TEST REPORT

Engineering recommendation G99/NI

Requirements for the connection of generation equipment in parallel with public distribution networks in Northern Ireland

Report reference number .....:	**19TH0534_G99/NI-1_2**
Date of issue.....:	2023-06-15
Total number of pages .....:	119
Testing laboratory name.....:	**Bureau Veritas Consumer Products Services Germany GmbH**
Address .....:	Businesspark A96 86842 Türkheim Germany
Accreditation.....:	ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12024-03-03
Applicant's name.....:	**SolarEdge Technologies Ltd.**
Address .....:	1 HaMada Street, Herzliya 4673335, Israel
Test specification	
Standard.....:	G99/NI-1:2019
Certificate.....:	**Certificate of compliance**
Test report form number.....:	G99/NI-1_01 A2-3 Compliance Verification Report – Tests for Type A Inverter Connected Power Generating Modules
Master TRF.....:	Bureau Veritas Consumer Products Services Germany GmbH
Test item description .....:	**Grid-tied photovoltaic inverter**
Trademark .....:	solaredge
Model / Type.....:	SE33.3K; SE30K; SE27.6K; SE25K

Ratings .....:	**SE25K**	**SE27.6K**	**SE30K**	**SE33.3K**
Input DC voltage range [V].....:	680 – 1000	680 – 1000	680 – 1000	680 – 1000
Input DC current [A].....:	36,25	40,00	43,50	48,25
Output AC voltage [V].....:	220/230 Vac, L-N 380/400 Vac, L-L	220/230 Vac, L-N 380/400 Vac, L-L	220/230 Vac, L-N 380/400 Vac, L-L	220/230 Vac, L-N 380/400 Vac, L-L
Output AC current [A].....:	36,25	40,00	43,50	48,25
Output power [VA].....:	25000	27600	30000	33300

Testing Location.....:	**Bureau Veritas Consumer Products Services Germany GmbH**
Address .....:	Businesspark A96, 86842 Türkheim, Germany
Tested by (name, function and signature) .....:	Hubert Glasmann Lab Technician Energy Systems - Grid Integration low voltage
Approved by (name and signature) .....:	Frederic SCHMITT Manager Energy Systems - Grid Integration low voltage
Manufacturer's name .....:	**Flextronics International Kft**
Factory address.....:	Posta ut 63 8900 Zalaegerszeg Hungary, part of EU
Manufacturer's name .....:	**Jabil Circuit (Guangzhou) Ltd.**
Factory address.....:	DEV EAST DISTRICT 128 JUN CHENG RD GUANGZHOU GUANGDONG 510530 China
Manufacturer's name .....:	**Jabil Circuit (Vietnam) Ltd.**
Factory address.....:	Lot i8-1, Saigon Hi-tech Park District 9, HCM City Vietnam

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2022-04-29	Kheiry Abdelaziz	Initial report was written	0
2022-02-13	Kheiry Abdelaziz	A.7.1.3 – Corrective action	1
2023-06-15	Hubert Glasmann	A.7.1.3 - Corrective action A.7.1.4.4 – calculation added	2
Supplementary information:			

Test items particulars	
Equipment mobility ..... :	Permanent connection
Operating condition ..... :	Continuous
Class of equipment..... :	Class I
Protection against ingress of water .. :	IP65 according to EN 60529
Mass of equipment [kg] ..... :	45
Test case verdicts	
Test case does not apply to the test object ..... :	N/A
Test item does meet the requirement ..... :	P(ass)
Test item does not meet the requirement ..... :	F(ail)
Testing	
Date of receipt of test item ..... :	2019-11-29, 2020-12-20
Date(s) of performance of test ..... :	2020-06-01 – 2020-10-28, 2022-04-11 – 2022-04-16, 2023-05-31

General remarks:

The test result presented in this report relate only to the object(s) tested. The report shall state compliance of the tested objects with the Type A requirements of G99/NI. This report must not be reproduced in part or in full without the written approval of the issuing testing laboratory.

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

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

Conformity statements are decided in accordance with IEC GUIDE 115:2021 Procedure 2 (accuracy method), unless otherwise normatively specified or contractually agreed.

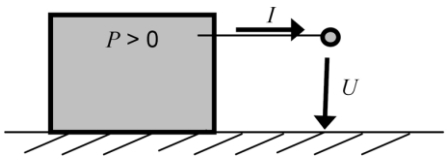
- “P_n” for the nominal active power:

  $P_n = V_n \times I_n \times \cos \varphi_n$ (single-Phase); $P_n = \sqrt{3} V_n \times I_n \times \cos \varphi_n$ (three-Phase)
- “P_m” for the momentary power
- “(c)” for over-excited
- “(i)” for under-excited

Active and reactive power:

The regarded system of the voltage and current vectors is the load view (Figure 2):

- If the inverter feeds to the grid the active power is measured with negative sign. For the sake of reading the document the measured active infeed power has a positive sign.



- If the inverter consumes inductive reactive power the reactive power is marked “inductive” or has a positive sign.
- If the inverter consumes capacitive reactive power the reactive power is marked “capacitive” or has a negative sign.

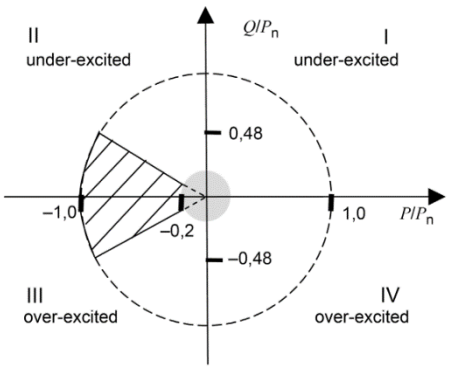
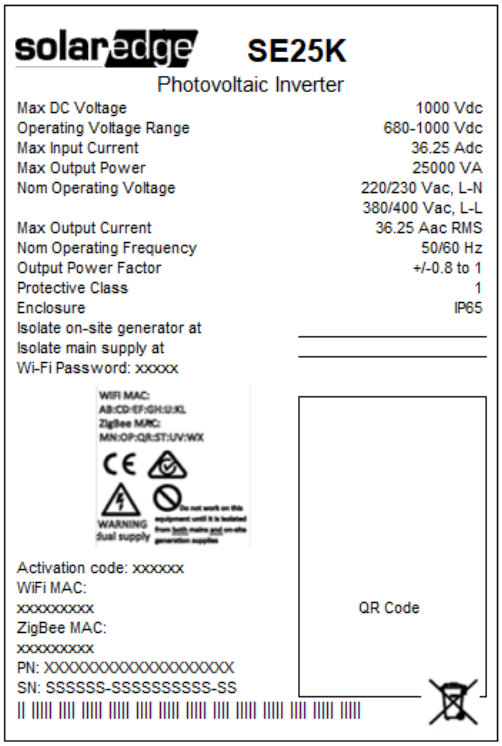
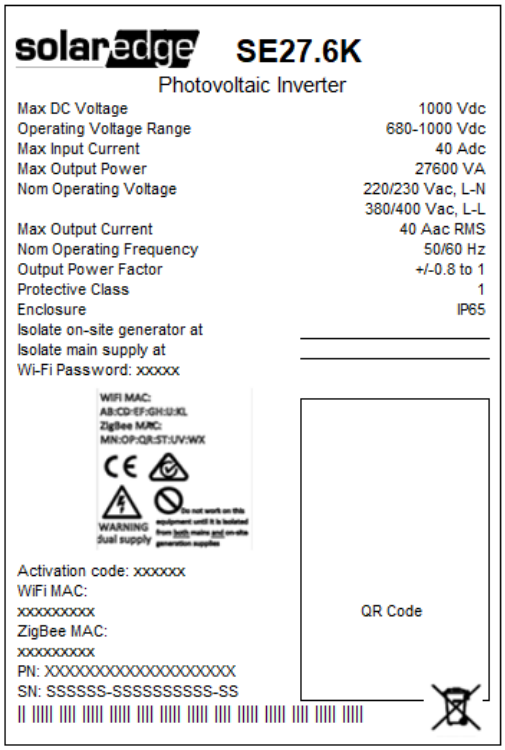


Figure 2

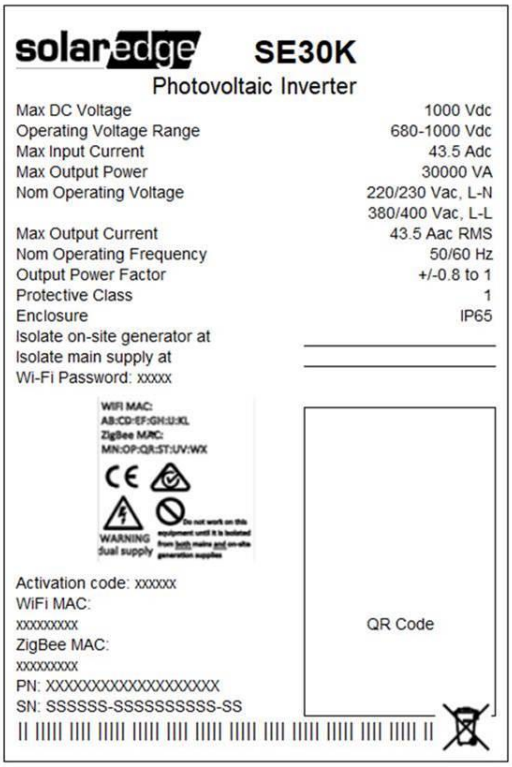
This Test Report consists of the following documents:

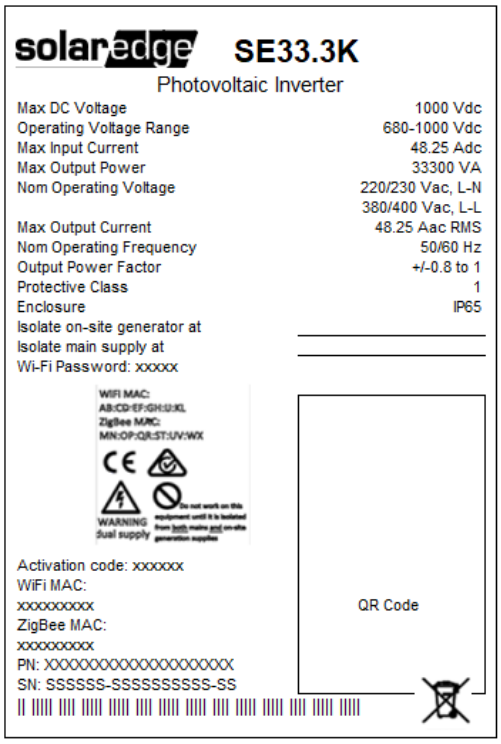
Copy of marking plate





Copy of marking plate

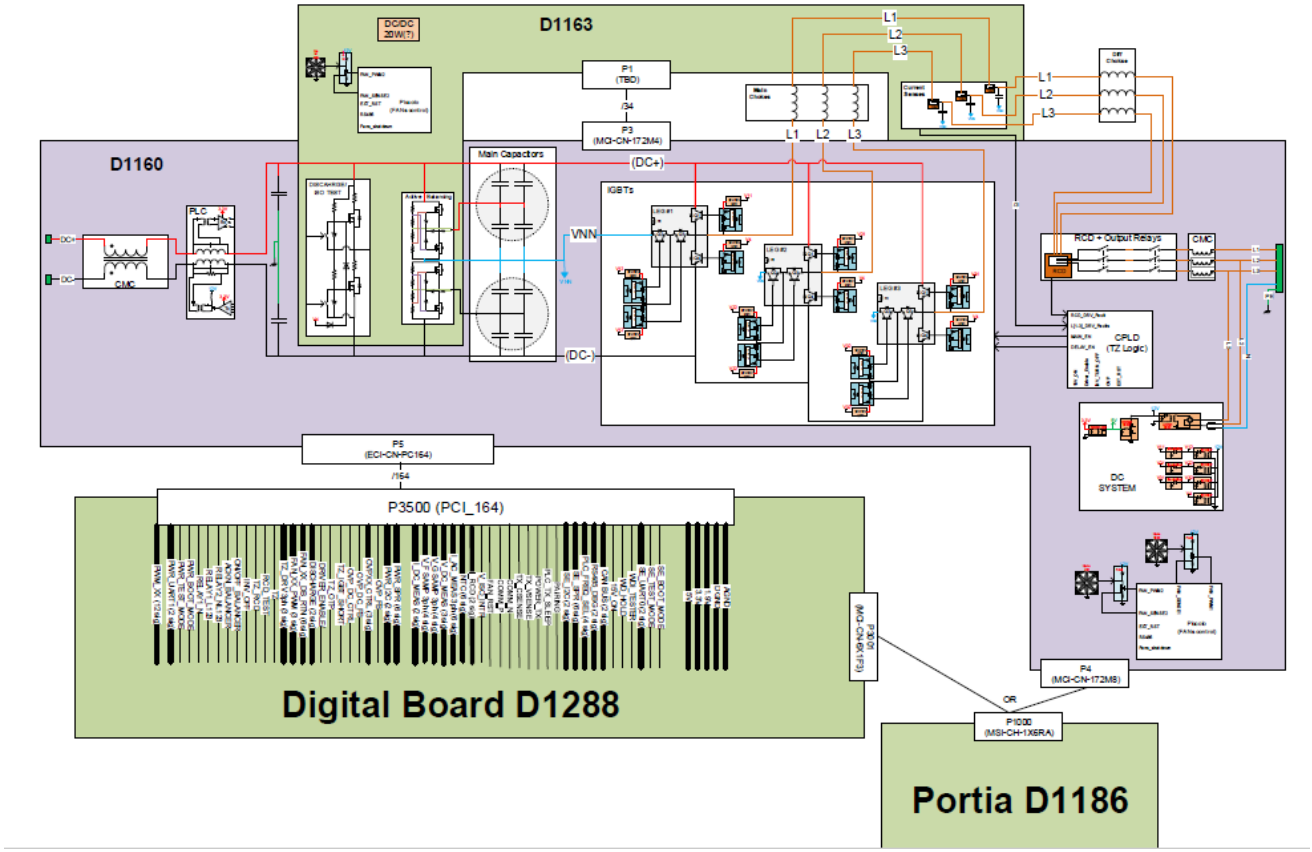




Note:

Example of marking plate

Block diagram of the utility interactive inverter:



(Figure 1)

Description of the differences of the models within a series:

The inverters of the SExx.xK series consist of following models: SE33.3K, SE30K, SE27.6K and SE25K. All the models use the same hardware and software. The different powers between SE25K, SE27.6k SE30K and SE33.3K is realized by software derating. The all models are equipped with four DC input.

The tests have been performed on the SE 33.3K model and is valid for the whole series.

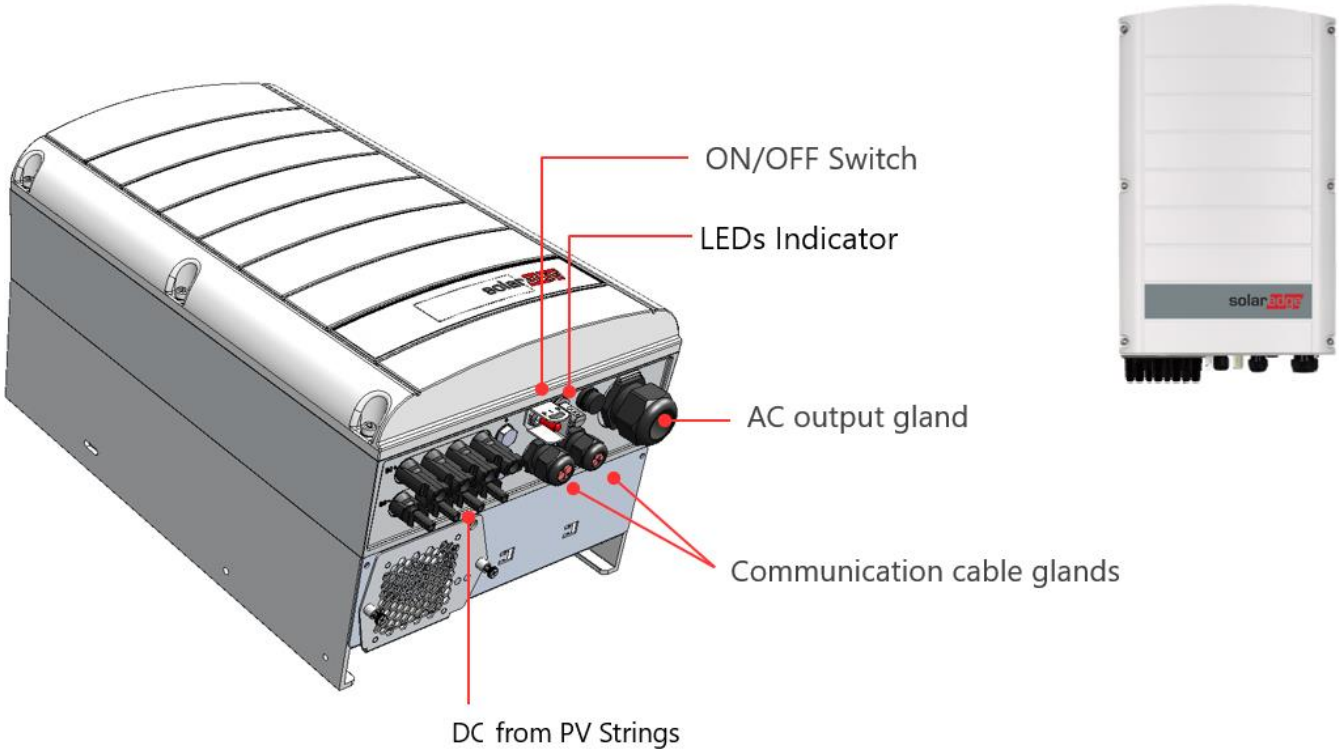
The product was tested on:

The product with serial number SJ4219-07E176CA9-AA was tested on

PCB versions: Power board is D1160G
Relay board is D1163F
Digital board is D1288A
Display board is D1186B
SPD AC board is D1296B
SPD DC board is D1297C
IMS board is D1437B
USB Adapter board is D1565

Software version: Main DSP software version is 1.20
Aux DSP software version is 2.20

Enclosure and user interface:



Test Results

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A.7	**Requirements for Type Testing Power Generating Modules**		
	This Annex describes methodologies for undertaking compliance verification for **Type A Power Generating Module**s. The Annex describes approaches which were originally intended for small **Power Park Module**s. **Manufacturer**s are free to adapt techniques described in Annex B where this is more economic or efficient, provided the **Type A** performance requirements are fully demonstrated. The Forms provided in Annex A.2 should be used as a basis for demonstration of compliance. Annex A.7.1. **Power Park Module** Requirements Annex A.7.2 **Synchronous Power Generating Module** Requirements. Annex A.7.3 Additional Technology Requirements. • A.7.3.1. Domestic CHP • A.7.3.2. Photovoltaic • A.7.3.3. Fuel Cells • A.7.3.4. Hydro • A.7.3.5. Wind • A.7.3.6. **Electricity Storage** devices Annex A.7.1 relates to any **Generating Unit** that uses an **Inverter** (or Converter) as its means of connecting to the **Distribution Network**. Annex A.7.2 relates to any **Synchronous Power Generating Module** that during normal running operation is connected directly to the **Distribution Network** and has a **Rated Capacity** < 50 kW, although **Manufacturer**s may choose to use these requirements for larger **Type A Synchronous Power Generating Module**s. For type testing any **Generating Unit** select either Annex A.7.1 or Annex A.7.2 as is most appropriate to the **Generating Unit** under test. Annex A.7.2 should also be used for asynchronous **Generating Unit**s that are not connected to the **Distribution Network** via an **Inverter** (ie induction **Generating Unit**s). The **Generating Unit** may also require additional technology type tests as identified in Annex A.7.3. **Examples** A Wind Turbine system using an **Inverter** (or **Inverter**s) for connection is required to use Annex A.7.1 – “Common **Power Park Module** Requirements” and Annex A.7.3.5 – “Wind” Additional Technology Requirements. A Hydro system using an induction generator connected directly to the **Distribution Network** is suggested to use Annex A.7.2 – “**Synchronous**” and Annex A.7.3.4– “Hydro” Additional Technology Requirements.	Test sample is a: A.7.3 Additional Technology Requirements • A.7.3.2. Photovoltaic	**P**
A.7.1	Power Park Module Requirements		**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A.7.1.1	Certification & Type Testing Generating Unit Requirements A.7.1 can apply to Power Park Modules or to individual Inverters and/or Generating Units if the functionality is included in each unit of a Power Park Module. Within this Section A.7.1 the term Power Park Module will be used but its meaning can be interpreted within A.7.1 to mean Power Park Module, Generating Unit or Inverter as appropriate. A.7.1 describes a methodology for obtaining type certification or type verification for a **Power Park Module** containing an **Inverter**. Typically, all interface functions are contained within the **Inverter** and in such cases it is only necessary to have the **Inverter Type Tested.** Alternatively, a package of specific separate parts of equivalent function may also be **Type Tested**. The Interface Protection shall satisfy the requirements of all of the following standards. Where these standards have more than one part, the requirements of all such parts shall be satisfied, so far as they are applicable. BS EN 61000 (Electromagnetic Standards) BS EN 60255 (Electrical Relays) BS EN 61810 (Electrical Elementary Relays) BS EN 60947 (Low Voltage Switchgear and Control gear) BS EN 61869 (Instrument Transformers: Additional requirements for current transformers). Currently there are no harmonised functional standards that apply to the Power Park Module's Interface Protection. Consequently, in cases where power electronics is used for energy conversion along with any separate Interface Protection unit they will need to be brought together and tested as a complete Power Park Module as described in this EREC G99/NI, and recorded in format similar to that shown in Annex A.2 (Form A2-3). Where the **Interface Protection** is physically integrated within the overall **Power Park Module** control system, the functionality of the **Interface Protection** unit should not be compromised by any failure of other elements of the control system (fail safe). For a **Full Type Tested Power Park Module** the completed **Power Park Module's Interface Protection** shall not rely on interconnection using cables which could be terminated incorrectly on site ie the interconnections shall be made by non-reversible plug and socket which the **Manufacturer** has made and tested prior to delivery to site. Where **Type Tested** components are wired together on site, ie not using specifically designed plugs and sockets for the purpose, it will be necessary to prove that all wiring has been correctly terminated by proving the functions which rely on the wiring at the	Considered. Test results see below.	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	time of commissioning as detailed in paragraph 15.2 and Form A2-4, Annex A.2. This Annex is primarily designed for the testing of three phase **Power Park Module**s. However, where practicable, a single phase, or split phase test may be carried out if it can be shown that it will produce the equivalent results. This Annex applies to **Power Park Module**s either with or without load management or without **Electricity Storage** devices connected on the prime mover side of the **Power Park Module**.		
A.7.1.2	**Type Verification Functional Testing of the Interface Protection** **Type Testing** is the responsibility of the **Manufacturer**. This test will verify that the operation of the **Power Park Module Interface Protection** shall result: a) in the safe disconnection of the **Power Park Module** from the **DNO's Distribution Network** in the event that system parameters exceed the protection settings specified in Table 10.1; and b) in the **Power Park Module** remaining connected to the **DNO**'s **Distribution Network** while **Distribution Network** conditions are: (1) within the envelope specified by the settings plus and minus the tolerances specified for equipment operation in Table 10.1; and (2) within the trip delay settings specified in Table 10.1. Wherever possible the type testing of a **Power Park Module** designed for a particular type of prime mover should be proved under normal conditions of operation for that technology (unless otherwise noted).	Considered. Test results see below.	**P**
A.7.1.2.1	**Disconnection times** The minimum trip time delay settings, for over / under voltage, over / under frequency and loss of mains tests below, are presented in Table 10.1. For over / under voltage, over / under frequency and loss of mains tests, reconnection shall be checked as detailed below.	Considered. Test results see below.	**P**
A.7.1.2.2	**Over / Under Voltage** The **Power Park Module** shall be tested by operating in parallel with a variable AC test supply, see Figure A.7.1. Correct protection and ride-through operation shall be confirmed during operation of the **Power Park Module.** The set points for over and under voltage at which the **Power Park Module** disconnects from the supply will be established by varying the AC supply voltage. To establish the trip voltage, the test voltage should be applied in steps of ± 0.5% or less, of the voltage setting for a duration that is longer than the trip time delay, for example 1 s in the case of a delay setting of 0.5 s starting at least 4 V below or above the setting. The test voltage at which this trip occurred is to be	Considered. Test results see below.	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	recorded. Additional tests just above and below the trip voltage should be undertaken to show that the test is repeatable and the figure at which a repeatable trip occurs should be recorded on the type verification test report Annex A.2-3. To establish the trip time, the test voltage should be applied starting from 4 V below or above the recorded trip voltage and should be changed to 4 V above or below the recorded trip voltage in a single step. The time taken from the step change to the **Inverter** tripping is to be recorded on the type verification test report Annex A.2-3. To establish correct ride-through operation, the test voltage should be applied at each setting ± 4 V and for the relevant times shown in the Table in Annex A.2-3. For example to test undervoltage setting stage 1 which is required to be set at nominally 195.5 V the circuit can be set up as shown below and the voltage adjusted to 199.5 V. In integrated designs where there is no separate way of establishing that the **Power Park Module** is disconnected, the **Power Park Module** should be powered up to export a measurable amount of energy so that it can be confirmed that the **Power Park Module** has ceased to output energy. The variable voltage supply is then decreased in steps of no more than 0.5% of nominal (1.15 V) maintaining the voltage for at least 3.5 s (trip time plus 0.5 s) at each voltage level. At each voltage level confirmation that the **Power Park Module** has not tripped after the time delay is required to be taken. At the voltage level at which a trip occurs then this should be recorded as the provisional trip voltage. Additional tests just above and if necessary just below the provisional trip voltage will allow the actual trip voltage to be established on a repeatable basis. This value should be recorded. For the sake of this example the actual trip level is assumed to have been established as being 195.5 V. The variable voltage supply should be set to 199.5 V, the **Power Park Module** set to produce a measurable output (if necessary) and then the voltage decreased to 191.5 V in a single step. The time from the step change to the disconnection of the **Power Park Module** should be recorded as the trip time. The **Power Park Module** then needs to operate at 4 V above the nominal undervoltage stage 1 setting which is 199.5 V for a period of at least 5 s without tripping and while producing a measurable output. This can be confirmed as a no trip in the relevant part of Annex A2-3. The voltage then needs to be stepped down to the next level of 142.0 V for a period of 2.5 s and then back to 199.5 V during which time the output of the relay should continue with no interruption though it may change due to the change in voltage, this can be recorded as a no trip for the second value. The step down and step up test needs to be done a second time with a min value of 134 V and with a time of 1.98 s.		

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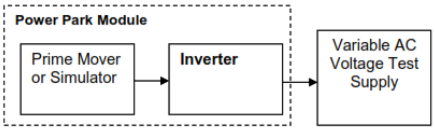
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	Note that this philosophy should be applied to the over voltage, over and under frequency, RoCoF and Vector shift stability tests which follow. Note: (1) The frequency required to trip is the setting ± 0.1 Hz (2) Measurement of operating time should be measured at a value of 0.3 Hz (suggestion – 2 x tolerance) above/below the setting to give "positive" operation (3) The "No trip tests" need to be carried out at the relevant values and times as shown in the table in Annex A.2-3 to ensure that the protection will not trip in error.  **Figure A.7.1. Power Park Module test set up – over / under voltage**		
A.7.1.2.3	**Over / Under Frequency** The **Power Park Module** shall be tested by operating in parallel with a low impedance, variable frequency test supply system, see Figure A.7.2. Correct protection and ride-through operation should be confirmed during operation of the **Power Park Module**. The set points for over and under frequency at which the **Power Park Module** system disconnects from the supply will be established by varying the test supply frequency. To establish a trip frequency, the test frequency should be applied in a slow ramp rate of less than 0.1 Hzs , or if this is not possible in steps of 0.05 Hz for a duration that is longer than the trip time delay, for example 1 s in the case of a delay setting of 0.5 s. The test frequency at which this trip occurred is to be recorded. Additional tests just above and below the trip frequency should be undertaken to show that the test is repeatable and the figure at which a repeatable trip occurs should be recorded on the type verification test report Annex A.2-3. To establish the trip time, the test frequency should be applied starting from 0.3 Hz below or above the recorded trip frequency and should be changed to 0.3 Hz above or below the recorded trip frequency in a single step. The time taken from the step change to the **Power Park Module** tripping is to be recorded on the type verification test report Annex A.2-3. It should be noted that with some loss of mains detection techniques this test may result in a faster trip due to operation of the loss of mains protection. There are two ways around this. Firstly the loss of mains protection may be able to be turned off in order to carry out this test. Secondly by establishing an accurate frequency for the trip a much smaller step change could be used to initiate the trip and establish a trip time. This may require the test to be repeated	Considered. Test results see below.	**P**

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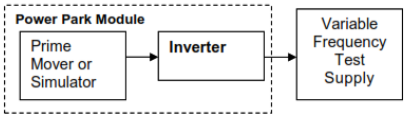
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	several times to establish that the time delay is correct. To establish correct ride-through operation, the test frequency should be applied at each setting ± 0.2 Hz and for the relevant times shown in the table in Annex A.2-3.  **Figure A.7.2 Power Park Module test set up – over / under frequency**		
A.7.1.2.4	**Loss of Mains Protection** The tests should be carried out in accordance with BS EN 62116 and a subset of results should be recorded as indicated in the Protection – loss of mains test section of Annex A.2-3 Type Test Verification Report. Multi phase Power Park Modules should be operated at part load while connected to a network running at about 50 Hz and one phase only shall be disconnected with no disturbance to the other phases. The Power Park Module should trip within 0.5 s. The test needs to be repeated with each phase disconnected in turn while the other two phases remain in operation and the results recorded in the Type Test declaration.	Considered. Test results see below.	**P**
A.7.1.2.5	**Re-connection** Further tests will be carried out with the three test circuits above to check the **Power Park Module** time out feature prior to automatic network reconnection. This test will confirm that once the AC supply voltage and frequency have returned to be within the stage 1 settings specified in Table 1 following an automatic protection trip operation there is a minimum time delay of 60 s before the **Power Park Module** output is restored (ie before the **Power Park Module** automatically reconnects to the **Distribution Network**).	Considered. Test results see below.	**P**
A.7.1.2.6	**Frequency Drift and Step Change Stability test.** The tests will be carried out using the same circuit as specified in A.7.1.2.3 above and following confirmation that the **Power Park Module** has passed the under and over frequency trip tests and the under and over frequency stability tests. Four tests are required to be carried out with all protection functions enabled including loss of mains. For each stability test the **Power Park Module** should not trip during the test. For the step change test the **Power Park Module** should be operated with a measurable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 s to complete	Considered. Test results see below.	**P**

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Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	the test. The **Power Park Module** should not trip during this test. For frequency drift tests the **Power Park Module** should be operated with a measurable output at the start frequency and then the frequency changed in a ramp function at 0.95 Hzs^{-1} to the end frequency. On reaching the end frequency it should be maintained for a period of at least 10 s. The **Power Park Module** should not trip during this test. The results shall be recorded on the test sheet of Annex A.2-3.		
A.7.1.3	**Limited Frequency Sensitive Mode – Over (LFSM-O)** There are two possible approaches to demonstrating **LFSM-O**. The first to use the test set up of Figure A.7.2. The second approach can be used where it is possible to inject a frequency control signal into the **Power Generating Module**. The **Manufacturer** or **Generator** can choose which is the more appropriate test for the **Power Generating Module**. The test below uses the test set up of Figure A.7.2 to demonstrate **LFSM-O** using a variable frequency supply. The alternative approach is covered in A.7.2.4. The test should be carried out above 80% **Registered Capacity** and repeated at 40-60% **Registered Capacity** using the specific threshold frequency of 50.2 Hz and **Droop** of 4%. The **Power Park Module** should be tested at the following frequencies: Step a) 50.00 Hz ±0.01 Hz Step b) 50.25 Hz ±0.05 Hz Step c) 50.70 Hz ±0.10 Hz Step d) 51.15 Hz ±0.05 Hz Step e) 50.70 Hz ±0.10 Hz Step f) 50.25 Hz ±0.05 Hz Step g) 50.00 Hz ±0.01 Hz The frequency at each step should be maintained for at least one minute and the **Active Power** reduction in the form of a gradient determined and assessed for compliance with paragraph 11.2.3.	Considered. Test results see below.	**P**
A.7.1.4	**Power Quality**		**P**
A.7.1.4.1	**Harmonics** The tests should be carried out as specified in BS EN 61000-3-12 and can be undertaken with a fixed source of energy at two power levels firstly between 45 and 55% and at 100% of **Registered Capacity**.	Considered. Test results see below.	**P**

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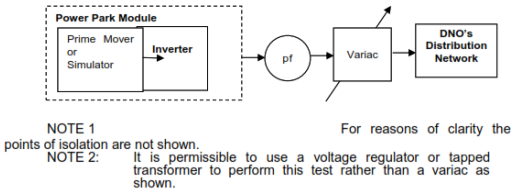
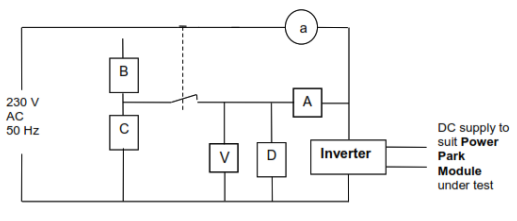
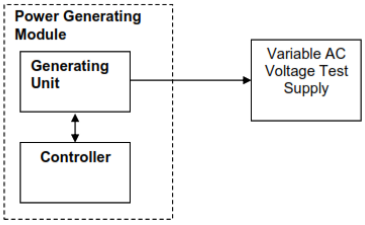
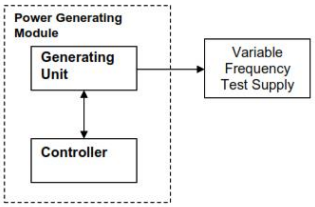
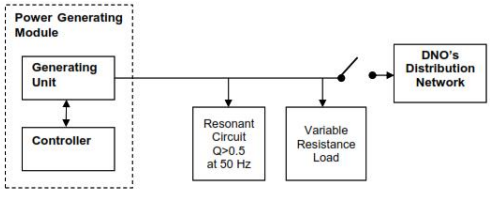
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A.7.1.4.2	**Power Factor** The test set up shall be such that the **Power Park Module** supplies full load to the **DNO's Distribution Network** via the **Power Factor** (pf) meter and the variac as shown below in Figure A.7.3. The **Power Park Module Power Factor** should be within the limits given in paragraph 11.1.5, for three test voltages 0.94 pu, 1 pu V[22] and 1.1 pu V.  NOTE 1 For reasons of clarity the points of isolation are not shown. NOTE 2: It is permissible to use a voltage regulator or tapped transformer to perform this test rather than a variac as shown. **Figure A.7.3 Power Park Module test set up – Power Factor** [22] For a LV connected Power Generating Module 1 pu V = 230 V	Considered. Test results see below.	**P**
A.7.1.4.3	**Voltage Flicker** The voltage fluctuations and flicker emissions from the **Power Park Module** shall be measured in accordance with BS EN 61000-3-11 and the technology specific Annex A.7.3. The required maximum supply impedance should be calculated and recorded in the relevant part of Compliance Verification Report Annex A.2 (Form A2-3).	Considered. Test results see below.	**P**
A.7.1.4.4	**DC Injection** The level of DC injection from the **Power Park Module**-connected prime mover in to the **DNO's Distribution Network** shall not exceed the levels specified in 9.4.6 when measured during operation at three levels, 10%, 55% and 100% of rating with a tolerance of ±5%. The DC injection requirements can be satisfied by the installation of an isolation transformer on the AC side of an **Inverter**-connected **Power Park Module**. A declaration that an isolating transformer is fitted can be made in lieu of the tests noted above.	Considered. Test results see below.	**P**
A.7.1.5	**Short Circuit Current Contribution** **Power Park Module** connected **Power Generating Module**'s generally have small short circuit fault contributions, however, the **DNO** needs to understand the contribution that they make to system fault levels in order to determine that they can continue to safely operate without exceeding design fault levels for switchgear and other circuit components. The following type tests shall be carried out and the results noted in Annex A.2-3.  **Figure A.7.4 Power Park Module short circuit test circuit**	Considered. Test results see below.	**P**

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A.7.1.6	**Self-Monitoring - Solid State Disconnection** Some **Power Park Module**s include solid state switching devices to disconnect from the **DNO**'s **Distribution Network**. In this case paragraph 9.7.9 requires the control equipment to monitor the output stage of the **Power Park Module** to ensure that in the event of a protection initiated trip the output voltage is either disconnected completely or reduced to a value below 50 V AC. This shall be verified either by self-certification by the **Manufacturer**, or additional material shall be presented to the tester sufficient to allow an assessment to be made.	A disconnection device with mechanical separation in the use of two relays in series in (each) line and neutral are provided in the SSEG. The internal disconnection device is comply with 4.1 function safety of the VDE 0126-1-1.	**N/A**
A.7.2	**Synchronous Power Generating Module Requirements (up to and including 50 kW)**		**N/A**
A7.2.1	**Certification & Type Testing Generating Unit Requirements** This Annex describes a methodology for obtaining type certification or type verification for a **Synchronous Power Generating Module** in conjunction with Form A2-1. Other compliance requirements are detailed in Form A2-2 which may be used as an alternative to this Annex. The **Interface Protection** of the **Synchronous Power Generating Module** shall satisfy the requirements of all of the following standards. Where these standards have more than one part, the requirements of all such parts shall be satisfied, so far as they are applicable. • BS EN 61000 (Electromagnetic Standards) • BS EN 60255 (Electrical Relays) • BS EN 61810 (Electrical Elementary Relays) • BS EN 60947 (Low Voltage Switchgear and Control gear) • BS EN 61869 (Instrument Transformers: Additional requirements for current transformers) Currently there are no harmonised functional standards that apply to the **Power Generating Module Interface Protection**, therefore in order to achieve **Type Tested** status the **Controller** and any separate **Interface Protection** unit will require their functionality to be **Type Tested** as described in this Annex, and recorded in format similar to that shown in Annex A.2-1. Where the **Interface Protection** is physically integrated within the overall **Power Generating Module** control system, the functionality of the **Interface Protection** unit should not be compromised by any failure of other elements of the control system (fail safe). For a **Fully Type Tested Power Generating Module** the completed **Power Generating Module**'s **Interface Protection** shall not rely on interconnection using cables which could be terminated incorrectly on site ie the interconnections shall be made by non-reversible plug and socket	No synchronous Power Generating Module	**N/A**

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	which the **Manufacturer** has made and tested prior to delivery to site. Where **Type Tested** components are wired together on site, ie not using specifically designed plugs and sockets for the purpose, it will be necessary to prove that all wiring has been correctly terminated by proving the functions which rely on the wiring at the time of commissioning as detailed in paragraph 15.2 and Form A2-4, Annex A.2. Wherever possible the type testing of a **Power Generating Module** utilising a particular type of prime mover should be proved under normal conditions of operation for that prime mover (unless otherwise noted). This Annex can also be used for asynchronous **Generating Unit**s that are not connected to the **Distribution Network** via an **Inverter** as appropriate. This Annex also applies to any **Synchronous Power Generating Module**s that are powered by stored energy (eg compressed air), but the requirement to demonstrate the **LFSM-O** will not be required.		
A.7.2.2	**Type Verification Testing of the Interface Protection Functions** Type verification testing is the responsibility of the **Manufacturer**. This test will verify that the operation of the **Power Generating Module Interface Protection** shall result: a) in the safe disconnection of the **Power Generating Module** from the **DNO's Distribution Network** in the event that the protection settings specified in Table 10.1 are exceeded; and b) in the **Power Generating Module** remaining connected to the **DNO's Distribution Network** while network conditions are: (1) within the envelope specified by the settings plus and minus the tolerances specified for equipment operation in Table 10.1; and (2) within the trip delay settings specified in Table 10.1. The **Interface Protection** may be incorporated into the **Controller** in which case it should be tested as part of the **Controller**. Alternatively, the constituent devices that form the **Interface Protection** may be discrete in which case the tests may be carried out on the discrete protection devices independently from the **Controller**. In either case it will be necessary to verify that a protection operation will disconnect the **Power Generating Module** from the **DNO's Distribution Network**.	No synchronous Power Generating Module	**N/A**

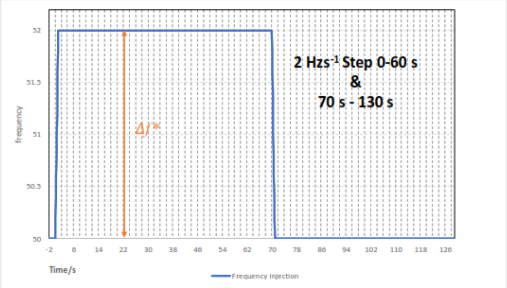
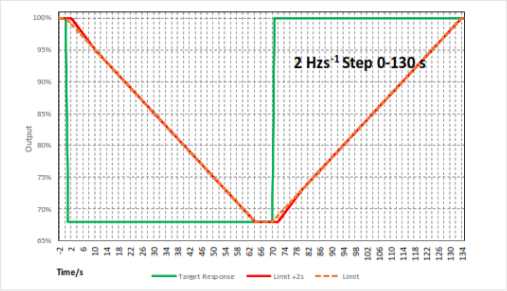
Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A7.2.2.1	**Disconnection times** The minimum trip time delay settings, for over / under voltage, over / under frequency and loss of mains tests below, are presented in Table 10.1. For over / under voltage, over / under frequency and loss of mains tests, reconnection shall be checked as detailed below. In some systems it may be safer and more convenient to test the trip delay time and the disconnection time separately. This will allow the trip delay time to be measured in a test environment (in a similar way as for a protection relay). The disconnection time can be measured in the **Power Generating Module**'s normal operation, allowing accurate measurement with correct inertia and prime mover characteristics. This is permitted providing the total disconnection time does not exceed the value specified in Section 10.6.7.1. When measuring the disconnection time where the **Interface Protection** is included in the **Controller**, 5 s disconnections should be initiated, and the average time recorded.	No synchronous Power Generating Module	**N/A**
A.7.2.2.2	**Over / Under Voltage** The **Interface Protection** shall be tested by operating the **Controller** in parallel with a variable AC test supply, as an example see Figure A.7.5. Correct protection and ride-through operation shall be confirmed. The set points for over and under voltage at which the **Interface Protection** disconnects from the supply, will be established by varying the AC supply voltage. The disconnect sequence should be initiated when the network conditions mean the protection should trip in accordance with the settings in Table 10.1, otherwise normal operation should continue. To establish the certified trip voltage, the test voltage should be applied in steps of ± 0.5% or less of the voltage setting for a duration that is longer than the trip time delay, for example 1 s in the case of a delay setting of 0.5 s starting at least 4 V below or above the setting. Additional tests just above and below the trip voltage should be undertaken to show that the test is repeatable and the figure at which a repeatable trip occurs should be recorded on the type verification test report Annex A.2-1. To establish the certified trip time, the test voltage should be applied starting from 4 V below or above the certified trip voltage and should be changed to 4 V above or below the certified trip voltage in a single step. The time taken from the step change to the **Power Generating Module** tripping is to be recorded on the type verification test report Annex A.2-1. To establish correct ride-through operation, the test voltage should be applied at each setting ± 4 V and for the relevant times shown in the Table in Annex A.2-1. For example, to test undervoltage setting which is required to be set at nominally 195.5 V the circuit can be set up as shown below and the voltage adjusted to	No synchronous Power Generating Module	**N/A**

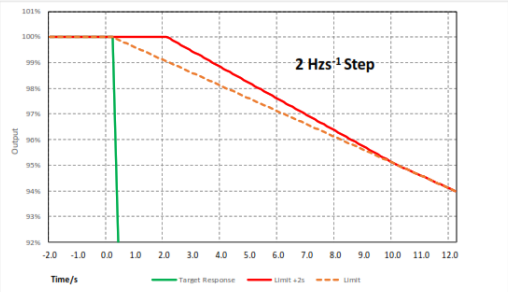
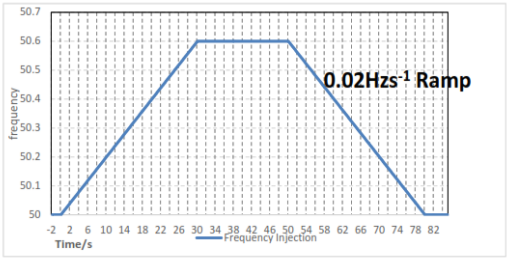
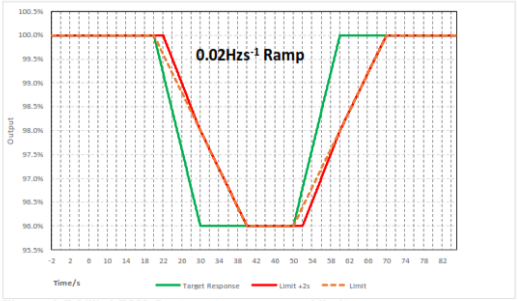
Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	195.5 V. In integrated designs where there is no separate way of establishing that the **Power Generating Module** is disconnected, the **Power Generating Module** should be powered up to export a measurable amount of energy so that it can be confirmed that the **Power Generating Module** has ceased to output energy. The variable voltage supply is then decreased in steps of no more than 0.5% of nominal voltage (1.15 V) maintaining the voltage for at least 3.5 s (trip time plus 0.5 s) at each voltage level. At each voltage level confirmation that the **Power Generating Module** has not tripped after the time delay is required to be taken. At the voltage level at which a trip occurs then this should be recorded as the provisional trip voltage. Additional tests just below and if necessary just above the provisional trip voltage will allow the actual trip voltage to be established on a repeatable basis. This value should be recorded. For the sake of this example the actual trip level is assumed to have been established as being 195.5 V. The variable voltage supply should be set to 199.5 V the **Power Generating Module** set to produce a measurable output (if necessary) and then the voltage raised to 191.5 V in a single step. The time from the step change to the disconnection of the **Power Generating Module**, the output of the **Power Generating Module** falling to zero should be recorded as the trip time. To confirm that the protection does not trip before the required time, the test voltage should be applied at each setting ± 4V and for the relevant times shown in the table in Annex A.2-1. Test results should be recorded on the Test Sheet shown in Annex A.2-1.  Figure A.7.5.- Power Generating Module test set up – over / under voltage		
A.7.2.2.3	**Over / Under Frequency** The **Interface Protection** shall be tested by operating the **Controller** in parallel with a low impedance, variable frequency test supply system, as an example, see Figure A.7.6. Correct protection and ride-through operation should be confirmed during the test. The set points for over and under frequency at which the **Interface Protection** disconnects from the supply will be established by varying the test supply frequency. To establish a trip frequency, the test frequency should be applied in a slow ramp rate of less than 0.1 Hzs^{-1}, or if this is not possible in steps of 0.05 Hz for a duration that is longer than the trip time delay, for example 1 s in the case of a delay setting of 0.5 s. The test frequency at which this trip occurred is to be	No synchronous Power Generating Module	**N/A**

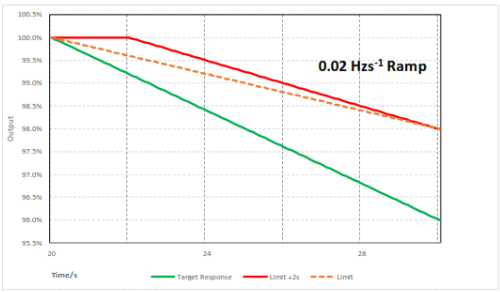
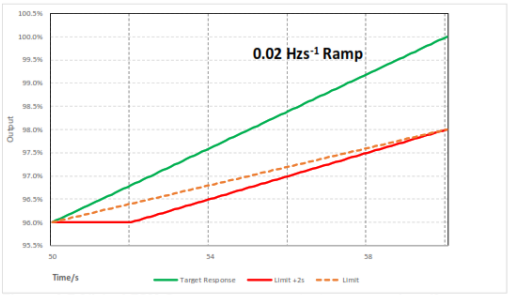
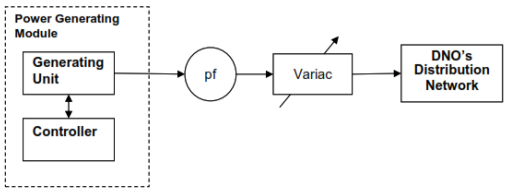
Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	recorded. Additional tests just above and below the trip frequency should be undertaken to show that the test is repeatable and the figure at which a repeatable trip occurs should be recorded on the type verification test report Annex A.2-1. To establish the trip time, the test frequency should be applied starting from 0.3 Hz below or above the recorded trip frequency and should be changed to 0.3 Hz above or below the recorded trip frequency in a single step. The time taken from the step change to the **Power Generating Module** tripping is to be recorded on the type verification test report Annex A.2-1. It should be noted that with some loss of mains detection techniques this test may result in a faster trip due to operation of the loss of mains protection and if possible the loss of mains protection should be turned off in order to carry out this test. Otherwise a much smaller step change should be used to initiate the trip and establish a trip time which may require the test to be repeated several times to establish that the time delay is correct. To confirm that the protection does not trip before the required time the test frequency should be applied at each setting ± 0.2 Hz and for the relevant times shown in the table in Annex A.2-1.  Figure A.7.6. set up – over / under frequency Power Generating Module test		
A.7.2.2.4	**Loss of Mains Protection** The resonant test circuit specified as an option for this test has been designed to model the interaction of the **Power Generating Module** under test with the local load including multiple **Power Generating Module**'s in parallel. The **Power Generating Module** output shall be connected to a network combining a resonant circuit with a Q factor of >0.5 and a variable load. The value of the load is to match the **Power Generating Module** output. To facilitate the test for LoM there shall be a switch placed between the test load/ **Power Generating Module** combination and the **DNO's Distribution Network**, as shown in Figure A.7.7.  Figure A.7.7 set up - loss of mains Power Generating Module test The **Power Generating Module** is to be tested at three levels of the **Power Generating Module**'s	No synchronous Power Generating Module	**N/A**

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	Registered Capacity: 10%, 55% and 100% and the results recorded on the test sheet of Annex A.2-1. For each test the load match is to be within ± 5%. Each test is to be repeated five times. Load match conditions are defined as being when the current from the **Power Generating Module** meets the requirements of the test load i.e. there is no export or import of supply frequency current to or from the **DNO's Distribution Network**. The tests will record the **Power Generating Module**'s output voltage and frequency from at least 2 cycles before the switch is opened until the protection system operates and disconnects itself from the **DNO's Distribution Network**, or for 5 s whichever is the lower duration. The time from the switch opening until the protection disconnection occurs is to be measured and shall comply with the requirements in Table 10.1. Multi phase **Power Generating Module**s should be operated at part load while connected to a network running at about 50 Hz and one phase only shall be disconnected with no disturbance to the other phases. The **Power Generating Module** should trip within 0.5 s. The test needs to be repeated with each phase disconnected in turn while the other two phases remain in operation and the results recorded in the **Type Test** declaration.		
A.7.2.2.5	**Re-connection** Further tests will be carried out with the three test circuits above to check the **Power Generating Module** time- out feature prior to automatic network reconnection. This test will confirm that once the AC supply voltage and frequency have returned to within the stage 1 settings specified in Table 10.1 following an automatic protection trip operation there is a minimum time delay of 60 s before reconnection will be allowed.	No synchronous Power Generating Module	**N/A**
A.7.2.2.6	**Frequency drift and vector shift stability test.** The tests will be carried out using the same circuit as specified in A.7.2.2.3 above and following confirmation that the **Power Generating Module** has passed the under and over frequency trip and no trip tests. Four tests are required to be carried out with all protection functions enabled including loss of mains. For each stability test the **Power Generating Module** should not trip during the test. For the step change test the **Power Generating Module** should be operated with a measurable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 s to complete the test. The **Power Generating Module** should not trip during this test.	No synchronous Power Generating Module	**N/A**

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	For frequency drift tests the **Power Generating Module** should be operated with a measurable output at the start frequency and then the frequency changed in a ramp function at 0.95 Hzs^{-1} to the end frequency. On reaching the end frequency it should be maintained for a period of at least 10 s. The **Power Generating Module** should not trip during this test. The results shall be recorded on the test sheet of Annex A.2-1.		
A.7.2.3	**Power Output with Falling Frequency** The **Generator** will propose and agree a test procedure with the **DNO**, which will demonstrate how the **Synchronous Power Generating Module Active Power** output responds to changes in system frequency under steady state conditions. The tests can be undertaken by the **Synchronous Power Generating Module** powering a suitable load bank, or alternatively using the test set up of Figure A.7.6. In both cases a suitable test could be to start the test at nominal frequency with the **Synchronous Power Generating Module** operating at 100% of its **Registered Capacity**. The frequency should then be set to 49.5 Hz for 5 minutes. The output should remain at 100% of **Registered Capacity**. The frequency should then be set to 49.0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The **Active Power** output shall not be below 99% of **Registered Capacity**. The frequency should then be set to 48.0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The **Active Power** output shall not be below 97% of **Registered Capacity**. The frequency should then be set to 47.6 Hz and once the output has stabilised, held at this frequency for 5 minutes. The **Active Power** output shall not be below 96.2% of **Registered Capacity**. The frequency should then be set to 47.1 Hz and held at this frequency for 20 s. The **Active Power** output shall not be below 95.0% of **Registered Capacity** and the **Synchronous Power Generating Module** shall not trip in less than the 20s of the test. The **Generator** shall inform the **DNO** if any load limiter control is additionally employed.	No synchronous Power Generating Module	**N/A**
A.7.2.4	**Limited Frequency Sensitive Mode – Over (LFSM-O)** Note that this test is also an alternative to the test in A.7.1.3. The two frequency response tests in **Limited Frequency Sensitive Mode (LFSM)** to demonstrate **LFSM-O** capability to a frequency injection as shown by Figure A.7.8 and Figure A.7.9 are to be conducted at **Registered Capacity** (although a lower power output may be agreed with the **DNO** if site conditions	No synchronous Power Generating Module	**N/A**

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	preclude attaining **Registered Capacity**, such as an absence of adequate wind). There should be sufficient time allowed between tests for control systems to reach steady state. The injection signal should be maintained until the **Active Power** (MW) output of the **Power Generating Module** has stabilised. The **DNO** may require repeat tests should the tests give unexpected results. The frequency input and the expected **Active Power** response are illustrated for different periods from 0 s to 130 s in Figure A.7.8 for a step change in frequency and in Figures A.7.9 for a ramp change in frequency. This should be in accordance with Section 11.2.5 (a threshold frequency of 50.2 Hz and a **Droop** of 4%) and undamped oscillations should not occur after the step or ramp frequency change. Note for diagram purposes only a short interval is shown between the frequency increase and decrease for each test. In practice the return step or ramp can start any time after the output has stabilized after the first step or ramp. The response should commence within 2 s and shall be to the left of the red line (i.e. between the green line and the red line) and be as close to the green line as possible when following the frequency step or ramp. Note that the red line represents the 0.5% s^{-1} specified in 11.2.5.1.  **Figure A.7.8(i): LFSM-O step response test – frequency injection**  **Figure A.7.8(ii): LFSM-O step response test – target response and limits**		

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	 **Figure A.7.8(iii): LFSM-O step response test – expansion of the allowed 2 s response delay (frequency increase)** * This frequency step Δf will generally be +2.0 Hz unless an injection of this size causes a reduction in plant output that takes the operating point below **Minimum Stable Operating Level** in which case an appropriate injection should be calculated in accordance with the following: For example 0.6 Hz is needed to take an initial output of 100% to a final output of 70%. If the initial output is not 100% and the **Minimum Stable Operating Level** is not 70% then the injected step should be adjusted accordingly as shown in the example given below: Initial output 100% **Minimum Stable Operating Level** 70% Frequency controller **Droop** 4% Frequency to be injected = (1.00 – 0.70) x 0.04 x 50 = 0.6Hz  **Figure A.7.9(i): LFSM-O ramp response test – frequency injection**  **Figure A.7.9(ii): LFSM-O – target response and limits**		

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	 **Figure A.7.9(iii): LFSM-O ramp response test – expansion (frequency increase)**  **Figure A.7.9(iv): LFSM-O ramp response test – expansion (frequency decrease)**		
A.7.2.5	**Power Quality**		**N/A**
A.7.2.5.1	**Harmonics** The tests should be carried out as specified in BS EN 61000-3-12 and can be undertaken with a fixed source of energy at two power levels firstly between 45 and 55% and at 100% of **Registered Capacity**.	No synchronous Power Generating Module	**N/A**
A.7.2.5.2	**Power Factor** The test set up shall be such that the **Power Generating Module** supplies full load to the **DNO's Distribution Network** via the **Power Factor** (pf) meter and the variac as shown below in Figure A.7.10. The **Power Generating Module** pf should be within the limits given in paragraph 11.1.5, for three test voltages 230 V –6%, 230 V and 230 V +10%.  NOTE 1. For reasons of clarity the points of isolation are not shown NOTE 2: It is permissible to use a voltage regulator or tapped transformer to perform this test rather than a variac as shown **Figure A.7.10 Power Generating Module test set up – Power Factor**	No synchronous Power Generating Module	**N/A**
A.7.2.5.3	**Voltage Flicker** The voltage fluctuations and flicker emissions from the **Generating Unit** shall be measured in accordance with BS EN 61000-3-11 and technology specific annex. The required maximum supply impedance should be calculated and recorded in the **Type Test** declaration Annex A.2-1.	No synchronous Power Generating Module	**N/A**

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A.7.3	**Additional Power Generating Module Technology Requirements**		
A.7.3.1	**Domestic CHP** For Domestic CHP **Power Park Module**s the type verification testing and **Interface Protection** requirements will be as per the requirements defined in Annex A.7.1. For Domestic CHP **Synchronous Power Generating Module**s the type verification testing and **Interface Protection** requirements will be as per the requirements defined in Annex A.7.2.	No Domestic CHP	**N/A**
A.7.3.2	**Photovoltaic** As all current Photovoltaic **Power Park Module**s will connect to the **DNO's Distribution Network** via an **Inverter**, the type verification testing and **Interface Protection** requirements will be as per the requirements defined in Annex A.7.1.	Photovoltaic inverter.	**P**
A.7.3.3	**Fuel Cells** As all current Fuel Cell **Power Generating Module**s will connect to the **DNO**'s **Distribution Network** via an **Inverter**, the type verification testing and **Interface Protection** requirements will be as per the requirements defined in Annex A.7.1.	No Fuel Cell System	**N/A**
A.7.3.4	**Hydro** Hydro can be connected to the **DNO**'s **Distribution Network** directly using induction or **Synchronous Power Generating Module**s or it can be connected by an **Inverter**. The common requirements for the generator technologies will apply to micro hydro in addition the following needs to be taken into consideration. **Power Generating Module**s with manually fixed output or where the output is fixed by controlling the water flow through the turbine to a steady rate, need to comply with the maximum voltage change requirements of BS EN 61000-3-2 but do not need to be tested for Pst or Plt. **Power Park Module**s where the output is controlled by varying the load on the generator using the **Inverter** and which therefore produces variable output need to comply with the maximum voltage change requirements of BS EN 61000-3-2 and also need to be tested for Pst and Plt over a period where the range of flows varies over the design range of the turbine with a period of at least 2 hours at each step with there being 10 steps from min flow to maximum flow. Pst and Plt values to recorded and normalised as per the method laid down in Annex A.3.	No Hydro	**N/A**
A7.3.5	**Wind** Wind turbines can be connected to the **DNO**'s **Distribution Network** directly, typically using asynchronous induction generators, or using **Inverter**s. For those connected via **Inverters**, the type verification testing and **Interface Protection** requirements shall be as specified in Annex A.7.1.	No Wind	**N/A**

Engineering recommendation G99/NI			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
	For those connected directly to the **DNO**'s **Distribution Network**, the type verification testing and **Interface Protection** requirements shall be as specified in Annex A.7.2. For wind turbines, flicker testing should be carried out during the performance tests specified in BS EN 61400-12. Flicker data should be recorded from wind speeds of 1 ms below cut-in to 1.5 times 85% of the rated power. The wind speed range should be divided into contiguous bins of $1ms^{-1}$ centred on multiples of 1 ms^{-1}. The dataset shall be considered complete when each bin includes a minimum of 10 minutes of sampled data. The highest recorded values across the whole range of measurements should be used as inputs to the calculations described in BS EN 61000-3-11 to remove background flicker values. Then the required maximum supply impedance values can be calculated as described in Annex A.2-3. Note that occasional very high values may be due to faults on the associated **HV** network and may be discounted, though care should be taken to avoid discounting values which appear regularly.		
A.7.3.6	**Electricity Storage Device** **Electricity Storage** devices can be connected to the **DNO**'s **Distribution Network** directly or using **Inverters**. For those connected via **Inverter**s, the type verification testing and **Interface Protection** requirements shall be as specified in Annex A.7.1 For those connected directly to the **DNO**'s **Distribution Network**, the type verification testing and **Interface Protection** requirements shall be as specified in Annex A.7.2. The tests associated with any requirements which have been identified in Annex A4 as not being applicable to **Electricity Storage** devices can be considered to be excluded tests in this Annex A7.	No Electricity Storage Device	**P**

G99/NI-1

A2-3 Compliance Verification Report – Tests for Type A Inverter Connected Power Generating Modules – test record

A.7.1.2	Type Verification Functional Testing of the Interface Protection (4.1 Functional safety - fault condition tests according DIN V VDE V 0126-1-1)	P

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
Relay K5901	Short before start up	230V 0A	500V 0A	10 min	Ext. 16A	230V 0A	500V 0A	Unit doesn't start up, Error message:" ERR 7702", No hazard, No defect, No fire
Relay K5900	Short before start up	230V 0A	500V 0A	10 min	Ext. 16A	230V 0A	500V 0A	Unit doesn't start up, Error message:" ERR 7702", No hazard, No defect, No fire
Monitoring voltage L 1 defect	3,1% voltage disbalance	230V 6,3A	500V 5,1A	10 min	Ext. 16A	230V 0A	500V 0A	Unit switched of immediately, Error message: "6305", No hazard No defect, No fire
Monitoring voltage L 1 defect	3,1% voltage disbalance	230V 6,3A	500V 5,1A	10 min	Ext. 16A	230V 0A	500V 0A	Unit switched of immediately, Error message: "6305", No hazard No defect, No fire
Frequency Measurement disabled	Measurement covered with the voltage test.							
Leakage Sensor defect	Offset unbalance	230V 6,3A	500V 5,1A	10 min	Ext. 16A	230V 0A	500V 0A	Unit switched of immediately, Error message: "6202", No hazard No defect, No fire
Leakage test winding	Test current changed	230V 6,3A	500V 5,1A	10 min	Ext. 16A	230V 0A	500V 0A	Unit switched of immediately, Error message: "6202", No hazard No defect, No fire
Communication Microcontroller defect	Run time error	230V 6,3A	500V 5,1A	10 min	Ext. 16A	230V 0A	500V 0A	Unit switched of immediately, Error message: "6105/6416", No hazard No defect, No fire
Loss of control	Reset	230V 6,3A	500V 5,1A	10 min	Ext. 16A	230V 0A	500V 0A	Unit switched of immediately, Error message: "6006", No hazard No defect, No fire
Loss of watchdog	R2601 open	230V 6,3A	500V 5,1A	10 min	Ext. 16A	230V 0A	500V 0A	Unit switched of immediately, No hazard No defect, No fire
Relay K5901	Short before start up	230V 0A	500V 0A	10min	Ext. 16A	230V 0A	500V 0A	Unit doesn't start up, Error message:" ERR 7702", No hazard, No defect, No fire
Relay K5900	Short before start up	230V 0A	500V 0A	10min	Ext. 16A	230V 0A	500V 0A	Unit doesn't start up, Error message:" ERR 7702", No hazard, No defect, No fire
The errors in the control circuit simulate that the safety is even under one error ensured.								

Addendum – Shutdown device	
Each active phase can be switched. (L and N)	Yes. In each line and neutral a Relay with min. 2,1 mm gab used.
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 according to IEC 62109-2.	Two relays in series used in each active phase (L and N).

Operating Range:	**P**
Test 1	Voltage = 85% of nominal (195,5 V) Frequency = 47,5 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 2	Voltage = 110% of nominal (253,0 V) Frequency = 51,5 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 3	Voltage = 110% of nominal (253,0 V) Frequency = 52,0 Hz Power Factor = 1 Period of test 15 minutes
Connection:	Always connected
Limit:	Always connected

Note:
During the tests the interface protection was disabled.
Operation at reduced power is allowed during test 1 and test 2, equal to the maximum power that can be supplied on reaching the maximum output current limit (P ≥ 0,85 Sn).
During the sequence of test 2, automatic adjustment to reduce power in the case of over-frequency was disabled.

A.7.1.2.2	**Over / Under Voltage** The test are carried out as stated in Annex A.7.1.2.2 (Inverter connected)					**P**
Phase 1						
Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V stage 1	195,5	3,0	195,0	3,273	199,5 V / 5,00 s	No trip
U/V stage 2	138,0	2,0	137,4	2,274	142,0 V / 2,50 s	No trip
					134,0 V / 1,98 s	No trip
O/V stage 1	253,0	0,5	253,0	0,773	249,0 V / 5,00 s	No trip
					257,0 V / 0,45 s	No trip
Phase 2						
Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V stage 1	195,5	3,0	195,2	3,266	199,5 V / 5,00 s	No trip
U/V stage 2	138,0	2,0	137,6	2,266	142,0 V / 2,50 s	No trip
					134,0 V / 1,98 s	No trip
O/V stage 1	253,0	0,5	252,8	0,767	249,0 V / 5,00 s	No trip
					257,0 V / 0,45 s	No trip

A.7.1.2.2	**Over / Under Voltage** The test are carried out as stated in Annex A.7.1.2.2 (Inverter connected)	**P**

Phase 3

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V stage 1	195,5	3,0	194,8	3,270	199,5 V / 5,00 s	No trip
U/V stage 2	138,0	2,0	137,2	2,270	142,0 V / 2,50 s	No trip
					134,0 V / 1,98 s	No trip
O/V stage 1	253,0	0,5	252,7	0,750	249,0 V / 5,00 s	No trip
					257,0 V / 0,45 s	No trip

Note:

The Voltage required to trip is the setting ± 3,45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ± 4,0 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

A.7.1.2.3	**Over / Under Frequency** The test are carried out as stated in Annex A.7.1.2.3 (Inverter connected)					**P**
Function	Setting		Trip test		No trip test	
	Frequency [Hz]	Time delay [s]	Frequency [Hz]	Time delay [s]	Frequency / time	Confirm no trip
U/F stage 1	48,0	0,5	47,99	0,766	48,2 Hz / 25,00 s	No trip
					47,8 Hz / 0,45 s	No trip
O/F stage 1	52,0	1,0	52,00	1,279	51,8 Hz / 120,00 s	No trip
					52,2 Hz / 0,98 s	No trip

Note:
For frequency trip tests the frequency required to trip is the setting ± 0,1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The “No trip tests” need to be carried out at the setting ± 0,2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

A.7.1.2.4	**Loss of mains protection according BS EN 62116** These test is carried out in accordance with BS EN 62116 as stated in Annex A.7.1.2.4. Load imbalance (real, reactive load) for test condition A (EUT output = 100%)	**P**

Test conditions	Frequency: 50,0 ± 0,1 Hz U_N = 230,0 ± 3 Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	0,5 s

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)	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [s]	Remarks4)
1	100	100	0	0	11000	850	1,00	0,146	BL
4	100	100	-5	-5	11000	850	0,95	0,098	IB
5	100	100	-5	0	11000	850	1,05	0,274	IB
6	100	100	-5	+5	11000	850	0,99	0,111	IB
7	100	100	0	-5	11000	850	0,99	0,111	IB
8	100	100	0	+5	11000	850	1,08	0,098	IB
9	100	100	+5	-5	11000	850	0,99	0,108	IB
10	100	100	+5	0	11000	850	1,07	0,193	IB
11	100	100	+5	+5	11000	850	1,01	0,113	IB

Parameter at 0%	L= 15,31 mH	R= 4,81 Ω	C= 661,9µF

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) = > 75% 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, 75% of range =X + 0,75 × (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.

A.7.1.2.4	**Loss of mains protection according BS EN 62116** These test is carried out in accordance with BS EN 62116 as stated in Annex A.7.1.2.4. Load imbalance (real, reactive load) for test condition B (EUT output = 50% – 66%)	**P**

Test conditions	Frequency: 50,0 ± 0,1 Hz U_N = 230,0 ± 3 Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	0,5 s

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)	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [s]	Remarks4)
12	66	66	0	-5	7215	850	0,96	0,150	Test B at IB
13	66	66	0	-4	7215	850	0,96	0,097	Test B at IB
14	66	66	0	-3	7215	850	0,97	0,110	Test B at IB
15	66	66	0	-2	7215	850	0,98	0,100	Test B at IB
16	66	66	0	-1	7215	850	0,99	0,113	Test B at IB
2	66	66	0	0	7215	850	1,00	0,133	Test B at BL
17	66	66	0	1	7215	850	1,01	0,097	Test B at IB
18	66	66	0	2	7215	850	1,01	0,098	Test B at IB
19	66	66	0	3	7215	850	1,02	0,096	Test B at IB
20	66	66	0	4	7215	850	1,04	0,106	Test B at IB
21	66	66	0	5	7215	850	1,05	0,097	Test B at IB

Parameter at 0%	L= 23,34 mH	R= 7,33 Ω	C= 434,14 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.

A.7.1.2.4	**Loss of mains protection according BS EN 62116** These test is carried out in accordance with BS EN 62116 as stated in Annex A.7.1.2.4. Load imbalance (real, reactive load) for test condition C (EUT output = 25% – 33%)	**P**

Test conditions	Frequency: 50,0 ± 0,1 Hz U_N =230,0 ± 3 Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	0,5 s

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)	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [s]	Remarks4)
22	33	33	0	-5	3352	850	0,96	0,132	Test C at IB
23	33	33	0	-4	3352	850	0,96	0,098	Test C at IB
24	33	33	0	-3	3352	850	0,97	0,103	Test C at IB
25	33	33	0	-2	3352	850	0,98	0,101	Test C at IB
26	33	33	0	-1	3352	850	0,99	0,106	Test C at IB
3	33	33	0	0	3352	850	1,00	0,103	Test C at BL
27	33	33	0	1	3352	850	1,01	0,132	Test C at IB
28	33	33	0	2	3352	850	1,01	0,098	Test C at IB
29	33	33	0	3	3352	850	1,02	0,099	Test C at IB
30	33	33	0	4	3352	850	1,04	0,104	Test C at IB
31	33	33	0	5	3352	850	1,05	0,172	Test C at IB

Parameter at 0%	L= 47,41 mH	R= 14,89 Ω	C= 213,73 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.

A.7.1.2.5	**Reconnection** The test procedure in Annex A.7.1.2.5 (Inverter connected)	**P**

Test should prove that the reconnection sequence starts after a minimum delay of 60 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.1

Under Voltage	
Time delay setting [s]	Measured delay [s]
60,0	68,9
Over Voltage	
Time delay setting [s]	Measured delay [s]
60,0	67,9
Under Frequency	
Time delay setting [s]	Measured delay [s]
60,0	68,2
Over Frequency	
Time delay setting [s]	Measured delay [s]
60,0	70,2

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 257,0 V	At 191,5 V	At 47,9 Hz	At 52,1 Hz
Confirmation that the SSEG does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

A.7.1.2.6	**Frequency Drift and Step change Stability test** This test is carried out in accordance with Annex A.7.1.2.6.			**P**
	Start Frequency [Hz]	Change	Test time	Confirm no trip
Positive Vector Shift	49,5	+ 50 degrees		No trip
Negative Vector Shift	50,5	- 50 degrees		No trip
Positive Frequency drift	49,0 – 51,0	+ 0,95 Hz/sec	2,1 s	No trip
Negative Frequency drift	51,0 – 49,0	- 0,95 Hz/sec	2,1 s	No trip

Note:

For the step change test the SSEG should be operated with a measurable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 seconds to complete the test. The SSEG should not trip during this test.

For frequency drift tests the SSEG should be operated with a measurable output at the start frequency and then the frequency changed in a ramp function at 0,95 Hz per second to the end frequency. On reaching the end frequency it should be maintained for a period of at least 10 seconds. The SSEG should not trip during this test.

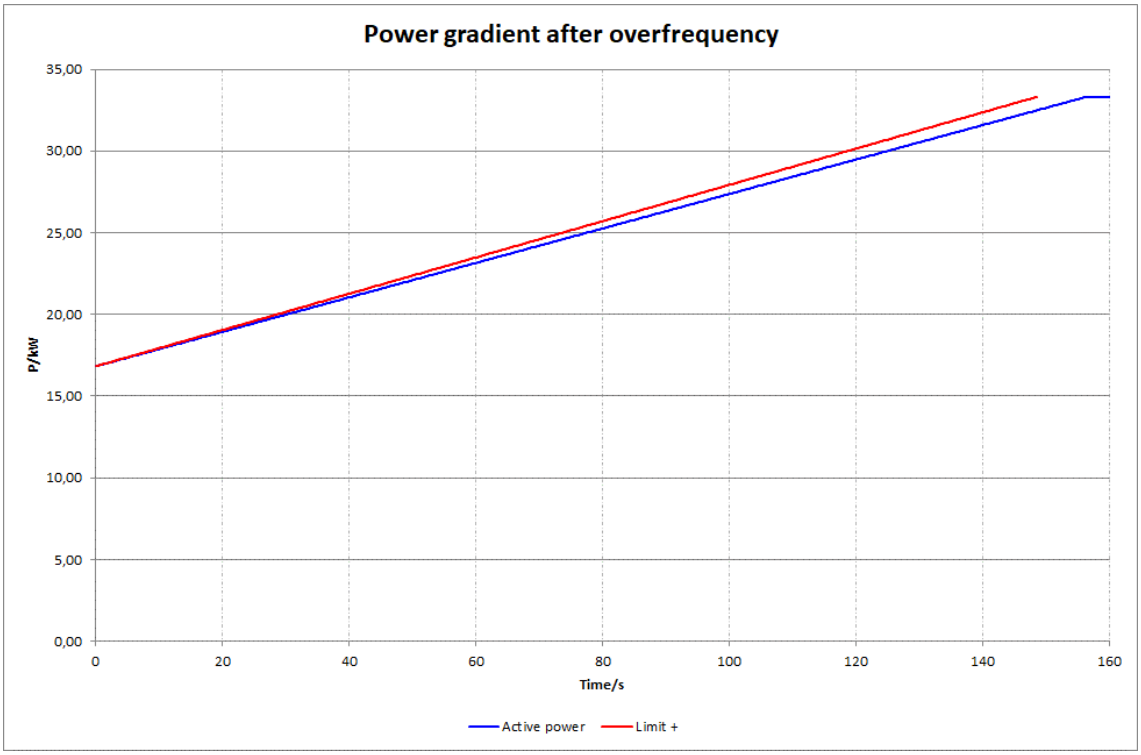
A.7.2.3	Power Output with Falling frequency					P
5-min mean value (each)	50,00 Hz	49,50 Hz	49,00 Hz	48,00 Hz	47,60 Hz	47,10 Hz
Frequency [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
Active power [W]:	32841	32850	32862	32870	32881	32884
ΔP/Pmax [%]:		0,03	0,07	0,10	0,11	0,13

Note:
Electronic inverter no power reduction take place.
47.10 Hz only for 20 seconds

A.7.1.3	**Limited Frequency Sensitive Mode – Over frequency test** The test should be carried out using the specific threshold frequency of 50.2 Hz and Droop of 4%. This test is carried out in accordance with Annex A.7.1.3.	**P**

1-min mean value [Hz]:	a) 50,00	b) 50,25	c) 50,70	d) 51,15	e) 50,70	f) 50,25	g) 50,00
1. Measurement a) to g): Active power output > 80% P_n							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
$P_{expected}$ [kW]:	33,30	32,20	24,77	17,34	24,77	32,20	33,30
$P_{measured}$ [kW]:	33,03	32,20	24,77	17,34	24,77	32,20	33,30
2. Measurement a) to g): Active power output 40% and 60%							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
$P_{expected}$ [kW]:	16,80	16,38	12,60	8,82	12,60	16,38	16,80
$P_{measured}$ [kW]:	16,80	16,38	12,60	8,82	12,60	16,38	16,80

Graph of power gradient:



A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 - 55% of rated output 4201 W		100% of rated output 8364 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,100	0,04	0,110	8%	8%
3rd	0,05	0,140	0,05	0,130	21,6%	N/A
4th	0,02	0,050	0,02	0,060	4%	4%
5th	0,19	0,510	0,15	0,420	10,7%	10,7%
6th	0,02	0,050	0,02	0,040	2,67%	2,67%
7th	0,13	0,350	0,11	0,300	7,2%	7,2%
8th	0,01	0,040	0,01	0,040	2%	2%
9th	0,04	0,110	0,04	0,100	3,8%	N/A
10th	0,01	0,030	0,01	0,030	1,6%	1,6%
11th	0,10	0,270	0,10	0,270	3,1%	3,1%
12th	0,01	0,030	0,01	0,030	1,33%	1,33%
13th	0,06	0,180	0,05	0,150	2%	2%
14th	0,01	0,030	0,01	0,030	N/A	N/A
15th	0,02	0,070	0,03	0,070	N/A	N/A
16th	0,01	0,030	0,01	0,030	N/A	N/A
17th	0,05	0,130	0,04	0,120	N/A	N/A
18th	0,01	0,020	0,01	0,020	N/A	N/A
19th	0,03	0,090	0,03	0,070	N/A	N/A
20th	0,01	0,030	0,01	0,030	N/A	N/A
21th	0,01	0,020	0,01	0,020	N/A	N/A
22th	0,01	0,020	0,01	0,020	N/A	N/A
23th	0,02	0,060	0,02	0,050	N/A	N/A
24th	0,01	0,020	0,01	0,020	N/A	N/A
25th	0,01	0,040	0,01	0,030	N/A	N/A
26th	0,01	0,020	0,01	0,020	N/A	N/A
27th	0,00	0,010	0,01	0,010	N/A	N/A
28th	0,01	0,020	0,01	0,020	N/A	N/A
29th	0,01	0,030	0,01	0,020	N/A	N/A
30th	0,01	0,020	0,01	0,020	N/A	N/A
31th	0,01	0,010	0,01	0,020	N/A	N/A
32th	0,01	0,020	0,01	0,020	N/A	N/A
33th	0,01	0,020	0,01	0,010	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 - 55% of rated output 4201 W		100% of rated output 8364 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
34th	0,01	0,020	0,01	0,020	N/A	N/A
35th	0,01	0,020	0,01	0,020	N/A	N/A
36th	0,00	0,010	0,01	0,010	N/A	N/A
37th	0,01	0,010	0,01	0,030	N/A	N/A
38th	0,01	0,020	0,01	0,020	N/A	N/A
39th	0,00	0,010	0,00	0,010	N/A	N/A
40th	0,01	0,020	0,01	0,020	N/A	N/A
41th	0,01	0,020	0,01	0,020	N/A	N/A
42th	0,00	0,010	0,00	0,010	N/A	N/A
43th	0,01	0,020	0,01	0,030	N/A	N/A
44th	0,01	0,020	0,01	0,020	N/A	N/A
45th	0,00	0,010	0,00	0,010	N/A	N/A
46th	0,01	0,020	0,01	0,020	N/A	N/A
47th	0,01	0,020	0,01	0,020	N/A	N/A
48th	0,00	0,010	0,00	0,010	N/A	N/A
49th	0,01	0,020	0,01	0,030	N/A	N/A
50th	0,01	0,020	0,01	0,020	N/A	N/A
51th	0,00	0,010	0,00	0,010	N/A	N/A
52th	0,01	0,020	0,01	0,020	N/A	N/A
53th	0,01	0,030	0,01	0,030	N/A	N/A
54th	0,00	0,010	0,00	0,010	N/A	N/A
55th	0,01	0,020	0,01	0,030	N/A	N/A
56th	0,01	0,020	0,01	0,020	N/A	N/A
57th	0,00	0,010	0,00	0,010	N/A	N/A
58th	0,01	0,020	0,01	0,020	N/A	N/A
59th	0,01	0,030	0,01	0,040	N/A	N/A
60th	0,00	0,010	0,00	0,010	N/A	N/A
61th	0,01	0,040	0,01	0,040	N/A	N/A
62th	0,01	0,020	0,01	0,020	N/A	N/A
63th	0,00	0,010	0,00	0,010	N/A	N/A
64th	0,01	0,020	0,01	0,020	N/A	N/A
65th	0,01	0,030	0,01	0,040	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 - 55% of rated output 4201 W		100% of rated output 8364 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
66th	0,00	0,010	0,00	0,010	N/A	N/A
67th	0,01	0,040	0,02	0,040	N/A	N/A
68th	0,01	0,020	0,01	0,020	N/A	N/A
69th	0,00	0,010	0,00	0,010	N/A	N/A
70th	0,01	0,020	0,01	0,020	N/A	N/A
71th	0,01	0,040	0,01	0,040	N/A	N/A
72th	0,00	0,010	0,00	0,010	N/A	N/A
73th	0,01	0,040	0,01	0,040	N/A	N/A
74th	0,01	0,020	0,01	0,020	N/A	N/A
75th	0,01	0,020	0,01	0,020	N/A	N/A
76th	0,01	0,020	0,01	0,020	N/A	N/A
77th	0,02	0,050	0,02	0,040	N/A	N/A
78th	0,00	0,010	0,00	0,010	N/A	N/A
79th	0,02	0,050	0,01	0,040	N/A	N/A
80th	0,01	0,020	0,01	0,020	N/A	N/A
81th	0,01	0,010	0,01	0,020	N/A	N/A
82th	0,01	0,020	0,01	0,020	N/A	N/A
83th	0,02	0,050	0,02	0,050	N/A	N/A
84th	0,00	0,010	0,00	0,010	N/A	N/A
85th	0,02	0,060	0,02	0,050	N/A	N/A
86th	0,01	0,020	0,01	0,020	N/A	N/A
87th	0,01	0,020	0,01	0,020	N/A	N/A
88th	0,01	0,020	0,01	0,020	N/A	N/A
89th	0,02	0,070	0,01	0,040	N/A	N/A
90th	0,00	0,010	0,01	0,010	N/A	N/A
91th	0,02	0,070	0,02	0,040	N/A	N/A
92th	0,01	0,030	0,01	0,030	N/A	N/A
93th	0,01	0,030	0,01	0,030	N/A	N/A
94th	0,01	0,030	0,01	0,030	N/A	N/A
95th	0,04	0,100	0,01	0,040	N/A	N/A
96th	0,01	0,020	0,01	0,020	N/A	N/A
97th	0,03	0,080	0,02	0,050	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 - 55% of rated output 4201 W		100% of rated output 8364 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
98th	0,01	0,030	0,01	0,030	N/A	N/A
99th	0,02	0,060	0,02	0,050	N/A	N/A
100th	0,01	0,040	0,01	0,030	N/A	N/A
THD_{40}		0,76		0,67	23%	13%
THD_{50}		0,77		0,67	23%	13%
THD_{60}		0,77		0,67	23%	13%
THD_{100}		0,81		0,70	23%	13%
PWHD		0,009		0,009	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4179 W		100% of rated output 8340 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,05	0,130	0,08	0,05	8%	8%
3rd	0,04	0,120	0,05	0,04	21,6%	N/A
4th	0,01	0,040	0,02	0,01	4%	4%
5th	0,16	0,450	0,14	0,16	10,7%	10,7%
6th	0,02	0,050	0,02	0,02	2,67%	2,67%
7th	0,11	0,300	0,09	0,11	7,2%	7,2%
8th	0,01	0,030	0,01	0,01	2%	2%
9th	0,03	0,100	0,04	0,03	3,8%	N/A
10th	0,01	0,030	0,01	0,01	1,6%	1,6%
11th	0,08	0,210	0,09	0,08	3,1%	3,1%
12th	0,01	0,040	0,01	0,01	1,33%	1,33%
13th	0,05	0,140	0,04	0,05	2%	2%
14th	0,01	0,030	0,01	0,01	N/A	N/A
15th	0,02	0,060	0,02	0,02	N/A	N/A
16th	0,01	0,030	0,01	0,01	N/A	N/A
17th	0,03	0,090	0,03	0,03	N/A	N/A
18th	0,01	0,030	0,01	0,01	N/A	N/A
19th	0,03	0,080	0,02	0,03	N/A	N/A
20th	0,01	0,020	0,01	0,01	N/A	N/A
21th	0,01	0,020	0,01	0,01	N/A	N/A
22th	0,01	0,020	0,01	0,01	N/A	N/A
23th	0,02	0,050	0,01	0,02	N/A	N/A
24th	0,01	0,020	0,01	0,01	N/A	N/A
25th	0,02	0,050	0,01	0,02	N/A	N/A
26th	0,01	0,020	0,01	0,01	N/A	N/A
27th	0,01	0,020	0,01	0,01	N/A	N/A
28th	0,01	0,020	0,01	0,01	N/A	N/A
29th	0,01	0,030	0,01	0,01	N/A	N/A
30th	0,01	0,020	0,01	0,01	N/A	N/A
31th	0,01	0,020	0,01	0,01	N/A	N/A
32th	0,01	0,020	0,01	0,01	N/A	N/A
33th	0,01	0,010	0,01	0,01	N/A	N/A
34th	0,01	0,020	0,01	0,01	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.					P
Generating Unit tested to BS EN 61000-3-12						
SE25K, Phase 2						
Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4179 W		100% of rated output 8340 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,020	0,00	0,01	N/A	N/A
36th	0,01	0,010	0,00	0,01	N/A	N/A
37th	0,00	0,010	0,01	0,00	N/A	N/A
38th	0,01	0,020	0,01	0,01	N/A	N/A
39th	0,00	0,010	0,00	0,00	N/A	N/A
40th	0,01	0,020	0,01	0,01	N/A	N/A
41th	0,01	0,020	0,01	0,01	N/A	N/A
42th	0,00	0,010	0,00	0,00	N/A	N/A
43th	0,01	0,020	0,01	0,01	N/A	N/A
44th	0,01	0,020	0,01	0,01	N/A	N/A
45th	0,00	0,010	0,00	0,00	N/A	N/A
46th	0,01	0,020	0,01	0,01	N/A	N/A
47th	0,01	0,020	0,01	0,01	N/A	N/A
48th	0,00	0,010	0,00	0,00	N/A	N/A
49th	0,01	0,020	0,01	0,01	N/A	N/A
50th	0,01	0,020	0,01	0,01	N/A	N/A
51th	0,00	0,010	0,00	0,00	N/A	N/A
52th	0,01	0,020	0,01	0,01	N/A	N/A
53th	0,01	0,020	0,01	0,01	N/A	N/A
54th	0,00	0,010	0,00	0,00	N/A	N/A
55th	0,01	0,030	0,01	0,01	N/A	N/A
56th	0,01	0,020	0,01	0,01	N/A	N/A
57th	0,00	0,010	0,00	0,00	N/A	N/A
58th	0,01	0,020	0,01	0,01	N/A	N/A
59th	0,01	0,030	0,01	0,01	N/A	N/A
60th	0,00	0,010	0,00	0,00	N/A	N/A
61th	0,01	0,030	0,01	0,01	N/A	N/A
62th	0,01	0,020	0,01	0,01	N/A	N/A
63th	0,00	0,010	0,00	0,00	N/A	N/A
64th	0,01	0,020	0,01	0,01	N/A	N/A
65th	0,01	0,030	0,01	0,01	N/A	N/A
66th	0,00	0,010	0,00	0,00	N/A	N/A
67th	0,01	0,040	0,01	0,01	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4179 W		100% of rated output 8340 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,020	0,01	0,01	N/A	N/A
69th	0,00	0,010	0,00	0,00	N/A	N/A
70th	0,01	0,020	0,01	0,01	N/A	N/A
71th	0,01	0,030	0,01	0,01	N/A	N/A
72th	0,00	0,010	0,00	0,00	N/A	N/A
73th	0,02	0,040	0,01	0,02	N/A	N/A
74th	0,01	0,020	0,01	0,01	N/A	N/A
75th	0,00	0,010	0,01	0,00	N/A	N/A
76th	0,01	0,020	0,01	0,01	N/A	N/A
77th	0,01	0,040	0,01	0,01	N/A	N/A
78th	0,00	0,010	0,00	0,00	N/A	N/A
79th	0,02	0,060	0,02	0,02	N/A	N/A
80th	0,01	0,020	0,01	0,01	N/A	N/A
81th	0,01	0,010	0,00	0,01	N/A	N/A
82th	0,01	0,020	0,01	0,01	N/A	N/A
83th	0,02	0,050	0,01	0,02	N/A	N/A
84th	0,00	0,010	0,00	0,00	N/A	N/A
85th	0,02	0,050	0,01	0,02	N/A	N/A
86th	0,01	0,020	0,01	0,01	N/A	N/A
87th	0,01	0,020	0,01	0,01	N/A	N/A
88th	0,01	0,020	0,01	0,01	N/A	N/A
89th	0,02	0,050	0,01	0,02	N/A	N/A
90th	0,00	0,010	0,00	0,00	N/A	N/A
91th	0,03	0,070	0,01	0,03	N/A	N/A
92th	0,01	0,020	0,01	0,01	N/A	N/A
93th	0,01	0,020	0,01	0,01	N/A	N/A
94th	0,01	0,020	0,01	0,01	N/A	N/A
95th	0,02	0,050	0,01	0,02	N/A	N/A
96th	0,01	0,010	0,01	0,01	N/A	N/A
97th	0,03	0,090	0,01	0,03	N/A	N/A
98th	0,01	0,020	0,01	0,01	N/A	N/A
99th	0,01	0,030	0,01	0,01	N/A	N/A
100th	0,01	0,030	0,01	0,01	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE25K, Phase 2					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 4179 W		100% of rated output 8340 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,62		0,62	23%	13%
THD_{50}		0,63		0,63	23%	13%
THD_{60}		0,63		0,63	23%	13%
THD_{100}		0,65		0,65	23%	13%
PWHD		0,008		0,001	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4208 W		100% of rated output 8392 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,120	0,08	0,210	8%	8%
3rd	0,02	0,060	0,02	0,060	21,6%	N/A
4th	0,02	0,040	0,02	0,050	4%	4%
5th	0,15	0,400	0,11	0,300	10,7%	10,7%
6th	0,01	0,040	0,01	0,040	2,67%	2,67%
7th	0,13	0,360	0,11	0,310	7,2%	7,2%
8th	0,01	0,040	0,01	0,040	2%	2%
9th	0,01	0,030	0,01	0,030	3,8%	N/A
10th	0,01	0,030	0,01	0,030	1,6%	1,6%
11th	0,08	0,210	0,08	0,210	3,1%	3,1%
12th	0,01	0,030	0,01	0,020	1,33%	1,33%
13th	0,06	0,160	0,05	0,140	2%	2%
14th	0,01	0,030	0,01	0,030	N/A	N/A
15th	0,01	0,020	0,01	0,020	N/A	N/A
16th	0,01	0,030	0,01	0,020	N/A	N/A
17th	0,04	0,100	0,03	0,080	N/A	N/A
18th	0,01	0,020	0,01	0,020	N/A	N/A
19th	0,03	0,080	0,02	0,050	N/A	N/A
20th	0,01	0,030	0,01	0,030	N/A	N/A
21th	0,01	0,010	0,01	0,010	N/A	N/A
22th	0,01	0,020	0,01	0,020	N/A	N/A
23th	0,02	0,060	0,01	0,040	N/A	N/A
24th	0,01	0,020	0,01	0,020	N/A	N/A
25th	0,02	0,040	0,01	0,030	N/A	N/A
26th	0,01	0,020	0,01	0,030	N/A	N/A
27th	0,01	0,010	0,00	0,010	N/A	N/A
28th	0,01	0,020	0,01	0,020	N/A	N/A
29th	0,01	0,020	0,01	0,020	N/A	N/A
30th	0,00	0,010	0,00	0,010	N/A	N/A
31th	0,01	0,020	0,01	0,020	N/A	N/A
32th	0,01	0,020	0,01	0,020	N/A	N/A
33th	0,00	0,010	0,00	0,010	N/A	N/A
34th	0,01	0,020	0,01	0,020	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4208 W		100% of rated output 8392 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,00	0,010	0,01	0,020	N/A	N/A
36th	0,00	0,010	0,00	0,010	N/A	N/A
37th	0,00	0,010	0,01	0,020	N/A	N/A
38th	0,01	0,020	0,01	0,020	N/A	N/A
39th	0,00	0,010	0,00	0,010	N/A	N/A
40th	0,01	0,020	0,01	0,020	N/A	N/A
41th	0,01	0,020	0,01	0,030	N/A	N/A
42th	0,00	0,010	0,00	0,010	N/A	N/A
43th	0,01	0,020	0,01	0,030	N/A	N/A
44th	0,01	0,020	0,01	0,020	N/A	N/A
45th	0,00	0,010	0,00	0,010	N/A	N/A
46th	0,01	0,020	0,01	0,020	N/A	N/A
47th	0,01	0,020	0,01	0,030	N/A	N/A
48th	0,00	0,010	0,00	0,010	N/A	N/A
49th	0,01	0,020	0,01	0,030	N/A	N/A
50th	0,01	0,020	0,01	0,020	N/A	N/A
51th	0,00	0,010	0,00	0,010	N/A	N/A
52th	0,01	0,020	0,01	0,020	N/A	N/A
53th	0,01	0,030	0,01	0,030	N/A	N/A
54th	0,00	0,010	0,00	0,010	N/A	N/A
55th	0,01	0,030	0,01	0,030	N/A	N/A
56th	0,01	0,020	0,01	0,020	N/A	N/A
57th	0,00	0,010	0,00	0,010	N/A	N/A
58th	0,01	0,020	0,01	0,020	N/A	N/A
59th	0,01	0,040	0,01	0,040	N/A	N/A
60th	0,00	0,010	0,00	0,010	N/A	N/A
61th	0,01	0,030	0,01	0,040	N/A	N/A
62th	0,01	0,020	0,01	0,020	N/A	N/A
63th	0,00	0,010	0,00	0,010	N/A	N/A
64th	0,01	0,020	0,01	0,020	N/A	N/A
65th	0,01	0,040	0,01	0,040	N/A	N/A
66th	0,00	0,010	0,00	0,010	N/A	N/A
67th	0,01	0,030	0,01	0,040	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE25K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4208 W		100% of rated output 8392 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,020	0,01	0,020	N/A	N/A
69th	0,00	0,010	0,01	0,010	N/A	N/A
70th	0,01	0,020	0,01	0,020	N/A	N/A
71th	0,01	0,040	0,01	0,040	N/A	N/A
72th	0,00	0,010	0,00	0,010	N/A	N/A
73th	0,01	0,030	0,01	0,030	N/A	N/A
74th	0,01	0,020	0,01	0,020	N/A	N/A
75th	0,01	0,020	0,01	0,030	N/A	N/A
76th	0,01	0,020	0,01	0,020	N/A	N/A
77th	0,02	0,060	0,01	0,040	N/A	N/A
78th	0,00	0,010	0,00	0,010	N/A	N/A
79th	0,02	0,060	0,02	0,040	N/A	N/A
80th	0,01	0,020	0,01	0,020	N/A	N/A
81th	0,01	0,020	0,01	0,030	N/A	N/A
82th	0,01	0,020	0,01	0,020	N/A	N/A
83th	0,03	0,070	0,02	0,070	N/A	N/A
84th	0,00	0,010	0,00	0,010	N/A	N/A
85th	0,02	0,050	0,02	0,050	N/A	N/A
86th	0,01	0,020	0,01	0,020	N/A	N/A
87th	0,01	0,030	0,01	0,030	N/A	N/A
88th	0,01	0,020	0,01	0,030	N/A	N/A
89th	0,02	0,060	0,02	0,050	N/A	N/A
90th	0,00	0,010	0,00	0,010	N/A	N/A
91th	0,02	0,060	0,02	0,040	N/A	N/A
92th	0,01	0,030	0,01	0,020	N/A	N/A
93th	0,02	0,040	0,02	0,040	N/A	N/A
94th	0,01	0,030	0,01	0,030	N/A	N/A
95th	0,03	0,090	0,02	0,050	N/A	N/A
96th	0,01	0,020	0,01	0,020	N/A	N/A
97th	0,03	0,090	0,02	0,060	N/A	N/A
98th	0,01	0,030	0,01	0,030	N/A	N/A
99th	0,03	0,080	0,03	0,070	N/A	N/A
100th	0,01	0,040	0,01	0,040	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE25K, Phase 3					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 4208 W		100% of rated output 8392 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,65		0,57	23%	13%
THD_{50}		0,65		0,57	23%	13%
THD_{60}		0,65		0,58	23%	13%
THD_{100}		0,70		0,62	23%	13%
PWHD		0,008		0,001	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4638 W		100% of rated output 9229 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,091	0,04	0,099	8%	8%
3rd	0,05	0,125	0,05	0,125	21,6%	N/A
4th	0,02	0,040	0,02	0,049	4%	4%
5th	0,17	0,434	0,14	0,338	10,7%	10,7%
6th	0,02	0,040	0,02	0,039	2,67%	2,67%
7th	0,12	0,309	0,10	0,249	7,2%	7,2%
8th	0,01	0,032	0,01	0,034	2%	2%
9th	0,04	0,101	0,04	0,111	3,8%	N/A
10th	0,01	0,028	0,01	0,027	1,6%	1,6%
11th	0,09	0,233	0,10	0,240	3,1%	3,1%
12th	0,01	0,025	0,01	0,024	1,33%	1,33%
13th	0,06	0,147	0,05	0,128	2%	2%
14th	0,01	0,026	0,01	0,028	N/A	N/A
15th	0,02	0,059	0,03	0,065	N/A	N/A
16th	0,01	0,024	0,01	0,023	N/A	N/A
17th	0,04	0,107	0,05	0,119	N/A	N/A
18th	0,01	0,019	0,01	0,019	N/A	N/A
19th	0,03	0,076	0,03	0,063	N/A	N/A
20th	0,01	0,022	0,01	0,023	N/A	N/A
21th	0,01	0,022	0,01	0,024	N/A	N/A
22th	0,01	0,021	0,01	0,021	N/A	N/A
23th	0,02	0,045	0,02	0,042	N/A	N/A
24th	0,01	0,016	0,01	0,016	N/A	N/A
25th	0,01	0,032	0,01	0,034	N/A	N/A
26th	0,01	0,021	0,01	0,021	N/A	N/A
27th	0,01	0,013	0,01	0,014	N/A	N/A
28th	0,01	0,020	0,01	0,020	N/A	N/A
29th	0,01	0,023	0,01	0,018	N/A	N/A
30th	0,01	0,014	0,01	0,015	N/A	N/A
31th	0,01	0,013	0,01	0,026	N/A	N/A
32th	0,01	0,019	0,01	0,020	N/A	N/A
33th	0,01	0,014	0,01	0,014	N/A	N/A
34th	0,01	0,017	0,01	0,018	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4638 W		100% of rated output 9229 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,021	0,01	0,020	N/A	N/A
36th	0,00	0,012	0,01	0,013	N/A	N/A
37th	0,01	0,015	0,01	0,026	N/A	N/A
38th	0,01	0,017	0,01	0,017	N/A	N/A
39th	0,00	0,010	0,00	0,011	N/A	N/A
40th	0,01	0,017	0,01	0,017	N/A	N/A
41th	0,01	0,017	0,01	0,022	N/A	N/A
42th	0,00	0,011	0,00	0,012	N/A	N/A
43th	0,01	0,019	0,01	0,024	N/A	N/A
44th	0,01	0,017	0,01	0,017	N/A	N/A
45th	0,00	0,009	0,00	0,010	N/A	N/A
46th	0,01	0,017	0,01	0,017	N/A	N/A
47th	0,01	0,019	0,01	0,023	N/A	N/A
48th	0,00	0,010	0,00	0,011	N/A	N/A
49th	0,01	0,022	0,01	0,026	N/A	N/A
50th	0,01	0,016	0,01	0,017	N/A	N/A
51th	0,00	0,010	0,00	0,010	N/A	N/A
52th	0,01	0,016	0,01	0,016	N/A	N/A
53th	0,01	0,025	0,01	0,028	N/A	N/A
54th	0,00	0,010	0,00	0,011	N/A	N/A
55th	0,01	0,023	0,01	0,023	N/A	N/A
56th	0,01	0,016	0,01	0,017	N/A	N/A
57th	0,00	0,009	0,00	0,010	N/A	N/A
58th	0,01	0,016	0,01	0,017	N/A	N/A
59th	0,01	0,031	0,01	0,033	N/A	N/A
60th	0,00	0,009	0,00	0,010	N/A	N/A
61th	0,01	0,033	0,01	0,033	N/A	N/A
62th	0,01	0,016	0,01	0,017	N/A	N/A
63th	0,00	0,007	0,00	0,008	N/A	N/A
64th	0,01	0,016	0,01	0,017	N/A	N/A
65th	0,01	0,032	0,01	0,033	N/A	N/A
66th	0,00	0,010	0,00	0,010	N/A	N/A
67th	0,01	0,036	0,01	0,036	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4638 W		100% of rated output 9229 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,016	0,01	0,018	N/A	N/A
69th	0,00	0,008	0,00	0,010	N/A	N/A
70th	0,01	0,017	0,01	0,017	N/A	N/A
71th	0,01	0,036	0,01	0,031	N/A	N/A
72th	0,00	0,009	0,00	0,010	N/A	N/A
73th	0,01	0,037	0,01	0,036	N/A	N/A
74th	0,01	0,017	0,01	0,019	N/A	N/A
75th	0,01	0,015	0,01	0,015	N/A	N/A
76th	0,01	0,017	0,01	0,019	N/A	N/A
77th	0,02	0,050	0,01	0,035	N/A	N/A
78th	0,00	0,010	0,00	0,010	N/A	N/A
79th	0,02	0,042	0,01	0,028	N/A	N/A
80th	0,01	0,017	0,01	0,019	N/A	N/A
81th	0,01	0,015	0,01	0,016	N/A	N/A
82th	0,01	0,018	0,01	0,019	N/A	N/A
83th	0,02	0,051	0,02	0,043	N/A	N/A
84th	0,00	0,011	0,00	0,011	N/A	N/A
85th	0,02	0,056	0,01	0,036	N/A	N/A
86th	0,01	0,021	0,01	0,021	N/A	N/A
87th	0,01	0,016	0,01	0,015	N/A	N/A
88th	0,01	0,021	0,01	0,022	N/A	N/A
89th	0,02	0,062	0,01	0,029	N/A	N/A
90th	0,00	0,012	0,00	0,012	N/A	N/A
91th	0,02	0,059	0,01	0,032	N/A	N/A
92th	0,01	0,025	0,01	0,024	N/A	N/A
93th	0,01	0,026	0,01	0,022	N/A	N/A
94th	0,01	0,025	0,01	0,024	N/A	N/A
95th	0,03	0,087	0,01	0,029	N/A	N/A
96th	0,01	0,016	0,01	0,015	N/A	N/A
97th	0,03	0,070	0,02	0,044	N/A	N/A
98th	0,01	0,031	0,01	0,029	N/A	N/A
99th	0,02	0,055	0,02	0,042	N/A	N/A
100th	0,01	0,031	0,01	0,029	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE27.6K, Phase 1					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 4638 W		100% of rated output 9229 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,66		0,057	23%	13%
THD_{50}		0,66		0,58	23%	13%
THD_{60}		0,66		0,58	23%	13%
THD_{100}		0,70		0,60	23%	13%
PWHD		0,008		0,008	23%	23%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4615 W		100% of rated output 9203 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,109	0,08	0,193	8%	8%
3rd	0,05	0,113	0,05	0,123	21,6%	N/A
4th	0,01	0,035	0,02	0,048	4%	4%
5th	0,16	0,391	0,13	0,319	10,7%	10,7%
6th	0,02	0,044	0,02	0,038	2,67%	2,67%
7th	0,10	0,258	0,09	0,237	7,2%	7,2%
8th	0,01	0,028	0,01	0,029	2%	2%
9th	0,04	0,093	0,05	0,114	3,8%	N/A
10th	0,01	0,026	0,01	0,027	1,6%	1,6%
11th	0,07	0,187	0,09	0,222	3,1%	3,1%
12th	0,01	0,031	0,01	0,026	1,33%	1,33%
13th	0,04	0,111	0,03	0,079	2%	2%
14th	0,01	0,023	0,01	0,024	N/A	N/A
15th	0,02	0,053	0,03	0,063	N/A	N/A
16th	0,01	0,023	0,01	0,023	N/A	N/A
17th	0,03	0,076	0,04	0,090	N/A	N/A
18th	0,01	0,023	0,01	0,020	N/A	N/A
19th	0,03	0,066	0,02	0,051	N/A	N/A
20th	0,01	0,020	0,01	0,021	N/A	N/A
21th	0,01	0,022	0,01	0,027	N/A	N/A
22th	0,01	0,021	0,01	0,022	N/A	N/A
23th	0,02	0,038	0,01	0,034	N/A	N/A
24th	0,01	0,019	0,01	0,017	N/A	N/A
25th	0,02	0,039	0,01	0,034	N/A	N/A
26th	0,01	0,019	0,01	0,019	N/A	N/A
27th	0,01	0,017	0,01	0,016	N/A	N/A
28th	0,01	0,019	0,01	0,021	N/A	N/A
29th	0,01	0,028	0,01	0,013	N/A	N/A
30th	0,01	0,015	0,01	0,015	N/A	N/A
31th	0,01	0,014	0,01	0,023	N/A	N/A
32th	0,01	0,018	0,01	0,019	N/A	N/A
33th	0,01	0,014	0,01	0,015	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4615 W		100% of rated output 9203 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
34th	0,01	0,018	0,01	0,019	N/A	N/A
35th	0,01	0,015	0,00	0,012	N/A	N/A
36th	0,00	0,012	0,00	0,012	N/A	N/A
37th	0,00	0,011	0,01	0,018	N/A	N/A
38th	0,01	0,017	0,01	0,017	N/A	N/A
39th	0,00	0,010	0,00	0,011	N/A	N/A
40th	0,01	0,017	0,01	0,018	N/A	N/A
41th	0,01	0,015	0,01	0,019	N/A	N/A
42th	0,00	0,010	0,00	0,011	N/A	N/A
43th	0,01	0,019	0,01	0,024	N/A	N/A
44th	0,01	0,017	0,01	0,017	N/A	N/A
45th	0,00	0,009	0,00	0,009	N/A	N/A
46th	0,01	0,017	0,01	0,018	N/A	N/A
47th	0,01	0,022	0,01	0,028	N/A	N/A
48th	0,00	0,009	0,00	0,010	N/A	N/A
49th	0,01	0,022	0,01	0,025	N/A	N/A
50th	0,01	0,017	0,01	0,017	N/A	N/A
51th	0,00	0,008	0,00	0,009	N/A	N/A
52th	0,01	0,016	0,01	0,017	N/A	N/A
53th	0,01	0,021	0,01	0,025	N/A	N/A
54th	0,00	0,008	0,00	0,009	N/A	N/A
55th	0,01	0,030	0,01	0,033	N/A	N/A
56th	0,01	0,017	0,01	0,017	N/A	N/A
57th	0,00	0,008	0,00	0,008	N/A	N/A
58th	0,01	0,016	0,01	0,016	N/A	N/A
59th	0,01	0,028	0,01	0,030	N/A	N/A
60th	0,00	0,008	0,00	0,009	N/A	N/A
61th	0,01	0,030	0,01	0,032	N/A	N/A
62th	0,01	0,016	0,01	0,017	N/A	N/A
63th	0,00	0,008	0,00	0,008	N/A	N/A
64th	0,01	0,015	0,01	0,016	N/A	N/A
65th	0,01	0,028	0,01	0,030	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4615 W		100% of rated output 9203 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
66th	0,00	0,007	0,00	0,008	N/A	N/A
67th	0,01	0,035	0,01	0,033	N/A	N/A
68th	0,01	0,016	0,01	0,017	N/A	N/A
69th	0,00	0,009	0,00	0,010	N/A	N/A
70th	0,01	0,016	0,01	0,016	N/A	N/A
71th	0,01	0,032	0,01	0,031	N/A	N/A
72th	0,00	0,007	0,00	0,008	N/A	N/A
73th	0,02	0,038	0,01	0,030	N/A	N/A
74th	0,01	0,016	0,01	0,018	N/A	N/A
75th	0,00	0,011	0,01	0,014	N/A	N/A
76th	0,01	0,016	0,01	0,016	N/A	N/A
77th	0,01	0,031	0,01	0,020	N/A	N/A
78th	0,00	0,008	0,00	0,009	N/A	N/A
79th	0,02	0,053	0,02	0,038	N/A	N/A
80th	0,01	0,017	0,01	0,017	N/A	N/A
81th	0,01	0,013	0,00	0,012	N/A	N/A
82th	0,01	0,016	0,01	0,017	N/A	N/A
83th	0,02	0,048	0,01	0,030	N/A	N/A
84th	0,00	0,009	0,00	0,009	N/A	N/A
85th	0,02	0,044	0,01	0,033	N/A	N/A
86th	0,01	0,018	0,01	0,019	N/A	N/A
87th	0,01	0,016	0,01	0,015	N/A	N/A
88th	0,01	0,018	0,01	0,018	N/A	N/A
89th	0,02	0,042	0,01	0,025	N/A	N/A
90th	0,00	0,010	0,00	0,010	N/A	N/A
91th	0,02	0,061	0,01	0,021	N/A	N/A
92th	0,01	0,019	0,01	0,019	N/A	N/A
93th	0,01	0,018	0,01	0,019	N/A	N/A
94th	0,01	0,021	0,01	0,020	N/A	N/A
95th	0,02	0,047	0,01	0,029	N/A	N/A
96th	0,01	0,013	0,01	0,013	N/A	N/A
97th	0,03	0,076	0,01	0,026	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.					P
Generating Unit tested to BS EN 61000-3-12						
SE27.6K, Phase 2						
Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4615 W		100% of rated output 9203 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
98th	0,01	0,021	0,01	0,021	N/A	N/A
99th	0,01	0,029	0,01	0,027	N/A	N/A
100th	0,01	0,024	0,01	0,023	N/A	N/A
THD_{40}		0,58		0,56	23%	13%
THD_{50}		0,59		0,56	23%	13%
THD_{60}		0,59		0,56	23%	13%
THD_{100}		0,62		0,58	23%	13%
PWHD		0,007		0,007	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4646 W		100% of rated output 9258 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,106	0,08	0,198	8%	8%
3rd	0,02	0,060	0,02	0,057	21,6%	N/A
4th	0,02	0,038	0,02	0,038	4%	4%
5th	0,13	0,329	0,10	0,245	10,7%	10,7%
6th	0,01	0,036	0,01	0,036	2,67%	2,67%
7th	0,13	0,318	0,11	0,275	7,2%	7,2%
8th	0,01	0,033	0,01	0,034	2%	2%
9th	0,01	0,025	0,02	0,040	3,8%	N/A
10th	0,01	0,028	0,01	0,028	1,6%	1,6%
11th	0,07	0,176	0,07	0,162	3,1%	3,1%
12th	0,01	0,024	0,01	0,022	1,33%	1,33%
13th	0,05	0,131	0,05	0,115	2%	2%
14th	0,01	0,027	0,01	0,027	N/A	N/A
15th	0,01	0,018	0,01	0,021	N/A	N/A
16th	0,01	0,023	0,01	0,022	N/A	N/A
17th	0,03	0,084	0,04	0,091	N/A	N/A
18th	0,01	0,018	0,01	0,017	N/A	N/A
19th	0,02	0,061	0,02	0,053	N/A	N/A
20th	0,01	0,023	0,01	0,024	N/A	N/A
21th	0,01	0,014	0,01	0,019	N/A	N/A
22th	0,01	0,020	0,01	0,020	N/A	N/A
23th	0,02	0,044	0,01	0,032	N/A	N/A
24th	0,01	0,015	0,01	0,013	N/A	N/A
25th	0,02	0,038	0,01	0,024	N/A	N/A
26th	0,01	0,021	0,01	0,022	N/A	N/A
27th	0,01	0,014	0,01	0,013	N/A	N/A
28th	0,01	0,019	0,01	0,019	N/A	N/A
29th	0,01	0,021	0,01	0,023	N/A	N/A
30th	0,00	0,012	0,00	0,012	N/A	N/A
31th	0,01	0,014	0,01	0,018	N/A	N/A
32th	0,01	0,020	0,01	0,020	N/A	N/A
33th	0,00	0,010	0,00	0,010	N/A	N/A
34th	0,01	0,017	0,01	0,017	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4646 W		100% of rated output 9258 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,014	0,01	0,020	N/A	N/A
36th	0,00	0,010	0,00	0,010	N/A	N/A
37th	0,01	0,014	0,01	0,022	N/A	N/A
38th	0,01	0,018	0,01	0,018	N/A	N/A
39th	0,00	0,009	0,00	0,009	N/A	N/A
40th	0,01	0,017	0,01	0,017	N/A	N/A
41th	0,01	0,017	0,01	0,024	N/A	N/A
42th	0,00	0,009	0,00	0,009	N/A	N/A
43th	0,01	0,018	0,01	0,026	N/A	N/A
44th	0,01	0,017	0,01	0,017	N/A	N/A
45th	0,00	0,008	0,00	0,009	N/A	N/A
46th	0,01	0,017	0,01	0,017	N/A	N/A
47th	0,01	0,021	0,01	0,026	N/A	N/A
48th	0,00	0,008	0,00	0,008	N/A	N/A
49th	0,01	0,017	0,01	0,024	N/A	N/A
50th	0,01	0,017	0,01	0,017	N/A	N/A
51th	0,00	0,011	0,00	0,010	N/A	N/A
52th	0,01	0,017	0,01	0,017	N/A	N/A
53th	0,01	0,023	0,01	0,024	N/A	N/A
54th	0,00	0,008	0,00	0,008	N/A	N/A
55th	0,01	0,026	0,01	0,028	N/A	N/A
56th	0,01	0,016	0,01	0,017	N/A	N/A
57th	0,00	0,011	0,00	0,012	N/A	N/A
58th	0,01	0,017	0,01	0,018	N/A	N/A
59th	0,01	0,035	0,01	0,036	N/A	N/A
60th	0,00	0,007	0,00	0,007	N/A	N/A
61th	0,01	0,031	0,01	0,035	N/A	N/A
62th	0,01	0,016	0,01	0,017	N/A	N/A
63th	0,00	0,009	0,00	0,009	N/A	N/A
64th	0,01	0,017	0,01	0,018	N/A	N/A
65th	0,01	0,033	0,01	0,035	N/A	N/A
66th	0,00	0,007	0,00	0,007	N/A	N/A
67th	0,01	0,032	0,01	0,035	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE27.6K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 4646 W		100% of rated output 9258 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,016	0,01	0,017	N/A	N/A
69th	0,00	0,011	0,01	0,013	N/A	N/A
70th	0,01	0,017	0,01	0,019	N/A	N/A
71th	0,01	0,035	0,01	0,034	N/A	N/A
72th	0,00	0,007	0,00	0,007	N/A	N/A
73th	0,01	0,028	0,01	0,022	N/A	N/A
74th	0,01	0,016	0,01	0,017	N/A	N/A
75th	0,01	0,022	0,01	0,026	N/A	N/A
76th	0,01	0,018	0,01	0,020	N/A	N/A
77th	0,02	0,050	0,01	0,027	N/A	N/A
78th	0,00	0,009	0,00	0,009	N/A	N/A
79th	0,02	0,055	0,01	0,033	N/A	N/A
80th	0,01	0,017	0,01	0,018	N/A	N/A
81th	0,01	0,026	0,01	0,028	N/A	N/A
82th	0,01	0,020	0,01	0,021	N/A	N/A
83th	0,03	0,069	0,02	0,059	N/A	N/A
84th	0,00	0,010	0,00	0,011	N/A	N/A
85th	0,02	0,052	0,02	0,044	N/A	N/A
86th	0,01	0,020	0,01	0,019	N/A	N/A
87th	0,01	0,024	0,01	0,025	N/A	N/A
88th	0,01	0,023	0,01	0,024	N/A	N/A
89th	0,02	0,056	0,01	0,034	N/A	N/A
90th	0,00	0,011	0,00	0,011	N/A	N/A
91th	0,02	0,057	0,01	0,036	N/A	N/A
92th	0,01	0,024	0,01	0,022	N/A	N/A
93th	0,01	0,037	0,01	0,037	N/A	N/A
94th	0,01	0,029	0,01	0,028	N/A	N/A
95th	0,03	0,081	0,02	0,051	N/A	N/A
96th	0,01	0,017	0,01	0,017	N/A	N/A
97th	0,03	0,072	0,03	0,068	N/A	N/A
98th	0,01	0,027	0,01	0,027	N/A	N/A
99th	0,03	0,080	0,03	0,068	N/A	N/A
100th	0,01	0,036	0,01	0,035	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE27.6K, Phase 3					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 4646 W		100% of rated output 9258 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,55		0,49	23%	13%
THD_{50}		0,55		0,50	23%	13%
THD_{60}		0,55		0,50	23%	13%
THD_{100}		0,60		0,54	23%	13%
PWHD		0,007		0,007	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5043 W		100% of rated output 10022 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,03	0,080	0,05	0,110	8%	8%
3rd	0,05	0,109	0,05	0,120	21,6%	N/A
4th	0,02	0,039	0,02	0,050	4%	4%
5th	0,17	0,387	0,13	0,301	10,7%	10,7%
6th	0,02	0,037	0,02	0,038	2,67%	2,67%
7th	0,12	0,270	0,10	0,223	7,2%	7,2%
8th	0,01	0,032	0,01	0,031	2%	2%
9th	0,04	0,093	0,04	0,102	3,8%	N/A
10th	0,01	0,028	0,01	0,027	1,6%	1,6%
11th	0,09	0,210	0,10	0,229	3,1%	3,1%
12th	0,01	0,024	0,01	0,024	1,33%	1,33%
13th	0,06	0,129	0,05	0,116	2%	2%
14th	0,01	0,025	0,01	0,025	N/A	N/A
15th	0,02	0,053	0,03	0,065	N/A	N/A
16th	0,01	0,023	0,01	0,023	N/A	N/A
17th	0,04	0,095	0,05	0,112	N/A	N/A
18th	0,01	0,019	0,01	0,019	N/A	N/A
19th	0,03	0,066	0,03	0,063	N/A	N/A
20th	0,01	0,022	0,01	0,022	N/A	N/A
21th	0,01	0,019	0,01	0,022	N/A	N/A
22th	0,01	0,020	0,01	0,022	N/A	N/A
23th	0,02	0,039	0,02	0,046	N/A	N/A
24th	0,01	0,015	0,01	0,016	N/A	N/A
25th	0,01	0,025	0,01	0,034	N/A	N/A
26th	0,01	0,020	0,01	0,020	N/A	N/A
27th	0,00	0,011	0,01	0,013	N/A	N/A
28th	0,01	0,019	0,01	0,020	N/A	N/A
29th	0,01	0,017	0,01	0,019	N/A	N/A
30th	0,01	0,013	0,01	0,015	N/A	N/A
31th	0,00	0,011	0,01	0,027	N/A	N/A
32th	0,01	0,018	0,01	0,019	N/A	N/A
33th	0,01	0,012	0,01	0,013	N/A	N/A
34th	0,01	0,016	0,01	0,018	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5043 W		100% of rated output 10022 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,018	0,01	0,019	N/A	N/A
36th	0,00	0,011	0,01	0,013	N/A	N/A
37th	0,01	0,014	0,01	0,025	N/A	N/A
38th	0,01	0,017	0,01	0,016	N/A	N/A
39th	0,00	0,008	0,00	0,010	N/A	N/A
40th	0,01	0,016	0,01	0,016	N/A	N/A
41th	0,01	0,016	0,01	0,019	N/A	N/A
42th	0,00	0,010	0,01	0,012	N/A	N/A
43th	0,01	0,018	0,01	0,021	N/A	N/A
44th	0,01	0,016	0,01	0,016	N/A	N/A
45th	0,00	0,007	0,00	0,008	N/A	N/A
46th	0,01	0,015	0,01	0,016	N/A	N/A
47th	0,01	0,018	0,01	0,020	N/A	N/A
48th	0,00	0,010	0,00	0,011	N/A	N/A
49th	0,01	0,021	0,01	0,023	N/A	N/A
50th	0,01	0,015	0,01	0,016	N/A	N/A
51th	0,00	0,009	0,00	0,009	N/A	N/A
52th	0,01	0,015	0,01	0,016	N/A	N/A
53th	0,01	0,024	0,01	0,024	N/A	N/A
54th	0,00	0,009	0,00	0,010	N/A	N/A
55th	0,01	0,021	0,01	0,018	N/A	N/A
56th	0,01	0,015	0,01	0,016	N/A	N/A
57th	0,00	0,009	0,00	0,009	N/A	N/A
58th	0,01	0,015	0,01	0,016	N/A	N/A
59th	0,01	0,029	0,01	0,028	N/A	N/A
60th	0,00	0,009	0,00	0,010	N/A	N/A
61th	0,01	0,030	0,01	0,027	N/A	N/A
62th	0,01	0,015	0,01	0,016	N/A	N/A
63th	0,00	0,007	0,00	0,008	N/A	N/A
64th	0,01	0,015	0,01	0,016	N/A	N/A
65th	0,01	0,030	0,01	0,028	N/A	N/A
66th	0,00	0,009	0,00	0,010	N/A	N/A
67th	0,01	0,034	0,01	0,030	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5043 W		100% of rated output 10022 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,015	0,01	0,016	N/A	N/A
69th	0,00	0,007	0,00	0,009	N/A	N/A
70th	0,01	0,015	0,01	0,016	N/A	N/A
71th	0,01	0,033	0,01	0,026	N/A	N/A
72th	0,00	0,009	0,00	0,010	N/A	N/A
73th	0,01	0,034	0,01	0,030	N/A	N/A
74th	0,01	0,016	0,01	0,018	N/A	N/A
75th	0,01	0,014	0,00	0,011	N/A	N/A
76th	0,01	0,016	0,01	0,017	N/A	N/A
77th	0,02	0,045	0,01	0,026	N/A	N/A
78th	0,00	0,009	0,00	0,010	N/A	N/A
79th	0,02	0,038	0,01	0,020	N/A	N/A
80th	0,01	0,016	0,01	0,018	N/A	N/A
81th	0,01	0,015	0,01	0,013	N/A	N/A
82th	0,01	0,017	0,01	0,017	N/A	N/A
83th	0,02	0,048	0,02	0,035	N/A	N/A
84th	0,00	0,010	0,00	0,011	N/A	N/A
85th	0,02	0,051	0,01	0,026	N/A	N/A
86th	0,01	0,019	0,01	0,019	N/A	N/A
87th	0,01	0,014	0,01	0,014	N/A	N/A
88th	0,01	0,019	0,01	0,019	N/A	N/A
89th	0,02	0,054	0,01	0,021	N/A	N/A
90th	0,01	0,012	0,00	0,011	N/A	N/A
91th	0,02	0,056	0,01	0,023	N/A	N/A
92th	0,01	0,023	0,01	0,022	N/A	N/A
93th	0,01	0,023	0,01	0,017	N/A	N/A
94th	0,01	0,022	0,01	0,021	N/A	N/A
95th	0,03	0,074	0,01	0,024	N/A	N/A
96th	0,01	0,016	0,01	0,014	N/A	N/A
97th	0,03	0,059	0,02	0,038	N/A	N/A
98th	0,01	0,029	0,01	0,026	N/A	N/A
99th	0,02	0,052	0,02	0,040	N/A	N/A
100th	0,01	0,029	0,01	0,026	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.					P
Generating Unit tested to BS EN 61000-3-12						
SE30K, Phase 1						
Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5043 W		100% of rated output 10022 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,58		0,56	23%	13%
THD_{50}		0,59		0,53	23%	13%
THD_{60}		0,59		0,54	23%	13%
THD_{100}		0,62		0,55	23%	13%
PWHD		0,007		0,008	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5018 W		100% of rated output 9994 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,05	0,106	0,09	0,202	8%	8%
3rd	0,04	0,103	0,05	0,117	21,6%	N/A
4th	0,01	0,033	0,02	0,047	4%	4%
5th	0,15	0,345	0,12	0,287	10,7%	10,7%
6th	0,02	0,043	0,02	0,039	2,67%	2,67%
7th	0,10	0,226	0,09	0,207	7,2%	7,2%
8th	0,01	0,025	0,01	0,028	2%	2%
9th	0,04	0,086	0,05	0,109	3,8%	N/A
10th	0,01	0,023	0,01	0,025	1,6%	1,6%
11th	0,07	0,167	0,09	0,207	3,1%	3,1%
12th	0,01	0,031	0,01	0,026	1,33%	1,33%
13th	0,04	0,094	0,03	0,079	2%	2%
14th	0,01	0,021	0,01	0,023	N/A	N/A
15th	0,02	0,048	0,03	0,061	N/A	N/A
16th	0,01	0,021	0,01	0,022	N/A	N/A
17th	0,03	0,066	0,04	0,089	N/A	N/A
18th	0,01	0,023	0,01	0,021	N/A	N/A
19th	0,02	0,056	0,02	0,044	N/A	N/A
20th	0,01	0,019	0,01	0,020	N/A	N/A
21th	0,01	0,018	0,01	0,025	N/A	N/A
22th	0,01	0,019	0,01	0,021	N/A	N/A
23th	0,01	0,030	0,02	0,035	N/A	N/A
24th	0,01	0,018	0,01	0,017	N/A	N/A
25th	0,01	0,033	0,01	0,034	N/A	N/A
26th	0,01	0,018	0,01	0,019	N/A	N/A
27th	0,01	0,013	0,01	0,013	N/A	N/A
28th	0,01	0,018	0,01	0,020	N/A	N/A
29th	0,01	0,022	0,01	0,012	N/A	N/A
30th	0,01	0,014	0,01	0,014	N/A	N/A
31th	0,00	0,011	0,01	0,023	N/A	N/A
32th	0,01	0,017	0,01	0,018	N/A	N/A
33th	0,01	0,012	0,01	0,014	N/A	N/A
34th	0,01	0,017	0,01	0,018	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5018 W		100% of rated output 9994 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,013	0,00	0,011	N/A	N/A
36th	0,01	0,012	0,01	0,012	N/A	N/A
37th	0,00	0,010	0,01	0,017	N/A	N/A
38th	0,01	0,016	0,01	0,017	N/A	N/A
39th	0,00	0,009	0,00	0,010	N/A	N/A
40th	0,01	0,016	0,01	0,017	N/A	N/A
41th	0,01	0,014	0,01	0,018	N/A	N/A
42th	0,00	0,010	0,00	0,010	N/A	N/A
43th	0,01	0,018	0,01	0,021	N/A	N/A
44th	0,01	0,016	0,01	0,017	N/A	N/A
45th	0,00	0,008	0,00	0,008	N/A	N/A
46th	0,01	0,016	0,01	0,016	N/A	N/A
47th	0,01	0,021	0,01	0,025	N/A	N/A
48th	0,00	0,008	0,00	0,009	N/A	N/A
49th	0,01	0,020	0,01	0,021	N/A	N/A
50th	0,01	0,016	0,01	0,016	N/A	N/A
51th	0,00	0,008	0,00	0,008	N/A	N/A
52th	0,01	0,015	0,01	0,016	N/A	N/A
53th	0,01	0,020	0,01	0,023	N/A	N/A
54th	0,00	0,007	0,00	0,009	N/A	N/A
55th	0,01	0,028	0,01	0,027	N/A	N/A
56th	0,01	0,015	0,01	0,017	N/A	N/A
57th	0,00	0,007	0,00	0,007	N/A	N/A
58th	0,01	0,015	0,01	0,015	N/A	N/A
59th	0,01	0,026	0,01	0,026	N/A	N/A
60th	0,00	0,006	0,00	0,008	N/A	N/A
61th	0,01	0,028	0,01	0,028	N/A	N/A
62th	0,01	0,015	0,01	0,016	N/A	N/A
63th	0,00	0,008	0,00	0,008	N/A	N/A
64th	0,01	0,014	0,01	0,015	N/A	N/A
65th	0,01	0,027	0,01	0,026	N/A	N/A
66th	0,00	0,006	0,00	0,007	N/A	N/A
67th	0,01	0,031	0,01	0,027	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5018 W		100% of rated output 9994 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,015	0,01	0,017	N/A	N/A
69th	0,00	0,009	0,00	0,009	N/A	N/A
70th	0,01	0,015	0,01	0,015	N/A	N/A
71th	0,01	0,029	0,01	0,026	N/A	N/A
72th	0,00	0,006	0,00	0,007	N/A	N/A
73th	0,02	0,035	0,01	0,024	N/A	N/A
74th	0,01	0,015	0,01	0,017	N/A	N/A
75th	0,00	0,010	0,01	0,013	N/A	N/A
76th	0,01	0,014	0,01	0,016	N/A	N/A
77th	0,01	0,029	0,01	0,017	N/A	N/A
78th	0,00	0,007	0,00	0,008	N/A	N/A
79th	0,02	0,048	0,01	0,028	N/A	N/A
80th	0,01	0,016	0,01	0,017	N/A	N/A
81th	0,01	0,012	0,00	0,010	N/A	N/A
82th	0,01	0,015	0,01	0,016	N/A	N/A
83th	0,02	0,043	0,01	0,022	N/A	N/A
84th	0,00	0,007	0,00	0,008	N/A	N/A
85th	0,02	0,042	0,01	0,028	N/A	N/A
86th	0,01	0,017	0,01	0,017	N/A	N/A
87th	0,01	0,015	0,01	0,014	N/A	N/A
88th	0,01	0,017	0,01	0,017	N/A	N/A
89th	0,02	0,040	0,01	0,020	N/A	N/A
90th	0,00	0,009	0,00	0,009	N/A	N/A
91th	0,02	0,052	0,01	0,015	N/A	N/A
92th	0,01	0,018	0,01	0,018	N/A	N/A
93th	0,01	0,019	0,01	0,016	N/A	N/A
94th	0,01	0,019	0,01	0,018	N/A	N/A
95th	0,02	0,040	0,01	0,023	N/A	N/A
96th	0,01	0,012	0,01	0,012	N/A	N/A
97th	0,03	0,068	0,01	0,028	N/A	N/A
98th	0,01	0,020	0,01	0,019	N/A	N/A
99th	0,01	0,028	0,01	0,025	N/A	N/A
100th	0,01	0,022	0,01	0,021	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE30K, Phase 2					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 5018 W		100% of rated output 9994 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,51		0,52	23%	13%
THD_{50}		0,51		0,52	23%	13%
THD_{60}		0,51		0,52	23%	13%
THD_{100}		0,54		0,54	23%	13%
PWHD		0,006		0,007	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5053 W		100% of rated output 10058 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,05	0,106	0,09	0,200	8%	8%
3rd	0,02	0,052	0,03	0,058	21,6%	N/A
4th	0,02	0,037	0,02	0,039	4%	4%
5th	0,13	0,298	0,09	0,212	10,7%	10,7%
6th	0,01	0,032	0,01	0,033	2,67%	2,67%
7th	0,12	0,280	0,11	0,241	7,2%	7,2%
8th	0,01	0,033	0,01	0,033	2%	2%
9th	0,01	0,021	0,01	0,030	3,8%	N/A
10th	0,01	0,026	0,01	0,027	1,6%	1,6%
11th	0,07	0,157	0,07	0,168	3,1%	3,1%
12th	0,01	0,021	0,01	0,020	1,33%	1,33%
13th	0,05	0,114	0,05	0,113	2%	2%
14th	0,01	0,026	0,01	0,027	N/A	N/A
15th	0,01	0,015	0,01	0,018	N/A	N/A
16th	0,01	0,022	0,01	0,022	N/A	N/A
17th	0,03	0,072	0,03	0,074	N/A	N/A
18th	0,01	0,016	0,01	0,015	N/A	N/A
19th	0,02	0,051	0,02	0,048	N/A	N/A
20th	0,01	0,022	0,01	0,024	N/A	N/A
21th	0,01	0,012	0,01	0,014	N/A	N/A
22th	0,01	0,019	0,01	0,020	N/A	N/A
23th	0,02	0,037	0,02	0,035	N/A	N/A
24th	0,01	0,013	0,01	0,012	N/A	N/A
25th	0,01	0,029	0,01	0,024	N/A	N/A
26th	0,01	0,020	0,01	0,022	N/A	N/A
27th	0,01	0,012	0,01	0,012	N/A	N/A
28th	0,01	0,018	0,01	0,019	N/A	N/A
29th	0,01	0,016	0,01	0,021	N/A	N/A
30th	0,00	0,011	0,00	0,010	N/A	N/A
31th	0,00	0,010	0,01	0,019	N/A	N/A
32th	0,01	0,018	0,01	0,020	N/A	N/A
33th	0,00	0,009	0,00	0,010	N/A	N/A
34th	0,01	0,017	0,01	0,017	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5053 W		100% of rated output 10058 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,012	0,01	0,019	N/A	N/A
36th	0,00	0,009	0,00	0,009	N/A	N/A
37th	0,01	0,014	0,01	0,022	N/A	N/A
38th	0,01	0,017	0,01	0,018	N/A	N/A
39th	0,00	0,008	0,00	0,008	N/A	N/A
40th	0,01	0,016	0,01	0,016	N/A	N/A
41th	0,01	0,018	0,01	0,021	N/A	N/A
42th	0,00	0,008	0,00	0,007	N/A	N/A
43th	0,01	0,018	0,01	0,023	N/A	N/A
44th	0,01	0,016	0,01	0,017	N/A	N/A
45th	0,00	0,007	0,00	0,008	N/A	N/A
46th	0,01	0,016	0,01	0,016	N/A	N/A
47th	0,01	0,020	0,01	0,023	N/A	N/A
48th	0,00	0,007	0,00	0,007	N/A	N/A
49th	0,01	0,017	0,01	0,022	N/A	N/A
50th	0,01	0,015	0,01	0,017	N/A	N/A
51th	0,00	0,009	0,00	0,008	N/A	N/A
52th	0,01	0,016	0,01	0,017	N/A	N/A
53th	0,01	0,021	0,01	0,020	N/A	N/A
54th	0,00	0,007	0,00	0,007	N/A	N/A
55th	0,01	0,024	0,01	0,023	N/A	N/A
56th	0,01	0,015	0,01	0,016	N/A	N/A
57th	0,00	0,010	0,00	0,011	N/A	N/A
58th	0,01	0,016	0,01	0,017	N/A	N/A
59th	0,01	0,033	0,01	0,031	N/A	N/A
60th	0,00	0,006	0,00	0,007	N/A	N/A
61th	0,01	0,030	0,01	0,031	N/A	N/A
62th	0,01	0,015	0,01	0,016	N/A	N/A
63th	0,00	0,008	0,00	0,009	N/A	N/A
64th	0,01	0,016	0,01	0,017	N/A	N/A
65th	0,01	0,032	0,01	0,031	N/A	N/A
66th	0,00	0,007	0,00	0,007	N/A	N/A
67th	0,01	0,029	0,01	0,029	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE30K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5053 W		100% of rated output 10058 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,015	0,01	0,016	N/A	N/A
69th	0,00	0,010	0,01	0,013	N/A	N/A
70th	0,01	0,016	0,01	0,018	N/A	N/A
71th	0,01	0,031	0,01	0,031	N/A	N/A
72th	0,00	0,007	0,00	0,007	N/A	N/A
73th	0,01	0,025	0,01	0,022	N/A	N/A
74th	0,01	0,015	0,01	0,016	N/A	N/A
75th	0,01	0,020	0,01	0,021	N/A	N/A
76th	0,01	0,017	0,01	0,019	N/A	N/A
77th	0,02	0,046	0,01	0,019	N/A	N/A
78th	0,00	0,008	0,00	0,008	N/A	N/A
79th	0,02	0,048	0,01	0,021	N/A	N/A
80th	0,01	0,016	0,01	0,017	N/A	N/A
81th	0,01	0,023	0,01	0,024	N/A	N/A
82th	0,01	0,018	0,01	0,020	N/A	N/A
83th	0,03	0,065	0,02	0,048	N/A	N/A
84th	0,00	0,009	0,00	0,009	N/A	N/A
85th	0,02	0,050	0,02	0,039	N/A	N/A
86th	0,01	0,018	0,01	0,018	N/A	N/A
87th	0,01	0,021	0,01	0,023	N/A	N/A
88th	0,01	0,021	0,01	0,023	N/A	N/A
89th	0,02	0,053	0,01	0,031	N/A	N/A
90th	0,00	0,010	0,00	0,010	N/A	N/A
91th	0,02	0,051	0,01	0,031	N/A	N/A
92th	0,01	0,021	0,01	0,020	N/A	N/A
93th	0,02	0,035	0,01	0,029	N/A	N/A
94th	0,01	0,026	0,01	0,026	N/A	N/A
95th	0,03	0,066	0,02	0,045	N/A	N/A
96th	0,01	0,016	0,01	0,015	N/A	N/A
97th	0,03	0,060	0,03	0,067	N/A	N/A
98th	0,01	0,026	0,01	0,024	N/A	N/A
99th	0,03	0,076	0,03	0,064	N/A	N/A
100th	0,01	0,034	0,01	0,032	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE30K, Phase 3					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 5053 W		100% of rated output 10058 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,49		0,46	23%	13%
THD_{50}		0,49		0,46	23%	13%
THD_{60}		0,49		0,46	23%	13%
THD_{100}		0,54		0,50	23%	13%
PWHD		0,006		0,006	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5576 W		100% of rated output 11067 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,080	0,03	0,068	8%	8%
3rd	0,05	0,097	0,05	0,107	21,6%	N/A
4th	0,02	0,032	0,03	0,053	4%	4%
5th	0,15	0,305	0,18	0,376	10,7%	10,7%
6th	0,02	0,034	0,02	0,032	2,67%	2,67%
7th	0,10	0,210	0,13	0,275	7,2%	7,2%
8th	0,01	0,028	0,02	0,044	2%	2%
9th	0,04	0,074	0,04	0,086	3,8%	N/A
10th	0,01	0,024	0,02	0,039	1,6%	1,6%
11th	0,08	0,176	0,11	0,238	3,1%	3,1%
12th	0,01	0,022	0,01	0,024	1,33%	1,33%
13th	0,05	0,103	0,06	0,127	2%	2%
14th	0,01	0,023	0,02	0,034	N/A	N/A
15th	0,02	0,040	0,02	0,051	N/A	N/A
16th	0,01	0,020	0,01	0,030	N/A	N/A
17th	0,04	0,073	0,05	0,109	N/A	N/A
18th	0,01	0,017	0,01	0,019	N/A	N/A
19th	0,02	0,051	0,03	0,064	N/A	N/A
20th	0,01	0,020	0,01	0,026	N/A	N/A
21th	0,01	0,013	0,01	0,017	N/A	N/A
22th	0,01	0,018	0,01	0,024	N/A	N/A
23th	0,01	0,030	0,02	0,050	N/A	N/A
24th	0,01	0,014	0,01	0,016	N/A	N/A
25th	0,01	0,018	0,02	0,039	N/A	N/A
26th	0,01	0,018	0,01	0,020	N/A	N/A
27th	0,00	0,010	0,01	0,012	N/A	N/A
28th	0,01	0,016	0,01	0,020	N/A	N/A
29th	0,01	0,014	0,01	0,025	N/A	N/A
30th	0,01	0,012	0,01	0,014	N/A	N/A
31th	0,00	0,010	0,02	0,031	N/A	N/A
32th	0,01	0,016	0,01	0,017	N/A	N/A
33th	0,00	0,010	0,01	0,012	N/A	N/A
34th	0,01	0,015	0,01	0,016	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5576 W		100% of rated output 11067 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,016	0,01	0,023	N/A	N/A
36th	0,01	0,011	0,01	0,011	N/A	N/A
37th	0,01	0,013	0,01	0,027	N/A	N/A
38th	0,01	0,015	0,01	0,013	N/A	N/A
39th	0,00	0,007	0,00	0,010	N/A	N/A
40th	0,01	0,014	0,01	0,014	N/A	N/A
41th	0,01	0,015	0,01	0,022	N/A	N/A
42th	0,00	0,010	0,00	0,010	N/A	N/A
43th	0,01	0,017	0,01	0,023	N/A	N/A
44th	0,01	0,014	0,01	0,012	N/A	N/A
45th	0,00	0,007	0,00	0,008	N/A	N/A
46th	0,01	0,014	0,01	0,013	N/A	N/A
47th	0,01	0,017	0,01	0,022	N/A	N/A
48th	0,00	0,010	0,00	0,009	N/A	N/A
49th	0,01	0,021	0,01	0,025	N/A	N/A
50th	0,01	0,014	0,01	0,012	N/A	N/A
51th	0,00	0,007	0,00	0,008	N/A	N/A
52th	0,01	0,013	0,01	0,012	N/A	N/A
53th	0,01	0,023	0,01	0,024	N/A	N/A
54th	0,00	0,008	0,00	0,009	N/A	N/A
55th	0,01	0,021	0,01	0,022	N/A	N/A
56th	0,01	0,014	0,01	0,011	N/A	N/A
57th	0,00	0,008	0,00	0,008	N/A	N/A
58th	0,01	0,013	0,01	0,012	N/A	N/A
59th	0,01	0,028	0,01	0,030	N/A	N/A
60th	0,00	0,008	0,00	0,008	N/A	N/A
61th	0,01	0,030	0,01	0,028	N/A	N/A
62th	0,01	0,014	0,01	0,012	N/A	N/A
63th	0,00	0,006	0,00	0,008	N/A	N/A
64th	0,01	0,013	0,01	0,011	N/A	N/A
65th	0,01	0,029	0,01	0,028	N/A	N/A
66th	0,00	0,009	0,00	0,009	N/A	N/A
67th	0,02	0,032	0,01	0,030	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 1

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5576 W		100% of rated output 11067 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,014	0,01	0,012	N/A	N/A
69th	0,00	0,007	0,00	0,009	N/A	N/A
70th	0,01	0,014	0,01	0,012	N/A	N/A
71th	0,01	0,031	0,01	0,026	N/A	N/A
72th	0,00	0,009	0,00	0,008	N/A	N/A
73th	0,02	0,032	0,01	0,029	N/A	N/A
74th	0,01	0,016	0,01	0,014	N/A	N/A
75th	0,01	0,015	0,01	0,011	N/A	N/A
76th	0,01	0,015	0,01	0,013	N/A	N/A
77th	0,02	0,044	0,01	0,021	N/A	N/A
78th	0,00	0,009	0,00	0,008	N/A	N/A
79th	0,02	0,037	0,01	0,019	N/A	N/A
80th	0,01	0,016	0,01	0,014	N/A	N/A
81th	0,01	0,015	0,01	0,012	N/A	N/A
82th	0,01	0,016	0,01	0,014	N/A	N/A
83th	0,02	0,049	0,01	0,031	N/A	N/A
84th	0,01	0,011	0,00	0,009	N/A	N/A
85th	0,02	0,052	0,01	0,022	N/A	N/A
86th	0,01	0,020	0,01	0,018	N/A	N/A
87th	0,01	0,015	0,01	0,015	N/A	N/A
88th	0,01	0,019	0,01	0,017	N/A	N/A
89th	0,03	0,056	0,01	0,024	N/A	N/A
90th	0,01	0,013	0,00	0,010	N/A	N/A
91th	0,03	0,059	0,01	0,022	N/A	N/A
92th	0,01	0,026	0,01	0,022	N/A	N/A
93th	0,01	0,029	0,01	0,019	N/A	N/A
94th	0,01	0,023	0,01	0,021	N/A	N/A
95th	0,04	0,079	0,02	0,038	N/A	N/A
96th	0,01	0,018	0,01	0,013	N/A	N/A
97th	0,03	0,057	0,02	0,044	N/A	N/A
98th	0,02	0,033	0,01	0,027	N/A	N/A
99th	0,03	0,058	0,02	0,037	N/A	N/A
100th	0,01	0,029	0,01	0,026	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE33.3K, Phase 1					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 5576 W		100% of rated output 11067 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,47		0,59	23%	13%
THD_{50}		0,47		0,60	23%	13%
THD_{60}		0,47		0,60	23%	13%
THD_{100}		0,51		0,61	23%	13%
PWHD		0,006		0,008	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5553 W		100% of rated output 11042 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,089	0,06	0,122	8%	8%
3rd	0,04	0,093	0,05	0,097	21,6%	N/A
4th	0,01	0,029	0,03	0,060	4%	4%
5th	0,12	0,258	0,17	0,360	10,7%	10,7%
6th	0,02	0,037	0,01	0,026	2,67%	2,67%
7th	0,09	0,182	0,13	0,264	7,2%	7,2%
8th	0,01	0,023	0,02	0,042	2%	2%
9th	0,04	0,079	0,04	0,090	3,8%	N/A
10th	0,01	0,021	0,02	0,042	1,6%	1,6%
11th	0,07	0,144	0,11	0,224	3,1%	3,1%
12th	0,01	0,026	0,01	0,021	1,33%	1,33%
13th	0,04	0,078	0,05	0,095	2%	2%
14th	0,01	0,019	0,01	0,031	N/A	N/A
15th	0,02	0,038	0,02	0,044	N/A	N/A
16th	0,01	0,018	0,02	0,032	N/A	N/A
17th	0,03	0,053	0,05	0,096	N/A	N/A
18th	0,01	0,020	0,01	0,017	N/A	N/A
19th	0,02	0,045	0,02	0,050	N/A	N/A
20th	0,01	0,017	0,01	0,023	N/A	N/A
21th	0,01	0,014	0,01	0,019	N/A	N/A
22th	0,01	0,017	0,01	0,026	N/A	N/A
23th	0,01	0,026	0,02	0,043	N/A	N/A
24th	0,01	0,016	0,01	0,015	N/A	N/A
25th	0,01	0,027	0,02	0,039	N/A	N/A
26th	0,01	0,016	0,01	0,018	N/A	N/A
27th	0,01	0,013	0,01	0,015	N/A	N/A
28th	0,01	0,016	0,01	0,022	N/A	N/A
29th	0,01	0,017	0,01	0,017	N/A	N/A
30th	0,01	0,013	0,01	0,013	N/A	N/A
31th	0,00	0,009	0,01	0,026	N/A	N/A
32th	0,01	0,015	0,01	0,015	N/A	N/A
33th	0,00	0,010	0,01	0,014	N/A	N/A
34th	0,01	0,015	0,01	0,017	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5553 W		100% of rated output 11042 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,011	0,01	0,016	N/A	N/A
36th	0,00	0,010	0,01	0,011	N/A	N/A
37th	0,01	0,011	0,01	0,021	N/A	N/A
38th	0,01	0,014	0,01	0,012	N/A	N/A
39th	0,00	0,008	0,01	0,011	N/A	N/A
40th	0,01	0,015	0,01	0,014	N/A	N/A
41th	0,01	0,015	0,01	0,023	N/A	N/A
42th	0,00	0,009	0,01	0,011	N/A	N/A
43th	0,01	0,019	0,01	0,026	N/A	N/A
44th	0,01	0,014	0,01	0,011	N/A	N/A
45th	0,00	0,008	0,00	0,009	N/A	N/A
46th	0,01	0,014	0,01	0,013	N/A	N/A
47th	0,01	0,020	0,01	0,028	N/A	N/A
48th	0,00	0,008	0,00	0,010	N/A	N/A
49th	0,01	0,020	0,01	0,025	N/A	N/A
50th	0,01	0,014	0,00	0,010	N/A	N/A
51th	0,00	0,007	0,00	0,009	N/A	N/A
52th	0,01	0,014	0,01	0,012	N/A	N/A
53th	0,01	0,018	0,01	0,025	N/A	N/A
54th	0,00	0,007	0,00	0,010	N/A	N/A
55th	0,01	0,026	0,01	0,029	N/A	N/A
56th	0,01	0,014	0,00	0,010	N/A	N/A
57th	0,00	0,006	0,00	0,008	N/A	N/A
58th	0,01	0,013	0,01	0,011	N/A	N/A
59th	0,01	0,024	0,01	0,027	N/A	N/A
60th	0,00	0,006	0,00	0,009	N/A	N/A
61th	0,01	0,027	0,01	0,030	N/A	N/A
62th	0,01	0,014	0,01	0,010	N/A	N/A
63th	0,00	0,008	0,00	0,008	N/A	N/A
64th	0,01	0,013	0,01	0,011	N/A	N/A
65th	0,01	0,026	0,01	0,027	N/A	N/A
66th	0,00	0,006	0,00	0,009	N/A	N/A
67th	0,01	0,029	0,01	0,029	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 2

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5553 W		100% of rated output 11042 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,014	0,01	0,011	N/A	N/A
69th	0,00	0,008	0,00	0,009	N/A	N/A
70th	0,01	0,013	0,01	0,011	N/A	N/A
71th	0,01	0,029	0,01	0,025	N/A	N/A
72th	0,00	0,006	0,00	0,009	N/A	N/A
73th	0,02	0,033	0,01	0,024	N/A	N/A
74th	0,01	0,015	0,01	0,013	N/A	N/A
75th	0,00	0,009	0,01	0,013	N/A	N/A
76th	0,01	0,014	0,01	0,012	N/A	N/A
77th	0,01	0,027	0,01	0,019	N/A	N/A
78th	0,00	0,007	0,00	0,009	N/A	N/A
79th	0,02	0,045	0,01	0,023	N/A	N/A
80th	0,01	0,015	0,01	0,014	N/A	N/A
81th	0,01	0,011	0,00	0,010	N/A	N/A
82th	0,01	0,015	0,01	0,012	N/A	N/A
83th	0,02	0,040	0,01	0,015	N/A	N/A
84th	0,00	0,008	0,00	0,009	N/A	N/A
85th	0,02	0,041	0,01	0,027	N/A	N/A
86th	0,01	0,016	0,01	0,016	N/A	N/A
87th	0,01	0,015	0,01	0,012	N/A	N/A
88th	0,01	0,017	0,01	0,015	N/A	N/A
89th	0,02	0,038	0,01	0,019	N/A	N/A
90th	0,00	0,010	0,00	0,010	N/A	N/A
91th	0,02	0,049	0,01	0,021	N/A	N/A
92th	0,01	0,018	0,01	0,017	N/A	N/A
93th	0,01	0,021	0,01	0,014	N/A	N/A
94th	0,01	0,020	0,01	0,018	N/A	N/A
95th	0,02	0,037	0,01	0,029	N/A	N/A
96th	0,01	0,014	0,01	0,011	N/A	N/A
97th	0,03	0,066	0,02	0,040	N/A	N/A
98th	0,01	0,021	0,01	0,019	N/A	N/A
99th	0,01	0,026	0,01	0,020	N/A	N/A
100th	0,01	0,024	0,01	0,022	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE33.3K, Phase 2					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 5553 W		100% of rated output 11042 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,41		0,57	23%	13%
THD_{50}		0,41		0,57	23%	13%
THD_{60}		0,41		0,57	23%	13%
THD_{100}		0,44		0,59	23%	13%
PWHD		0,005		0,009	23%	22%

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5591 W		100% of rated output 11106 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
2nd	0,04	0,092	0,06	0,125	8%	8%
3rd	0,02	0,049	0,02	0,039	21,6%	N/A
4th	0,02	0,032	0,03	0,053	4%	4%
5th	0,10	0,217	0,14	0,296	10,7%	10,7%
6th	0,01	0,028	0,01	0,023	2,67%	2,67%
7th	0,10	0,212	0,14	0,297	7,2%	7,2%
8th	0,01	0,029	0,02	0,047	2%	2%
9th	0,01	0,019	0,01	0,024	3,8%	N/A
10th	0,01	0,024	0,02	0,037	1,6%	1,6%
11th	0,06	0,134	0,09	0,188	3,1%	3,1%
12th	0,01	0,018	0,01	0,017	1,33%	1,33%
13th	0,05	0,095	0,06	0,133	2%	2%
14th	0,01	0,023	0,02	0,036	N/A	N/A
15th	0,01	0,016	0,01	0,016	N/A	N/A
16th	0,01	0,020	0,01	0,027	N/A	N/A
17th	0,03	0,052	0,04	0,081	N/A	N/A
18th	0,01	0,013	0,01	0,014	N/A	N/A
19th	0,02	0,038	0,03	0,057	N/A	N/A
20th	0,01	0,020	0,01	0,028	N/A	N/A
21th	0,01	0,011	0,01	0,012	N/A	N/A
22th	0,01	0,017	0,01	0,021	N/A	N/A
23th	0,01	0,029	0,02	0,044	N/A	N/A
24th	0,01	0,011	0,01	0,011	N/A	N/A
25th	0,01	0,022	0,02	0,031	N/A	N/A
26th	0,01	0,017	0,01	0,023	N/A	N/A
27th	0,00	0,010	0,01	0,012	N/A	N/A
28th	0,01	0,016	0,01	0,018	N/A	N/A
29th	0,01	0,011	0,01	0,025	N/A	N/A
30th	0,00	0,009	0,00	0,010	N/A	N/A
31th	0,00	0,008	0,01	0,024	N/A	N/A
32th	0,01	0,016	0,01	0,020	N/A	N/A
33th	0,00	0,008	0,00	0,010	N/A	N/A
34th	0,01	0,015	0,01	0,013	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5591 W		100% of rated output 11106 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
35th	0,01	0,012	0,01	0,023	N/A	N/A
36th	0,00	0,008	0,00	0,009	N/A	N/A
37th	0,01	0,013	0,01	0,025	N/A	N/A
38th	0,01	0,014	0,01	0,016	N/A	N/A
39th	0,00	0,007	0,00	0,008	N/A	N/A
40th	0,01	0,015	0,01	0,012	N/A	N/A
41th	0,01	0,017	0,01	0,023	N/A	N/A
42th	0,00	0,007	0,00	0,008	N/A	N/A
43th	0,01	0,017	0,01	0,025	N/A	N/A
44th	0,01	0,014	0,01	0,014	N/A	N/A
45th	0,00	0,007	0,00	0,008	N/A	N/A
46th	0,01	0,014	0,01	0,012	N/A	N/A
47th	0,01	0,019	0,01	0,026	N/A	N/A
48th	0,00	0,006	0,00	0,007	N/A	N/A
49th	0,01	0,016	0,01	0,024	N/A	N/A
50th	0,01	0,014	0,01	0,013	N/A	N/A
51th	0,00	0,008	0,00	0,008	N/A	N/A
52th	0,01	0,014	0,01	0,012	N/A	N/A
53th	0,01	0,020	0,01	0,022	N/A	N/A
54th	0,00	0,006	0,00	0,007	N/A	N/A
55th	0,01	0,023	0,01	0,023	N/A	N/A
56th	0,01	0,013	0,01	0,012	N/A	N/A
57th	0,00	0,009	0,00	0,010	N/A	N/A
58th	0,01	0,014	0,01	0,012	N/A	N/A
59th	0,01	0,031	0,01	0,031	N/A	N/A
60th	0,00	0,006	0,00	0,007	N/A	N/A
61th	0,01	0,029	0,02	0,032	N/A	N/A
62th	0,01	0,013	0,01	0,012	N/A	N/A
63th	0,00	0,008	0,00	0,009	N/A	N/A
64th	0,01	0,014	0,01	0,012	N/A	N/A
65th	0,01	0,031	0,02	0,032	N/A	N/A
66th	0,00	0,006	0,00	0,007	N/A	N/A
67th	0,01	0,028	0,01	0,031	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.	P

Generating Unit tested to BS EN 61000-3-12

SE33.3K, Phase 3

Generating Unit rating per phase (rpp)						
	At 45 – 55% of rated output 5591 W		100% of rated output 11106 W			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
68th	0,01	0,014	0,01	0,012	N/A	N/A
69th	0,00	0,010	0,01	0,011	N/A	N/A
70th	0,01	0,015	0,01	0,013	N/A	N/A
71th	0,01	0,029	0,01	0,030	N/A	N/A
72th	0,00	0,006	0,00	0,007	N/A	N/A
73th	0,01	0,023	0,01	0,021	N/A	N/A
74th	0,01	0,014	0,01	0,013	N/A	N/A
75th	0,01	0,020	0,01	0,021	N/A	N/A
76th	0,01	0,016	0,01	0,015	N/A	N/A
77th	0,02	0,043	0,01	0,015	N/A	N/A
78th	0,00	0,008	0,00	0,008	N/A	N/A
79th	0,02	0,046	0,01	0,018	N/A	N/A
80th	0,01	0,015	0,01	0,014	N/A	N/A
81th	0,01	0,023	0,01	0,021	N/A	N/A
82th	0,01	0,018	0,01	0,017	N/A	N/A
83th	0,03	0,063	0,02	0,036	N/A	N/A
84th	0,00	0,010	0,00	0,009	N/A	N/A
85th	0,02	0,051	0,01	0,031	N/A	N/A
86th	0,01	0,018	0,01	0,017	N/A	N/A
87th	0,01	0,023	0,01	0,024	N/A	N/A
88th	0,01	0,022	0,01	0,021	N/A	N/A
89th	0,03	0,052	0,02	0,034	N/A	N/A
90th	0,01	0,011	0,00	0,010	N/A	N/A
91th	0,03	0,052	0,02	0,033	N/A	N/A
92th	0,01	0,022	0,01	0,020	N/A	N/A
93th	0,02	0,043	0,01	0,030	N/A	N/A
94th	0,01	0,028	0,01	0,025	N/A	N/A
95th	0,03	0,063	0,03	0,061	N/A	N/A
96th	0,01	0,017	0,01	0,015	N/A	N/A
97th	0,03	0,061	0,04	0,075	N/A	N/A
98th	0,01	0,026	0,01	0,023	N/A	N/A
99th	0,04	0,078	0,03	0,054	N/A	N/A
100th	0,02	0,034	0,01	0,031	N/A	N/A

A.7.1.4.1	Power Quality. Harmonics.				P
Generating Unit tested to BS EN 61000-3-12					
SE33.3K, Phase 3					
Generating Unit rating per phase (rpp)					
	At 45 – 55% of rated output 5591 W		100% of rated output 11106 W		
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in%	Measured Value (MV) in Amps	Measured Value (MV) in%	Limit in BS EN61000-3-12 in%	
					1 phase	3 phase
THD_{40}		0,38		0,52	23%	13%
THD_{50}		0,38		0,53	23%	13%
THD_{60}		0,39		0,53	23%	13%
THD_{100}		0,44		0,56	23%	13%
PWHD		0,005		0,007	23%	22%

A7.1.4.2	**Power factor** Test is carried out at three voltage levels and at Registered Capacity. Voltage is maintained within ± 1,5% of the stated level during the test. This test is undertaken in accordance with Annex A.7.1.4.2.			**P**
SE25K				
Output power	216,2 V	230,0 V	253,0 V	
20%	0,993	0,992	0,992	Measured at three voltage levels and at full output. Voltage to be maintained within ± 1,5% of the stated level during the test.
50%	0,999	0,999	0,999	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	> 0,95	> 0,95	> 0,95	
SE27.6K				
Output power	216,2 V	230,0 V	253,0 V	
20%	0,994	0,993	0,993	Measured at three voltage levels and at full output. Voltage to be maintained within ± 1,5% of the stated level during the test.
50%	0,999	0,999	0,999	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	> 0,95	> 0,95	> 0,95	
SE30K				
Output power	216,2 V	230,0 V	253,0 V	
20%	0,996	0,995	0,995	Measured at three voltage levels and at full output. Voltage to be maintained within ± 1,5% of the stated level during the test.
50%	0,999	0,999	0,999	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	> 0,95	> 0,95	> 0,95	
SE33.3K				
Output power	216,2 V	230,0 V	253,0 V	
20%	0,997	0,996	0,995	Measured at three voltage levels and at full output. Voltage to be maintained within ± 1,5% of the stated level during the test.
50%	0,999	0,999	1,000	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	> 0,95	> 0,95	> 0,95	

A.7.1.4.3	Voltage Flicker	P

	Starting			Stopping			Running	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
Measured values at test impedance	2,99	2,04	0,00	2,81	1,98	0,00	0,24	0,24
Measured values at standard impedance	3,34	2,28	0,00	3,14	2,28	0,00	0,27	0,27
Values at maximum impedance	4,00	2,73	0,00	3,76	2,73	0,00	0,32	0,32
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Test impedance	R	0,19	Ω	X_l	0,12	Ω
	Z	0,23	Ω			
Standard impedance	R	0,24	Ω	X_l	0,15	Ω
	Z	0,25	Ω			
Maximum impedance	R	0,30	Ω	X_l	0,26	Ω
	Z_{max}	0,16	Ω			

Note:

For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the power factor of the generation output is 0,98 or above.

Normalised value = Measured value*reference source resistance/measured source resistance at test point.

Single phase unit reference source resistance is 0,4 Ω

Two phase units in a three phase system reference source resistance 0,4 Ω

Two phase units in a split phase system reference source resistance is 0,24 Ω

Three phase units reference source resistance is 0,24 Ω

Where the power factor of the output is under 0,98 then the X_l to R ratio of the test impedance should be close to that of the Standard impedance.

The stopping test should be a trip from full load operation.

A.7.1.4.4	**DC injection** These tests should be undertaken in accordance with Annex A.7.1.4.4.		**P**
SE25K			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	- 61,7	- 66,0	- 64,7
As% of rated AC current [%]	- 0,17	- 0,18	- 0,18
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	15,0	12,9	22,6
As% of rated AC current [%]	0,04	0,04	0,06
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	- 19,5	- 23,9	- 38,3
As% of rated AC current [%]	- 0,05	- 0,07	- 0,11
Limit [%]	0,25	0,25	0,25
Note: Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.			
Sum of all Phases Tests are carried out at three defined power levels ±5%. At 230 V a 25 kW three phase Inverter has a current output of 108,7 A so DC limit is 271,3 mA. These tests is undertaken in accordance with Annex A.7.1.4.4. The % DC injection (“as % of rated AC current” below) is calculated as follows: % DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.			
Test level power [%]	10	55	100
Recorded value Sum [mA]	-66,2	-77	-80,4
As % of rated AC current [%]	-0,06	-0,07	-0,07
Limit [%]	0,25	0,25	0,25

A.7.1.4.4	**DC injection** These tests should be undertaken in accordance with Annex A.7.1.4.4.		**P**
SE27.6K			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	- 61,7	- 65,5	- 65,1
As% of rated AC current [%]	- 0,15	- 0,16	- 0,16
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	15,0	13,0	23,1
As% of rated AC current [%]	0,04	0,03	0,06
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	- 19,5	- 28,8	- 41,0
As% of rated AC current [%]	- 0,05	- 0,07	- 0,10
Limit [%]	0,25	0,25	0,25
Note: Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.			
Sum of all Phases Tests are carried out at three defined power levels ±5%. At 230 V a 25 kW three phase Inverter has a current output of 120,0 A so DC limit is 300,0 mA. These tests is undertaken in accordance with Annex A.7.1.4.4. The % DC injection (“as % of rated AC current” below) is calculated as follows: % DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.			
Test level power [%]	10	55	100
Recorded value Sum [mA]	-66,2	-81,3	-83
As % of rated AC current [%]	-0,06	-0,07	-0,08
Limit [%]	0,25	0,25	0,25

A.7.1.4.4	**DC injection** These tests should be undertaken in accordance with Annex A.7.1.4.4.		**P**
SE30K			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	- 64,2	- 63,8	- 66,0
As% of rated AC current [%]	- 0,15	- 0,15	- 0,15
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	15,8	16,2	24,6
As% of rated AC current [%]	0,04	0,04	0,06
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	- 20,6	- 27,2	- 40,8
As% of rated AC current [%]	- 0,05	- 0,06	- 0,09
Limit [%]	0,25	0,25	0,25
Note: Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.			
Sum of all Phases Tests are carried out at three defined power levels ±5%. At 230 V a 25 kW three phase Inverter has a current output of 130,4 A so DC limit is 326 mA. These tests is undertaken in accordance with Annex A.7.1.4.4. The % DC injection (“as % of rated AC current” below) is calculated as follows: % DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.			
Test level power [%]	10	55	100
Recorded value Sum [mA]	-69	-74,8	-82,2
As % of rated AC current [%]	-0,06	-0,07	-0,08
Limit [%]	0,25	0,25	0,25

A.7.1.4.4	**DC injection** These tests should be undertaken in accordance with Annex A.7.1.4.4.		**P**
SE33.3K			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	- 62,9	- 68,5	- 70,4
As% of rated AC current [%]	- 0,13	- 0,14	- 0,15
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	15,4	18,7	28,8
As% of rated AC current [%]	0,03	0,04	0,06
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	- 20,7	- 27,9	- 43,3
As% of rated AC current [%]	- 0,04	- 0,06	- 0,09
Limit [%]	0,25	0,25	0,25
Note: Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.			
Sum of all Phases Tests are carried out at three defined power levels ±5%. At 230 V a 25 kW three phase Inverter has a current output of 130,4 A so DC limit is 362 mA. These tests is undertaken in accordance with Annex A.7.1.4.4. The % DC injection (“as % of rated AC current” below) is calculated as follows: % DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.			
Test level power [%]	10	55	100
Recorded value Sum [mA]	-68,2	-77,7	-84,9
As % of rated AC current [%]	-0,06	-0,07	-0,08
Limit [%]	0,25	0,25	0,25

A.7.1.5	Short Circuit Current Contribution				P
SE33.3K					
Phase 1					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	N/A	20 ms	33,16	48,74
Initial Value of aperiodic current	A	N/A	100 ms	32,82	48,11
Initial symmetrical short-circuit current*	I_k	N/A	250 ms	32,89	48,19
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500 ms	32,81	48,14
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,578	
Phase 2					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	N/A	20 ms	120,33	48,09
Initial Value of aperiodic current	A	N/A	100 ms	61,15	48,15
Initial symmetrical short-circuit current*	I_k	N/A	250 ms	46,28	48,48
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500 ms	40,03	48,52
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,578	
Phase 3					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	N/A	20 ms	53,07	45,81
Initial Value of aperiodic current	A	N/A	100 ms	37,51	47,56
Initial symmetrical short-circuit current*	I_k	N/A	250 ms	34,63	47,97
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500 ms	33,58	48,05
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,578	

Note:
The values of voltage and current should be recorded for a period of up to 1 second when the changeover switch should be returned to the normal position. The voltage and current at relevant times shall be recorded in the type test report (Annex A.2-3) including the time taken for the Inverter to trip.

A.7.1.6	Self-Monitoring – Solid state switching	N/A
It has been verified that in the event of the solid-state switching device failing to disconnect the Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.		(No solid-state switching device)
Note: Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open (4.1 Functional safety of the internal automatic disconnection device according to VDE 0126-1-1).		

Logic Interface (input port) Required by paragraph 9.4.3	**P**
Confirm that an input port is provided and can be used to shut down the module.	Yes

Annex No. 1
EMC test report

The complete EMC test report is stored at Bureau Veritas Consumer Products Services Germany GmbH Türkheim in the project 19TH0534

Electromagnetic Compatibility Test Report

Test Report No: SED 240919 Rev.2
Issued on: March 29, 2020

Product Name
Jupiter Plus Improved (Three Phase Inverter)
Models: SE25K, SE27.6K, SE30K, SE33.3K, SE40K

Tested According to
EN 61000-6-3:2007/A1:2011/AC:2012
EN 61000-6-2:2005/AC:2005, EN 61000-6-4: 2019
EN 61000-3-11: 2001 & EN 61000-3-12:2011
IEC 61000-4-16: 2015, IEC 61000-4-18:2006
IEC 62109-1:2010 (Impulse voltage test)

Tests Performed for
SolarEdge Technologies Ltd.
1 HaMada Street, Herzeliya 4673335, Israel
Tel: +972-9-9576620

QualiTech EMC Laboratory
30 Hasivim Street,P.O.Box 7500
Petah-Tikva, 4951169, Israel
Tel: +972-3-926-6994
Fax: +972-3-928 7490

Certificate 1633.01
Electrical Testing

Test Personnel

Tests Performed By: ----------

Michael Shtier Nissim Bitan Agi Yizhak

Report Prepared By: ----------

Bina Talkar

Report Approved By: ----------

Rami Nataf
EMC Lab. Manager
QualiTech EMC Laboratory

Test Report details:

Test commencement date: 13.08.2019

Test completion date: 01.09.2019

Customer's Representative: Lior Maor

Issued on: 29.03.2020

Revision details:

Version	Date	Details/Reasons
Rev. 1	24.09.2019	-
Rev.2	29.03.2020	Added standard EN 61000-6-4: 2019 to the test report

Assessment information:

This report contains an assessment of the EUT against Electromagnetic Compatibility based upon tests carried out on the samples submitted. The results contained in this report relate only to the items tested. Manufactured products will not necessarily give identical results due to production and measurement tolerances. QualiTech, EMC Lab does not assume responsibility for any conclusion and generalization drawn from the test results with regards to other specimens or samples of type of the equipment represented by test item.

The EUT was setup and exercised using the configuration, modes of operation and arrangements defined in this report only.

Customer's Declaration:

Per customer's declaration the EUT i.e. Jupiter Plus (Three Phase Inverter) has five models, i.e. SE25K, SE27.6K, SE30K, SE33.3K, SE40K. All models are identical and belong to one product family with no essential differences. All tests were performed on model SE40K.

Modifications:

Modifications made to the EUT

None

Modifications made to the Test Standard

None

Summary of Compliance Status

The EUT was tested according to the following test methods.
Test results are given in full in sections 3 to 16.

Emission Tests

Test type	Test Method	Class applied	Frequency Range	Test results
Radiated Emissions on EUT standalone	EN 55032	A	30MHz to1GHz	**Comply**
Radiated Emissions on EUT with DCD	EN 55032	A	30MHz to1GHz	**Comply**
Conducted Emission on 3Phase AC	EN 55032	A	150kHz to30MHz	**Comply**
Conducted Emission on 750 VDC	EN 55011	A	150kHz to30MHz	**Comply**
Harmonic current emission	EN 61000-3-12	-	50Hz to harmonic order 40	**Comply**
Voltage Fluctuations & flicker	EN 61000-3-3	-	50Hz	**Comply**

Immunity Tests

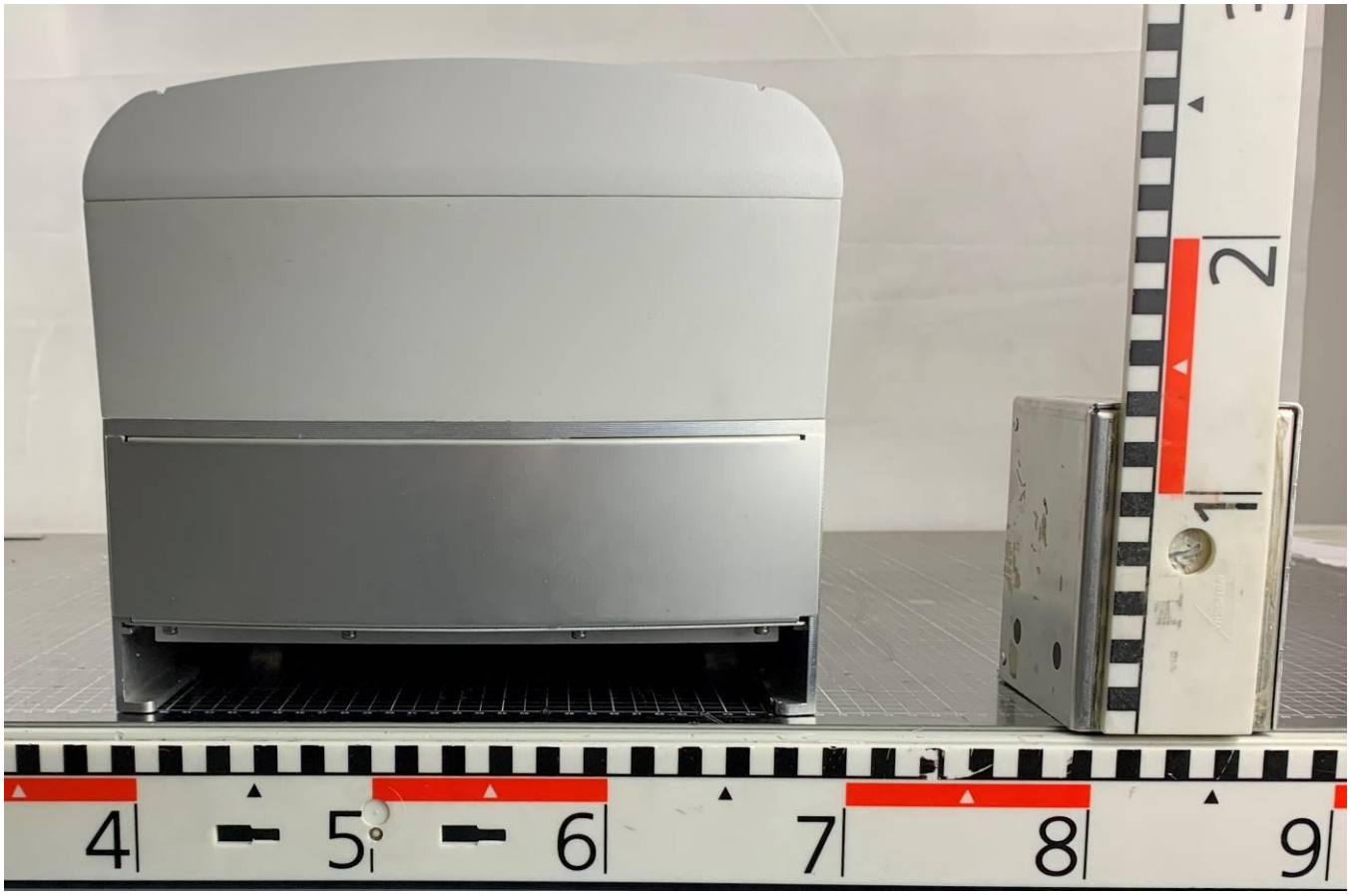
Test type	Applied on	Test Method	Frequency Range/ application type	Test level	Performance Criteria applied	Test results
ESD	Enclosure	EN61000-4-2	Contact	±4kV	A	**Comply**
			Air	±8kV	A	**Comply**
Radiated Immunity	System	EN61000-4-3	80 MHz - 6000MHz	10V/m	A	**Comply**
EFT	3Phase AC	EN61000-4-4	-	±2kV	B	**Comply**
	750 VDC		-	±2kV	B	**Comply**
Surge	3Phase AC	EN61000-4-5	Line to Line	±1kV	B	**Comply**
			Line to Earth	±2kV	B	**Comply**
	750 VDC		Line to Line	±1kV	B	**Comply**
			Line to Earth	±1kV	B	**Comply**
Conducted Immunity	3Phase AC	EN61000-4-6	150kHz to 80MHz	10Vrms	A	**Comply**
	750 VDC		150kHz to80MHz	10Vrms	A	**Comply**
Magnetic Field	System	EN61000-4-8	50Hz	30A/m	A	**Comply**
Voltage dips and short interruptions	230 VAC	EN61000-4-11	50 Hz	100%,60%,30%	B & C	**Comply**
Power frequency	3Phase AC	IEC 61000-4-16	Differential mode	100 Vrms	A	**Comply**
			Common mode	300 Vrms	A	**Comply**
	750 VDC		Differential mode	100 Vrms	A	**Comply**
			Common mode	300 Vrms	A	**Comply**
Damped Oscillatory Wave	3Phase AC	IEC 61000-4-18	Line to Line	±1kV	A	**Comply**
			Line to Earth	±2.5kV	A	**Comply**
	750 VDC		Line to Line	±1kV	A	**Comply**
			Line to Earth	±2.5kV	A	**Comply**
Impulse voltage test	3Phase AC	IEC 62109-1	PE	4.450	-	**Comply**
			SELV	6.450	-	**Comply**
	750 VDC		PE	4.450	-	**Comply**
			SELV	6.450	-	**Comply**

Annex No. 2
Pictures of the unit

Enclosure front

Enclosure bottom (connectors)

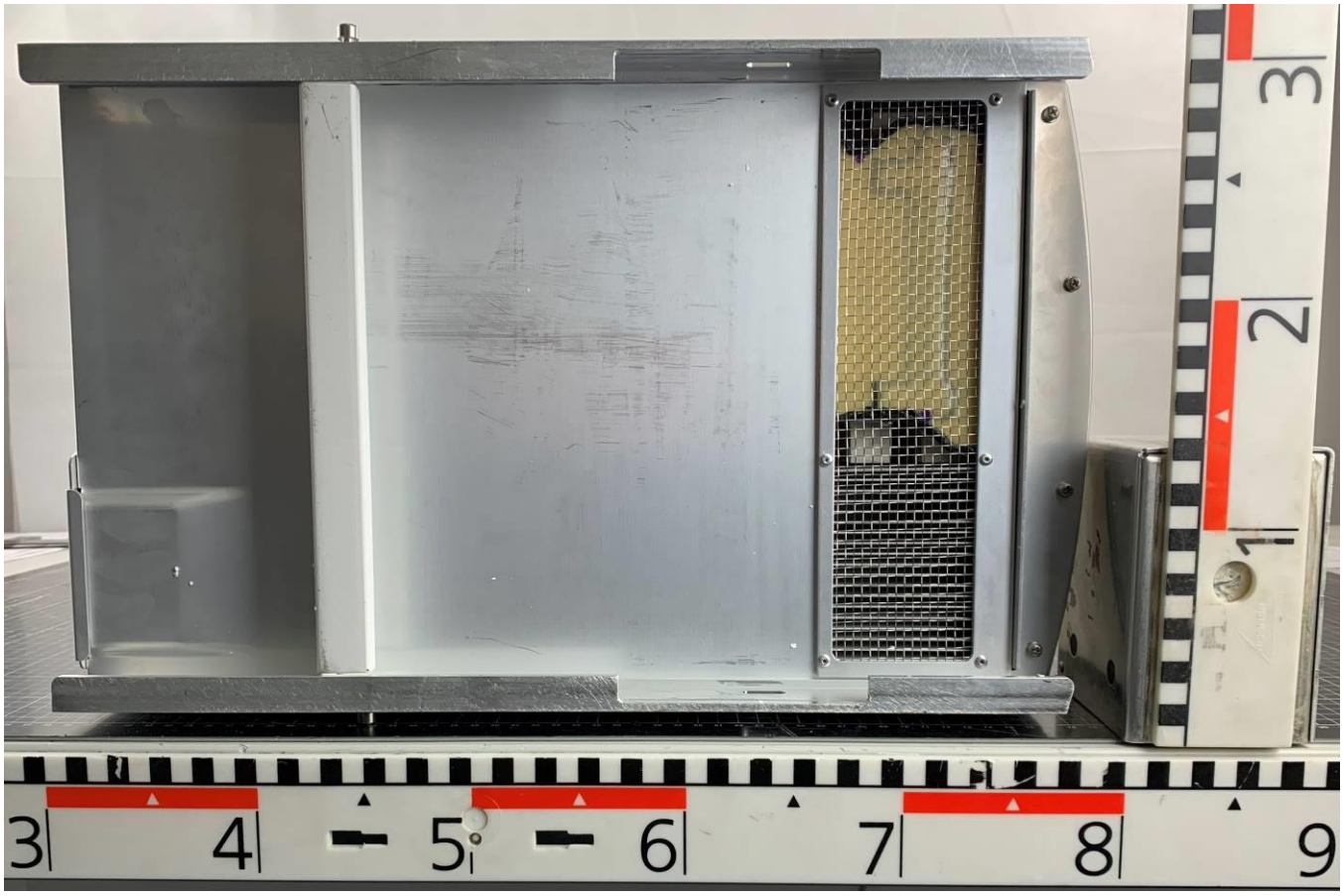
Enclosure top side



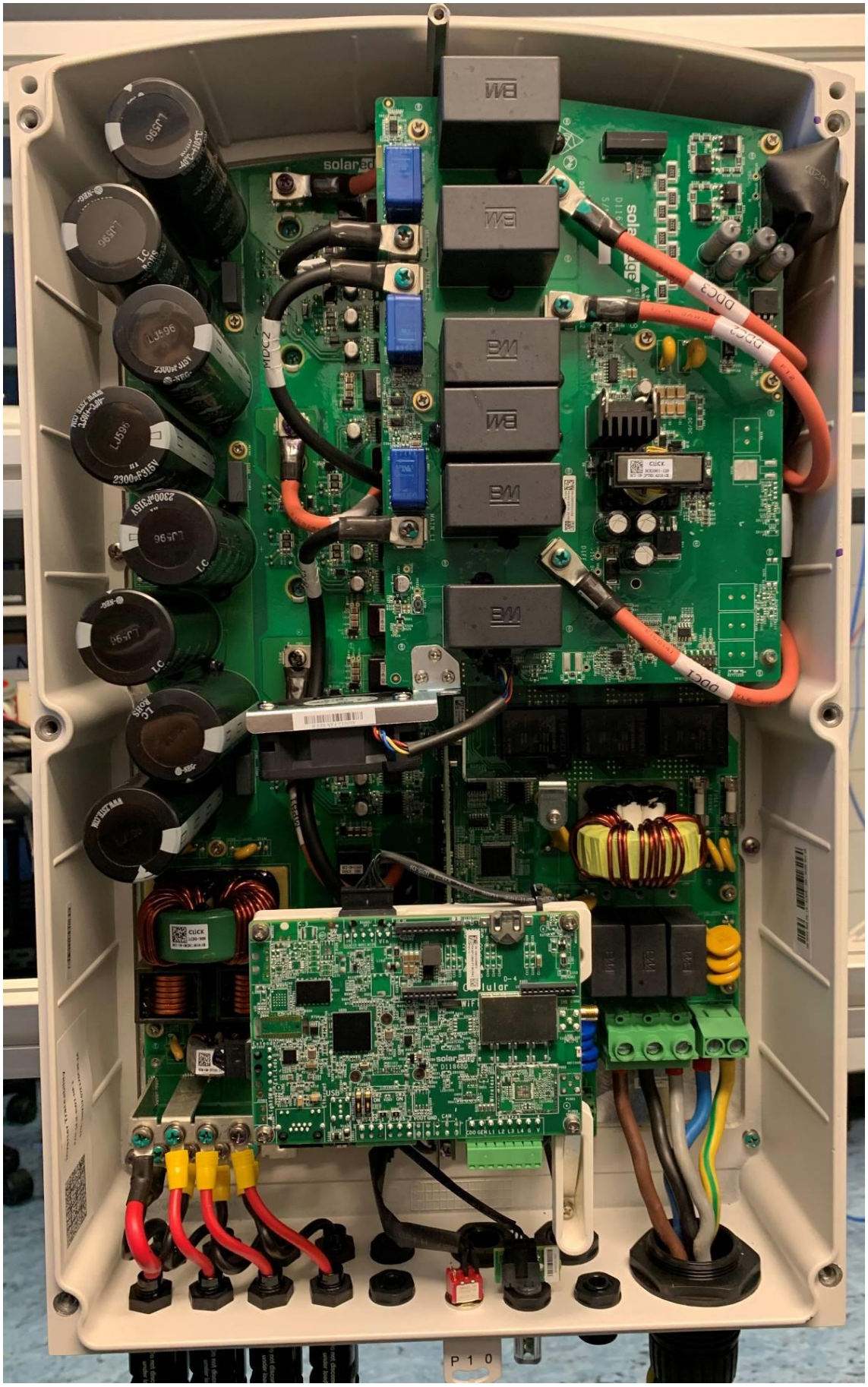
Enclosure left side

Enclosure right side

Enclosure back



Enclosure open



Annex No. 3
Test equipment list

Testing Location: Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96, 86842 Türkheim, Germany

Date(s) of performance test: 2020-06-01 – 2020-10-28

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Current Transducer	1032	LEM Danfysik	IT 200-S Ultrastab	9112220137	Apr-20
Current Transducer	1033	LEM Danfysik	IT 200-S Ultrastab	9112220138	Apr-20
Current Transducer	1034	Signaltec	IT 200-S	9112220139	Apr-20
Hygro- /Thermo- /Barometer	1073	Greisinger	GFTB 100	90258040	Mar-19
Spitzenberger & Spies Test System for PV-Inverter	1091	Spitzenberger & Spies	PVS 127500 / EMV D 75000/PAS / PRU 12750 / Mobile box / RLC 3500/2.5	A5191 00 / A5192 00 / A5193 00 / A5194 00 / A5195 00	N/A
Dewetron Multi Channel Data Acquisition System	1092	Dewetron	DEWE-800 / DEWE-30-16 with Voltage an Current Modules	12130573, 56121690	N/A
PV Simulator	1091.1	Spitzenberger & Spies	PVS 127500	A5191 00	N/A
PV Simulator (Compartment 1)	1091.1.1	Spitzenberger & Spies	PVS 42500	A5191 00/1	N/A
Voltage Module	1092.1.0	Dewetron	DAQP-HV	429391	Jan-20
Current Module	1092.1.1	Dewetron	DAQP-LA	410873	Jan-20
Multi Channel Data Acquisition System, Part 2	1092.2	Dewetron	DEWE-30-16	56121690	Jan-20
PV Simulator (Compartment 2)	1091.1.2	Spitzenberger & Spies	PVS 42500	A5191 00/2	N/A
PV Simulator (Compartment 3)	1091.1.3	Spitzenberger & Spies	PVS 42500	A5191 00/3	N/A
Voltage Module	1092.1.2	Dewetron	DAQP-HV	429388	Jan-20
Current Module	1092.1.3	Dewetron	DAQP-LA	410874	Jan-20
Current Transducer	1096	LEM Danfysik	IT 400-S	1131010011	Jan-20
Current Transducer	1096	LEM Danfysik	IT 400-S	1131010011	Jan-20
PV Simulator (Compartment 4)	1091.1.4	Spitzenberger & Spies	PVS 42500	A5191 00/4	N/A
Current Transducer	1097	LEM Danfysik	IT 400-S	1131010012	Jan-20
Current Transducer	1097	LEM Danfysik	IT 400-S	1131010012	Jan-20
PV Simulator (Compartment 5)	1091.1.5	Spitzenberger & Spies	PVS 42500	A5191 00/5	N/A
Voltage Module	1092.1.4	Dewetron	DAQP-HV	429392	Jan-20
Current Module	1092.1.5	Dewetron	DAQP-LA	410865	Jan-20
Current Transducer	1098	LEM Danfysik	IT 400-S	1131010013	Jan-20
PV Simulator (Compartment 6)	1091.1.6	Spitzenberger & Spies	PVS 42500	A5191 00/6	N/A

Current Transducer	1099	LEM Danfysik	IT 200-S	1131480016	Jan-20
Voltage Module	1092.1.6	Dewetron	DAQP-HV	429395	Jan-20
Current Module	1092.1.7	Dewetron	DAQP-LA	412956	Jan-20
Current Transducer	1100	LEM Danfysik	IT 200-S	1131480017	Jan-20
Current Transducer	1101	LEM Danfysik	IT 200-S	1131480018	Jan-20
Voltage Module	1092.1.8	Dewetron	DAQP-HV	429393	Jan-20
Current Module	1092.1.9	Dewetron	DAQP-LA	410869	Jan-20
Voltage Module	1092.1.10	Dewetron	DAQP-HV	429394	Jan-20
Current Module	1092.1.11	Dewetron	DAQP-LA	410870	Jan-20
Voltage Module	1092.1.12	Dewetron	DAQP-HV	429390	Jan-20
Current Module	1092.1.13	Dewetron	DAQP-LA	410871	Jan-20
Voltage Module	1092.1.14	Dewetron	DAQP-HV	429387	Jan-20
Current Module	1092.1.15	Dewetron	DAQP-LA	410872	Jan-20
Voltage Module	1092.2.16	Dewetron	DAQP-HV	429386	Jan-20
Current Module	1092.2.17	Dewetron	DAQP-LA	412967	Jan-20
Current Module	1092.2.18	Dewetron	DAQP-LV	492893	Jan-20
Current Module	1092.2.19	Dewetron	DAQP-LA	412961	Jan-20
Current Module	1092.2.20	Dewetron	DAQP-LV	385057	Jan-20
Current Module	1092.2.21	Dewetron	DAQP-LV	385044	Jan-20
Current Probe	1214	Chauvin Arnoux	PAC 12	116289 RBH	Jun-20

Testing Location: Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96, 86842 Türkheim, Germany

Date(s) of performance test: 2022-04-11 – 2022-04-16

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
Spitzenberger & Spies Test System for PV-Inverter"	E-005727	Spitzenberger & Spies	PVS 127500 / EMC D 75000/PAS / PRU 12750 / Mobile box / RLC 3500/2.5	A5191 00 / A5192 00 / A5193 00 / A5194 00 / A5195 00	N/A
PV Simulator	E-005727	Spitzenberger & Spies	PVS 127500	A5191 00	N/A
PV Simulator (Compartment 1)	E-005728	Spitzenberger & Spies	PVS 42500	A5191 00/1	N/A
PV Simulator (Compartment 2)	E-005729	Spitzenberger & Spies	PVS 42500	A5191 00/2	N/A
PV Simulator (Compartment 3)	E-005730	Spitzenberger & Spies	PVS 42500	A5191 00/3	N/A
PV Simulator (Compartment 4)	E-005731	Spitzenberger & Spies	PVS 42500	A5191 00/4	N/A
PV Simulator (Compartment 5)	E-005732	Spitzenberger & Spies	PVS 42500	A5191 00/5	N/A
PV Simulator (Compartment 6)	E-005733	Spitzenberger & Spies	PVS 42500	A5191 00/6	N/A
EMC Basic System	E-005734	Spitzenberger & Spies	EMC D 75000/PAS	A5192 00	N/A
EMC Basic System (L1)	E-005735	Spitzenberger & Spies	PAS 25000	A5192 00/1	N/A
EMC Basic System (L2)	E-005736	Spitzenberger & Spies	PAS 25000	A5192 00/2	N/A
EMC Basic System (L3)	E-005737	Spitzenberger & Spies	PAS 25000	A5192 00/3	N/A
EMC Basic System (Control System)	E-005738	Spitzenberger & Spies	SyCore 2M4	A5192 00/4	N/A
Laboratory Connection Box	E-005739	Spitzenberger & Spies	Laboratory Connection Box	A5192 00/5	N/A
Power Recovering System	E-005740	Spitzenberger & Spies	PRU 12750	A5193 00	N/A
Mobile Box	E-005741	Spitzenberger & Spies	Mobile Box	A5194 00	N/A
Dewetron Multi Channel Data Acquisition System	E-005744	Dewetron	DEWE-800 / DEWE-30-16 with Voltage an Current Modules	12130573, 56121690	N/A
Multi-Channel Data Acquisition System, Part 1	E-005745	Dewetron	DEWE-800	12130573	Mar - 22
Voltage Module	E-005746	Dewetron	DAQP-HV	429391	Mar - 22
Current Module	E-005747	Dewetron	DAQP-LA	410873	Mar - 22

Voltage Module	E-005748	Dewetron	DAQP-HV	429388	Mar - 22
Current Module	E-005749	Dewetron	DAQP-LA	410874	Mar - 22
Voltage Module	E-005750	Dewetron	DAQP-HV	429392	Mar - 22
Current Module	E-005751	Dewetron	DAQP-LA	410865	Mar - 22
Voltage Module	E-005752	Dewetron	DAQP-HV	429395	Mar - 22
Current Module	E-005753	Dewetron	DAQP-LA	412956	Mar - 22
Voltage Module	E-005754	Dewetron	DAQP-HV	429393	Mar - 22
Current Module	E-005755	Dewetron	DAQP-LA	410869	Mar - 22
Voltage Module	E-005756	Dewetron	DAQP-HV	429394	Mar - 22
Current Module	E-005757	Dewetron	DAQP-LA	410870	Mar - 22
Voltage Module	E-005758	Dewetron	DAQP-HV	429390	Mar - 22
Current Module	E-005759	Dewetron	DAQP-LA	410871	Mar - 22
Voltage Module	E-005760	Dewetron	DAQP-HV	429387	Mar - 22
Current Module	E-005761	Dewetron	DAQP-LA	410872	Mar - 22
Current Module	E-005761	Dewetron	DAQP-LA	410872	Mar - 22
Multi-Channel Data Acquisition System, Part 2	E-005762	Dewetron	DEWE-30-16	56121690	Mar - 22
Voltage Module	E-005763	Dewetron	DAQP-HV	429386	Mar - 22
Current Module	E-005764	Dewetron	DAQP-LA	412967	Mar - 22
Current Module	E-005765	Dewetron	DAQP-LV	492893	Mar - 22
Current Module	E-005766	Dewetron	DAQP-LA	412961	Mar - 22
Current Module	E-005767	Dewetron	DAQP-LV	385057	Mar - 22
Current Module	E-005768	Dewetron	DAQP-LV	385044	Mar - 22
Hygro- / Thermo- / Barometer	E-005711	Greisinger	GFTB 100	90258040	Apr- 21

Testing Location: Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96, 86842 Türkheim, Germany

Date(s) of performance test: 2023-05-31

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
3-phasige elektronische Spannungsquelle	E-005892	Ametek CTS Europa GmbH	NetWave 67.2-400	P1818220431	N/A
Current Transducer	E-005668	LEM Danfysik	IT 200-S Ultrastab	9112220137	2022-06-01
Current Transducer	E-005669	LEM Danfysik	IT 200-S Ultrastab	9112220138	2022-06-01
Current Transducer	E-005670	LEM Danfysik	IT 200-S Ultrastab	9112220139	2022-06-01
Current Transducer	E-005671	LEM Danfysik	IT 200-S Ultrastab	8181740016	2022-06-01
Messshunt 10 mOhm	E-005714	Isabellenhütte	RUG-Z-R010-0.1-TK1	N/A	N/A
Dewetron Multi Channel Data Acquisition System	E-005679	Dewetron	DEWE-2600 with Voltage and Current Modules	28110299	2022-06-01
Electronics Rack/Current Transducer Powersupply	E-005676	Signaltec	MCTS	37-004-0201	N/A
Voltage Module	E-005680	Dewetron	DAQP-HV	376625	2022-06-01
Voltage Module	E-005681	Dewetron	DAQP-HV	380290	2022-06-01
Voltage Module	E-005682	Dewetron	DAQP-HV	380291	2022-06-01
Voltage Module	E-005683	Dewetron	DAQP-HV	380289	2022-06-01
Voltage Module	E-005684	Dewetron	DAQP-HV-S4 (bis 1600 V)	500282	2022-06-01
Current Module	E-005686	Dewetron	DAQP-LA	504019	2022-06-01
Current Module	E-005687	Dewetron	DAQP-LA	504020	2022-06-01
Current Module	E-005688	Dewetron	DAQP-LA	504017	2022-06-01
Current Module	E-005900	Dewetron	DAQP-LA	504018	2022-06-01
LV Karte für Dewetron	E-006108	Dewetron	DAQP-LV-B	521198	2022-06-01

End of Test report