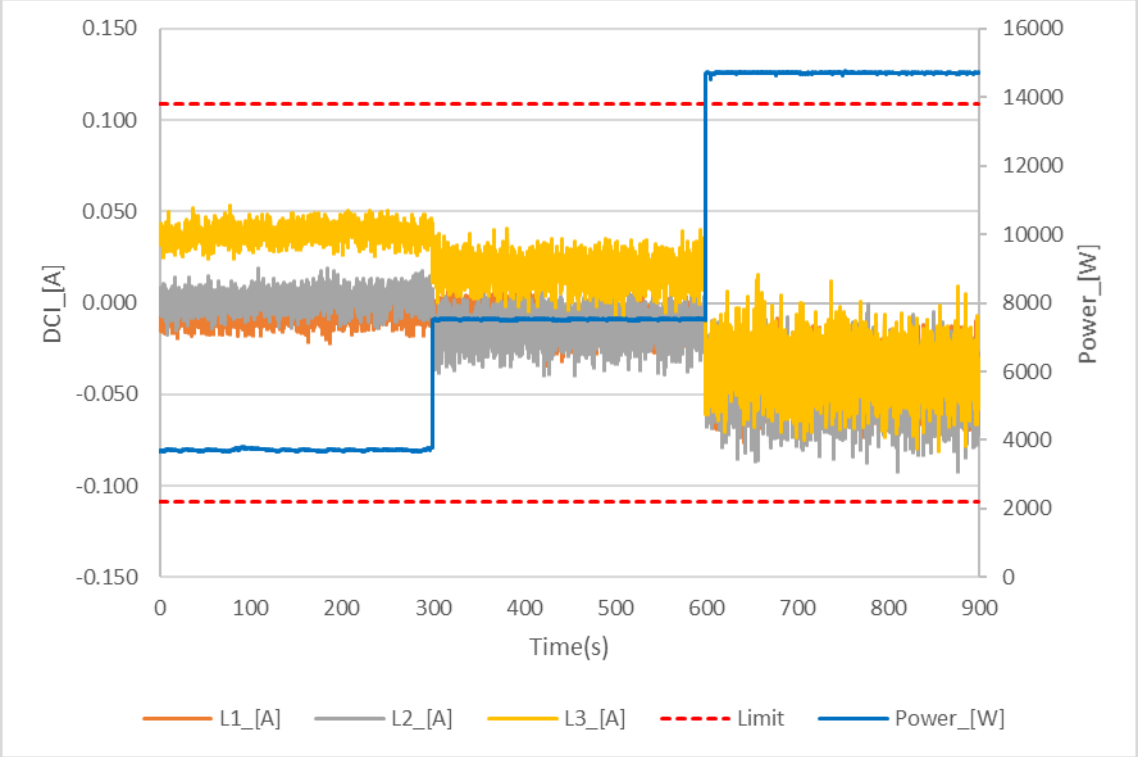
Clause	Requirement - Test	Result - Remark	Verdict

Test result: (INFINI WP 15KW)			
IEC61727 Limit:	0,5% of Inom (108mA)		
Output power:	25%	50%	100%
max test value: (L1)	22	34	76
max test value: (L2)	19	39	92
max test value: (L3)	54	41	81



Note:
Testing must be performed according to WI 10.4.-03.doc rev D. The internal temperature of the EUT must be stabilized. No temperature drift of more than 2K within 1 hour is allowed.

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Clause	Requirement - Test	Result - Remark	Verdict

4.1.10	**Harmonics and waveform distortion**	P

The currents of the interharmonics to 2 kHz must be measured in accordance with IEC 61000-4-7, Annex A. The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with IEC 61000-4-7, Annex B.

Test:

Harmonics: (INFINI WP 8KW)											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
THD	1,304	2,870	2,882	3,891	3,177	1,594	3,805	3,302	2,330	2,465	2,613
1	4,530	9,619	19,544	29,780	40,129	49,859	60,297	70,460	80,492	90,517	100,342
2	0,844	0,695	0,665	0,637	0,521	0,501	0,372	0,257	0,119	0,209	0,185
3	0,505	1,097	1,236	1,088	1,440	0,847	1,367	1,168	0,919	0,921	0,935
4	0,200	0,166	0,161	0,168	0,162	0,114	0,128	0,077	0,049	0,077	0,065
5	0,384	0,377	0,788	0,838	1,419	0,687	1,377	1,064	0,692	0,651	0,625
6	0,077	0,103	0,086	0,118	0,167	0,096	0,174	0,111	0,050	0,055	0,048
7	0,359	0,188	0,625	0,721	1,330	0,438	1,461	1,015	0,525	0,516	0,517
8	0,062	0,051	0,042	0,061	0,191	0,075	0,224	0,130	0,049	0,042	0,054
9	0,200	0,406	0,516	0,866	1,418	0,408	1,933	1,397	0,684	0,692	0,711
10	0,079	0,095	0,045	0,054	0,270	0,087	0,352	0,206	0,076	0,064	0,089
11	0,134	0,521	0,555	1,238	1,115	0,329	1,982	1,685	0,802	0,820	0,854
12	0,047	0,079	0,092	0,137	0,254	0,093	0,309	0,293	0,130	0,108	0,136
13	0,178	0,839	0,891	1,599	0,516	0,343	1,021	1,455	0,877	0,909	0,944
14	0,043	0,067	0,120	0,196	0,177	0,091	0,136	0,235	0,148	0,133	0,174
15	0,154	1,235	1,038	1,616	0,345	0,339	0,368	0,752	0,956	1,025	1,093
16	0,027	0,066	0,113	0,163	0,105	0,078	0,074	0,114	0,183	0,174	0,206
17	0,143	1,063	0,785	1,481	0,293	0,308	0,156	0,340	0,853	0,973	1,075
18	0,034	0,055	0,081	0,117	0,081	0,059	0,046	0,063	0,144	0,162	0,207
19	0,112	0,851	0,645	1,178	0,246	0,287	0,078	0,196	0,634	0,752	0,843
20	0,026	0,049	0,067	0,095	0,074	0,055	0,038	0,045	0,082	0,089	0,131
21	0,166	0,747	0,685	0,881	0,267	0,277	0,084	0,080	0,304	0,377	0,433
22	0,030	0,045	0,058	0,083	0,073	0,043	0,038	0,040	0,067	0,073	0,090
23	0,147	0,627	0,621	0,603	0,283	0,231	0,137	0,105	0,161	0,198	0,241
24	0,035	0,032	0,052	0,061	0,066	0,028	0,046	0,050	0,055	0,054	0,068
25	0,109	0,523	0,501	0,413	0,278	0,194	0,140	0,132	0,091	0,145	0,188
26	0,025	0,041	0,041	0,064	0,059	0,017	0,031	0,047	0,049	0,054	0,064
27	0,176	0,459	0,447	0,425	0,283	0,193	0,113	0,124	0,064	0,081	0,119
28	0,034	0,025	0,038	0,056	0,074	0,023	0,039	0,057	0,043	0,053	0,049
29	0,133	0,399	0,384	0,420	0,277	0,183	0,107	0,144	0,092	0,086	0,089
30	0,036	0,028	0,032	0,062	0,091	0,026	0,046	0,068	0,046	0,048	0,042
31	0,186	0,354	0,353	0,379	0,243	0,174	0,119	0,142	0,110	0,096	0,076
32	0,045	0,032	0,026	0,053	0,074	0,029	0,039	0,057	0,050	0,046	0,041
33	0,191	0,329	0,343	0,316	0,247	0,191	0,131	0,145	0,130	0,103	0,073
34	0,016	0,027	0,030	0,039	0,075	0,031	0,035	0,046	0,045	0,047	0,053
35	0,189	0,267	0,303	0,240	0,226	0,180	0,119	0,128	0,133	0,118	0,085
36	0,041	0,030	0,030	0,032	0,076	0,044	0,043	0,042	0,059	0,058	0,061
37	0,204	0,235	0,278	0,205	0,195	0,189	0,131	0,135	0,145	0,128	0,119

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Harmonics: (INFINI WP 8KW)											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
38	0,025	0,035	0,046	0,026	0,057	0,060	0,067	0,060	0,065	0,055	0,059
39	0,250	0,236	0,269	0,190	0,228	0,205	0,149	0,138	0,159	0,148	0,136
40	0,056	0,038	0,034	0,043	0,052	0,073	0,069	0,055	0,074	0,048	0,056
41	0,221	0,176	0,219	0,142	0,194	0,189	0,140	0,118	0,159	0,163	0,152
42	0,037	0,050	0,036	0,073	0,054	0,072	0,061	0,038	0,081	0,064	0,059
43	0,237	0,156	0,188	0,161	0,173	0,160	0,157	0,123	0,200	0,193	0,165
44	0,050	0,043	0,037	0,074	0,051	0,068	0,066	0,055	0,085	0,066	0,063
45	0,259	0,166	0,207	0,208	0,150	0,157	0,168	0,122	0,180	0,171	0,170
46	0,053	0,072	0,052	0,080	0,058	0,052	0,060	0,064	0,078	0,061	0,053
47	0,190	0,139	0,142	0,168	0,129	0,118	0,131	0,107	0,154	0,145	0,124
48	0,066	0,056	0,044	0,050	0,071	0,046	0,074	0,069	0,073	0,067	0,045
49	0,164	0,111	0,132	0,134	0,097	0,124	0,113	0,087	0,118	0,138	0,105
50	0,073	0,080	0,065	0,052	0,065	0,058	0,075	0,057	0,072	0,055	0,046
51	0,121	0,125	0,096	0,153	0,067	0,112	0,103	0,090	0,110	0,102	0,087
52	0,043	0,045	0,042	0,039	0,067	0,066	0,061	0,049	0,052	0,059	0,053
53	0,089	0,140	0,115	0,143	0,036	0,092	0,074	0,066	0,094	0,081	0,083
54	0,069	0,083	0,081	0,070	0,060	0,063	0,060	0,064	0,050	0,045	0,040
55	0,072	0,123	0,097	0,138	0,044	0,106	0,069	0,071	0,071	0,055	0,057
56	0,041	0,058	0,026	0,039	0,071	0,062	0,079	0,070	0,038	0,044	0,055
57	0,034	0,090	0,069	0,097	0,035	0,075	0,069	0,080	0,053	0,055	0,071
58	0,056	0,083	0,083	0,085	0,055	0,046	0,040	0,041	0,038	0,035	0,038
59	0,046	0,106	0,080	0,115	0,064	0,066	0,063	0,090	0,030	0,050	0,074
60	0,028	0,026	0,019	0,034	0,075	0,036	0,074	0,069	0,049	0,045	0,053

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Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,039	0,118	0,098	0,067	0,066	0,085	0,062	0,060	0,057	0,051	0,058
125	0,040	0,071	0,080	0,048	0,049	0,065	0,048	0,049	0,044	0,043	0,046
175	0,045	0,055	0,067	0,044	0,045	0,060	0,047	0,046	0,041	0,042	0,044
225	0,047	0,081	0,054	0,043	0,050	0,064	0,056	0,051	0,046	0,045	0,046
275	0,058	0,072	0,057	0,047	0,061	0,086	0,063	0,058	0,051	0,052	0,049
325	0,071	0,070	0,064	0,054	0,073	0,111	0,075	0,069	0,055	0,058	0,051
375	0,087	0,064	0,065	0,058	0,082	0,138	0,085	0,074	0,058	0,059	0,052
425	0,101	0,060	0,064	0,062	0,088	0,162	0,091	0,080	0,059	0,060	0,056
475	0,103	0,062	0,062	0,067	0,090	0,160	0,093	0,082	0,058	0,058	0,057
525	0,103	0,063	0,069	0,073	0,089	0,141	0,089	0,088	0,061	0,063	0,059
575	0,074	0,092	0,070	0,081	0,080	0,104	0,079	0,094	0,068	0,070	0,065
625	0,056	0,093	0,074	0,087	0,069	0,081	0,067	0,087	0,071	0,071	0,071
675	0,053	0,111	0,083	0,090	0,056	0,057	0,055	0,078	0,078	0,078	0,075
725	0,036	0,113	0,085	0,089	0,048	0,046	0,047	0,067	0,080	0,080	0,079
775	0,072	0,122	0,101	0,105	0,076	0,076	0,080	0,090	0,106	0,109	0,111
825	0,031	0,088	0,080	0,079	0,037	0,037	0,037	0,049	0,080	0,080	0,082
875	0,036	0,079	0,071	0,071	0,045	0,046	0,050	0,056	0,081	0,084	0,087
925	0,026	0,070	0,060	0,062	0,031	0,030	0,031	0,039	0,073	0,077	0,083
975	0,069	0,071	0,072	0,070	0,059	0,059	0,062	0,065	0,081	0,084	0,086
1025	0,026	0,053	0,051	0,050	0,029	0,029	0,028	0,034	0,064	0,069	0,077
1075	0,046	0,051	0,054	0,051	0,038	0,037	0,038	0,042	0,066	0,070	0,076
1125	0,024	0,038	0,044	0,039	0,027	0,025	0,025	0,030	0,056	0,061	0,067
1175	0,023	0,036	0,038	0,037	0,026	0,024	0,025	0,029	0,052	0,058	0,062
1225	0,022	0,034	0,037	0,035	0,026	0,025	0,024	0,028	0,049	0,054	0,059
1275	0,023	0,034	0,033	0,034	0,024	0,024	0,024	0,027	0,045	0,049	0,054
1325	0,035	0,037	0,036	0,038	0,031	0,031	0,033	0,033	0,044	0,047	0,052
1375	0,023	0,031	0,031	0,033	0,024	0,023	0,024	0,026	0,041	0,043	0,047
1425	0,034	0,038	0,038	0,039	0,032	0,032	0,033	0,035	0,046	0,047	0,050
1475	0,023	0,029	0,029	0,032	0,023	0,023	0,024	0,026	0,038	0,040	0,043
1525	0,022	0,031	0,030	0,032	0,023	0,023	0,024	0,027	0,038	0,040	0,043
1575	0,023	0,030	0,030	0,030	0,024	0,024	0,024	0,025	0,037	0,038	0,040
1625	0,024	0,030	0,030	0,031	0,023	0,023	0,025	0,027	0,037	0,038	0,040
1675	0,023	0,029	0,031	0,030	0,023	0,023	0,024	0,025	0,036	0,036	0,038
1725	0,023	0,030	0,031	0,030	0,024	0,025	0,027	0,025	0,036	0,036	0,038
1775	0,023	0,030	0,031	0,031	0,023	0,025	0,025	0,025	0,036	0,036	0,038
1825	0,024	0,030	0,032	0,031	0,025	0,025	0,026	0,026	0,036	0,036	0,038
1875	0,024	0,031	0,031	0,032	0,024	0,025	0,027	0,027	0,036	0,036	0,038
1925	0,025	0,031	0,033	0,033	0,027	0,025	0,029	0,027	0,037	0,037	0,038
1975	0,029	0,034	0,035	0,037	0,029	0,030	0,034	0,032	0,041	0,041	0,044
2025	0,029	0,035	0,036	0,038	0,029	0,031	0,035	0,032	0,041	0,041	0,043
2075	0,029	0,038	0,038	0,040	0,033	0,033	0,034	0,035	0,041	0,042	0,044
2125	0,029	0,038	0,039	0,040	0,034	0,034	0,037	0,035	0,040	0,041	0,044
2175	0,029	0,034	0,035	0,040	0,027	0,026	0,036	0,029	0,039	0,038	0,039
2225	0,028	0,037	0,037	0,041	0,028	0,028	0,039	0,031	0,039	0,040	0,041
2275	0,029	0,038	0,038	0,041	0,029	0,027	0,039	0,032	0,040	0,040	0,042
2325	0,030	0,038	0,037	0,037	0,030	0,027	0,041	0,032	0,042	0,042	0,043
2375	0,031	0,039	0,039	0,035	0,032	0,027	0,040	0,032	0,042	0,041	0,041
2425	0,031	0,040	0,038	0,035	0,029	0,027	0,041	0,033	0,043	0,042	0,041

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Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2475	0,029	0,040	0,035	0,036	0,028	0,026	0,040	0,033	0,042	0,041	0,040
2525	0,029	0,041	0,034	0,032	0,027	0,026	0,041	0,033	0,044	0,042	0,040
2575	0,029	0,046	0,040	0,038	0,036	0,034	0,046	0,042	0,049	0,048	0,048
2625	0,028	0,045	0,040	0,038	0,035	0,034	0,045	0,041	0,049	0,047	0,047
2675	0,032	0,037	0,031	0,031	0,028	0,029	0,037	0,031	0,042	0,040	0,037
2725	0,033	0,035	0,030	0,030	0,028	0,028	0,036	0,031	0,041	0,040	0,036
2775	0,025	0,033	0,027	0,028	0,025	0,025	0,035	0,030	0,039	0,037	0,033
2825	0,025	0,030	0,025	0,026	0,023	0,025	0,035	0,029	0,038	0,036	0,032
2875	0,025	0,029	0,026	0,024	0,022	0,025	0,034	0,028	0,037	0,035	0,030
2925	0,024	0,028	0,024	0,022	0,021	0,025	0,032	0,027	0,035	0,034	0,029
2975	0,023	0,025	0,023	0,022	0,022	0,022	0,032	0,027	0,035	0,033	0,027

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Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies components:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,320	0,252	0,301	0,252	0,270	0,271	0,233	0,191	0,281	0,278	0,255
2,3	0,326	0,235	0,264	0,280	0,215	0,210	0,239	0,192	0,258	0,255	0,238
2,5	0,212	0,195	0,183	0,216	0,158	0,188	0,190	0,154	0,205	0,192	0,169
2,7	0,147	0,216	0,170	0,216	0,115	0,170	0,144	0,140	0,150	0,129	0,143
2,9	0,098	0,151	0,137	0,168	0,113	0,116	0,124	0,132	0,101	0,106	0,125
3,1	0,094	0,145	0,123	0,133	0,098	0,086	0,100	0,109	0,096	0,109	0,111
3,3	0,089	0,122	0,118	0,112	0,086	0,080	0,089	0,096	0,102	0,094	0,100
3,5	0,081	0,098	0,097	0,092	0,070	0,070	0,083	0,084	0,091	0,087	0,080
3,7	0,072	0,088	0,089	0,083	0,061	0,063	0,078	0,076	0,092	0,077	0,067
3,9	0,070	0,082	0,083	0,073	0,060	0,060	0,075	0,071	0,076	0,070	0,059
4,1	0,065	0,071	0,067	0,066	0,057	0,059	0,066	0,068	0,065	0,060	0,056
4,3	0,065	0,067	0,070	0,065	0,054	0,053	0,062	0,061	0,060	0,054	0,054
4,5	0,064	0,065	0,062	0,064	0,054	0,052	0,062	0,060	0,059	0,058	0,056
4,7	0,060	0,065	0,059	0,060	0,049	0,053	0,058	0,060	0,055	0,056	0,053
4,9	0,057	0,061	0,061	0,057	0,051	0,052	0,056	0,054	0,054	0,055	0,050
5,1	0,057	0,056	0,058	0,063	0,053	0,056	0,056	0,055	0,061	0,058	0,048
5,3	0,057	0,058	0,059	0,056	0,053	0,052	0,056	0,053	0,053	0,050	0,053
5,5	0,057	0,060	0,057	0,057	0,051	0,052	0,055	0,051	0,055	0,051	0,050
5,7	0,060	0,055	0,055	0,054	0,049	0,051	0,052	0,054	0,054	0,054	0,050
5,9	0,062	0,054	0,057	0,054	0,050	0,049	0,052	0,051	0,053	0,053	0,054
6,1	0,067	0,057	0,056	0,056	0,052	0,053	0,054	0,053	0,055	0,054	0,054
6,3	0,075	0,056	0,055	0,057	0,051	0,053	0,054	0,053	0,055	0,053	0,052
6,5	0,075	0,059	0,067	0,055	0,067	0,054	0,064	0,055	0,054	0,054	0,060
6,7	0,061	0,072	0,076	0,067	0,071	0,054	0,069	0,073	0,081	0,076	0,066
6,9	0,059	0,077	0,062	0,085	0,061	0,093	0,070	0,077	0,065	0,071	0,076
7,1	0,063	0,058	0,057	0,057	0,053	0,055	0,056	0,053	0,058	0,060	0,055
7,3	0,073	0,066	0,066	0,066	0,064	0,063	0,065	0,064	0,067	0,067	0,069
7,5	0,065	0,059	0,058	0,057	0,055	0,053	0,056	0,055	0,057	0,056	0,059
7,7	0,065	0,059	0,059	0,058	0,056	0,055	0,058	0,057	0,057	0,056	0,058
7,9	0,062	0,059	0,058	0,058	0,057	0,056	0,059	0,058	0,058	0,057	0,059
8,1	0,124	0,105	0,109	0,108	0,106	0,107	0,110	0,108	0,111	0,114	0,115
8,3	0,155	0,144	0,154	0,160	0,168	0,175	0,184	0,198	0,217	0,236	0,255
8,5	0,139	0,140	0,146	0,151	0,159	0,164	0,177	0,191	0,208	0,226	0,241
8,7	0,141	0,115	0,118	0,123	0,122	0,130	0,131	0,132	0,134	0,140	0,144
8,9	0,078	0,068	0,064	0,067	0,062	0,065	0,067	0,066	0,064	0,064	0,064

Assessment criterion:

The harmonic and inter-harmonic current distortion shall comply with the relevant emission limits in accordance with IEC 61727, reproduced in table 1.

Note:

The normalization current is 11,6A.

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Harmonics: (INFINI WP 10KW)											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
THD	1,026	1,156	1,302	1,314	1,219	1,155	1,134	1,131	1,157	1,209	1,289
1	3,660	9,715	19,640	30,003	40,238	50,276	60,275	70,448	80,708	90,686	100,627
2	0,651	0,440	0,427	0,362	0,241	0,143	0,095	0,240	0,372	0,481	0,579
3	0,407	0,796	0,806	0,728	0,671	0,632	0,620	0,606	0,609	0,623	0,658
4	0,153	0,099	0,108	0,088	0,056	0,033	0,052	0,081	0,110	0,139	0,159
5	0,302	0,286	0,549	0,570	0,541	0,505	0,464	0,424	0,388	0,362	0,343
6	0,060	0,061	0,062	0,072	0,058	0,046	0,038	0,059	0,066	0,083	0,100
7	0,290	0,144	0,334	0,343	0,328	0,330	0,325	0,318	0,311	0,312	0,315
8	0,046	0,036	0,040	0,052	0,046	0,038	0,038	0,042	0,055	0,066	0,074
9	0,159	0,120	0,239	0,304	0,315	0,338	0,357	0,356	0,356	0,349	0,336
10	0,061	0,048	0,041	0,048	0,056	0,049	0,043	0,043	0,046	0,052	0,057
11	0,102	0,155	0,213	0,285	0,263	0,309	0,335	0,335	0,323	0,321	0,312
12	0,035	0,056	0,045	0,051	0,061	0,057	0,050	0,044	0,044	0,051	0,057
13	0,142	0,152	0,192	0,328	0,262	0,229	0,266	0,286	0,286	0,299	0,323
14	0,034	0,041	0,034	0,048	0,062	0,055	0,044	0,040	0,041	0,044	0,047
15	0,121	0,231	0,215	0,284	0,272	0,203	0,225	0,256	0,291	0,320	0,346
16	0,022	0,026	0,024	0,035	0,052	0,050	0,041	0,034	0,031	0,033	0,035
17	0,115	0,235	0,225	0,225	0,254	0,181	0,177	0,224	0,257	0,277	0,295
18	0,026	0,022	0,027	0,021	0,042	0,041	0,032	0,027	0,026	0,024	0,026
19	0,088	0,136	0,147	0,173	0,216	0,172	0,130	0,159	0,181	0,198	0,230
20	0,021	0,023	0,031	0,023	0,038	0,038	0,029	0,025	0,023	0,025	0,028
21	0,133	0,127	0,087	0,173	0,212	0,199	0,125	0,092	0,120	0,147	0,182
22	0,024	0,017	0,021	0,022	0,032	0,041	0,035	0,027	0,023	0,018	0,021
23	0,117	0,154	0,150	0,187	0,201	0,207	0,140	0,086	0,105	0,130	0,153
24	0,028	0,027	0,032	0,021	0,018	0,032	0,032	0,026	0,019	0,016	0,025
25	0,087	0,146	0,194	0,178	0,159	0,181	0,133	0,083	0,084	0,096	0,114
26	0,020	0,017	0,031	0,025	0,021	0,034	0,029	0,027	0,024	0,024	0,034
27	0,143	0,153	0,178	0,162	0,151	0,180	0,147	0,103	0,060	0,068	0,092
28	0,027	0,030	0,035	0,022	0,014	0,023	0,037	0,038	0,031	0,024	0,030
29	0,106	0,136	0,157	0,136	0,149	0,169	0,170	0,123	0,066	0,058	0,078
30	0,029	0,022	0,027	0,030	0,021	0,034	0,045	0,037	0,031	0,026	0,036
31	0,150	0,146	0,158	0,138	0,161	0,166	0,164	0,122	0,079	0,052	0,056
32	0,036	0,026	0,025	0,035	0,018	0,019	0,024	0,029	0,033	0,032	0,038
33	0,153	0,196	0,175	0,158	0,160	0,162	0,185	0,151	0,100	0,065	0,047
34	0,012	0,018	0,018	0,047	0,022	0,022	0,021	0,033	0,038	0,038	0,036
35	0,152	0,169	0,164	0,166	0,154	0,140	0,168	0,149	0,122	0,072	0,055
36	0,033	0,021	0,029	0,038	0,016	0,028	0,026	0,035	0,038	0,036	0,036
37	0,163	0,167	0,159	0,183	0,142	0,126	0,167	0,170	0,145	0,088	0,071
38	0,020	0,016	0,026	0,036	0,038	0,032	0,024	0,028	0,037	0,044	0,035
39	0,201	0,209	0,208	0,220	0,167	0,139	0,175	0,175	0,153	0,102	0,065
40	0,043	0,039	0,039	0,039	0,039	0,048	0,044	0,036	0,039	0,043	0,029
41	0,177	0,193	0,208	0,168	0,130	0,114	0,148	0,170	0,148	0,098	0,056
42	0,030	0,029	0,031	0,036	0,066	0,047	0,051	0,035	0,041	0,040	0,029
43	0,189	0,192	0,206	0,171	0,110	0,106	0,134	0,157	0,145	0,119	0,063
44	0,039	0,037	0,032	0,048	0,049	0,041	0,054	0,032	0,027	0,038	0,038
45	0,207	0,225	0,196	0,117	0,083	0,100	0,145	0,145	0,125	0,124	0,049

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Harmonics: (INFINI WP 10KW)											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
46	0,042	0,035	0,045	0,047	0,060	0,056	0,053	0,043	0,024	0,034	0,039
47	0,152	0,179	0,161	0,113	0,087	0,086	0,103	0,116	0,106	0,118	0,077
48	0,053	0,045	0,042	0,053	0,054	0,064	0,056	0,052	0,025	0,034	0,037
49	0,130	0,153	0,135	0,094	0,071	0,078	0,098	0,081	0,105	0,116	0,101
50	0,062	0,047	0,071	0,058	0,041	0,066	0,051	0,035	0,026	0,026	0,035
51	0,097	0,136	0,122	0,070	0,067	0,083	0,093	0,095	0,098	0,082	0,080
52	0,035	0,059	0,050	0,055	0,031	0,046	0,039	0,025	0,026	0,020	0,022
53	0,072	0,097	0,060	0,028	0,054	0,073	0,076	0,071	0,097	0,065	0,081
54	0,059	0,041	0,055	0,059	0,060	0,060	0,029	0,036	0,036	0,030	0,025
55	0,058	0,082	0,048	0,032	0,061	0,060	0,051	0,066	0,097	0,055	0,068
56	0,032	0,058	0,027	0,050	0,064	0,057	0,043	0,023	0,034	0,021	0,019
57	0,027	0,034	0,024	0,030	0,049	0,047	0,054	0,068	0,066	0,051	0,047
58	0,048	0,053	0,058	0,056	0,069	0,038	0,030	0,018	0,030	0,021	0,022
59	0,036	0,042	0,030	0,026	0,057	0,052	0,041	0,053	0,057	0,063	0,045
60	0,023	0,038	0,026	0,023	0,042	0,037	0,028	0,025	0,031	0,021	0,024

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0,029	0,080	0,062	0,051	0,048	0,048	0,051	0,053	0,046	0,057	0,064
125	0,030	0,056	0,045	0,041	0,048	0,058	0,061	0,056	0,043	0,044	0,049
175	0,033	0,069	0,053	0,041	0,044	0,044	0,045	0,043	0,049	0,051	0,051
225	0,038	0,068	0,056	0,051	0,056	0,060	0,061	0,059	0,054	0,061	0,063
275	0,044	0,079	0,074	0,067	0,068	0,068	0,070	0,071	0,072	0,076	0,079
325	0,056	0,092	0,087	0,086	0,093	0,090	0,090	0,084	0,080	0,088	0,092
375	0,069	0,102	0,108	0,105	0,113	0,107	0,106	0,103	0,100	0,104	0,107
425	0,079	0,121	0,120	0,124	0,131	0,135	0,127	0,124	0,121	0,123	0,126
475	0,082	0,111	0,116	0,118	0,130	0,140	0,131	0,129	0,127	0,124	0,128
525	0,081	0,125	0,115	0,105	0,110	0,120	0,124	0,125	0,124	0,122	0,126
575	0,059	0,077	0,072	0,075	0,085	0,095	0,104	0,110	0,114	0,114	0,119
625	0,043	0,080	0,057	0,054	0,061	0,068	0,079	0,087	0,100	0,107	0,112
675	0,042	0,054	0,041	0,042	0,045	0,049	0,057	0,067	0,082	0,092	0,102
725	0,029	0,057	0,034	0,034	0,037	0,039	0,043	0,049	0,062	0,075	0,087
775	0,057	0,064	0,060	0,059	0,060	0,062	0,065	0,068	0,075	0,084	0,094
825	0,024	0,045	0,031	0,026	0,029	0,031	0,032	0,034	0,042	0,050	0,059
875	0,028	0,041	0,038	0,037	0,037	0,039	0,040	0,043	0,047	0,052	0,059
925	0,021	0,036	0,026	0,023	0,024	0,025	0,026	0,028	0,032	0,037	0,043
975	0,055	0,050	0,049	0,048	0,048	0,049	0,050	0,050	0,051	0,055	0,061
1025	0,020	0,028	0,025	0,022	0,023	0,024	0,025	0,025	0,028	0,031	0,036
1075	0,037	0,032	0,031	0,029	0,030	0,031	0,032	0,031	0,032	0,035	0,040
1125	0,019	0,023	0,023	0,020	0,021	0,021	0,022	0,023	0,025	0,027	0,031
1175	0,018	0,022	0,021	0,019	0,019	0,020	0,022	0,021	0,022	0,025	0,028
1225	0,018	0,021	0,021	0,019	0,019	0,020	0,021	0,021	0,022	0,024	0,027
1275	0,018	0,023	0,021	0,019	0,019	0,019	0,020	0,020	0,021	0,023	0,025
1325	0,028	0,027	0,026	0,026	0,025	0,025	0,026	0,026	0,026	0,027	0,028
1375	0,018	0,023	0,021	0,019	0,019	0,018	0,019	0,019	0,020	0,022	0,023
1425	0,028	0,029	0,027	0,026	0,025	0,025	0,026	0,025	0,026	0,027	0,029
1475	0,019	0,024	0,020	0,019	0,018	0,018	0,019	0,019	0,019	0,020	0,024
1525	0,018	0,024	0,020	0,019	0,018	0,018	0,019	0,018	0,019	0,020	0,024
1575	0,019	0,023	0,019	0,019	0,018	0,019	0,019	0,019	0,019	0,020	0,023
1625	0,018	0,023	0,020	0,019	0,018	0,018	0,019	0,018	0,019	0,020	0,024
1675	0,018	0,022	0,020	0,019	0,018	0,019	0,019	0,018	0,019	0,020	0,024
1725	0,018	0,022	0,020	0,019	0,018	0,019	0,019	0,018	0,019	0,020	0,025
1775	0,018	0,022	0,019	0,019	0,019	0,020	0,019	0,019	0,019	0,020	0,025
1825	0,019	0,022	0,020	0,020	0,018	0,020	0,019	0,019	0,019	0,021	0,025
1875	0,019	0,022	0,019	0,019	0,020	0,021	0,020	0,020	0,020	0,020	0,024
1925	0,020	0,023	0,020	0,020	0,020	0,021	0,020	0,020	0,020	0,022	0,025
1975	0,023	0,026	0,024	0,024	0,024	0,025	0,024	0,025	0,026	0,026	0,029
2025	0,023	0,026	0,024	0,024	0,024	0,024	0,023	0,025	0,026	0,026	0,030
2075	0,024	0,028	0,027	0,027	0,027	0,027	0,029	0,029	0,029	0,029	0,033
2125	0,022	0,028	0,026	0,026	0,027	0,027	0,027	0,031	0,030	0,029	0,033
2175	0,023	0,027	0,023	0,022	0,022	0,021	0,021	0,022	0,022	0,022	0,026
2225	0,022	0,028	0,025	0,023	0,024	0,021	0,021	0,023	0,024	0,023	0,026
2275	0,023	0,030	0,025	0,024	0,024	0,022	0,023	0,023	0,025	0,026	0,031
2325	0,023	0,030	0,027	0,025	0,025	0,021	0,022	0,023	0,025	0,026	0,031
2375	0,025	0,032	0,027	0,025	0,026	0,022	0,025	0,023	0,024	0,027	0,030
2425	0,024	0,033	0,027	0,026	0,026	0,021	0,023	0,022	0,024	0,026	0,030

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Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2475	0,023	0,032	0,027	0,026	0,026	0,021	0,023	0,021	0,021	0,022	0,024
2525	0,023	0,033	0,028	0,026	0,025	0,021	0,021	0,021	0,021	0,021	0,023
2575	0,023	0,037	0,032	0,031	0,030	0,028	0,027	0,028	0,028	0,030	0,031
2625	0,022	0,038	0,032	0,031	0,030	0,027	0,026	0,028	0,029	0,030	0,031
2675	0,025	0,031	0,027	0,025	0,023	0,023	0,023	0,023	0,024	0,025	0,027
2725	0,024	0,031	0,026	0,025	0,022	0,022	0,022	0,022	0,023	0,025	0,027
2775	0,020	0,029	0,024	0,025	0,019	0,018	0,020	0,018	0,018	0,021	0,021
2825	0,019	0,029	0,024	0,025	0,019	0,018	0,019	0,018	0,018	0,019	0,023
2875	0,019	0,028	0,023	0,024	0,018	0,017	0,019	0,017	0,017	0,019	0,021
2925	0,019	0,027	0,023	0,023	0,018	0,017	0,019	0,017	0,018	0,018	0,022
2975	0,018	0,026	0,022	0,023	0,017	0,017	0,018	0,016	0,018	0,018	0,020

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Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies components:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0,256	0,270	0,286	0,249	0,194	0,173	0,211	0,240	0,214	0,171	0,109
2,3	0,261	0,288	0,256	0,181	0,145	0,162	0,199	0,203	0,173	0,185	0,108
2,5	0,169	0,219	0,195	0,132	0,107	0,144	0,151	0,132	0,154	0,152	0,142
2,7	0,121	0,148	0,108	0,094	0,107	0,125	0,111	0,111	0,154	0,103	0,121
2,9	0,080	0,088	0,081	0,076	0,102	0,088	0,084	0,094	0,102	0,094	0,082
3,1	0,076	0,078	0,082	0,073	0,083	0,073	0,066	0,071	0,077	0,092	0,080
3,3	0,071	0,076	0,071	0,075	0,074	0,070	0,067	0,063	0,071	0,067	0,075
3,5	0,065	0,073	0,064	0,063	0,060	0,057	0,058	0,057	0,056	0,055	0,051
3,7	0,058	0,067	0,063	0,060	0,056	0,056	0,057	0,050	0,048	0,050	0,047
3,9	0,056	0,068	0,062	0,061	0,054	0,052	0,048	0,046	0,044	0,049	0,055
4,1	0,053	0,062	0,055	0,054	0,052	0,046	0,045	0,044	0,042	0,046	0,056
4,3	0,052	0,057	0,052	0,050	0,049	0,049	0,045	0,045	0,043	0,042	0,047
4,5	0,050	0,053	0,049	0,050	0,048	0,044	0,041	0,039	0,039	0,038	0,039
4,7	0,048	0,055	0,051	0,049	0,047	0,044	0,039	0,040	0,039	0,038	0,038
4,9	0,046	0,048	0,045	0,048	0,049	0,042	0,041	0,038	0,037	0,038	0,038
5,1	0,045	0,050	0,048	0,045	0,045	0,046	0,040	0,037	0,038	0,038	0,038
5,3	0,046	0,048	0,046	0,046	0,046	0,041	0,043	0,040	0,037	0,038	0,038
5,5	0,046	0,045	0,045	0,047	0,044	0,041	0,040	0,041	0,039	0,039	0,039
5,7	0,048	0,048	0,046	0,044	0,042	0,042	0,039	0,040	0,041	0,040	0,041
5,9	0,051	0,047	0,045	0,044	0,042	0,040	0,041	0,038	0,041	0,040	0,039
6,1	0,052	0,047	0,046	0,045	0,043	0,041	0,041	0,040	0,041	0,044	0,042
6,3	0,057	0,047	0,045	0,044	0,043	0,041	0,040	0,040	0,040	0,040	0,040
6,5	0,062	0,048	0,048	0,046	0,042	0,047	0,042	0,051	0,043	0,042	0,044
6,7	0,049	0,048	0,045	0,046	0,059	0,068	0,071	0,061	0,050	0,067	0,055
6,9	0,047	0,048	0,047	0,063	0,061	0,044	0,045	0,045	0,051	0,053	0,051
7,1	0,050	0,049	0,061	0,061	0,044	0,043	0,042	0,043	0,060	0,046	0,056
7,3	0,059	0,069	0,070	0,052	0,051	0,051	0,052	0,051	0,051	0,050	0,051
7,5	0,049	0,065	0,049	0,045	0,044	0,044	0,043	0,045	0,044	0,044	0,044
7,7	0,054	0,049	0,047	0,047	0,045	0,044	0,043	0,043	0,046	0,045	0,047
7,9	0,051	0,050	0,048	0,049	0,045	0,045	0,045	0,047	0,044	0,044	0,044
8,1	0,098	0,085	0,086	0,084	0,085	0,088	0,089	0,090	0,091	0,095	0,101
8,3	0,125	0,114	0,123	0,132	0,141	0,156	0,168	0,189	0,210	0,235	0,264
8,5	0,111	0,109	0,113	0,121	0,134	0,144	0,161	0,177	0,197	0,224	0,248
8,7	0,113	0,091	0,092	0,102	0,101	0,102	0,105	0,108	0,117	0,121	0,131
8,9	0,061	0,053	0,063	0,055	0,051	0,050	0,050	0,051	0,051	0,052	0,054

Assessment criterion:

The harmonic and inter-harmonic current distortion shall comply with the relevant emission limits in accordance with IEC 61727, reproduced in table 1.

Note:

The normalization current is 14,5A

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Clause	Requirement - Test	Result - Remark	Verdict

Harmonics: (INFINI WP 12KW)											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
THD	1.885	0,963	1,104	1,043	0,950	0,938	0,938	0,982	1,052	1,133	1,228
1	3.142	9,837	20,035	29,942	40,349	50,531	60,520	70,634	80,509	90,589	100,452
2	0.619	0,291	0,267	0,203	0,085	0,099	0,242	0,379	0,477	0,536	0,593
3	1.101	0,679	0,645	0,577	0,535	0,514	0,503	0,510	0,531	0,566	0,595
4	0.206	0,068	0,066	0,051	0,024	0,052	0,079	0,113	0,137	0,153	0,164
5	0.204	0,302	0,479	0,459	0,424	0,383	0,341	0,307	0,282	0,273	0,277
6	0.101	0,042	0,052	0,051	0,041	0,035	0,051	0,064	0,081	0,097	0,106
7	0.794	0,129	0,289	0,263	0,260	0,253	0,247	0,245	0,250	0,272	0,297
8	0.101	0,029	0,031	0,039	0,030	0,029	0,038	0,052	0,060	0,071	0,083
9	0.849	0,083	0,252	0,253	0,262	0,280	0,277	0,281	0,282	0,276	0,281
10	0.084	0,033	0,035	0,046	0,038	0,033	0,035	0,039	0,045	0,049	0,056
11	0.451	0,125	0,235	0,227	0,239	0,275	0,279	0,278	0,281	0,263	0,246
12	0.031	0,039	0,036	0,046	0,048	0,043	0,039	0,043	0,045	0,049	0,061
13	0.342	0,160	0,226	0,247	0,188	0,223	0,243	0,255	0,264	0,266	0,275
14	0.032	0,031	0,034	0,044	0,044	0,037	0,037	0,040	0,047	0,052	0,059
15	0.126	0,102	0,189	0,259	0,174	0,181	0,216	0,248	0,269	0,291	0,320
16	0.030	0,023	0,021	0,035	0,037	0,030	0,028	0,030	0,033	0,038	0,042
17	0.261	0,168	0,179	0,242	0,169	0,139	0,183	0,219	0,243	0,264	0,291
18	0.026	0,018	0,017	0,022	0,026	0,024	0,023	0,020	0,023	0,026	0,032
19	0.194	0,177	0,170	0,184	0,149	0,114	0,149	0,170	0,184	0,203	0,223
20	0.026	0,020	0,016	0,024	0,030	0,020	0,016	0,016	0,021	0,027	0,032
21	0.157	0,129	0,150	0,164	0,150	0,085	0,095	0,115	0,134	0,153	0,178
22	0.017	0,016	0,019	0,016	0,027	0,024	0,020	0,020	0,027	0,027	0,027
23	0.174	0,116	0,128	0,145	0,175	0,118	0,065	0,078	0,107	0,136	0,156
24	0.012	0,013	0,023	0,016	0,033	0,027	0,016	0,016	0,017	0,018	0,019
25	0.150	0,110	0,104	0,139	0,170	0,121	0,067	0,074	0,099	0,117	0,135
26	0.011	0,015	0,028	0,012	0,018	0,022	0,020	0,016	0,016	0,020	0,021
27	0.147	0,120	0,116	0,128	0,142	0,114	0,066	0,060	0,087	0,107	0,128
28	0.017	0,016	0,029	0,022	0,030	0,028	0,022	0,018	0,025	0,022	0,028
29	0.144	0,140	0,144	0,114	0,131	0,138	0,099	0,048	0,061	0,087	0,122
30	0.017	0,017	0,027	0,019	0,024	0,030	0,030	0,032	0,030	0,021	0,024
31	0.150	0,143	0,155	0,136	0,135	0,147	0,114	0,061	0,046	0,079	0,113
32	0.014	0,013	0,031	0,020	0,019	0,033	0,031	0,022	0,021	0,019	0,022
33	0.142	0,149	0,172	0,148	0,134	0,155	0,121	0,062	0,043	0,078	0,113
34	0.029	0,015	0,024	0,023	0,014	0,017	0,017	0,025	0,025	0,024	0,030
35	0.133	0,143	0,150	0,138	0,125	0,144	0,121	0,076	0,029	0,059	0,098
36	0.027	0,016	0,026	0,028	0,023	0,019	0,021	0,030	0,029	0,027	0,034
37	0.133	0,156	0,133	0,116	0,104	0,143	0,127	0,094	0,053	0,043	0,086
38	0.036	0,019	0,020	0,025	0,021	0,022	0,036	0,033	0,029	0,027	0,027
39	0.144	0,185	0,156	0,128	0,124	0,169	0,147	0,114	0,067	0,038	0,089
40	0.031	0,021	0,025	0,040	0,034	0,032	0,032	0,034	0,034	0,028	0,032
41	0.115	0,150	0,148	0,141	0,095	0,128	0,129	0,111	0,069	0,048	0,073
42	0.057	0,036	0,033	0,036	0,030	0,046	0,026	0,028	0,035	0,034	0,033
43	0.113	0,147	0,140	0,133	0,106	0,126	0,132	0,123	0,092	0,055	0,061
44	0.049	0,040	0,039	0,030	0,037	0,044	0,032	0,034	0,034	0,032	0,030
45	0.097	0,154	0,170	0,133	0,077	0,107	0,131	0,113	0,086	0,045	0,063

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Clause	Requirement - Test	Result - Remark	Verdict

Harmonics: (INFINI WP 12KW)											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
46	0.050	0,043	0,044	0,027	0,027	0,048	0,034	0,041	0,038	0,036	0,035
47	0.117	0,126	0,144	0,112	0,078	0,086	0,125	0,112	0,102	0,064	0,038
48	0.059	0,044	0,037	0,025	0,034	0,055	0,050	0,046	0,038	0,037	0,036
49	0.066	0,091	0,122	0,085	0,051	0,060	0,092	0,103	0,099	0,055	0,040
50	0.077	0,058	0,033	0,030	0,058	0,054	0,055	0,036	0,036	0,044	0,035
51	0.074	0,065	0,106	0,070	0,050	0,044	0,090	0,082	0,062	0,041	0,033
52	0.043	0,039	0,030	0,050	0,054	0,066	0,056	0,044	0,039	0,039	0,035
53	0.048	0,049	0,098	0,047	0,040	0,040	0,077	0,069	0,056	0,056	0,039
54	0.052	0,054	0,047	0,039	0,039	0,034	0,038	0,023	0,028	0,029	0,033
55	0.046	0,036	0,043	0,046	0,039	0,045	0,062	0,060	0,037	0,044	0,034
56	0.034	0,035	0,052	0,061	0,045	0,049	0,056	0,046	0,036	0,036	0,033
57	0.043	0,016	0,041	0,031	0,028	0,047	0,057	0,055	0,037	0,033	0,033
58	0.040	0,053	0,042	0,030	0,039	0,031	0,029	0,021	0,027	0,034	0,030
59	0.042	0,018	0,044	0,046	0,048	0,038	0,052	0,045	0,031	0,031	0,027
60	0.030	0,025	0,035	0,040	0,037	0,042	0,054	0,039	0,029	0,025	0,028

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.024	0,071	0,039	0,041	0,038	0,042	0,043	0,041	0,046	0,045	0,073
125	0.026	0,049	0,033	0,033	0,031	0,035	0,035	0,035	0,040	0,041	0,053
175	0.028	0,050	0,036	0,035	0,034	0,037	0,036	0,053	0,055	0,043	0,064
225	0.031	0,060	0,059	0,043	0,045	0,055	0,062	0,044	0,046	0,049	0,053
275	0.036	0,058	0,056	0,058	0,058	0,052	0,052	0,056	0,062	0,061	0,072
325	0.045	0,074	0,070	0,078	0,076	0,066	0,065	0,065	0,066	0,072	0,088
375	0.049	0,090	0,094	0,097	0,095	0,089	0,090	0,080	0,078	0,085	0,091
425	0.050	0,102	0,099	0,108	0,112	0,099	0,096	0,098	0,092	0,098	0,118
475	0.041	0,091	0,094	0,104	0,114	0,108	0,109	0,103	0,100	0,105	0,115
525	0.033	0,098	0,087	0,098	0,103	0,109	0,111	0,105	0,101	0,108	0,129
575	0.027	0,059	0,061	0,070	0,081	0,093	0,102	0,105	0,105	0,108	0,117
625	0.023	0,059	0,045	0,050	0,058	0,074	0,087	0,096	0,099	0,111	0,134
675	0.032	0,040	0,035	0,037	0,041	0,052	0,066	0,082	0,092	0,106	0,111
725	0.019	0,043	0,029	0,030	0,033	0,040	0,051	0,064	0,076	0,097	0,119
775	0.046	0,055	0,051	0,051	0,053	0,056	0,062	0,071	0,082	0,101	0,112
825	0.017	0,032	0,024	0,023	0,025	0,027	0,032	0,040	0,051	0,068	0,089
875	0.022	0,034	0,030	0,031	0,033	0,035	0,037	0,042	0,049	0,061	0,075
925	0.016	0,025	0,022	0,019	0,021	0,022	0,025	0,028	0,035	0,048	0,062
975	0.046	0,043	0,040	0,040	0,042	0,042	0,043	0,045	0,048	0,055	0,061
1025	0.016	0,023	0,021	0,019	0,020	0,020	0,021	0,024	0,028	0,035	0,044
1075	0.030	0,026	0,028	0,025	0,025	0,026	0,026	0,028	0,031	0,035	0,043
1125	0.015	0,019	0,021	0,017	0,018	0,018	0,019	0,021	0,024	0,029	0,035
1175	0.014	0,017	0,020	0,016	0,017	0,018	0,018	0,019	0,022	0,026	0,032
1225	0.014	0,016	0,020	0,016	0,017	0,018	0,018	0,019	0,021	0,025	0,031
1275	0.014	0,017	0,020	0,016	0,016	0,017	0,016	0,018	0,020	0,023	0,028
1325	0.023	0,022	0,024	0,022	0,022	0,022	0,022	0,023	0,024	0,025	0,028
1375	0.014	0,017	0,020	0,018	0,016	0,017	0,016	0,017	0,019	0,021	0,026
1425	0.022	0,022	0,027	0,024	0,023	0,022	0,022	0,022	0,024	0,025	0,029
1475	0.016	0,017	0,022	0,019	0,016	0,016	0,016	0,016	0,018	0,020	0,024
1525	0.014	0,017	0,022	0,019	0,016	0,016	0,016	0,016	0,018	0,019	0,023
1575	0.014	0,017	0,022	0,018	0,016	0,016	0,015	0,016	0,017	0,019	0,023
1625	0.014	0,016	0,023	0,018	0,016	0,016	0,016	0,016	0,017	0,019	0,023
1675	0.014	0,017	0,024	0,019	0,016	0,017	0,016	0,016	0,017	0,019	0,023
1725	0.014	0,016	0,025	0,019	0,016	0,016	0,017	0,016	0,017	0,019	0,022
1775	0.015	0,016	0,026	0,020	0,016	0,016	0,016	0,016	0,017	0,019	0,021
1825	0.015	0,016	0,027	0,019	0,016	0,016	0,016	0,017	0,018	0,019	0,022
1875	0.015	0,016	0,029	0,021	0,016	0,016	0,016	0,016	0,017	0,019	0,022
1925	0.015	0,016	0,030	0,021	0,017	0,017	0,017	0,017	0,018	0,019	0,023
1975	0.019	0,019	0,033	0,024	0,020	0,020	0,021	0,021	0,022	0,024	0,028
2025	0.019	0,019	0,033	0,024	0,021	0,020	0,021	0,021	0,023	0,025	0,030
2075	0.018	0,023	0,033	0,023	0,022	0,023	0,023	0,024	0,025	0,026	0,027
2125	0.018	0,023	0,034	0,024	0,023	0,022	0,023	0,024	0,026	0,027	0,028
2175	0.017	0,018	0,036	0,024	0,019	0,018	0,018	0,018	0,018	0,020	0,024
2225	0.017	0,018	0,037	0,025	0,020	0,018	0,019	0,019	0,019	0,021	0,025
2275	0.021	0,018	0,038	0,026	0,021	0,020	0,020	0,021	0,023	0,027	0,032
2325	0.019	0,019	0,040	0,027	0,021	0,019	0,020	0,021	0,023	0,028	0,033
2375	0.020	0,018	0,040	0,028	0,021	0,020	0,019	0,020	0,023	0,028	0,032
2425	0.022	0,018	0,042	0,028	0,022	0,020	0,019	0,021	0,024	0,028	0,032

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Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2475	0.020	0,018	0,042	0,029	0,022	0,019	0,018	0,020	0,020	0,021	0,022
2525	0.022	0,017	0,043	0,029	0,022	0,019	0,019	0,021	0,020	0,021	0,022
2575	0.020	0,023	0,045	0,032	0,027	0,024	0,025	0,026	0,027	0,027	0,028
2625	0.020	0,023	0,045	0,032	0,027	0,024	0,025	0,026	0,027	0,028	0,029
2675	0.023	0,018	0,042	0,029	0,021	0,019	0,020	0,020	0,021	0,022	0,023
2725	0.023	0,019	0,041	0,028	0,021	0,021	0,019	0,020	0,021	0,023	0,024
2775	0.018	0,016	0,040	0,027	0,020	0,017	0,017	0,017	0,018	0,018	0,020
2825	0.017	0,015	0,039	0,026	0,020	0,017	0,017	0,017	0,017	0,017	0,019
2875	0.018	0,015	0,038	0,025	0,019	0,017	0,016	0,016	0,017	0,018	0,019
2925	0.016	0,014	0,037	0,024	0,018	0,017	0,016	0,017	0,016	0,017	0,018
2975	0.017	0,014	0,036	0,024	0,018	0,016	0,016	0,015	0,016	0,016	0,018

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Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies components:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0.181	0,219	0,220	0,203	0,155	0,194	0,191	0,176	0,128	0,095	0,113
2,3	0.173	0,203	0,219	0,177	0,122	0,154	0,192	0,173	0,143	0,093	0,093
2,5	0.137	0,136	0,178	0,130	0,112	0,118	0,151	0,143	0,127	0,089	0,077
2,7	0.094	0,096	0,134	0,097	0,082	0,092	0,117	0,103	0,085	0,095	0,075
2,9	0.072	0,070	0,107	0,077	0,074	0,075	0,094	0,089	0,070	0,064	0,059
3,1	0.064	0,057	0,089	0,064	0,073	0,069	0,076	0,081	0,065	0,058	0,056
3,3	0.065	0,056	0,082	0,065	0,067	0,064	0,059	0,069	0,059	0,051	0,052
3,5	0.052	0,049	0,079	0,061	0,057	0,054	0,049	0,063	0,060	0,049	0,047
3,7	0.051	0,048	0,076	0,057	0,048	0,049	0,043	0,054	0,057	0,049	0,045
3,9	0.048	0,047	0,081	0,058	0,047	0,045	0,042	0,045	0,049	0,045	0,043
4,1	0.042	0,043	0,076	0,058	0,043	0,042	0,043	0,038	0,045	0,044	0,043
4,3	0.041	0,043	0,065	0,053	0,047	0,042	0,040	0,036	0,041	0,042	0,042
4,5	0.040	0,045	0,060	0,047	0,044	0,039	0,040	0,036	0,037	0,040	0,041
4,7	0.040	0,042	0,060	0,048	0,042	0,040	0,037	0,037	0,036	0,040	0,041
4,9	0.039	0,037	0,055	0,043	0,037	0,035	0,033	0,038	0,039	0,040	0,040
5,1	0.037	0,038	0,055	0,044	0,038	0,037	0,036	0,036	0,034	0,036	0,038
5,3	0.039	0,037	0,053	0,044	0,039	0,041	0,041	0,036	0,034	0,036	0,038
5,5	0.038	0,036	0,052	0,043	0,041	0,038	0,035	0,034	0,034	0,034	0,037
5,7	0.037	0,037	0,053	0,045	0,039	0,037	0,036	0,033	0,033	0,033	0,035
5,9	0.038	0,036	0,053	0,042	0,036	0,036	0,035	0,033	0,033	0,033	0,035
6,1	0.049	0,036	0,054	0,041	0,037	0,035	0,035	0,034	0,035	0,035	0,035
6,3	0.049	0,037	0,052	0,042	0,036	0,034	0,034	0,035	0,035	0,034	0,034
6,5	0.042	0,039	0,049	0,040	0,038	0,036	0,036	0,035	0,036	0,037	0,038
6,7	0.040	0,038	0,051	0,042	0,039	0,038	0,037	0,037	0,038	0,037	0,036
6,9	0.041	0,038	0,049	0,040	0,038	0,038	0,037	0,036	0,035	0,037	0,037
7,1	0.041	0,037	0,048	0,040	0,037	0,037	0,036	0,036	0,035	0,035	0,036
7,3	0.051	0,044	0,054	0,047	0,044	0,043	0,043	0,043	0,043	0,043	0,044
7,5	0.042	0,037	0,049	0,041	0,039	0,038	0,037	0,038	0,037	0,037	0,041
7,7	0.040	0,069	0,049	0,041	0,039	0,038	0,037	0,038	0,039	0,044	0,060
7,9	0.042	0,038	0,052	0,042	0,039	0,038	0,038	0,059	0,065	0,064	0,049
8,1	0.084	0,072	0,072	0,070	0,071	0,072	0,073	0,077	0,081	0,085	0,090
8,3	0.099	0,098	0,103	0,110	0,121	0,136	0,155	0,180	0,206	0,234	0,261
8,5	0.091	0,094	0,098	0,103	0,115	0,130	0,149	0,169	0,192	0,218	0,243
8,7	0.091	0,078	0,077	0,081	0,084	0,087	0,091	0,097	0,104	0,112	0,122
8,9	0.052	0,041	0,051	0,044	0,045	0,045	0,045	0,044	0,045	0,047	0,052

Assessment criterion:

The harmonic and inter-harmonic current distortion shall comply with the relevant emission limits in accordance with IEC 61727, reproduced in table 1.

Note:

The normalization current is 17,4A .

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Clause	Requirement - Test	Result - Remark	Verdict

Harmonics: (INFINI WP 15KW)

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
THD	1.518	0,803	0,852	0,768	0,763	0,789	0,846	0,934	1,037	1,111	1,191
1	2.496	9,985	20,203	30,274	40,514	50,474	60,506	70,448	80,408	90,297	100,180
2	0.523	0,207	0,126	0,038	0,153	0,314	0,417	0,502	0,572	0,608	0,658
3	0.878	0,549	0,484	0,433	0,409	0,400	0,411	0,442	0,478	0,500	0,514
4	0.177	0,050	0,032	0,026	0,059	0,088	0,117	0,135	0,150	0,160	0,164
5	0.168	0,310	0,377	0,348	0,305	0,264	0,236	0,220	0,222	0,244	0,290
6	0.085	0,029	0,030	0,023	0,032	0,053	0,066	0,085	0,096	0,104	0,114
7	0.638	0,158	0,224	0,210	0,203	0,196	0,197	0,212	0,236	0,263	0,281
8	0.084	0,023	0,021	0,024	0,028	0,038	0,049	0,060	0,072	0,078	0,089
9	0.675	0,090	0,210	0,210	0,223	0,222	0,224	0,220	0,222	0,228	0,232
10	0.072	0,025	0,028	0,041	0,034	0,037	0,036	0,042	0,049	0,054	0,058
11	0.356	0,089	0,194	0,184	0,222	0,222	0,223	0,214	0,194	0,186	0,206
12	0.027	0,030	0,030	0,039	0,034	0,033	0,039	0,044	0,056	0,058	0,051
13	0.271	0,150	0,225	0,152	0,179	0,195	0,207	0,211	0,218	0,228	0,232
14	0.027	0,021	0,027	0,032	0,029	0,031	0,039	0,046	0,055	0,053	0,055
15	0.102	0,133	0,207	0,156	0,147	0,179	0,207	0,228	0,252	0,272	0,273
16	0.025	0,018	0,022	0,025	0,022	0,023	0,027	0,033	0,037	0,037	0,042
17	0.207	0,057	0,165	0,153	0,112	0,155	0,184	0,207	0,232	0,252	0,275
18	0.022	0,020	0,012	0,017	0,015	0,015	0,020	0,025	0,029	0,034	0,033
19	0.155	0,110	0,123	0,133	0,093	0,124	0,142	0,158	0,179	0,200	0,223
20	0.021	0,017	0,015	0,019	0,013	0,012	0,018	0,025	0,030	0,037	0,028
21	0.125	0,144	0,113	0,128	0,068	0,079	0,099	0,119	0,142	0,158	0,170
22	0.014	0,017	0,011	0,016	0,017	0,017	0,021	0,026	0,025	0,029	0,030
23	0.138	0,109	0,117	0,140	0,094	0,050	0,075	0,103	0,124	0,132	0,139
24	0.011	0,011	0,014	0,020	0,018	0,012	0,015	0,018	0,019	0,028	0,025
25	0.119	0,083	0,124	0,131	0,096	0,045	0,071	0,091	0,109	0,117	0,136
26	0.009	0,010	0,011	0,009	0,013	0,013	0,012	0,018	0,022	0,029	0,020
27	0.117	0,095	0,115	0,111	0,090	0,047	0,059	0,082	0,103	0,116	0,133
28	0.014	0,012	0,017	0,018	0,017	0,013	0,017	0,021	0,028	0,023	0,025
29	0.115	0,104	0,086	0,101	0,110	0,067	0,038	0,064	0,098	0,113	0,128
30	0.013	0,012	0,016	0,017	0,022	0,020	0,024	0,019	0,024	0,021	0,030
31	0.120	0,101	0,079	0,105	0,119	0,079	0,031	0,058	0,091	0,105	0,117
32	0.011	0,014	0,019	0,015	0,023	0,019	0,013	0,014	0,023	0,029	0,022
33	0.114	0,129	0,117	0,102	0,123	0,081	0,031	0,055	0,091	0,114	0,125
34	0.023	0,009	0,019	0,012	0,011	0,014	0,017	0,018	0,029	0,033	0,020
35	0.106	0,127	0,120	0,099	0,117	0,089	0,040	0,040	0,080	0,109	0,117
36	0.021	0,015	0,020	0,015	0,011	0,019	0,021	0,019	0,030	0,032	0,023
37	0.106	0,120	0,117	0,087	0,116	0,094	0,059	0,025	0,071	0,098	0,100
38	0.029	0,019	0,015	0,013	0,021	0,029	0,019	0,019	0,021	0,032	0,022
39	0.116	0,132	0,148	0,111	0,140	0,115	0,074	0,029	0,074	0,092	0,100
40	0.024	0,022	0,020	0,024	0,032	0,028	0,022	0,019	0,023	0,029	0,021
41	0.093	0,117	0,122	0,090	0,106	0,106	0,080	0,040	0,060	0,081	0,087
42	0.046	0,029	0,016	0,020	0,031	0,025	0,027	0,024	0,024	0,029	0,022
43	0.092	0,121	0,127	0,100	0,103	0,107	0,086	0,047	0,051	0,074	0,077
44	0.038	0,033	0,027	0,028	0,035	0,032	0,030	0,024	0,020	0,026	0,017
45	0.079	0,123	0,113	0,072	0,091	0,113	0,090	0,052	0,044	0,077	0,083
46	0.040	0,031	0,029	0,025	0,041	0,031	0,028	0,028	0,023	0,025	0,018

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Harmonics: (INFINI WP 15KW)											
P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
47	0.096	0,092	0,083	0,066	0,067	0,101	0,087	0,049	0,029	0,055	0,051
48	0.047	0,039	0,024	0,025	0,038	0,035	0,032	0,027	0,027	0,026	0,027
49	0.055	0,071	0,061	0,034	0,043	0,084	0,079	0,041	0,031	0,046	0,050
50	0.059	0,048	0,029	0,037	0,033	0,044	0,030	0,031	0,024	0,020	0,018
51	0.062	0,042	0,060	0,035	0,037	0,084	0,064	0,040	0,025	0,047	0,040
52	0.031	0,032	0,031	0,035	0,047	0,035	0,033	0,035	0,024	0,019	0,017
53	0.040	0,032	0,049	0,025	0,033	0,052	0,043	0,041	0,031	0,021	0,046
54	0.041	0,043	0,023	0,024	0,032	0,023	0,022	0,022	0,023	0,024	0,017
55	0.036	0,030	0,037	0,027	0,034	0,042	0,043	0,040	0,025	0,021	0,037
56	0.025	0,030	0,036	0,029	0,036	0,038	0,030	0,029	0,023	0,024	0,020
57	0.035	0,015	0,022	0,025	0,034	0,042	0,041	0,031	0,026	0,028	0,037
58	0.030	0,041	0,027	0,028	0,021	0,017	0,021	0,028	0,023	0,026	0,016
59	0.033	0,016	0,039	0,029	0,026	0,044	0,032	0,032	0,027	0,029	0,034
60	0.023	0,023	0,023	0,025	0,032	0,037	0,029	0,023	0,020	0,023	0,024

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.022	0,043	0,031	0,031	0,031	0,031	0,037	0,041	0,049	0,042	0,058
125	0.021	0,037	0,026	0,026	0,028	0,028	0,030	0,032	0,038	0,036	0,045
175	0.024	0,035	0,029	0,028	0,029	0,029	0,031	0,034	0,039	0,038	0,044
225	0.025	0,038	0,034	0,034	0,033	0,034	0,036	0,039	0,053	0,046	0,045
275	0.030	0,060	0,060	0,061	0,059	0,061	0,059	0,045	0,048	0,047	0,048
325	0.037	0,056	0,048	0,059	0,054	0,052	0,053	0,053	0,060	0,056	0,063
375	0.041	0,071	0,062	0,074	0,067	0,064	0,064	0,063	0,075	0,062	0,070
425	0.040	0,087	0,074	0,089	0,078	0,073	0,083	0,076	0,083	0,073	0,081
475	0.034	0,074	0,076	0,096	0,093	0,083	0,083	0,081	0,090	0,083	0,090
525	0.026	0,079	0,069	0,084	0,082	0,082	0,088	0,084	0,098	0,086	0,089
575	0.022	0,046	0,050	0,065	0,077	0,078	0,087	0,081	0,095	0,088	0,090
625	0.018	0,038	0,038	0,048	0,058	0,070	0,082	0,081	0,100	0,089	0,092
675	0.025	0,030	0,027	0,034	0,045	0,055	0,073	0,079	0,093	0,091	0,089
725	0.015	0,030	0,023	0,026	0,033	0,045	0,059	0,073	0,092	0,088	0,093
775	0.036	0,040	0,041	0,043	0,046	0,052	0,063	0,076	0,093	0,098	0,107
825	0.014	0,024	0,019	0,020	0,023	0,027	0,038	0,051	0,070	0,076	0,090
875	0.018	0,026	0,025	0,025	0,027	0,031	0,037	0,046	0,063	0,070	0,088
925	0.013	0,020	0,016	0,017	0,018	0,020	0,027	0,036	0,051	0,060	0,079
975	0.035	0,034	0,032	0,033	0,034	0,035	0,037	0,043	0,050	0,057	0,072
1025	0.013	0,017	0,016	0,015	0,017	0,018	0,021	0,027	0,037	0,045	0,063
1075	0.024	0,022	0,021	0,020	0,021	0,021	0,024	0,028	0,036	0,042	0,057
1125	0.012	0,015	0,014	0,014	0,015	0,016	0,018	0,022	0,029	0,035	0,049
1175	0.011	0,013	0,014	0,014	0,014	0,015	0,017	0,021	0,026	0,031	0,044
1225	0.011	0,014	0,015	0,013	0,014	0,015	0,016	0,020	0,024	0,029	0,039
1275	0.011	0,012	0,015	0,013	0,014	0,014	0,015	0,018	0,023	0,026	0,035
1325	0.017	0,017	0,017	0,017	0,018	0,017	0,018	0,020	0,023	0,025	0,033
1375	0.011	0,013	0,015	0,013	0,014	0,013	0,014	0,016	0,021	0,023	0,030
1425	0.018	0,017	0,020	0,019	0,018	0,018	0,019	0,020	0,024	0,026	0,030
1475	0.011	0,013	0,016	0,013	0,014	0,013	0,014	0,016	0,019	0,021	0,025
1525	0.013	0,012	0,017	0,014	0,014	0,013	0,014	0,016	0,019	0,021	0,025
1575	0.012	0,013	0,017	0,013	0,013	0,013	0,013	0,015	0,018	0,020	0,023
1625	0.011	0,013	0,017	0,013	0,013	0,013	0,014	0,015	0,018	0,020	0,022
1675	0.011	0,013	0,018	0,013	0,014	0,014	0,013	0,015	0,017	0,019	0,021
1725	0.011	0,012	0,018	0,013	0,014	0,014	0,013	0,015	0,017	0,020	0,021
1775	0.011	0,013	0,018	0,014	0,014	0,014	0,013	0,015	0,017	0,020	0,020
1825	0.012	0,013	0,019	0,014	0,014	0,014	0,014	0,015	0,018	0,020	0,020
1875	0.012	0,013	0,019	0,015	0,015	0,014	0,013	0,015	0,018	0,020	0,020
1925	0.012	0,014	0,021	0,015	0,015	0,014	0,014	0,015	0,019	0,021	0,021
1975	0.015	0,015	0,022	0,017	0,018	0,017	0,017	0,019	0,022	0,025	0,026
2025	0.015	0,015	0,024	0,018	0,018	0,018	0,017	0,020	0,023	0,027	0,027
2075	0.014	0,018	0,023	0,017	0,018	0,019	0,019	0,021	0,022	0,025	0,021
2125	0.014	0,018	0,024	0,018	0,018	0,019	0,019	0,022	0,022	0,026	0,022
2175	0.014	0,014	0,025	0,019	0,017	0,015	0,014	0,016	0,019	0,021	0,021
2225	0.014	0,014	0,025	0,021	0,017	0,015	0,015	0,016	0,018	0,021	0,022
2275	0.015	0,014	0,027	0,021	0,018	0,016	0,017	0,021	0,026	0,031	0,035
2325	0.015	0,014	0,027	0,023	0,018	0,017	0,018	0,022	0,026	0,031	0,036
2375	0.015	0,014	0,027	0,024	0,018	0,015	0,017	0,021	0,026	0,032	0,037
2425	0.016	0,014	0,028	0,025	0,019	0,017	0,018	0,021	0,026	0,033	0,037

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Clause	Requirement - Test	Result - Remark	Verdict

Interharmonics at continuous operation:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2475	0.015	0,014	0,028	0,025	0,019	0,016	0,014	0,016	0,017	0,019	0,020
2525	0.014	0,013	0,029	0,026	0,019	0,015	0,015	0,016	0,018	0,019	0,020
2575	0.015	0,018	0,030	0,028	0,023	0,021	0,020	0,022	0,023	0,024	0,024
2625	0.016	0,018	0,030	0,027	0,022	0,020	0,020	0,022	0,024	0,023	0,023
2675	0.017	0,015	0,029	0,024	0,018	0,015	0,016	0,018	0,018	0,022	0,023
2725	0.017	0,015	0,028	0,023	0,018	0,016	0,016	0,018	0,019	0,022	0,023
2775	0.013	0,012	0,028	0,022	0,017	0,014	0,013	0,013	0,015	0,016	0,017
2825	0.013	0,012	0,027	0,020	0,017	0,014	0,013	0,013	0,015	0,015	0,017
2875	0.013	0,012	0,027	0,020	0,016	0,014	0,012	0,013	0,014	0,015	0,016
2925	0.013	0,012	0,026	0,019	0,016	0,013	0,013	0,012	0,014	0,015	0,015
2975	0.012	0,013	0,026	0,018	0,015	0,013	0,012	0,012	0,013	0,015	0,015

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Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies components:

P/Pn [%]	0/5	10	20	30	40	50	60	70	80	90	100
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2,1	0.146	0,172	0,179	0,142	0,156	0,160	0,129	0,078	0,091	0,123	0,124
2,3	0.141	0,155	0,148	0,106	0,123	0,161	0,133	0,083	0,068	0,103	0,100
2,5	0.111	0,104	0,111	0,076	0,086	0,125	0,108	0,079	0,062	0,084	0,088
2,7	0.075	0,075	0,080	0,069	0,079	0,084	0,077	0,076	0,058	0,056	0,077
2,9	0.057	0,057	0,072	0,060	0,062	0,066	0,069	0,059	0,051	0,053	0,060
3,1	0.053	0,049	0,067	0,067	0,055	0,055	0,058	0,052	0,046	0,043	0,047
3,3	0.049	0,045	0,072	0,058	0,049	0,049	0,054	0,046	0,044	0,039	0,044
3,5	0.041	0,038	0,067	0,045	0,044	0,042	0,046	0,042	0,041	0,043	0,040
3,7	0.040	0,037	0,058	0,040	0,041	0,036	0,042	0,038	0,038	0,041	0,038
3,9	0.038	0,036	0,049	0,041	0,037	0,033	0,036	0,036	0,036	0,037	0,039
4,1	0.035	0,035	0,048	0,036	0,033	0,033	0,034	0,032	0,032	0,033	0,035
4,3	0.032	0,034	0,043	0,035	0,033	0,034	0,032	0,033	0,031	0,032	0,034
4,5	0.031	0,033	0,042	0,034	0,031	0,031	0,028	0,030	0,030	0,032	0,034
4,7	0.033	0,032	0,041	0,033	0,030	0,029	0,028	0,028	0,030	0,032	0,032
4,9	0.032	0,029	0,037	0,035	0,029	0,028	0,027	0,027	0,028	0,029	0,030
5,1	0.030	0,030	0,038	0,031	0,031	0,027	0,026	0,026	0,028	0,029	0,031
5,3	0.030	0,030	0,038	0,032	0,028	0,028	0,026	0,026	0,029	0,030	0,031
5,5	0.030	0,028	0,038	0,032	0,030	0,029	0,029	0,029	0,028	0,029	0,031
5,7	0.029	0,030	0,038	0,029	0,028	0,028	0,027	0,027	0,027	0,027	0,029
5,9	0.033	0,029	0,036	0,029	0,028	0,027	0,027	0,026	0,027	0,027	0,029
6,1	0.037	0,029	0,035	0,030	0,028	0,028	0,027	0,028	0,028	0,028	0,030
6,3	0.036	0,029	0,035	0,030	0,028	0,028	0,027	0,028	0,027	0,028	0,028
6,5	0.033	0,032	0,037	0,030	0,030	0,030	0,027	0,027	0,027	0,029	0,029
6,7	0.035	0,032	0,050	0,032	0,033	0,048	0,034	0,030	0,031	0,029	0,030
6,9	0.032	0,039	0,036	0,051	0,034	0,030	0,047	0,036	0,030	0,030	0,030
7,1	0.035	0,035	0,035	0,031	0,042	0,028	0,029	0,046	0,045	0,031	0,030
7,3	0.041	0,035	0,041	0,036	0,035	0,034	0,034	0,034	0,042	0,047	0,037
7,5	0.033	0,030	0,037	0,032	0,031	0,030	0,031	0,030	0,030	0,041	0,043
7,7	0.032	0,030	0,038	0,033	0,031	0,031	0,030	0,030	0,030	0,030	0,043
7,9	0.034	0,031	0,039	0,032	0,031	0,032	0,031	0,031	0,030	0,030	0,033
8,1	0.067	0,058	0,055	0,056	0,059	0,059	0,062	0,067	0,074	0,081	0,085
8,3	0.078	0,081	0,088	0,095	0,110	0,131	0,153	0,181	0,211	0,235	0,250
8,5	0.073	0,077	0,080	0,092	0,105	0,122	0,146	0,170	0,196	0,220	0,232
8,7	0.072	0,064	0,063	0,067	0,071	0,073	0,080	0,090	0,101	0,107	0,116
8,9	0.041	0,034	0,039	0,035	0,034	0,035	0,035	0,036	0,038	0,047	0,043

Assessment criterion:

The harmonic and inter-harmonic current distortion shall comply with the relevant emission limits in accordance with IEC 61727, reproduced in table 1.

Note:

The normalization current is 21,7A

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Clause	Requirement - Test	Result - Remark	Verdict

4.1.11	**Power factor**					**P**
Test result:						
Test conditions:						
Output power / Test voltage (Vac)	**~10% 0,767kW**	**~20% 1,467kW**	**~50% 3,985kW**	**~75% 6,070kW**	**~100% 8,026kW**	
230V	0,9999c	0,9999c	0,9999i	0,9999i	0,9999i	
Test conditions:						
Output power / Test voltage (Vac)	**~10% 1,494kW**	**~20% 2,917kW**	**~50% 7,526kW**	**~75% 11,202kW**	**~100% 14,719kW**	
230V	0,9992i	0,9999i	0,9999i	0,9999i	0,9999i	

Note:
*The PV system shall have a lagging power factor greater than 0,9 when the output is greater than 50% of the rated inverter output power.

The letter “i” is short for “inductive” and indicates inductive power factor. In case of capacitive power factor the letter “c” is used instead.

The test had been performed on the model INFINI WP 15KW and INFINI WP 12KW the test results are valid for the INFINI WP 8KW and INFINI WP 10KW since it is identical in hardware and just power derated by software.

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Clause	Requirement - Test	Result - Remark	Verdict

4.1.11.3	Power factor (Fixed cos φ)	P

Test:

Test condition: over-excited (c) (cos φ = 0,98)

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,484	0,431	0,9603	229,99
20%	2,944	0,731	0,9705	230,05
50%	7,423	1,581	0,9781	230,12
75%	11,202	2,346	0,9788	230,11
100%	14,786	3,057	0,9793	230,12

Test condition: under-excited (i) (cos φ = 0,98)

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,490	-0,432	0,9604	230,05
20%	2,938	-0,669	0,9750	230,03
50%	7,486	-1,567	0,9788	230,07
75%	11,256	-2,339	0,9791	230,06
100%	14,660	-3,117	0,9781	230,00

Test condition: power factor (cos φ = 1)

Rating power [%]	Active power [kW]	Reactive power [kVar]	Power factor [cos φ]	Voltage [V]
10%	1,494	0,058	0,9992	229,92
20%	2,917	0,006	0,9999	229,98
50%	7,526	0,057	0,9999	229,93
75%	11,202	0,013	0,9999	230,00
100%	14,719	0,092	0,9999	229,49

Assessment criterion:

The power factor resulting in each of the measurement points greater than between 20 % of the nominal power is equal to or lower than 0,98 for SSEG categories A1/A2 and 0,95 for SSEG categories A3 both in over excited and under excited operation.

The maximum tolerance on the reactive power setting is ±0,01 of power factor.

Note:

a) 1 min-average-values were calculated using measurements at the basic frequency in a period of 200 ms.

b) For each of the 10 active power levels, at least 3 under excited and 3 over excited reactive power levels were recorded.

c) 1 min-average-values were calculated using voltage measurements at the basic frequency in a period of 200 ms.

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.1.12 4.2.4	**Synchronization Response to utility recovery**	**P**

Test:		
	Voltage conditons	
a) Out of voltage range	<=95%V	>=105%
Connection:	No connection	No connection
Limit	No connection allowed	
a) In voltage range	95% U_n < U <105% U_n	
Reconnection time [s]	70,0s	70,6s
Limit:	At least 60s	
	Frequency conditons	
b) Out of frequency range	<=49,7Hz	>=50,3Hz
Connection:	No connection	No connection
Limit	No connection allowed	
b) In frequency range	49,7Hz < f<50,3Hz	
Reconnection time [s]	70,6s	71,0s
Limit:	At least 60s	
	Phase angle condition	
c) Out of Phase angle range	<=100°	>=140°
Connection:	No connection	
Limit	No connection allowed	
c) In phase angle range	100° < φ <140°	
Reconnection time [s]	89,0s	
Limit:	At least 60s	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P_n/min. The connection after trip of the interface protection is delayed by a randomized value between 1 min and 10 min. For recorded gradient see diagram underneath.	

Note:
The limits for the synchronizing parameters for each phase are

a) frequency difference: 0,3 Hz,

b) voltage difference: 5 % = 11,5 V per phase, and

c) phase angle difference: 20°.

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Clause	Requirement - Test	Result - Remark	Verdict

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.
Test: Test condition a) : voltage within the limits of 95% to 105%Vn Test condition b) : frequency within the limits of 47Hz to 50,5Hz Test condition c) : phase angle within the limits of 100° to 140° (Three phase type of genneration only) In order to avoid continuous starting and disengaging operations of the interface protection relay, the disengaging value of frequency and voltage functions shall be above 0,2%Fn and 2%Un deviating from the operate value.

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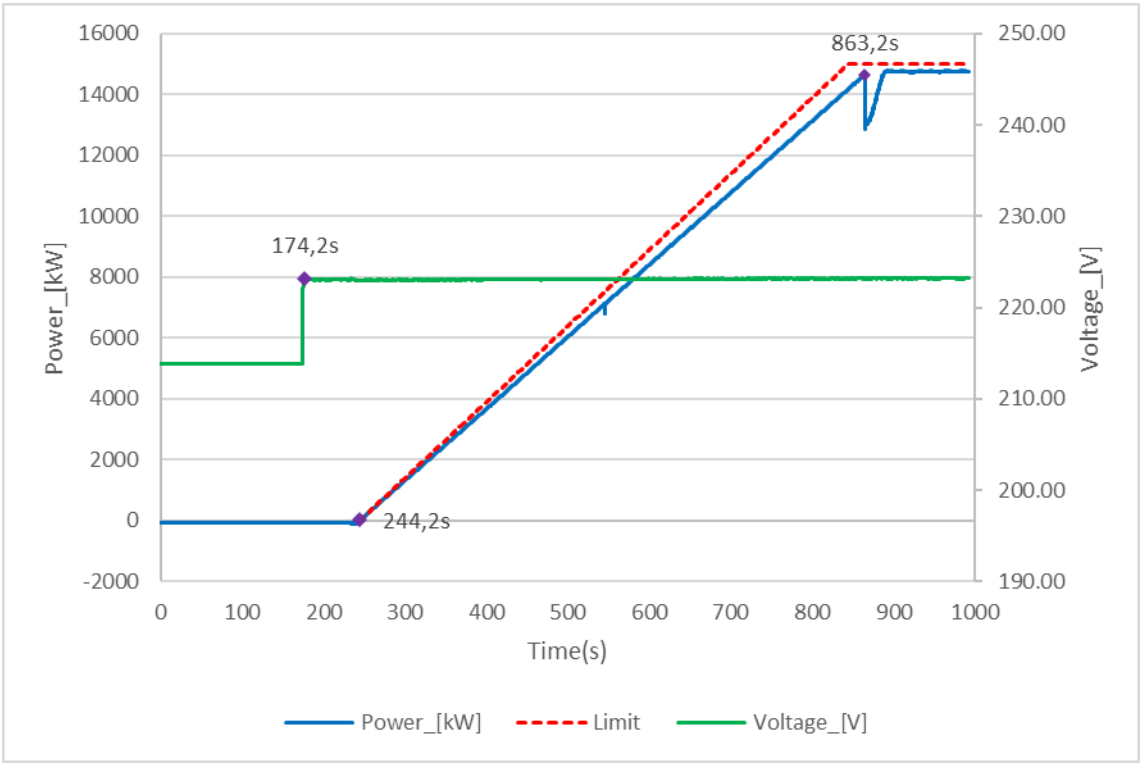
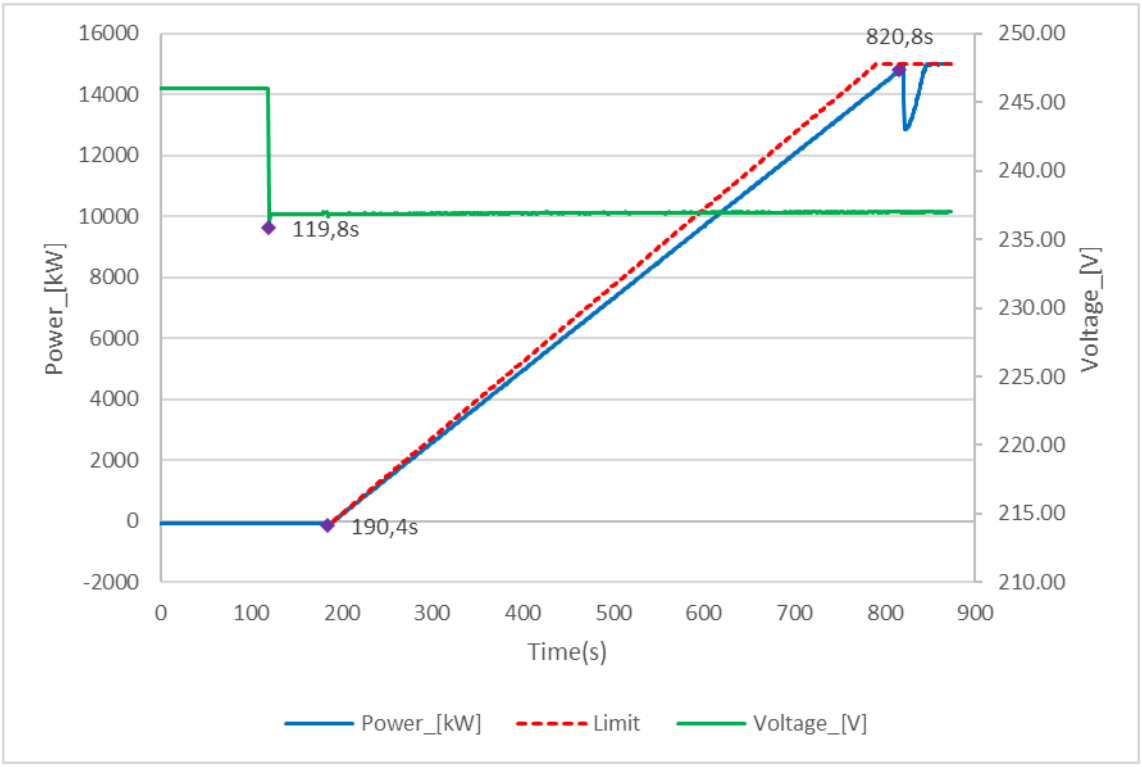
Clause	Requirement - Test	Result - Remark	Verdict

Graph of reconnection with gradient: Under Voltage

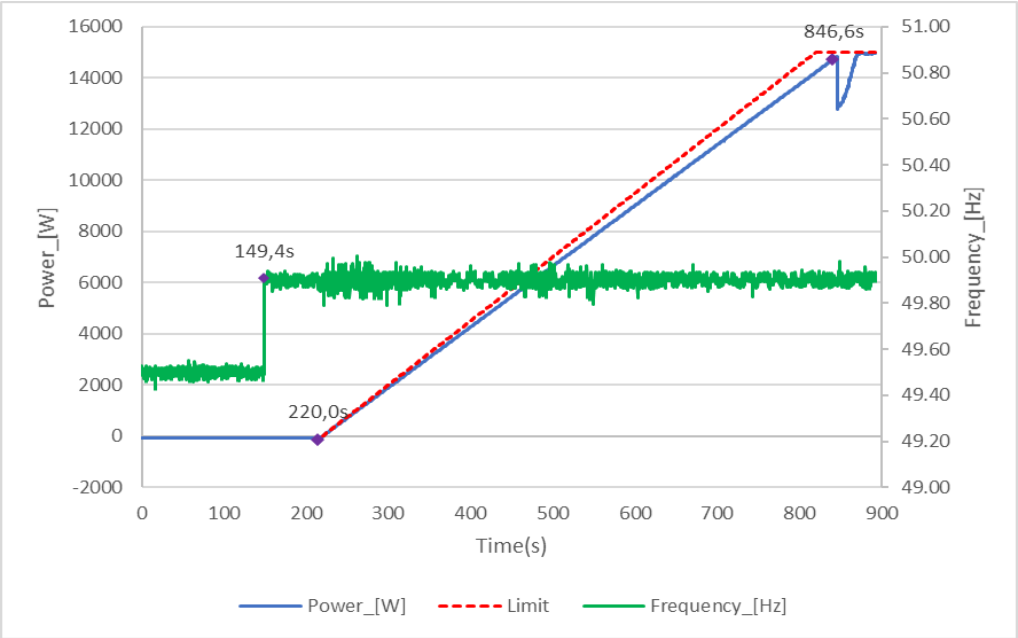


Graph of reconnection with gradient: Over Voltage

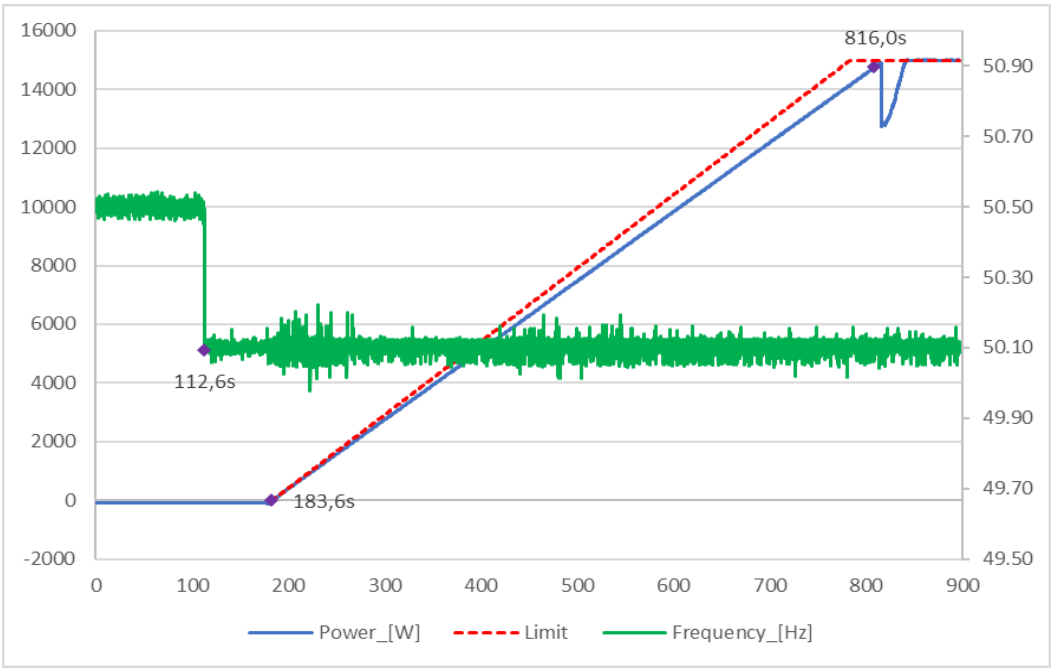


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Graph of reconnection with gradient: Under Frequency



Graph of reconnection with gradient: Over Frequency



NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.3.2	**Overvoltage and undervoltage**	**P**

First Level

	Under Voltage				**Over Voltage**			
Parameter		Voltage [V]				Voltage [V]		
Set value		**195,5**				**253**		
Measured trip value [V]	Phase	L1	L2	L3	Phase	L1	L2	L3
		195,3	195,2	195,3		254,6	253,7	254,8
		195,4	195,3	195,2		254,6	253,7	254,7
		195,3	195,2	195,2		254,7	253,7	254,8
Parameter		Time [s]				Time [s]		
Limit		**≤ 10,0**				**≤ 40,0**		
Disconnetion time [s]	200V to 190V	2,040	2,045	2,025	248V to 258V	2,030	2,005	2,035
		2,035	2,035	2,030		2,025	1,715	2,020
		2,030	2,040	2,025		2,045	2,050	2,035

Second Level

	Under Voltage				**Over Voltage**			
Parameter		Voltage [V]				Voltage [V]		
Set value		**115**				**264,5**		
Measured trip value [V]	Phase	L1	L2	L3	Phase	L1	L2	L3
		114,7	114,8	114,5		265,3	265,1	265,0
		114,8	114,8	114,5		265,3	265,2	265,0
		114,5	114,7	114,6		265,4	265,1	265,1
Parameter		Time [s]				Time [s]		
Limit		**≤ 0,2**				**≤ 2,0**		
Disconnetion time [s]	200V to 113V	0,098	0,105	0,099	248V to 270V	1,050	1,035	1,035
		0,110	0,111	0,099		1,035	1,045	1,023
		0,104	0,109	0,098		1,040	1,035	1,040

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Clause	Requirement - Test	Result - Remark	Verdict

Third Level						
	--		**Over Voltage**			
Parameter				Voltage [V]		
Set value				**276**		
Measured trip value [V]	--		Phase	L1	L2	L3
				276,5	276,2	276,4
				276,6	276,2	276,4
		--		276,5	276,3	276,5
Parameter				Time [s]		
Limit				**≤ 0,16**		
Disconnetion time [s]	--		248V to 280V	0,140	0,131	0,144
				0,128	0,139	0,141
				0,132	0,138	0,137

Note:

The NRS 097-2-1 provide limits of accuracy for the utility voltage and frequency measurement of the power system. The values for tolerances given in Table 2 are used.

The accuracy for voltage trip values shall be within 0 % to +1 % of the nominal voltage from the upper boundary trip setting, and within -1% to 0% of the nominal voltage from the lower boundary trip setting.

If multi-voltage control settings are not possible, the more stringent trip time should be implemented, e.g. 2 s between 110% and 120% of voltage.

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

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Clause	Requirement - Test	Result - Remark	Verdict

Under Voltage First Level:

Over voltage First Level:

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Clause	Requirement - Test	Result - Remark	Verdict

Under Voltage Second Level:

Over voltage Second Level:

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Clause	Requirement - Test	Result - Remark	Verdict

Over voltage Third Level:

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.3.2	**Low voltage fault Ride through capability (for category A1 and A2)**	**P**

General:

The purpose of these tests is to ensure that the converter, which in category A1 and A2, is insensitive to voltage dips according to the time-amplitude profile shown in the diagram.

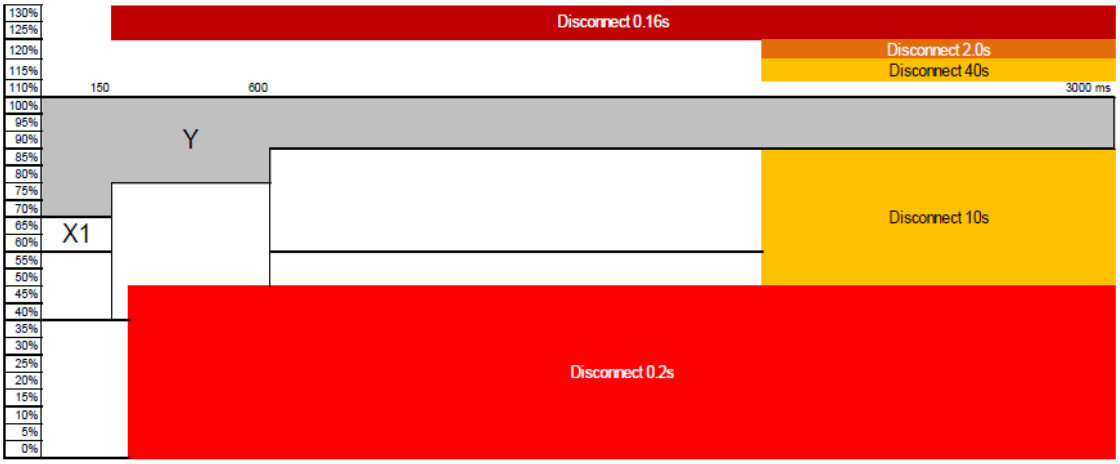

Figure 4 — Graphical representation of voltage-ride-through and voltage disconnect requirements for A1 and A2 EG

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Duration [ms]	Form (*)
file: 1 - three-phase symmetrical fault	0,60 ± 0,05 ($V1/V_{nom}$)	150 + 20	
file: 2 - three-phase symmetrical fault	0,70 ± 0,05 ($V2/V_{nom}$)	150 + 20	
file: 3 - three-phase symmetrical fault	0,80-0,85 ($V3/V_{nom}$)	600 + 20	
file: 4 - two-phase asymmetrical fault	0,60 ± 0,05 ($V4/V_{nom}$)	150 + 20	
file: 5 - two -phase asymmetrical fault	0,70 ± 0,05 ($V5/V_{nom}$)	150 + 20	
file: 6 - two -phase asymmetrical fault	0,80-0,85 ($V6/V_{nom}$)	600 + 20	
file: 7 - single-phase symmetrical fault	0,60 ± 0,05 ($V7/V_{nom}$)	150 + 20	
file: 8 - single-phase symmetrical fault	0,70 ± 0,05 ($V8/V_{nom}$)	150 + 20	
file: 9 - single-phase symmetrical fault	0,80-0,85 ($V9/V_{nom}$)	600 + 20	

* Regardless of the method used to simulate transients (simulator or impedance network), the rise and fall time of the voltage must be less than 10 ms

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Clause	Requirement - Test	Result - Remark	Verdict

Graph of LVRT test one

Test:

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Duration limit of Voltage dips [ms]	Duration measured [ms]	Result
1 – three-phase symmetrical fault (P = 0,1 - 0,3)	0,60± 0,05	150 ± 20	160	P
1 – three-phase symmetrical fault (P > 0,9)	0,60± 0,05	150 ± 20	160	P
2 – three-phase symmetrical fault (P = 0,1 - 0,3)	0,70± 0,05	150 ± 20	160	P
2 – three-phase symmetrical fault (P > 0,9)	0,70± 0,05	150 ± 20	160	P
3 – three-phase symmetrical fault (P = 0,1 - 0,3)	0,80-0,85	600 ± 20	601	P
3 – three-phase symmetrical fault (P > 0,9)	0,80-0,85	600 ± 20	601	P
4 – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,60± 0,05	150 ± 20	160	P
4 – two-phase asymmetrical fault (P > 0,9)	0,60± 0,05	150 ± 20	160	P
5 – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,70± 0,05	150 ± 20	160	P
5 – two-phase asymmetrical fault (P > 0,9)	0,70± 0,05	150 ± 20	161	P
6 – two-phase asymmetrical fault (P = 0,1 - 0,3)	0,80-0,85	600 ± 20	601	P
6 – two-phase asymmetrical fault (P > 0,9)	0,80-0,85	600 ± 20	601	P
7 –single-phase symmetrical fault (P = 0,1 - 0,3)	0,60± 0,05	150 ± 20	161	P
7 –single-phase symmetrical fault (P > 0,9)	0,60± 0,05	150 ± 20	161	P
8 –single-phase symmetrical fault (P = 0,1 - 0,3)	0,70± 0,05	150 ± 20	160	P
8 –single-phase symmetrical fault (P > 0,9)	0,70± 0,05	150 ± 20	161	P
9 –single-phase symmetrical fault (P = 0,1 - 0,3)	0,80-0,85	600 ± 20	601	P
9 –single-phase symmetrical fault (P > 0,9)	0,80-0,85	600 ± 20	601	P

Test conditions:

Voltage simulator fall and rise time: < 10ms

Note:

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

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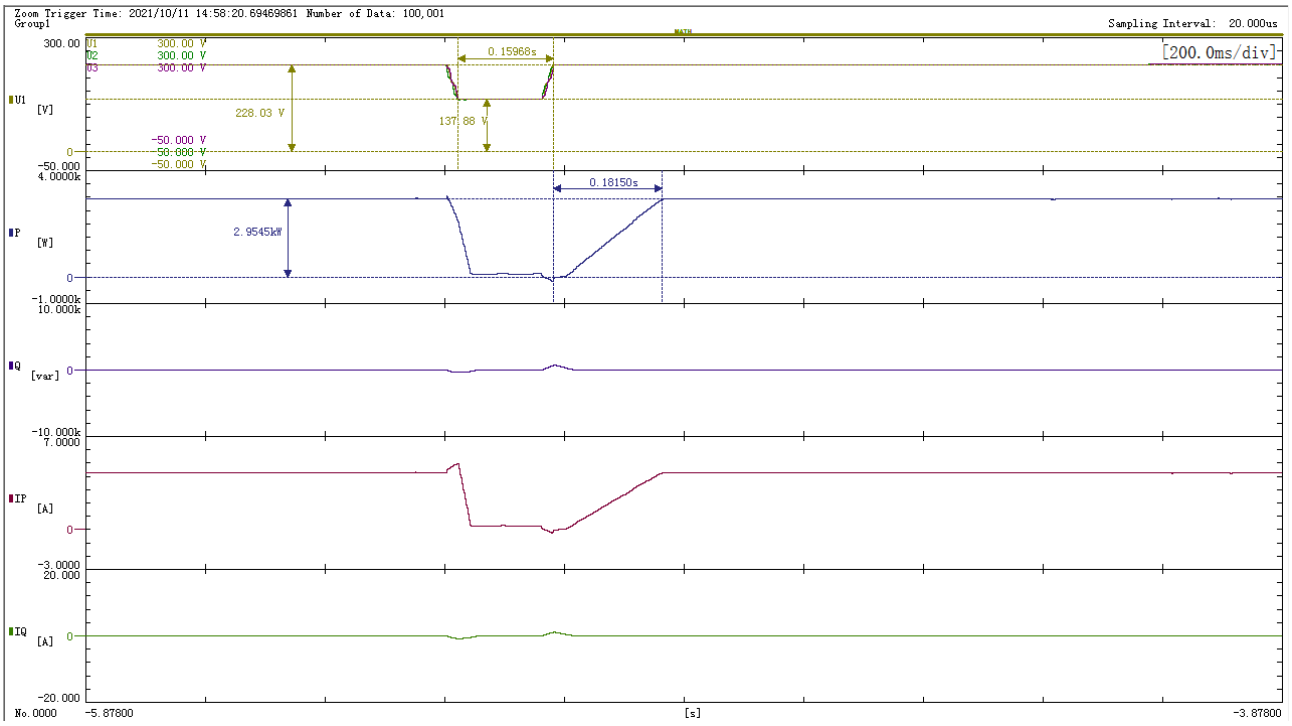
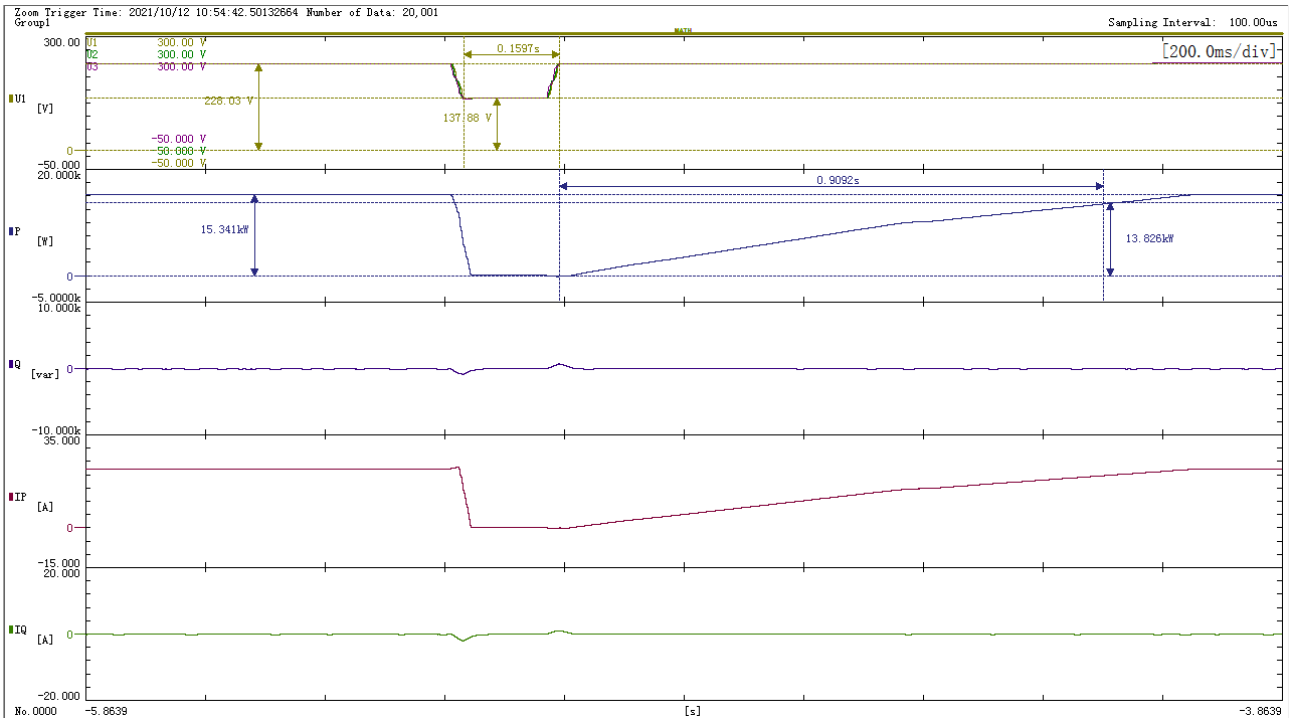
Clause	Requirement - Test	Result - Remark	Verdict

Test 1 – three-phase symmetrical fault (V/V_{nom} = 0,60)
P = 0,1 - 0,3



Test 1 – three-phase symmetrical fault (V/V_{nom} = 0,60)
P > 0,9



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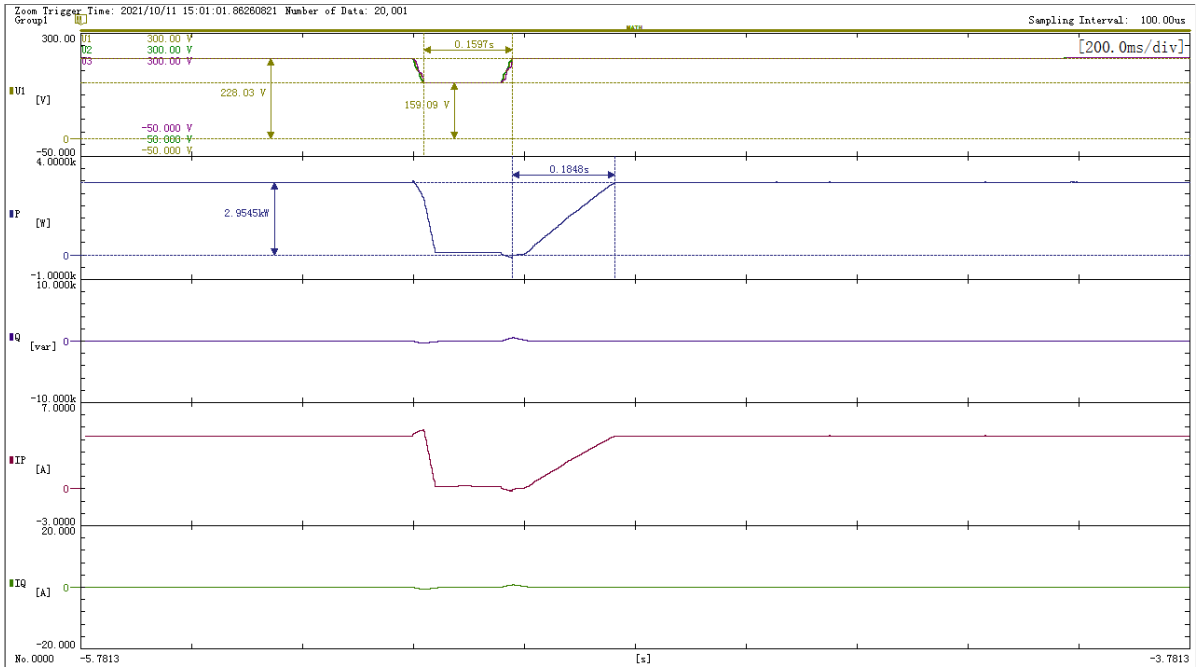
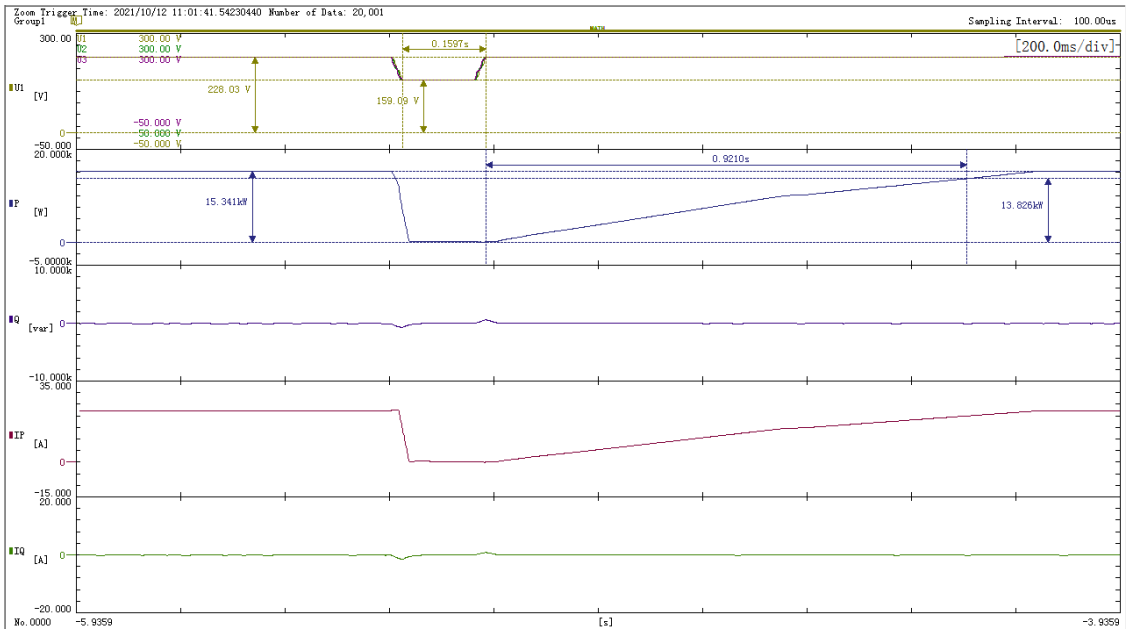
Clause	Requirement - Test	Result - Remark	Verdict

Test 2 – three-phase symmetrical fault (V/V_{nom} = 0,70)
P = 0,1 - 0,3



Test 2 – three-phase symmetrical fault (V/V_{nom} = 0,70)
P > 0,9



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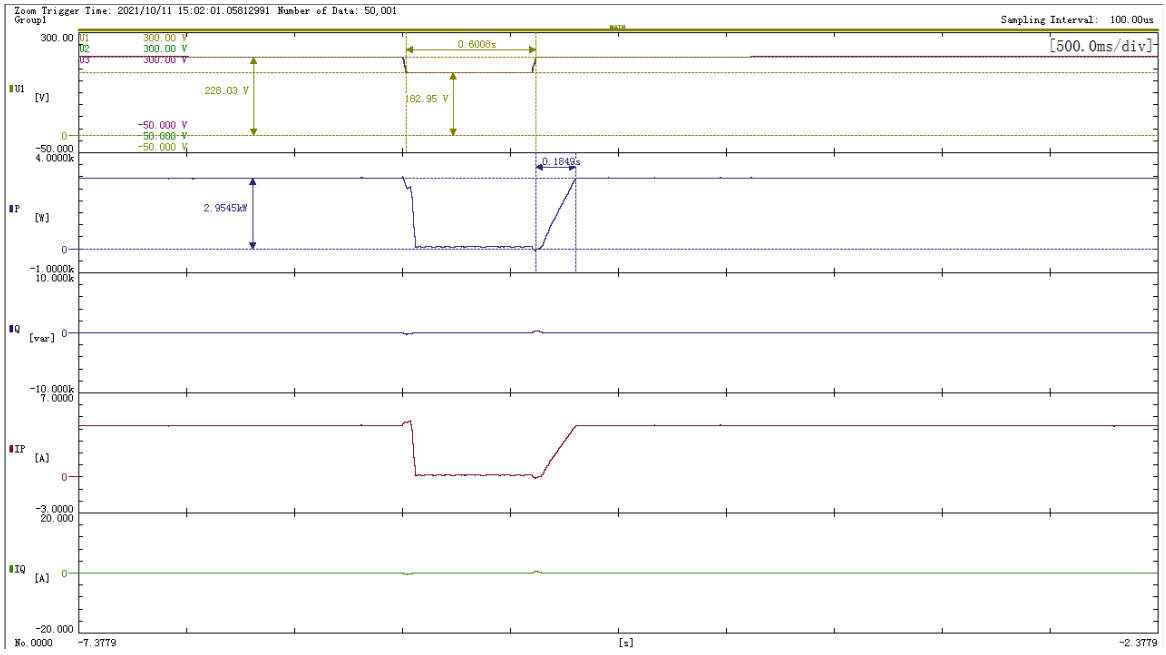
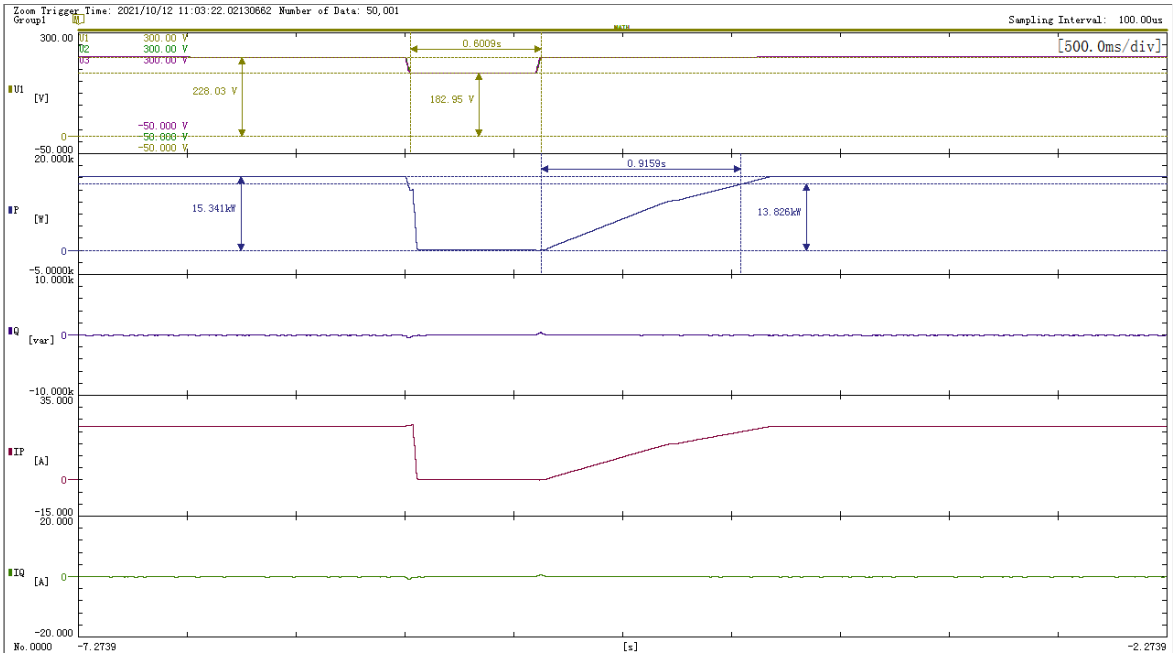
Clause	Requirement - Test	Result - Remark	Verdict

Test 3 – three-phase symmetrical fault (V/V_{nom} = 0,80)
P = 0,1 - 0,3

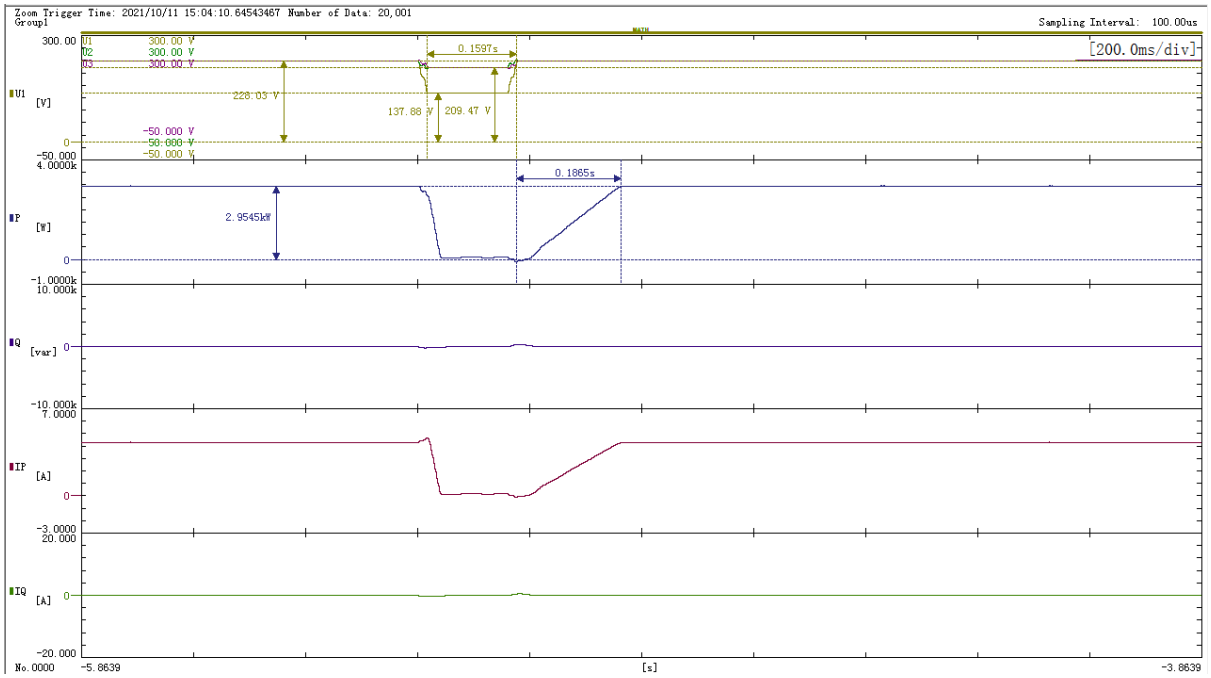


Test 3 – three-phase symmetrical fault (V/V_{nom} = 0,80)
P > 0,9

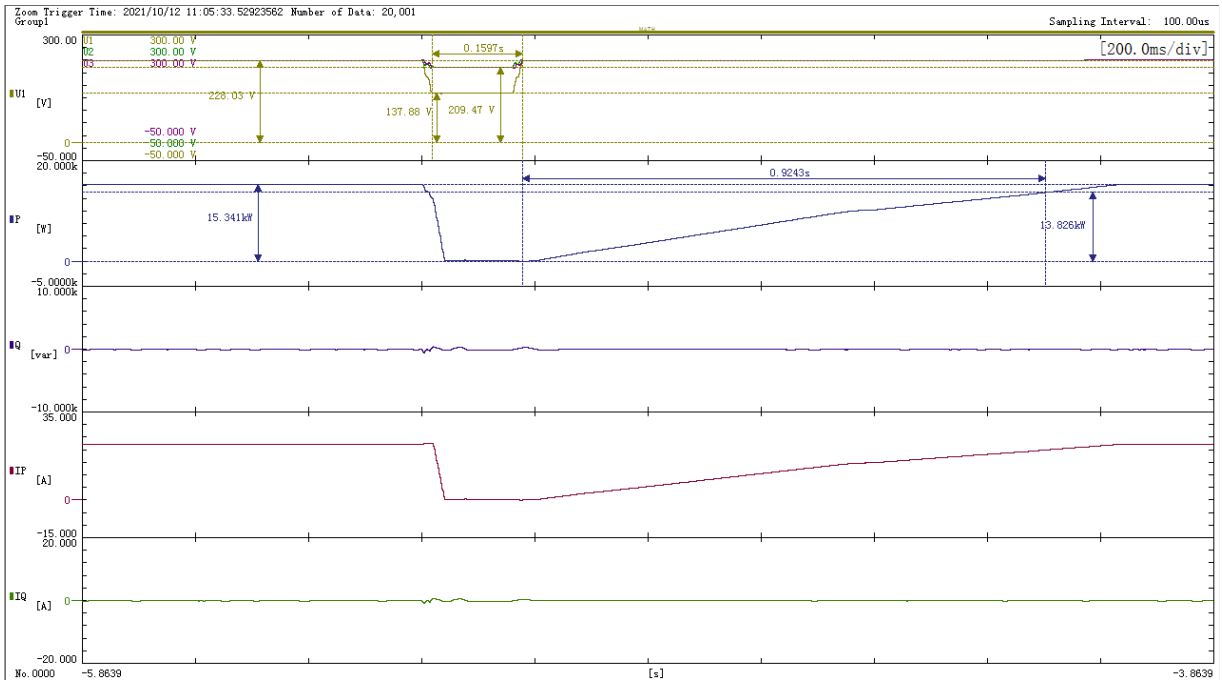


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4 – two-phase asymmetrical fault (V/V_{nom} = 0,60)
P = 0,1 - 0,3

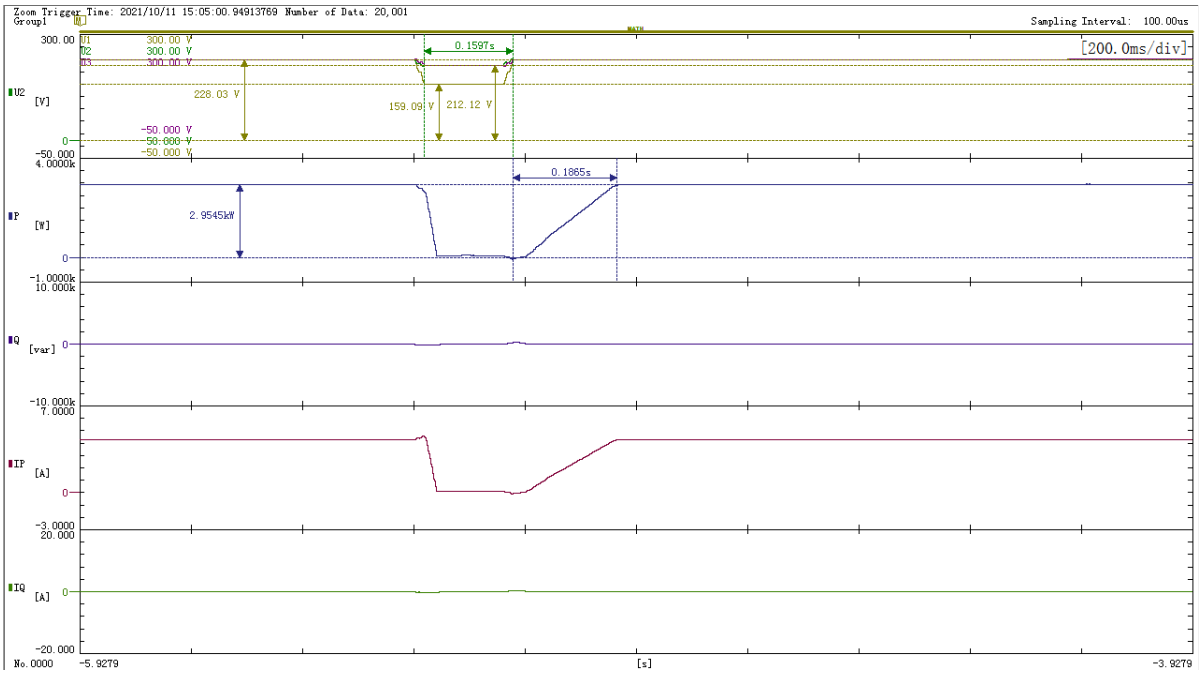


Test 4 – two-phase asymmetrical fault (V/V_{nom} = 0,60)
P > 0,9

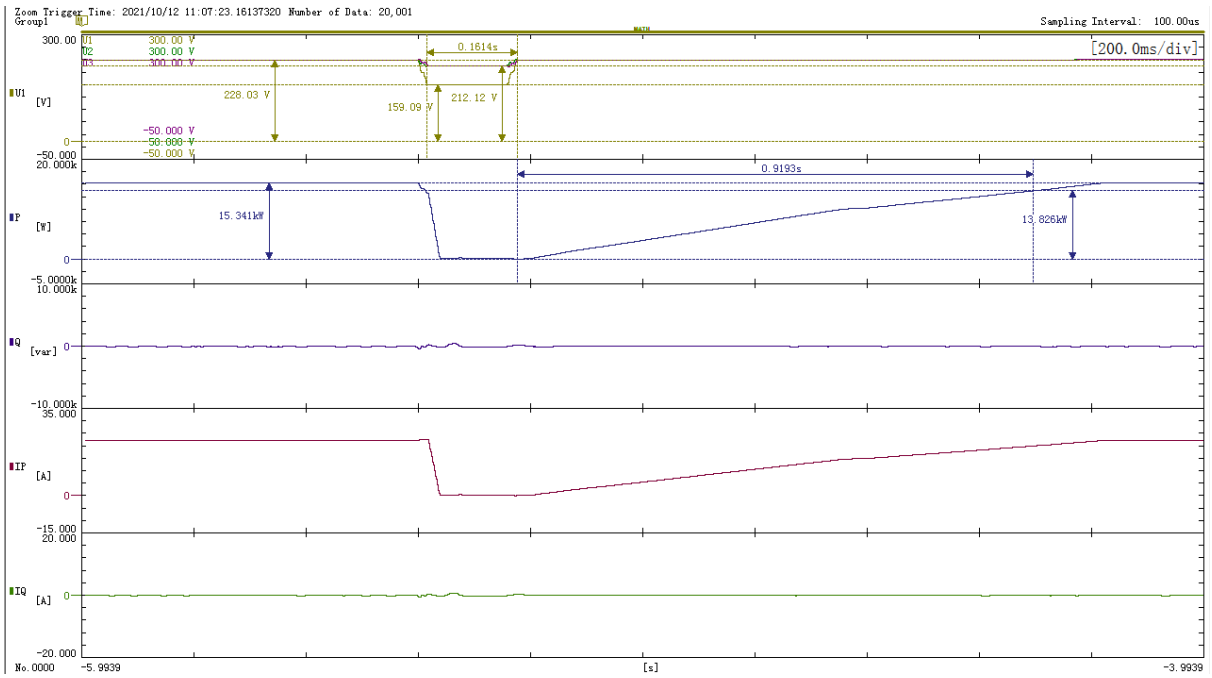


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5 – two-phase asymmetrical fault (V/V_{nom} = 0,70)
P = 0,1 - 0,3



Test 5 – two-phase asymmetrical fault (V/V_{nom} = 0,70)
P > 0,9



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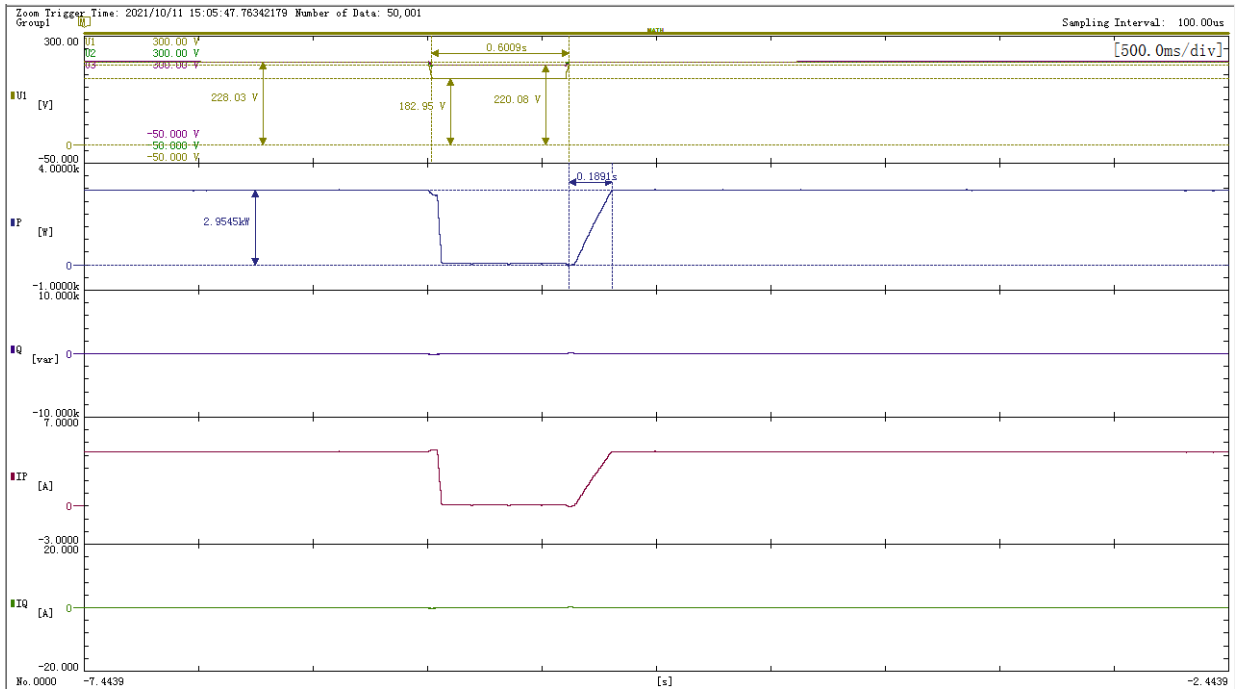
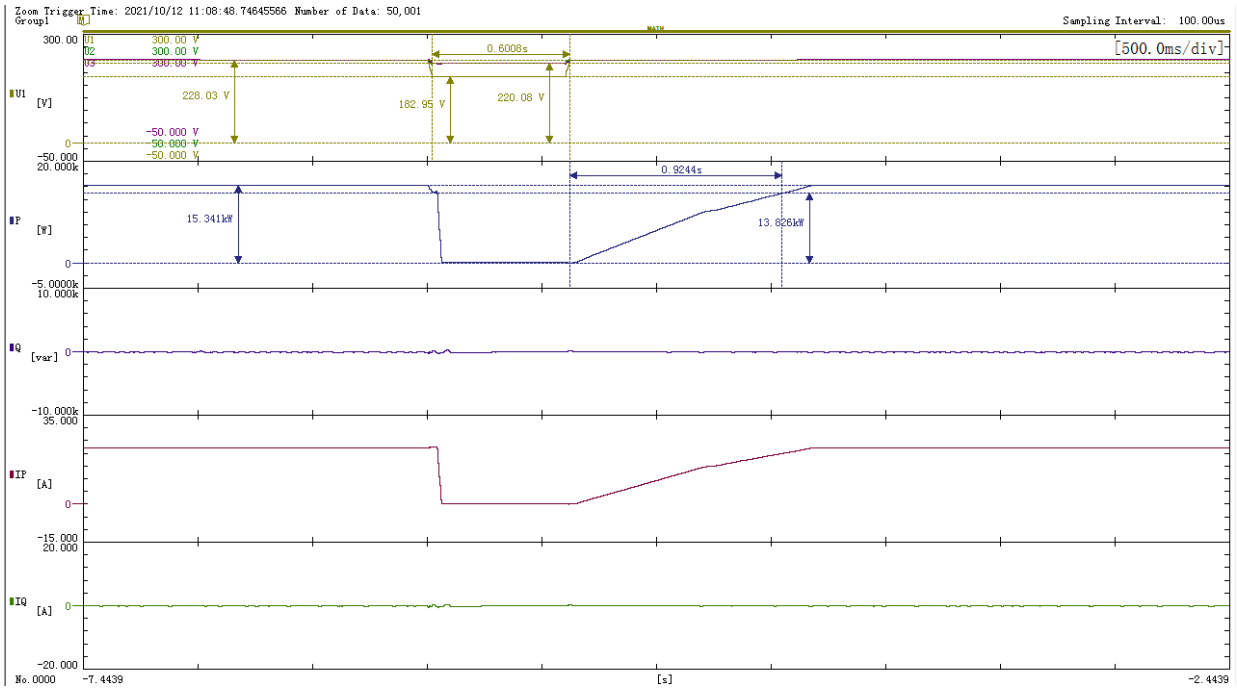
Clause	Requirement - Test	Result - Remark	Verdict

Test 6 – two-phase asymmetrical fault (V/V_{nom} = 0,80)
P = 0,1 - 0,3



Test 6 – two-phase asymmetrical fault (V/V_{nom} = 0,80)
P > 0,9



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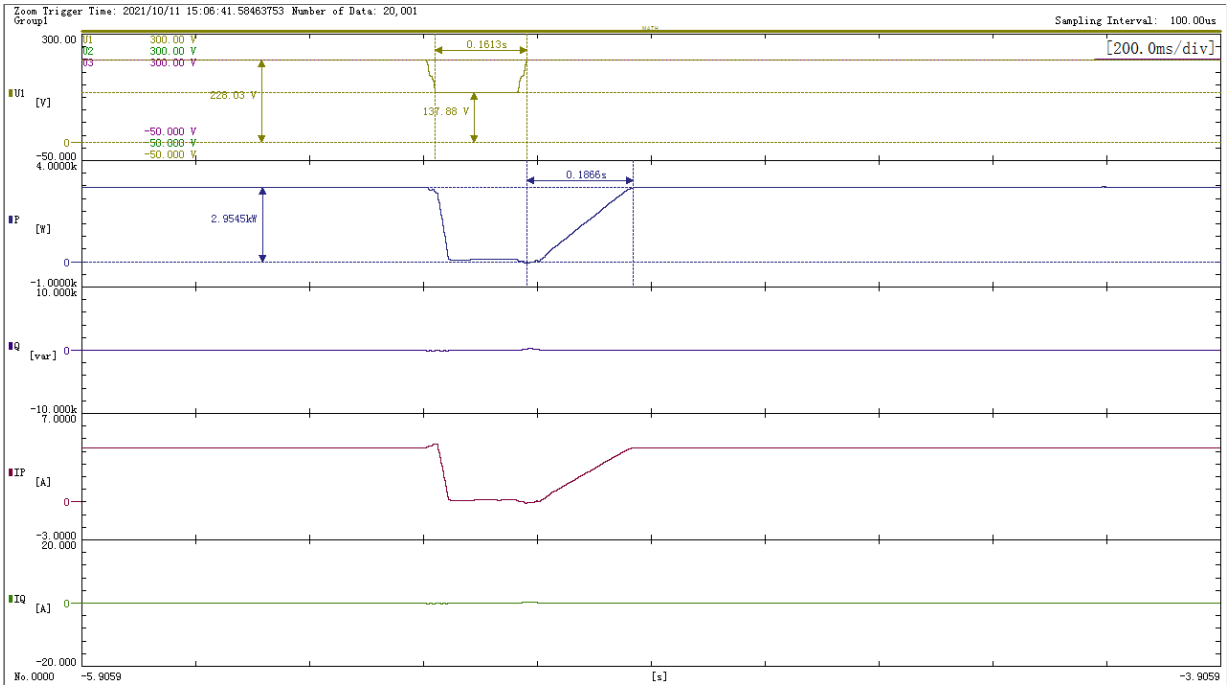
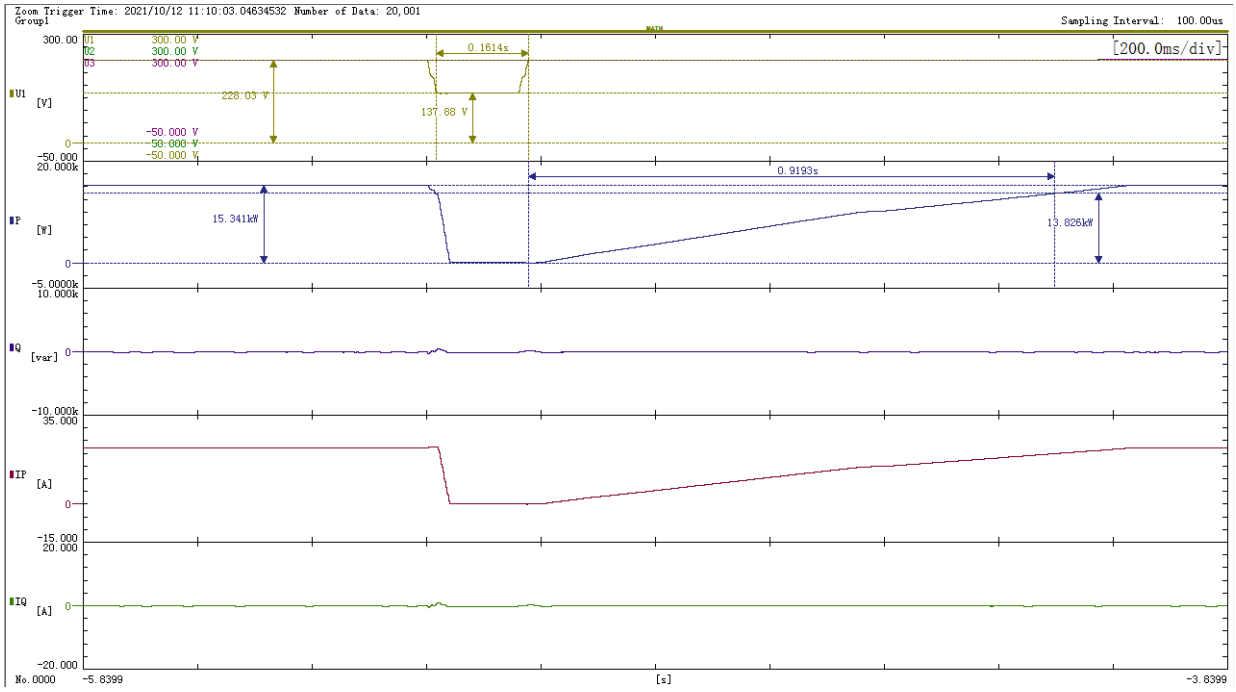
Clause	Requirement - Test	Result - Remark	Verdict

Test 7 – single-phase symmetrical fault (V/V_{nom} = 0,60)
P = 0,1 - 0,3



Test 7 – single-phase symmetrical fault (V/V_{nom} = 0,60)
P > 0,9



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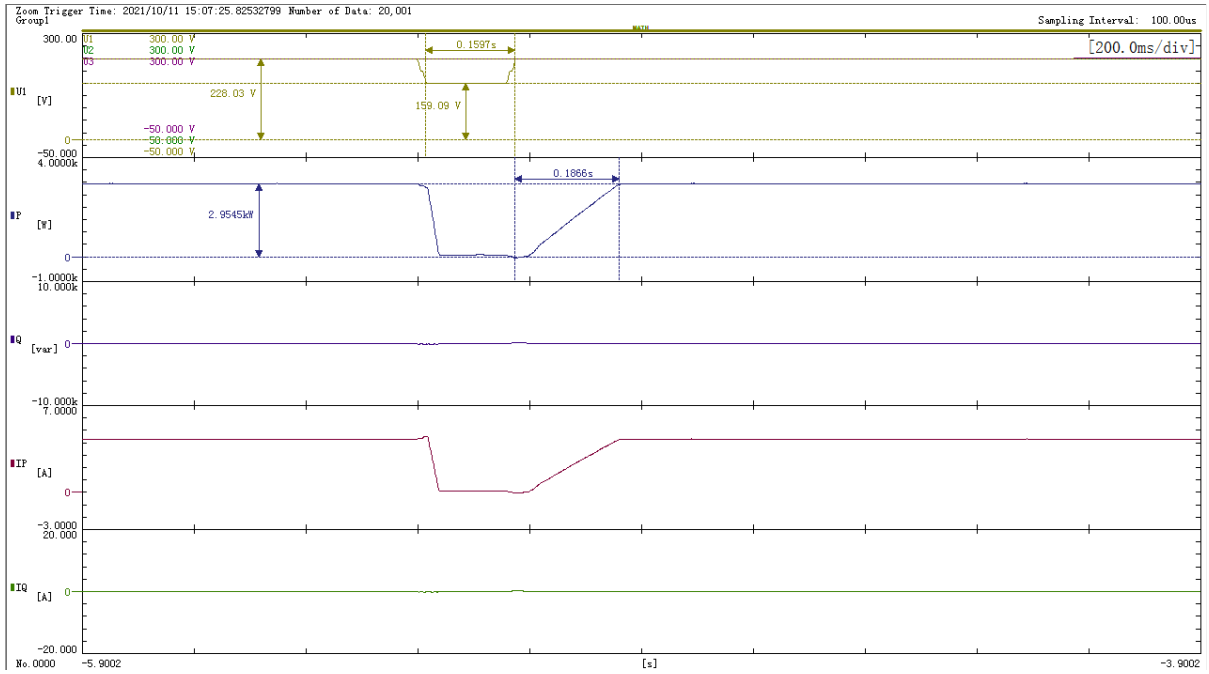
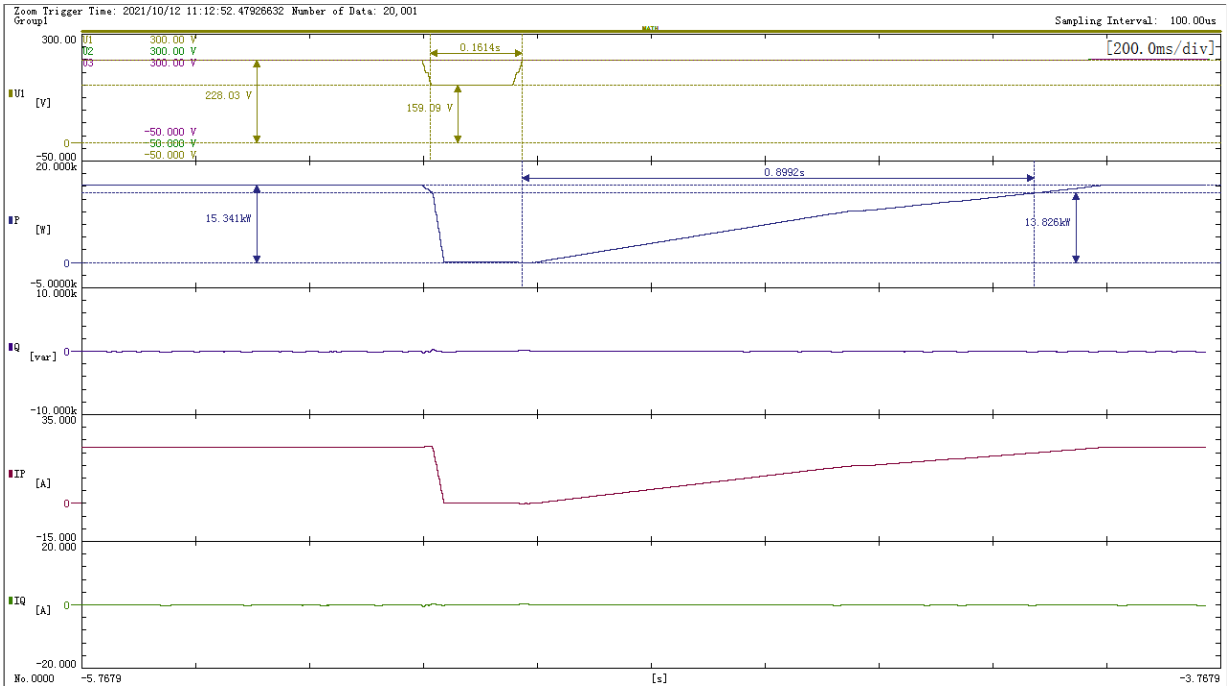
Clause	Requirement - Test	Result - Remark	Verdict

Test 8 – single-phase symmetrical fault (V/V_{nom} = 0,70)
P = 0,1 - 0,3



Test 8 – single-phase symmetrical fault (V/V_{nom} = 0,70)
P > 0,9



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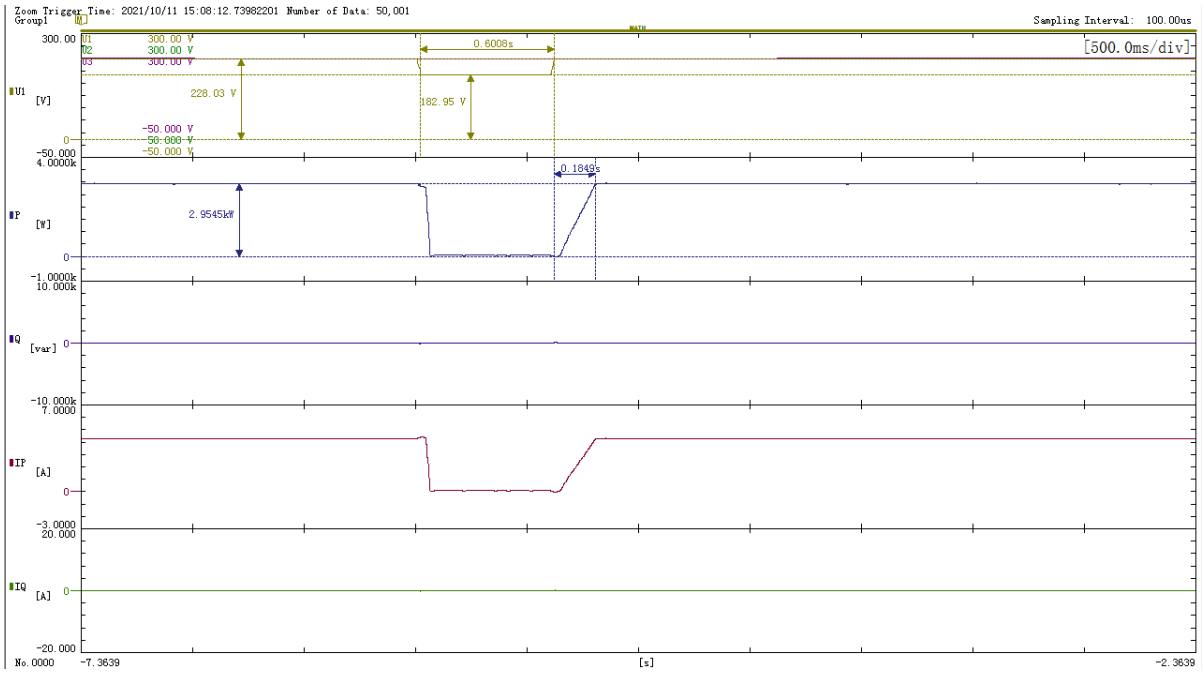
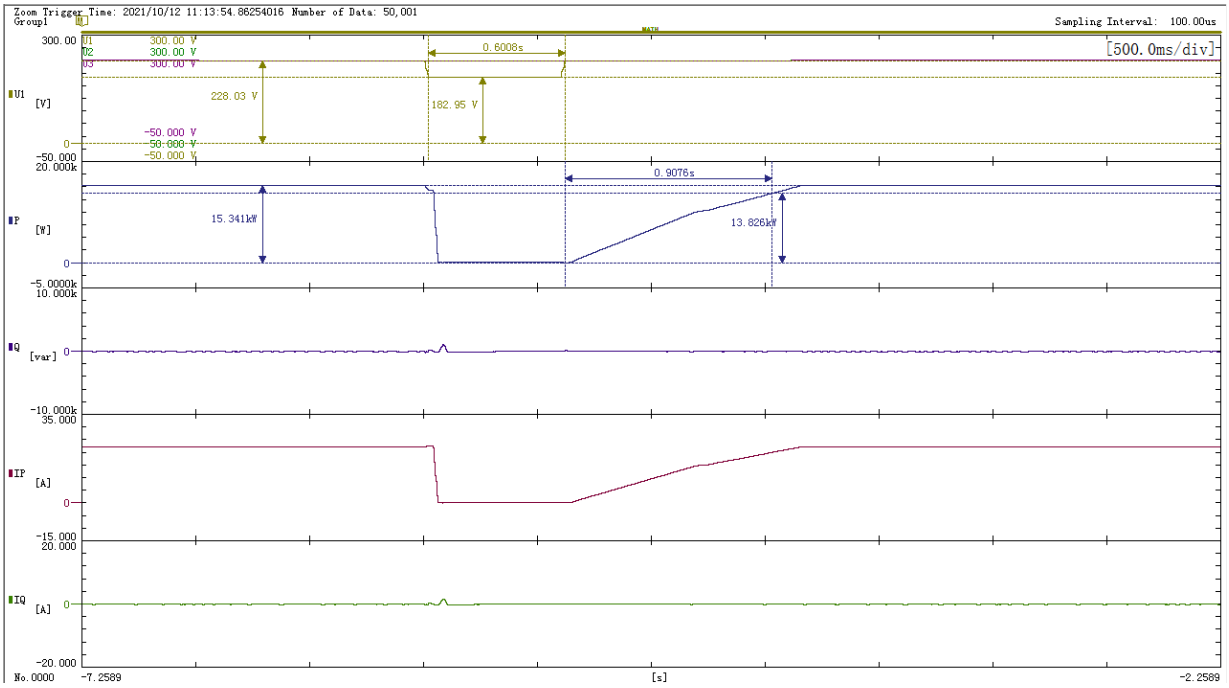
Clause	Requirement - Test	Result - Remark	Verdict

Test 9 – single-phase symmetrical fault (V/V_{nom} = 0,80)
P = 0,1 - 0,3



Test 9 – single-phase symmetrical fault (V/V_{nom} = 0,80)
P > 0,9



NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.3.3	Overfrequency and underfrequency	P

Test:

Test conditions:	Any output power level							
	Under frequency				**Over frequency**			
Parameter	Frequency (Hz)	Time (s)			Frequency (Hz)	Time (s)		
Output Voltage		85%U_N	U_N	110%U_N		85%U_N	U_N	110%U_N
Limit	47,00Hz	200ms			52,00Hz	4s < t ≤ 4,5s		
Trip value		47,01	47,00	47,00		52,03	52,02	52,03
Disconnection time (s)	47,50Hz to 46,50Hz	0,185	0,186	0,187	51,50Hz to 52,50Hz	4,100	4,070	4,090
Reconnection time	60s	60,2			60s	60,2		

Note:

Method for trip:

The frequency which inverter stops feeding power to electrical system in each test must be in the range of the frequency trip setting +/- 0,1Hz and the time it takes to cut off the power must be within limit value.

The accuracy for frequency trip values shall be within 0 % to +1 % of the nominal frequency from the upper boundary trip setting, and within -1% to 0% of the nominal frequency from the lower boundary trip setting.

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

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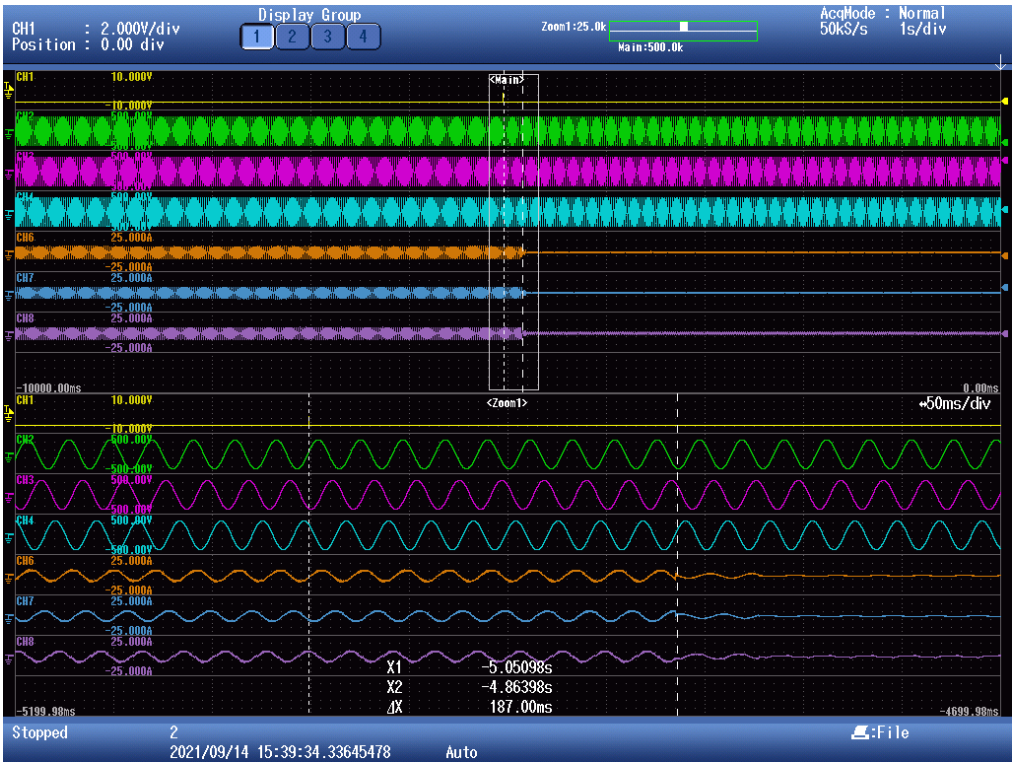
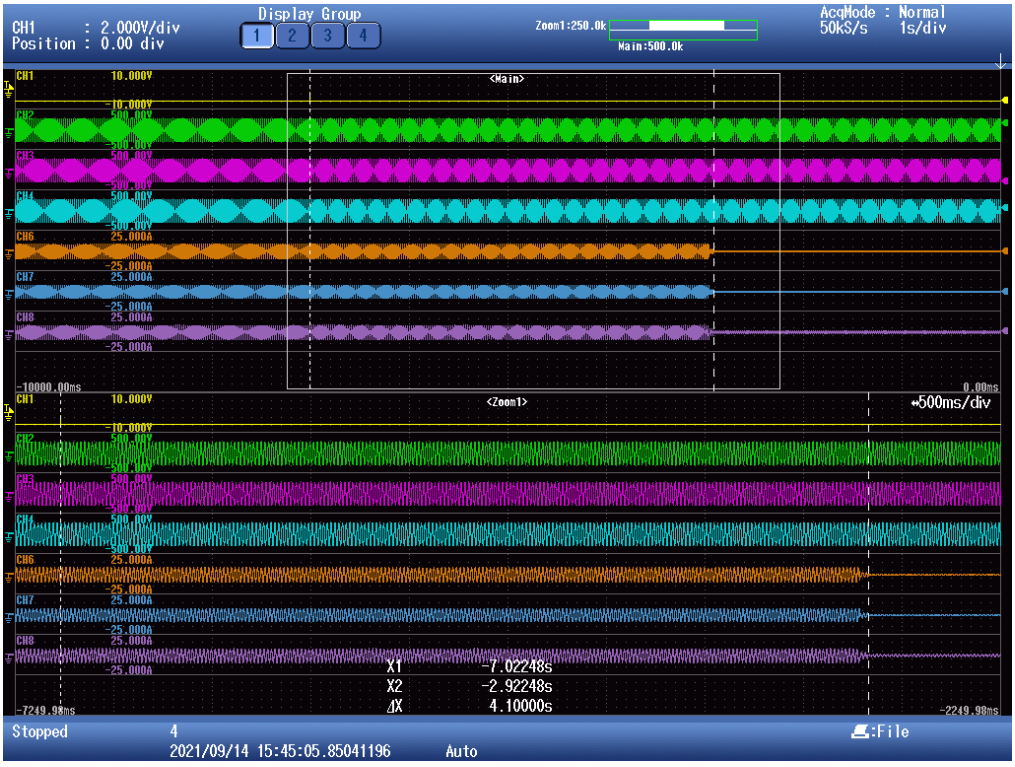
Clause	Requirement - Test	Result - Remark	Verdict

Under Frequency:

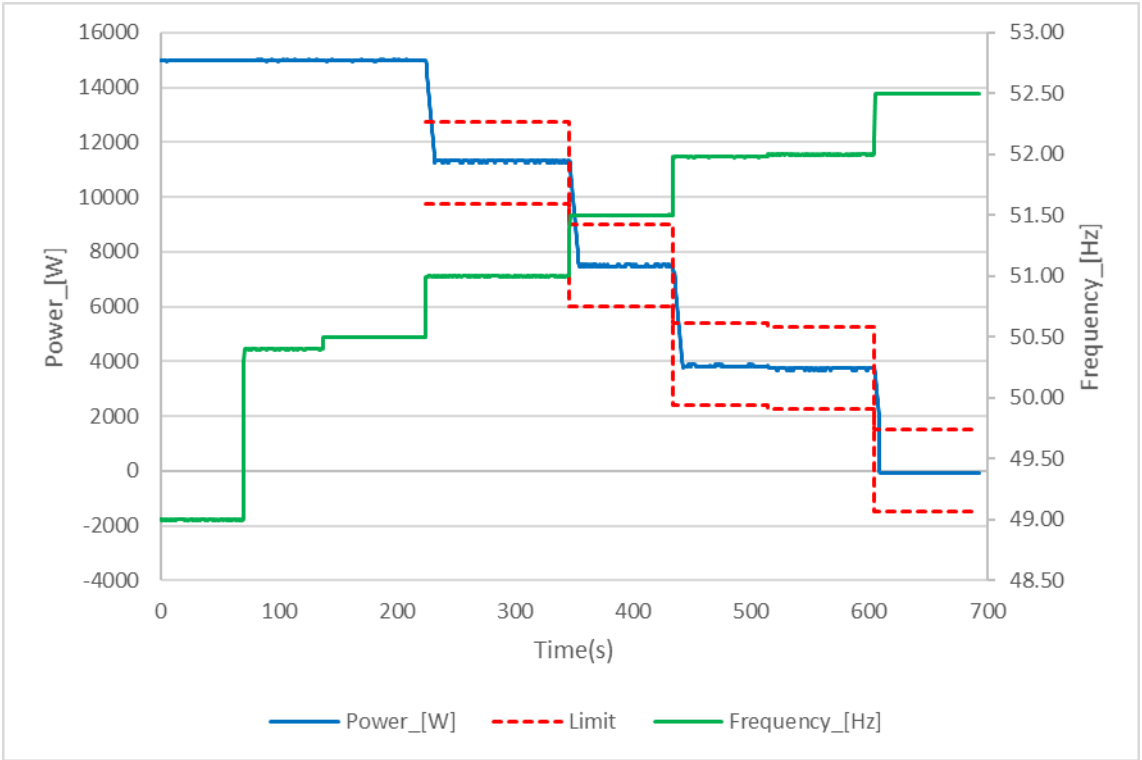


Over Frequency:



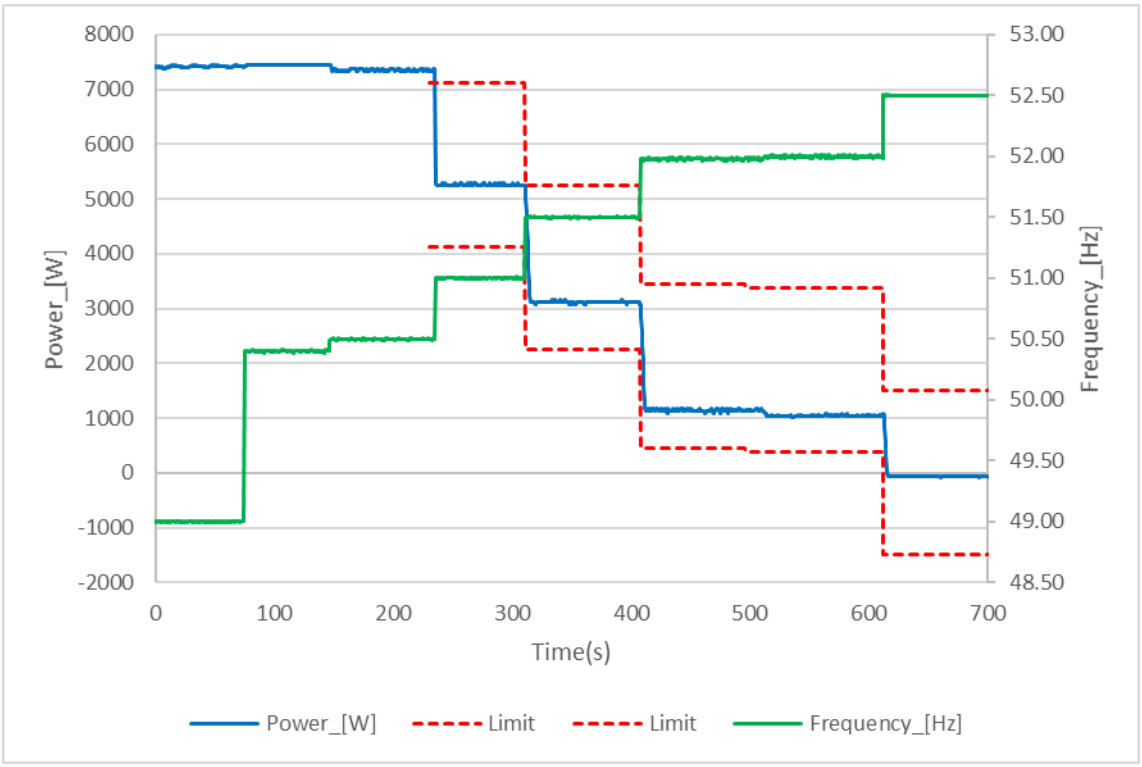
NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.3.3	**Active power feed-in for over-frequency**							**P**
Test:								
1-min mean value [Hz]	a) 49,00	b) 50,40	c) 50,50	d) 51,00	e) 51,50	f) 51,98	g) 52,00	h) 52,50
1. Measurement a) to g): Active power output > 80% P_n								
Frequency [Hz]:	49,00	50,40	50,50	51,00	51,50	51,98	52,00	52,50
$P_{setpoint}$ [W]:	15000	15000	15000	11250	7500	3900	3750	0
P_{E60} [W]:	14990	14994	14996	11310	7492	3835	3743	-78
$\Delta P_{E60}/P_{Setpoint}$ [%]:	0,067	0,040	0,029	-0,398	0,054	0,435	0,044	0,517
2. Measurement a) to i): Active power output 40% and 60%								
Frequency [Hz]:	49,00	50,40	50,50	51,00	51,50	51,98	52,00	52,50
$P_{setpoint}$ [W]:	7500	7500	7500	5625	3750	1950	1875	0
P_{E60} [W]:	7414	7444	7353	5256	3123	1145	1052	-72
$\Delta P_{E60}/P_{Setpoint}$ [%]:	0,572	0,372	0,980	2,458	4,180	5,369	5,487	0,479
Limit $\Delta P_{E60}/P_{Setpoint}$:	+ 10 % of P_{Emax}							
Graph of Measurement 1.: Active power output > 80% P_n								



NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Graph of Measurement 2: Active power output 40% and 60%



Test:

The test is conducted for two powers. First, the test must start at a power > 80% P_n ("Measurement 1"), and in a second test, for a power between 40% to 60% P_n ("Measurement 2"). In the second test, after freezing of the PM, the available active power output must be increased to a value > 80% P_n, and after the network frequency of 50,5 Hz is fallen below, the rise of the active power gradient must be recorded.

Assessment criterion:

For f=50,5 Hz, the value of the PM active power currently being generated is "frozen".

For adjustable PGUs when:

1) the active power reduces between measuring points c) and g) given above with a gradient of 50% P_M per Hz for a decreasing frequency (or rises for a frequency decreasing again).

2) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_n by more than ± 10%.

When the utility frequency exceeds 50,5 Hz, the active power available at the time shall be stored as the maximum power value P_M; this value P_M shall not be exceeded until the frequency has stabilised below 50,5 Hz for at least 4 seconds.

Note:

The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.4	Preventing of islanding (Islanding protection, Condition A)	P

Test result:

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	2s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	Run on Time (ms)	P_{EUT} (W per phase)	Q_f	V_{DC} (V)	Remarks4)
1	100	100	0	0	249	4950	1,003	680	Test A at BL
8	100	100	-5	-5	164	4950	1,029	680	Test A at IB
9	100	100	-5	0	160	4950	1,056	680	Test A at IB
10	100	100	-5	+5	80	4950	1,082	680	Test A at IB
13	100	100	0	-5	210	4950	0,978	680	Test A at IB
14	100	100	0	+5	212	4950	1,028	680	Test A at IB
17	100	100	+5	-5	163	4950	0,931	680	Test A at IB
18	100	100	+5	0	170	4950	0,955	680	Test A at IB
19	100	100	+5	+5	116	4950	0,979	680	Test A at IB

Parameter at 0% per phase	L= 33,48 mH	R= 10,64 Ω	C= 297,25 µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition A:
EUT output power PEUT = Maximum 5)
EUT input voltage 6) = >90% of rated input voltage range

5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 80 % of range =X + 0,8 × (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.

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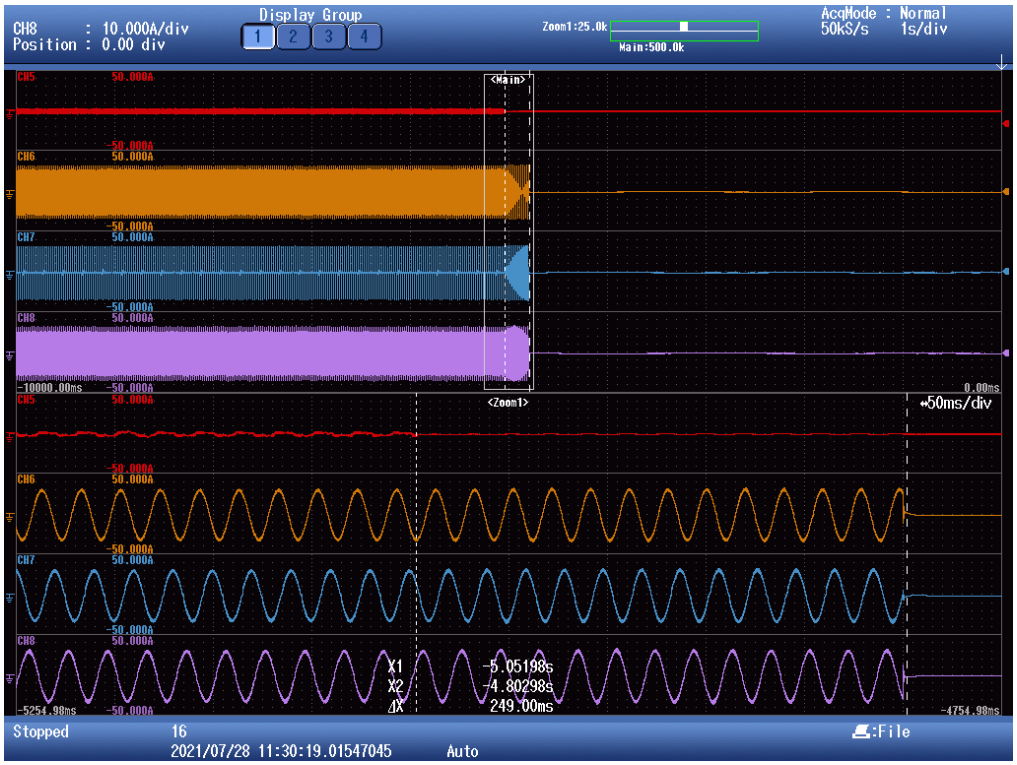
Clause	Requirement - Test	Result - Remark	Verdict

Disconnection at Pac 0% and Qac 0% reactive load and 100% nominal power



NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.4	Preventing of islanding (Islanding protection, Condition B)	P

Test result:

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	2s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	Run on Time (ms)	P_{EUT} (W per phase)	Q_f	V_{DC} (V)	Remarks4)
12	66	66	0	-5	111	3400	0,973	560	Test B at IB
13	66	66	0	-4	201	3400	0,978	560	Test B at IB
14	66	66	0	-3	145	3400	0,983	560	Test B at IB
15	66	66	0	-2	187	3400	0,988	560	Test B at IB
16	66	66	0	-1	255	3400	0,993	560	Test B at IB
2	66	66	0	0	152	3400	0,999	560	Test B at BL
17	66	66	0	1	140	3400	1,003	560	Test B at IB
18	66	66	0	2	162	3400	1,008	560	Test B at IB
19	66	66	0	3	150	3400	1,013	560	Test B at IB
20	66	66	0	4	144	3400	1,018	560	Test B at IB
21	66	66	0	5	91	3400	1,023	560	Test B at IB

Parameter at 0% per phase	L= 49,57 mH	R= 15,56 Ω	C= 204,38 µF

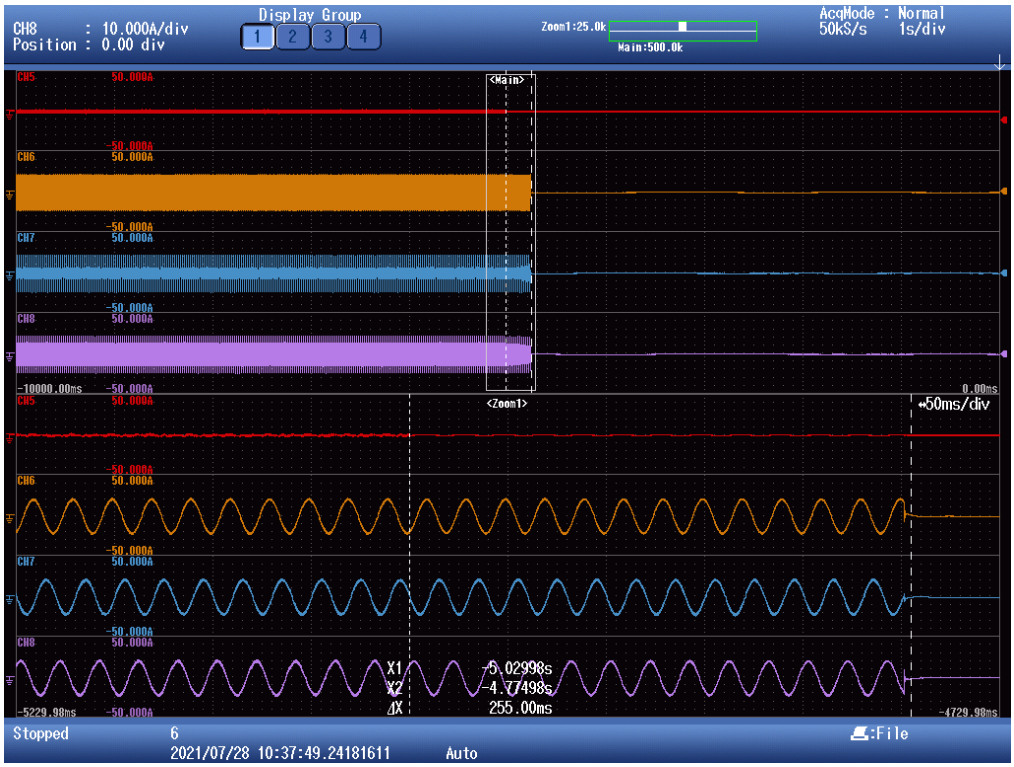
Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage 5) = 50 % of rated input voltage range, ±10 %

5) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 50 % of range =X + 0,5 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Disconnection at Pac 0% and Qac -1% reactive load and 66% nominal power



NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

4.2.2.4	**Preventing of islanding (Islanding protection, Condition C)**	P

Test result:

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac RLC consumes inverter real power within +/- 3% Distortion factor of chokes < 3% Quality =1
Disconnection limit	2s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	Run on Time (ms)	P_{EUT} (W)	Q_f	V_{DC} (V)	Remarks4)
22	33	33	0	-5	125	1660	0,969	416	Test C at IB
23	33	33	0	-4	174	1660	0,974	416	Test C at IB
24	33	33	0	-3	233	1660	0,979	416	Test C at IB
25	33	33	0	-2	166	1660	0,984	416	Test C at IB
26	33	33	0	-1	207	1660	0,989	416	Test C at IB
3	33	33	0	0	172	1660	0,994	416	Test C at BL
27	33	33	0	1	154	1660	0,999	416	Test C at IB
28	33	33	0	2	161	1660	1,004	416	Test C at IB
29	33	33	0	3	127	1660	1,009	416	Test C at IB
30	33	33	0	4	117	1660	1,014	416	Test C at IB
31	33	33	0	5	113	1660	1,019	416	Test C at IB

Parameter at 0% per phase	L= 102,05 mH	R= 31,87 Ω	C= 99,29 µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.

Condition C:
EUT output power PEUT = 25 % – 33 % 5) of maximum
EUT input voltage 6) = <10 % of rated input voltage range
5) Or minimum allowable EUT output level if greater than 33 %.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.
The test had been performed on the model INFINI WP 15KW the test results are valid for the INFINI WP 8KW, INFINI WP 10KW and INFINI WP 12KW since it is identical in hardware and just power derated by software.

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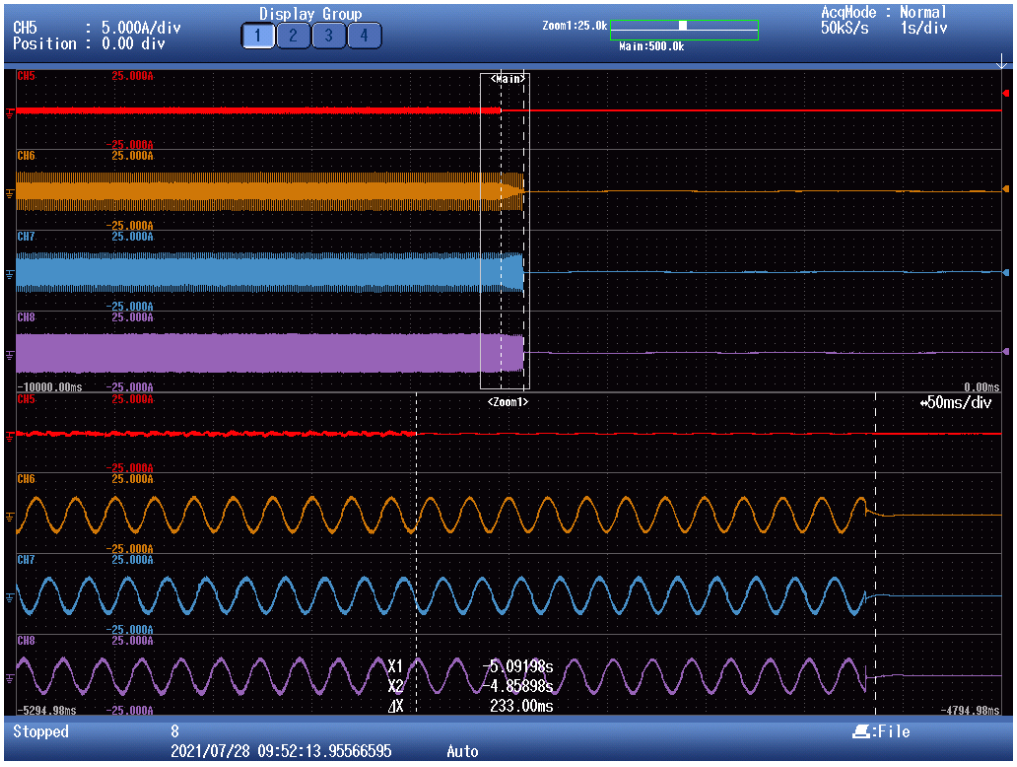
Clause	Requirement - Test	Result - Remark	Verdict

Disconnection at Pac 0% and Qac -3% reactive load and 33% nominal power

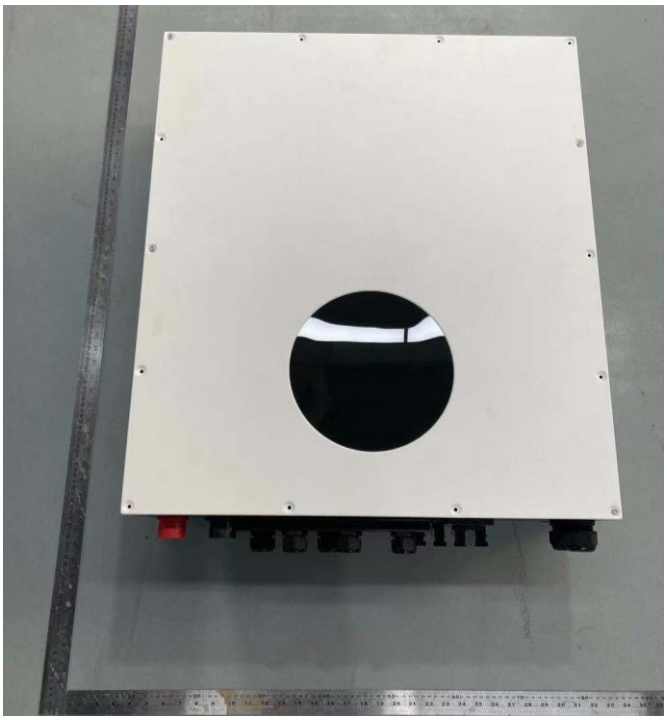


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Photos

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

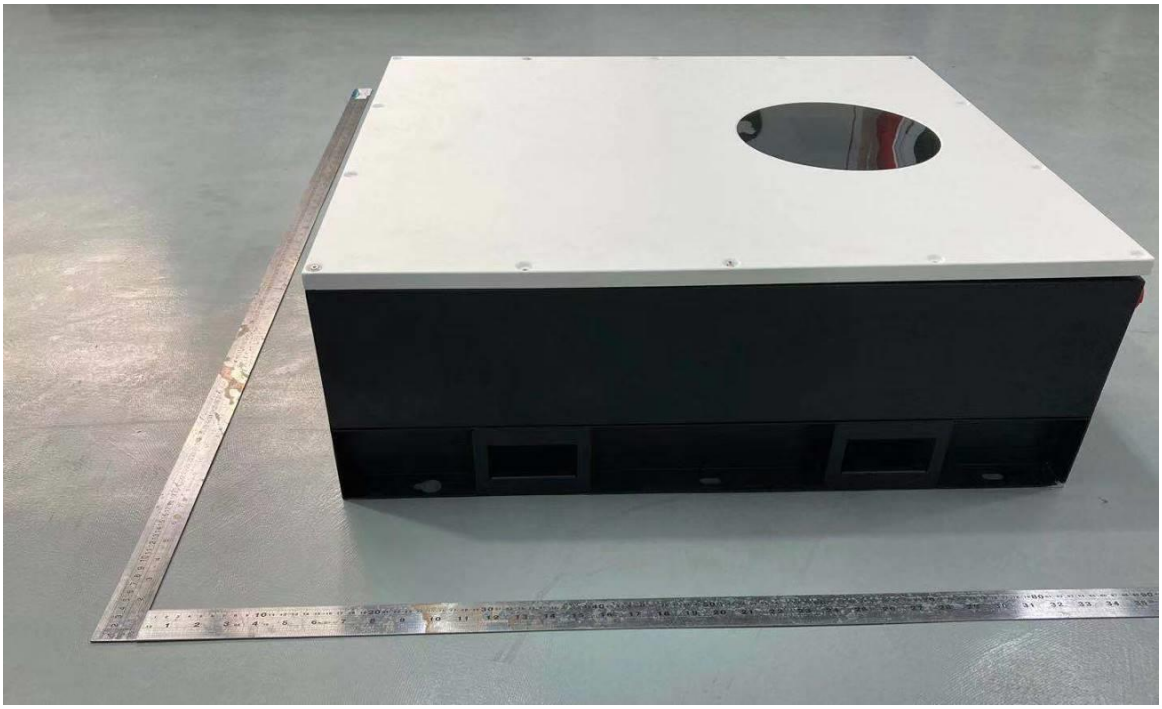
Enclosure front view



Enclosure rear view:

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Enclosure side view-1

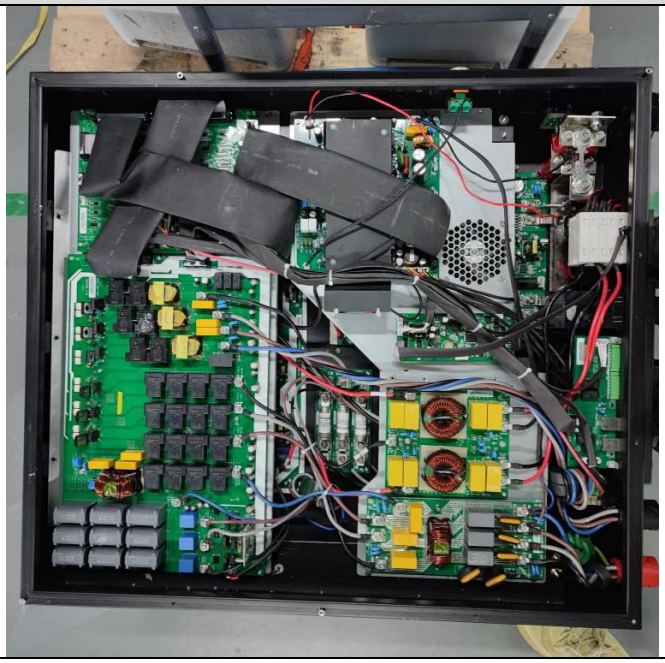


Enclosure side view-2

NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

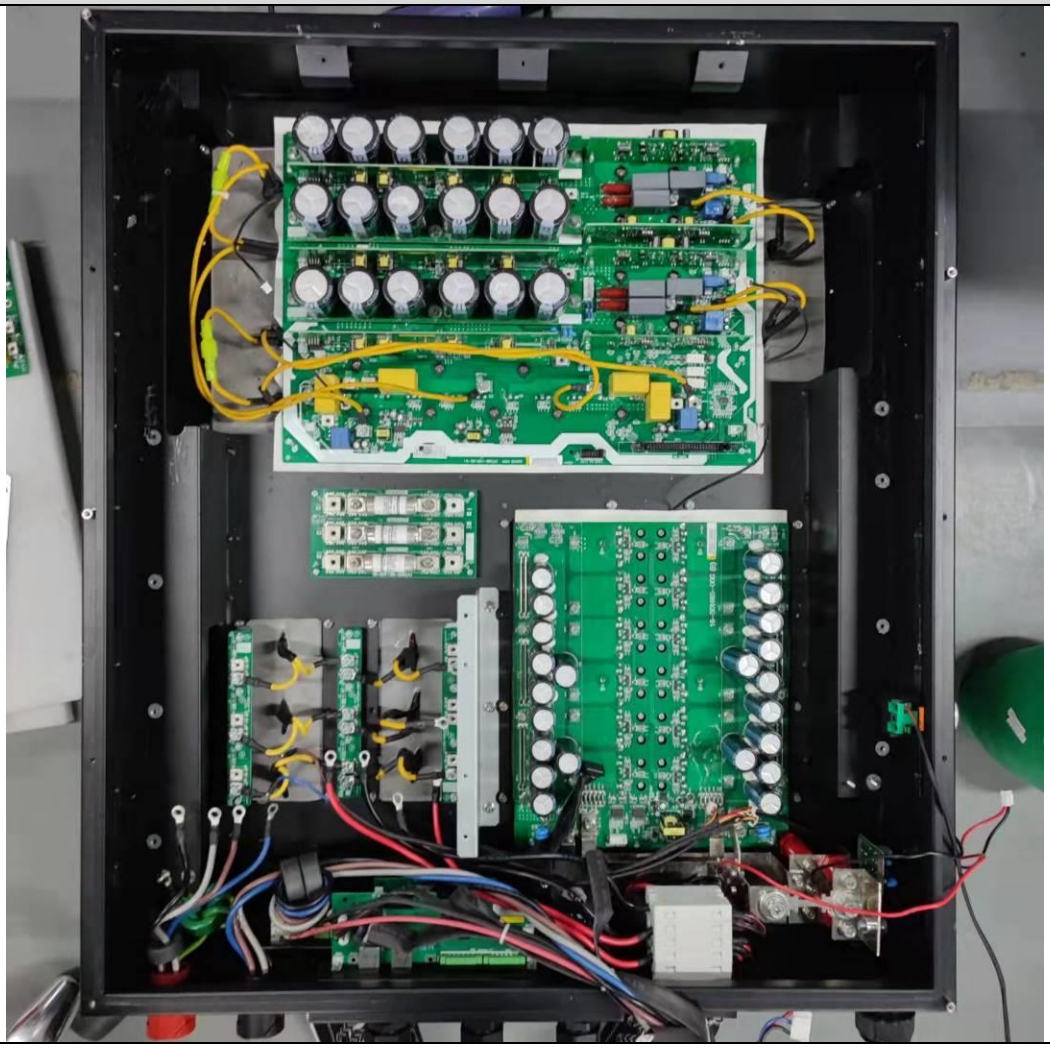
Enclosure bottom view:

Interior view:



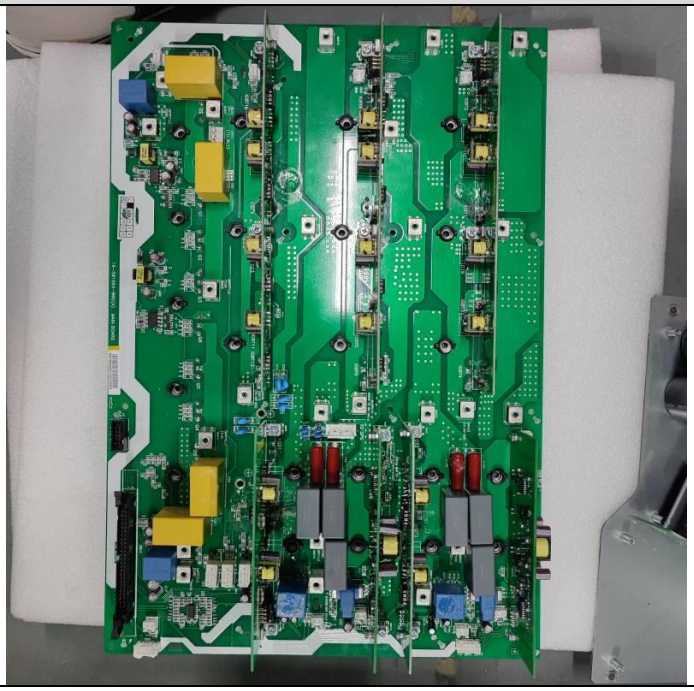
NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Interior view:

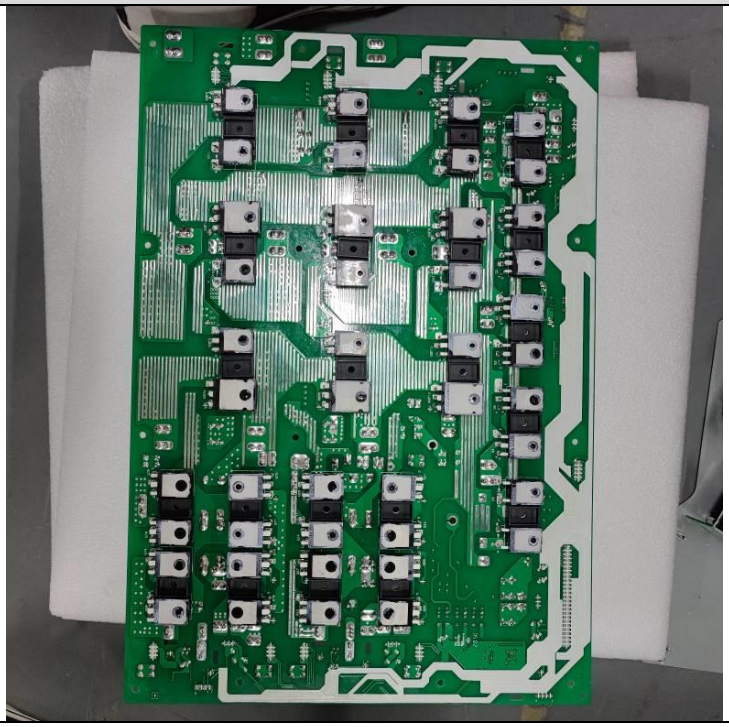


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Mainboard component side:

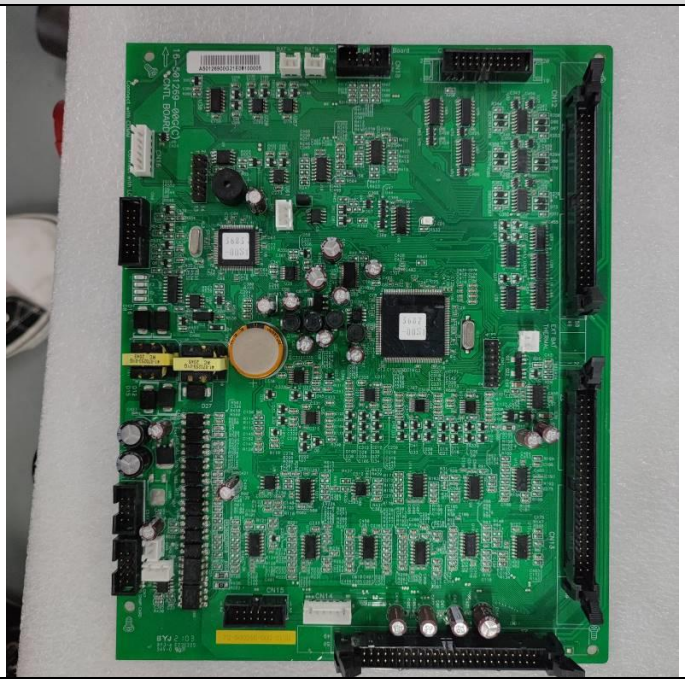


Mainboard solder side:

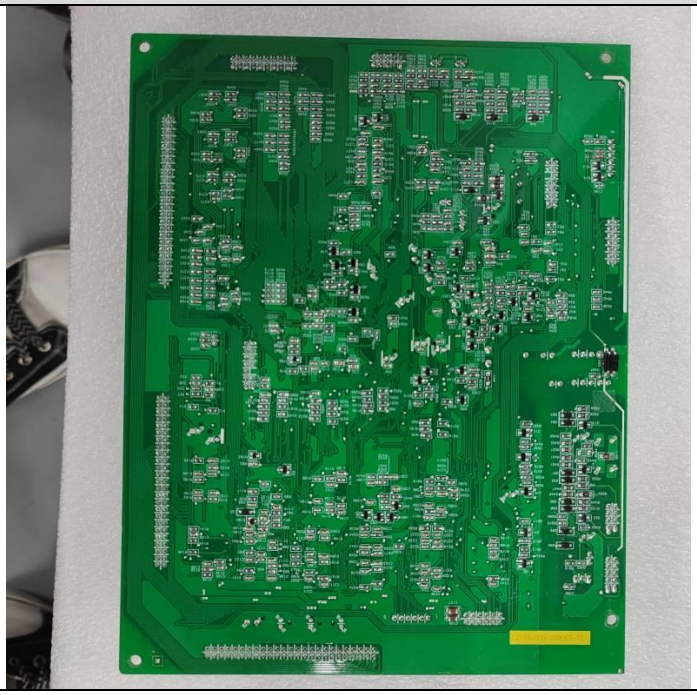


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Control board component side:

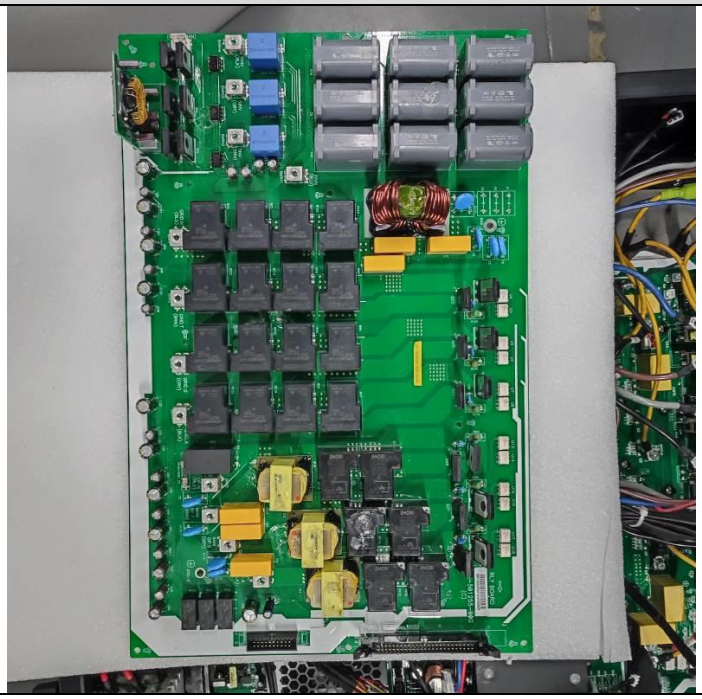


Control board solder side:

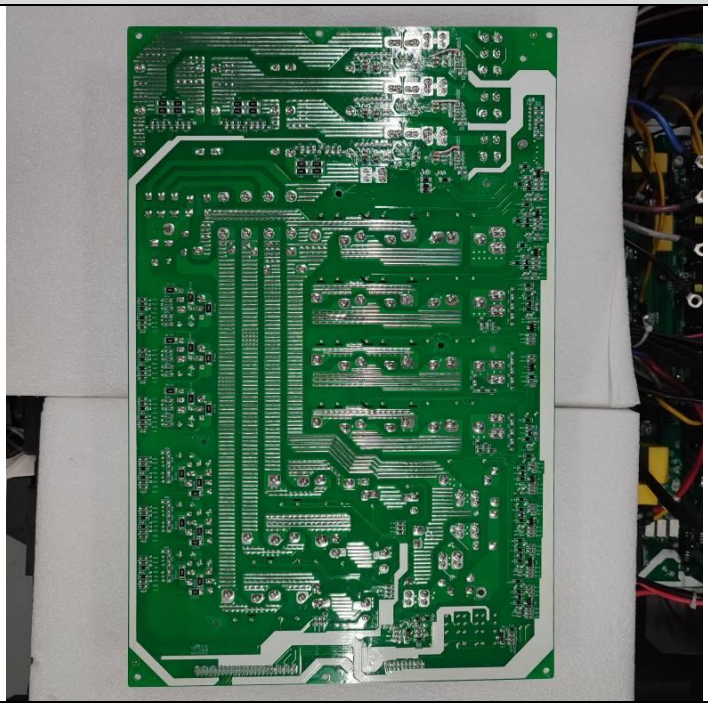


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

Grid board component side:

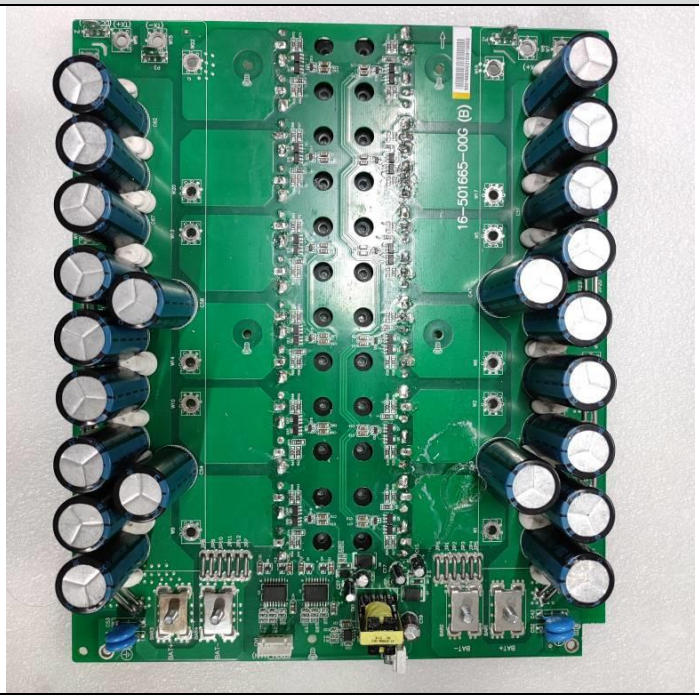


Grid board solder side:

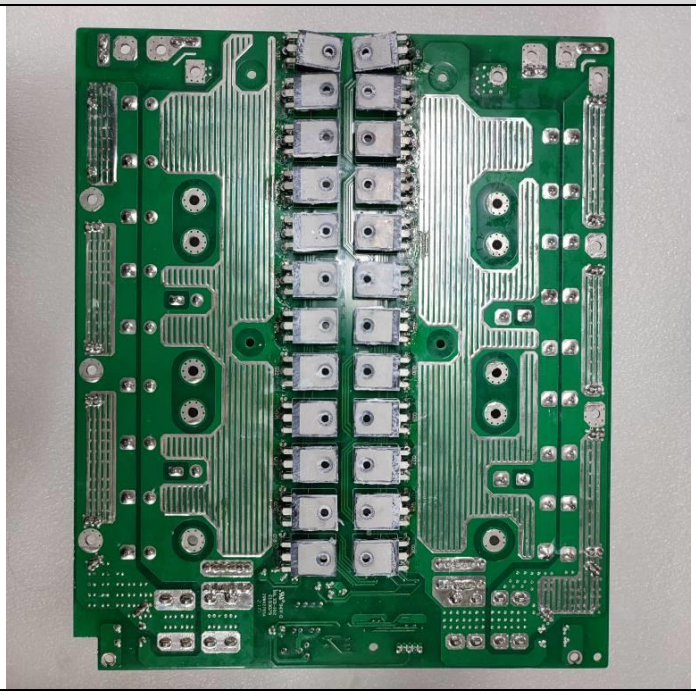


NRS 097-2-1:2017			
Clause	Requirement - Test	Result - Remark	Verdict

DC-DC board component side:



DC-DC board solder side:



(End of Report)