TEST REPORT

Engineering recommendation G99

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

Report reference number ..... :	**17TH0199-G99/1-4_4**
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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 ..... :	**SMA Solar Technology AG**
Address ..... :	Sonnenallee 1, 34266 Niestetal
Test specification	
Standard ..... :	G99/1-6:2020 Tests for Type A Inverter Connected Power Generating Modules
Certificate ..... :	**Certificate of compliance**
Test report form number. ..... :	G99/1
Master TRF ..... :	Bureau Veritas Consumer Products Services Germany GmbH
Test item description ..... :	**Photovoltaic inverter**
Trademark ..... :	SMA
Model / Type ..... :	STP 50-40
Ratings ..... :	**STP 50-40**
MPP DC voltage range [V] ..... :	500 – 800
Input DC voltage range [V] ..... :	Max. 1000
Input DC current [A] ..... :	6 x 20
Output AC voltage [V] ..... :	400 3 / N / PE @ 50 / 60 Hz
Output AC current [A] ..... :	72,5
Output power [VA] ..... :	50000

Testing Location ..... :	**Bureau Veritas Consumer Products Services Germany GmbH**
Address ..... :	Businesspark A96, 86842 Türkheim, Germany
Testing Location ..... :	**SMA Solar Technology AG**
Address ..... :	Sonnenallee 1, 34266 Niestetal, Germany
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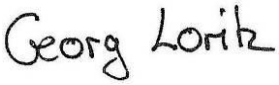
Approved by (name and signature) ..... :	Georg Loritz 
Manufacturer's name ..... :	**SMA Solar Technology AG**
Manufacturer address ..... :	Sonnenallee 1, 34266 Niestetal

Document History

Date	Internal reference	Modification / Change / Status	Revision
2019-04-17	Christian Schaller	Initial report was written	0
2019-06-07	Christian Schaller	- comment about logic interface included	1
2019-06-09	Christian Schaller	- A7.1.3 with standard droop test of 5% - A.7.1.4.3 comment attached and updated	2
2019-10-09	Christian Schaller	Retesting according to G99-1/4:2019 and update to software version 3.00.05.R	3
2020-09-30	Christian Schaller	Update to G99/1-6:2020, Flicker updated	4

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] ..... :	83

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 ..... :	2017-11-23
Date(s) of performance of test..... :	2019-04-16 to 2019-04-18 2019-08-29 to 2019-09-02

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 requirements of G99-1. 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.

This Test Report consists of the following documents:

1. Test Results
2. Annex No. 1 – EMC Test Report
3. Annex No. 2 – Pictures of the unit
4. Annex No. 3 – Test equipment list

Copy of marking plate:

General product information:

1. The maximum ambient temperature is specified as 60°C
2. Dimension of EUT: 800 by 600 by 886 mm.

The Solar converter converts DC voltage into AC voltage.

The input and output are protected by varistors to earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output. The output is switched off redundant by the high power switching bridge and a two relays in series. This assures that the opening of the output circuit will also operate in case of one error.

The product was tested on

Software version: 3.00.05.R

Description of the power circuit (Figure 1):

The unit is a three phase inverter. It is a non-isolated, grid-connected inverter for three phase AC grids (L1, L2, L3, N and PE). It has 12 PV-inputs (6 MPP Tracker).

The photovoltaic input is connected via lockable PV connector and provides a DC switch. The input provides an overvoltage protection build of varistors to PE. The input current is measured via a current sensor. EMC filtering is done via x-capacitors, y-capacitors and inductances. After the EMC filter, the Control Board checks the DC input voltage and current, before it is going to the IGBT modules which are also monitored by the control board with the gate driver control unit. A three level inverter makes the PWM signal. The PWM signal is smoothed by a LCL filter into a sine wave. The unit does not provide galvanic separation from input to output (transformerless inverter). The output is switched off redundant by the high power switching bridge and two relays in series. This assures that the opening of the output circuit will also operate in case of one error. Additionally varistors are provided for overvoltage protection from the grid.

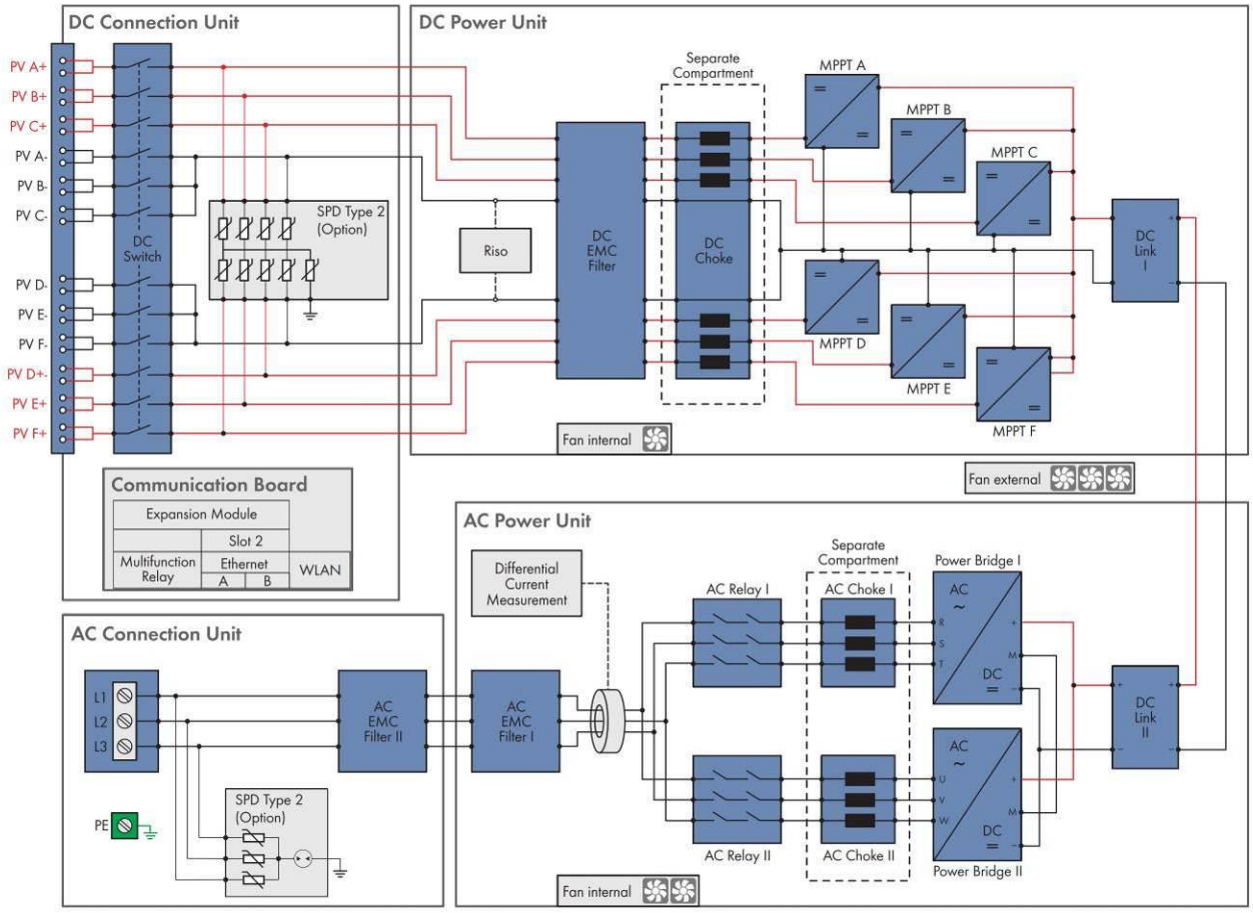


Figure 1 – Block diagram

Engineering recommendation G99-1			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A.7	**Requirements for Type Testing Power Generating Modules**		
A.7.1	**Power Park Module Requirements**		
A.7.1.1	**Certification & Type Testing Generating Unit Requirements**		
A.7.1.2	Type Verification Functional Testing of the Interface Protection		**P**
A.7.2.1	Disconnection times		**P**
A7.1.2.2	Over / Under Voltage		**P**
A.7.1.2.3	Over / Under Frequency		**P**
A.7.1.2.4	Loss of Mains Protection		**P**
A.7.1.2.5	Re-connection		**P**
A.7.1.2.6	Frequency Drift and Step Change Stability test		**P**
A.7.1.3	Limited Frequency Sensitive Mode – Over (LFSM-O)		**P**
A.7.1.4.1	Harmonics		**P**
A.7.1.4.2	Power Factor		**P**
A.7.1.4.3	Voltage Flicker		**P**
A.7.1.4.4	DC Injection		**P**
A.7.1.5	Short Circuit Current Contribution		**P**
A.7.1.6	Self-Monitoring - Solid State Disconnection		**P**
	Logic Inverface (Input port)	Required by paragraph 11.1.3	**P**

G99-1 Test Results:

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

Note:

Response to protection operation was tested by

“Prüf- und Zertifizierungsstelle Fachauschuss Elektrotechnik im BG-PRÜFZERT“

Report No.: UB.017.10/06-122

Address:

Berufsgenossenschaft Energie Textil Elektro

Gustav-Heinemann-Ufer 130

50968 Köln

The requirements of functional safety with regard to the changeover to be met.

The measurements for detection and control of faults in the microprocessor system are described in (1) Section 4. These measurements are based inter alia UL1998:1998-08, and are comparable with measurements such as they were described in DIN V VDE 0801. The software is created in the (certified) integrated OMS.

The VDE0126-1-1 test report is stored at the Bureau Veritas Consumer Products Services Germany Server; Project: 10TH0052 for Grid Guard 4.

Additional spot testing of Grid Guard 4 in STP 50-40 see test results below.

Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
K1102	Short Pin 1 to Pin 2	401Vac / 793Vdc	3h 30min	ext. 100 A	---	Unit ceases output power, no restart until manual reset; no event of message No fire, no risk of electric shock or other hazard occurred as a result of the fault.
RA1801	Short	403Vac / 801Vdc	2h	ext. 100 A	---	Unit ceases output power, no restart until manual reset; event message: “6008 CPLD (HW) / Gerätestörung” No fire, no risk of electric shock or other hazard occurred as a result of the fault.
L1400	Open Pin 6	401Vac / 792Vdc	15min	ext. 100 A	---	Unit ceases output power, no restart until manual reset No fire, no risk of electric shock or other hazard occurred as a result of the fault.
K2500	Short Pin 3 and 4	402Vac / 796Vdc	35min	ext. 100 A	---	Unit continues power export, but did not re-start after PV disconnect; event message: "3302, Unstable operation" (PV isolation is only checked at startup) No fire, no risk of electric shock or other hazard occurred as a result of the fault.
N2500	Open Pin 2	399Vac / 793Vdc	20min	ext. 100 A	---	Unit continues power export, but did not re-start after PV disconnect; event messages: "3501,Insulation failure; 3302, Unstable operation" No fire, no risk of electric shock or other hazard occurred as a result of the fault.
C2503	Short	401Vac / 798Vdc	1h 21min	ext. 100 A	---	Unit continues power export, but did not re-start after PV disconnect; event message: "3302, Unstable operation" No fire, no risk of electric shock or other hazard occurred as a result of the fault.
Check that the relays fulfil the basic insulation or simple separation based on the PV circuit working voltage.						The relay provides a contact gap of at least 2 x 1,85 mm (Zettler AZSR250)
Each active phase can be switched.						Two relays in series used in each phase with two contacts of 2x 1,85mm (Zettler AZSR250).
The errors in the control circuit simulate that the safety is even ensured during single fault.						

Operating Range	**P**

- Test 1: U = 195,5 V; f = 47,0 Hz; P = 1,00 Sn; cosφ = 1; at least 20 s
- Test 2: U = 195,5 V; f = 47,5 Hz; P = 1,00 Sn; cosφ = 1; at least 90 mins
- Test 3: U = 253,0 V; f = 51,5 Hz; P = 1,00 Sn; cosφ = 1; at least 90 mins
- Test 4: U = 253,0 V; f = 52,0 Hz; P = 1,00 Sn; cosφ = 1; at least 15 mins
- Test 5: Confirm that the Power Generating Module is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms.

Test sequence	Voltage [V]	Frequency [Hz]	Output power [W]	Cos φ [1]
1	195,5	47,05	43021,6	1,000
2	195,5	47,50	42993,0	1,000
3	253,0	51,50	50343,3	1,000
4	253,0	51,95	50339,7	1,000
5	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 Table 10.1 Settingd for long term parallel Operation						**P**
Test: L1 to N						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay (s)	Voltage / time	Confirm no trip
U/V	184,0V (0,8 pu)	2,5s	183,7	2,527	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2V (1,14 pu)	1,0s	264,3	1,027	258,2V / 5,0s	No trip
O/V stage 2	273,7V (1,19 pu)	0,5s	275,7	0,527	269,7V / 0,95s	No trip
					277,7V / 0,45s	No trip
Test: L2 to N						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay (ms)	Voltage / time	Confirm no trip
U/V	184,0V (0,8 pu)	2,5s	183,7	2,527	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2V (1,14 pu)	1,0s	264,2	1,027	258,2V / 5,0s	No trip
O/V stage 2	273,7V (1,19 pu)	0,5s	275,7	0,527	269,7V / 0,95s	No trip
					277,7V / 0,45s	No trip

Test: L3 to N						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay (ms)	Voltage / time	Confirm no trip
U/V	184,0V (0,8 pu)	2,5s	183,8	2,527	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2V (1,14 pu)	1,0s	264,3	1,027	258,2V / 5,0s	No trip
O/V stage 2	273,7V (1,19 pu)	0,5s	275,8	0,527	269,7V / 0,95s	No trip
					277,7V / 0,45s	No trip

Note:

The total disconnection time for voltage and frequency protection, including the operating time of the disconnection device, shall be the time delay setting with a tolerance of, -0s +0,5 s.

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 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 — P

Test:

Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay (s)	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,45	20,08	47,7Hz / 30s	No trip
U/F stage 2	47Hz	0,5s	46,95	0,586	47,2Hz / 19,5s	No trip
					46,8 Hz / 0,45s	No trip
O/F	52Hz	0,5s	51,99	0,580	51,8Hz / 120s	No trip
					52,2 Hz / 0,45s	No trip

Note:

The total disconnection time for voltage and frequency protection, including the operating time of the disconnection device, shall be the time delay setting with a tolerance of, -0s +0,5 s.

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

The requirement is specified in section 10.2, test procedure in Annex A.2.2.4
Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)

P

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

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]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks4)
1	100	100	0	0	49162	750	0,977	135	Test A at BL
32	100	100	-10	-10	49153	737	1,020	94	Test A at IB
33	100	100	-10	-5	49218	738	1,047	111	Test A at IB
34	100	100	-10	0	49143	748	1,070	138	Test A at IB
35	100	100	-10	+5	49237	750	1,101	110	Test A at IB
36	100	100	-10	+10	49132	737	1,123	99	Test A at IB
37	100	100	-5	-10	49159	754	0,969	89	Test A at IB
4	100	100	-5	-5	49117	750	0,995	106	Test A at IB
5	100	100	-5	0	49205	746	1,021	156	Test A at IB
6	100	100	-5	+5	49047	749	1,046	117	Test A at IB
38	100	100	-5	+10	49175	756	1,067	101	Test A at IB
39	100	100	0	-10	49086	749	0,924	88	Test A at IB
7	100	100	0	-5	49200	753	0,952	103	Test A at IB
8	100	100	0	+5	49178	750	1,000	119	Test A at IB
40	100	100	0	+10	49177	750	1,020	103	Test A at IB
41	100	100	+5	-10	49158	752	0,883	87	Test A at IB
9	100	100	+5	-5	49211	745	0,910	100	Test A at IB
10	100	100	+5	0	49259	750	0,930	141	Test A at IB
11	100	100	+5	+5	49192	748	0,954	117	Test A at IB
42	100	100	+5	+10	49190	748	0,979	105	Test A at IB
43	100	100	+10	-10	49132	744	0,850	85	Test A at IB
44	100	100	+10	-5	49149	748	0,870	101	Test A at IB
45	100	100	+10	0	49291	745	0,895	141	Test A at IB
46	100	100	+10	+5	49188	743	0,915	118	Test A at IB
47	100	100	+10	+10	49158	746	0,936	107	Test A at IB

Parameter at 0%	L= 10,10mH	R= 3,17Ω	C= 1002,9 µF

Note:

Note for technologies which have a substantial shut down time this can be added to the 0.5 seconds in establishing that the trip occurred in less than 0.5s. Maximum shut down time could therefore be up to 1.0 seconds for these technologies.

RLC is adjusted to min. +/-1% of the inverter rated output power

1) P_{EUT}: EUT output power

2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

4) BL: Balance condition, IB: Imbalance condition.

Condition A:

EUT output power PEUT = Maximum 5)

EUT input voltage 6) = >90% of rated input voltage range

5) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.

6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

A.7.1.2.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 10.2, test procedure in Annex A.2.2.4

Load imbalance (real, reactive load) for test condition A (EUT output = 50 % – 66 %)

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

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]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks4)
12	66	66	0	-5	32608	656	0,992	106	Test B at IB
13	66	66	0	-4	32598	661	0,996	110	Test B at IB
14	66	66	0	-3	32635	662	1,001	122	Test B at IB
15	66	66	0	-2	32561	657	1,007	129	Test B at IB
16	66	66	0	-1	32669	660	1,008	161	Test B at IB
2	66	66	0	0	32581	647	1,012	144	Test B at BL
17	66	66	0	1	32598	648	1,020	178	Test B at IB
18	66	66	0	2	32586	647	1,021	144	Test B at IB
19	66	66	0	3	32588	660	1,027	133	Test B at IB
20	66	66	0	4	32598	645	1,032	126	Test B at IB
21	66	66	0	5	32637	655	1,041	116	Test B at IB

Parameter at 0%	L= 17,42mH	R= 5,47Ω	C= 581,67 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, 90 % 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 The requirement is specified in section 10.2, test procedure in Annex A.2.2.4 Load imbalance (real, reactive load) for test condition A (EUT output = 25 % – 33 %)	**P**

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

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} [kW per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks4)
22	33	33	0	-5	16285	563	1,016	110	Test B at IB
23	33	33	0	-4	16286	557	1,015	120	Test B at IB
24	33	33	0	-3	16293	555	1,021	132	Test B at IB
25	33	33	0	-2	16298	558	1,026	150	Test B at IB
26	33	33	0	-1	16282	557	1,036	202	Test B at IB
3	33	33	0	0	16288	553	1,038	160	Test B at BL
27	33	33	0	1	16282	556	1,043	217	Test B at IB
28	33	33	0	2	16280	568	1,051	179	Test B at IB
29	33	33	0	3	16285	556	1,057	146	Test B at IB
30	33	33	0	4	16276	557	1,061	139	Test B at IB
31	33	33	0	5	16286	563	1,068	129	Test B at IB

Parameter at 0%	L= 31,8mH	R= 10Ω	C= 315µF

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, 90 % 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	P

Test:

Test should prove that the reconnection sequence starts after a minimum delay of 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 1.

Under Voltage (182V)	
Time delay setting	Measured delay
20s	28,73s
Over Voltage (275V)	
Time delay setting	Measured delay
20s	27,21s
Under Frequency (47,4Hz)	
Time delay setting	Measured delay
20s	27,58s
Over Frequency (52,1Hz)	
Time delay setting	Measured delay
20s	27,64s

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 180V	At 47,4Hz	At 52,1Hz
Confirmation that the SSEG does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

A7.1.2.6 Frequency Drift and Step Change Stability test				P
Test:				
	Start Frequency	Change	Test Duration	Confirm no trip
Positive Vector Shift	49,5Hz	+50 degrees		No trip
Negative Vector Shift	50,5Hz	-50 degrees		No trip
Positive Frequency drift	49,0Hz to 51,0Hz	+0,95Hz/sec	2,1s	No trip
Negative Frequency drift	51,0Hz to 49,0Hz	-0,95Hz/sec	2,1s	No trip

Note:

Manufacturers considering new designs should allow for the RoCoF where stability is required to be increased to, up to 2Hz per second, as proposed in the new European network codes, which are expected to come into force over the period 2014/2015. Under these conditions RoCoF will cease to be an effective loss of mains protection and is unlikely to be permitted in future revisions of this document.

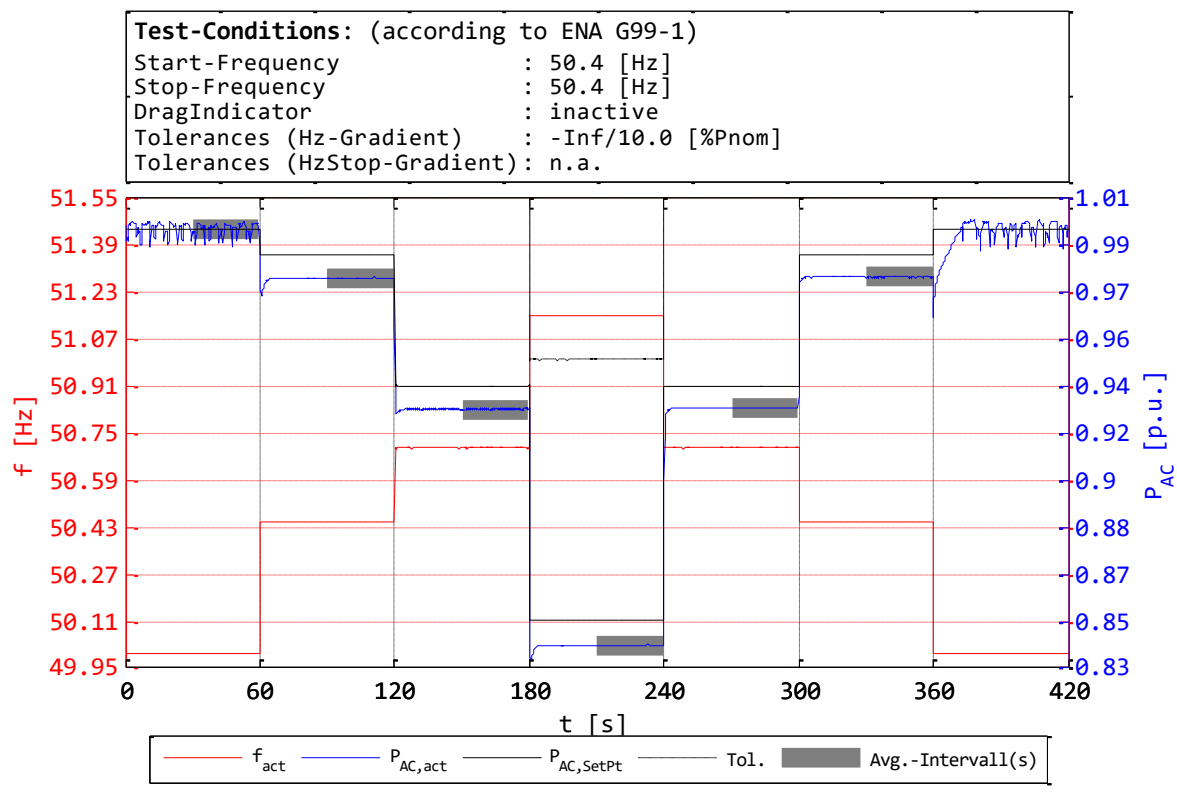
For the step change test the SSEG should be operated with a measureable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for 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 measureable output at the start frequency and then the frequency changed in a ramp function at 0,95Hz per second to the end frequency. On reaching the end frequency it should be maintained for a period of at least10 seconds. The SSEG should not trip during this test.

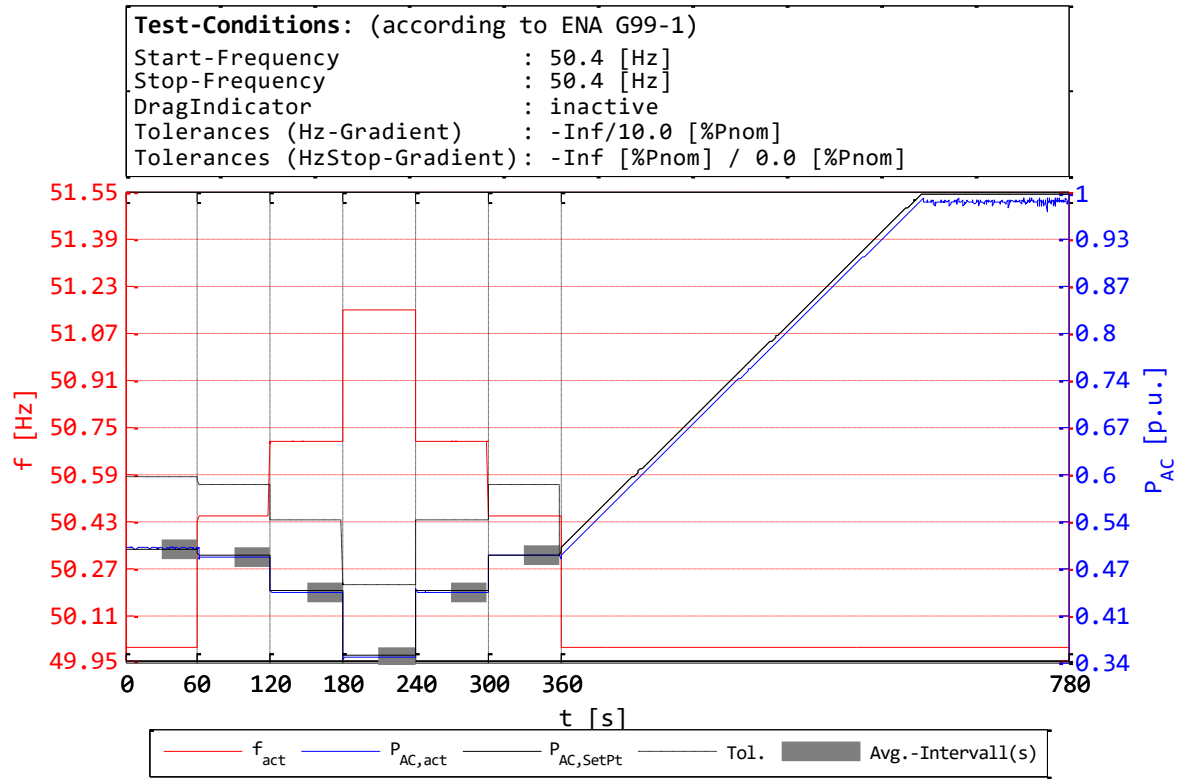
A7.1.3 Power response to over-frequency	P

Test:							
1-min mean value [Hz]:	a) 50,00	b) 50,45	c) 50,70	d) 51,15	e) 50,70	f) 50,45	g) 50,00
1. Measurement a) to g): Active power output > 80% P_n							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
$P_{expected}$ [kW]:	49,99	49,42	46,92	42,42	46,92	49,42	49,99
$P_{measured}$ [kW]:	49,99	48,98	46,48	41,94	46,49	49,42	49,99
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_n							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
$P_{expected}$ [kW]:	25,00	24,50	22,00	17,50	22,00	24,50	25,00
$P_{measured}$ [kW]:	25,00	24,44	21,93	17,40	21,98	24,47	25,00

Graph of Measuremenet 1.: Active power output > 80% Pn



Graph of Measuremenet 2.: Active power output 40% and 60% after freezing > 80% Pn



Test:

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

Point g) must be held until the micro-generator is again feeding in with the active power output available.

Assessment criterion:

For f = 50,2 Hz, the value of the P_M active power currently being generated is "frozen".

a) For adjustable micro-generators when:

1) the active power reduces between measuring points b) and f) given above with the set gradient P_M per Hz for a increasing frequency (or rises for a frequency decreasing again).

2) the maximum active power gradient occurring in point is less than the configured maximum active power per minute

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

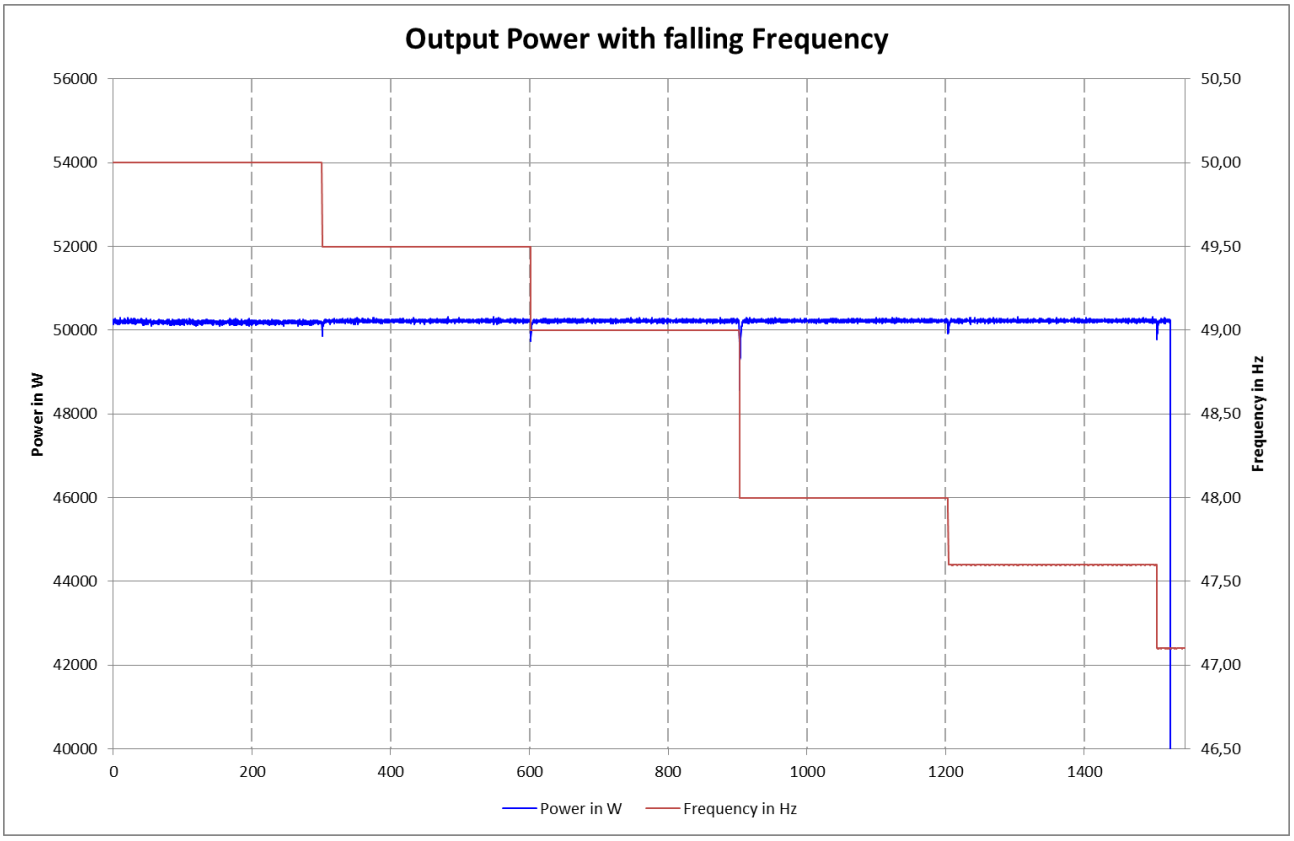
4) the settling time is equal or below 2 s with an intentional delay set to zero

b) For partly adjustable micro-generators

1) when they behave as in a) within their adjustment range, and

2) when, outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51,5 Hz.

A.7.2.3 Power Output with Falling Frequency						P
Frequency Setpoint(Hz):	50,00	49,50	49,00	48,00	47,60	47,10
Frequency (Hz):	50,00	49,50	49,00	48,00	47,60	47,10
Active power [kW]:	50,19	50,22	50,21	50,22	50,19	0,00



Criteria:

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 must 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 must 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 must 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 must not be below 95,0% of Registered Capacity and the Synchronous Power Generating Module must not trip in less than the 20s of the test.

A.7.1.4.1 Harmonic Current Emissions						P
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated ouput 8,3kW		100% of rated output 16,5kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit inBS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,128	0,181	0,108	0,152	8	8
3rd	0,015	0,021	0,013	0,018	21,6	N/A
4th	0,062	0,088	0,058	0,082	4	4
5th	0,290	0,410	0,323	0,456	10,7	10,7
6th	0,035	0,049	0,036	0,050	2,67	2,67
7th	0,179	0,253	0,283	0,401	7,2	7,2
8th	0,062	0,088	0,054	0,077	2	2
9th	0,018	0,026	0,020	0,028	3,8	N/A
10th	0,031	0,043	0,019	0,026	1,6	1,6
11th	0,080	0,113	0,113	0,159	3,1	3,1
12th	0,068	0,096	0,068	0,097	1,33	1,33
13th	0,069	0,097	0,098	0,139	2	2
14th	0,015	0,021	0,013	0,019	N/A	N/A
15th	0,012	0,017	0,014	0,020	N/A	N/A
16th	0,025	0,036	0,032	0,046	N/A	N/A
17th	0,036	0,050	0,065	0,092	N/A	N/A
18th	0,017	0,024	0,016	0,023	N/A	N/A
19th	0,027	0,038	0,048	0,068	N/A	N/A
20th	0,009	0,012	0,008	0,011	N/A	N/A
21th	0,007	0,010	0,008	0,012	N/A	N/A
22th	0,013	0,019	0,014	0,020	N/A	N/A
23th	0,020	0,029	0,044	0,062	N/A	N/A
24th	0,007	0,010	0,006	0,008	N/A	N/A
25th	0,015	0,021	0,031	0,044	N/A	N/A
26th	0,008	0,011	0,010	0,014	N/A	N/A
27th	0,005	0,007	0,006	0,009	N/A	N/A
28th	0,004	0,006	0,006	0,008	N/A	N/A
29th	0,012	0,017	0,026	0,036	N/A	N/A

30th	0,004	0,005	0,004	0,006	N/A	N/A
31th	0,013	0,019	0,022	0,031	N/A	N/A
32th	0,005	0,007	0,004	0,005	N/A	N/A
33th	0,004	0,006	0,005	0,007	N/A	N/A
34th	0,003	0,005	0,003	0,004	N/A	N/A
35th	0,007	0,011	0,016	0,022	N/A	N/A
36th	0,004	0,005	0,004	0,005	N/A	N/A
37th	0,007	0,010	0,013	0,019	N/A	N/A
38th	0,003	0,005	0,003	0,004	N/A	N/A
39th	0,003	0,004	0,004	0,006	N/A	N/A
40th	0,003	0,005	0,002	0,004	N/A	N/A
THD	--	1,13	--	0,70	23	13
PWHD	--	0,0006	--	0,0005	23	22

A.7.1.4.1 Harmonic Current Emissions						P
Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated ouput 8,3kW		100% of rated output 16,5kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit inBS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,131	0,184	0,177	0,250	8	8
3rd	0,016	0,023	0,022	0,031	21,6	N/A
4th	0,029	0,041	0,025	0,035	4	4
5th	0,282	0,398	0,311	0,439	10,7	10,7
6th	0,036	0,050	0,040	0,056	2,67	2,67
7th	0,184	0,260	0,289	0,408	7,2	7,2
8th	0,057	0,081	0,045	0,063	2	2
9th	0,013	0,019	0,017	0,023	3,8	N/A
10th	0,081	0,115	0,074	0,105	1,6	1,6
11th	0,084	0,119	0,117	0,165	3,1	3,1
12th	0,036	0,051	0,034	0,049	1,33	1,33
13th	0,071	0,100	0,102	0,143	2	2
14th	0,057	0,080	0,059	0,084	N/A	N/A
15th	0,012	0,017	0,014	0,020	N/A	N/A
16th	0,024	0,034	0,035	0,050	N/A	N/A
17th	0,035	0,050	0,066	0,093	N/A	N/A
18th	0,016	0,023	0,016	0,023	N/A	N/A
19th	0,026	0,037	0,047	0,067	N/A	N/A
20th	0,011	0,015	0,012	0,017	N/A	N/A
21th	0,008	0,011	0,009	0,012	N/A	N/A
22th	0,012	0,018	0,008	0,011	N/A	N/A
23th	0,022	0,031	0,044	0,061	N/A	N/A
24th	0,014	0,020	0,014	0,020	N/A	N/A
25th	0,016	0,022	0,034	0,048	N/A	N/A
26th	0,006	0,009	0,009	0,013	N/A	N/A
27th	0,005	0,006	0,006	0,009	N/A	N/A
28th	0,005	0,007	0,006	0,008	N/A	N/A
29th	0,014	0,020	0,027	0,038	N/A	N/A

30th	0,006	0,008	0,006	0,008	N/A	N/A
31th	0,013	0,018	0,022	0,031	N/A	N/A
32th	0,006	0,008	0,005	0,007	N/A	N/A
33th	0,004	0,006	0,005	0,007	N/A	N/A
34th	0,004	0,006	0,003	0,005	N/A	N/A
35th	0,008	0,011	0,016	0,023	N/A	N/A
36th	0,003	0,004	0,003	0,004	N/A	N/A
37th	0,009	0,013	0,015	0,021	N/A	N/A
38th	0,004	0,005	0,005	0,007	N/A	N/A
39th	0,003	0,004	0,004	0,006	N/A	N/A
40th	0,004	0,005	0,004	0,005	N/A	N/A
THD	--	1,13	--	0,73	23	13
PWHD	--	0,0011	--	0,0006	23	22

A.7.1.4.1 Harmonic Current Emissions					P	
Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated ouput 8,3kW		100% of rated output 16,5kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit inBS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,090	0,127	0,118	0,167	8	8
3rd	0,012	0,016	0,020	0,028	21,6	N/A
4th	0,035	0,050	0,037	0,052	4	4
5th	0,278	0,393	0,310	0,439	10,7	10,7
6th	0,030	0,043	0,030	0,042	2,67	2,67
7th	0,169	0,239	0,273	0,386	7,2	7,2
8th	0,064	0,091	0,055	0,078	2	2
9th	0,018	0,025	0,018	0,025	3,8	N/A
10th	0,077	0,109	0,072	0,102	1,6	1,6
11th	0,081	0,115	0,112	0,158	3,1	3,1
12th	0,038	0,054	0,037	0,052	1,33	1,33
13th	0,060	0,084	0,089	0,125	2	2
14th	0,052	0,074	0,053	0,075	N/A	N/A
15th	0,013	0,018	0,015	0,021	N/A	N/A
16th	0,024	0,034	0,030	0,042	N/A	N/A
17th	0,038	0,054	0,070	0,098	N/A	N/A
18th	0,016	0,023	0,017	0,024	N/A	N/A
19th	0,026	0,037	0,042	0,060	N/A	N/A
20th	0,010	0,014	0,012	0,017	N/A	N/A
21th	0,007	0,011	0,009	0,013	N/A	N/A
22th	0,014	0,020	0,014	0,020	N/A	N/A
23th	0,024	0,034	0,045	0,064	N/A	N/A
24th	0,014	0,020	0,014	0,020	N/A	N/A
25th	0,015	0,021	0,031	0,044	N/A	N/A
26th	0,006	0,009	0,005	0,008	N/A	N/A
27th	0,005	0,008	0,006	0,009	N/A	N/A
28th	0,005	0,007	0,004	0,006	N/A	N/A
29th	0,013	0,019	0,024	0,033	N/A	N/A

30th	0,005	0,007	0,004	0,006	N/A	N/A
31th	0,012	0,017	0,020	0,029	N/A	N/A
32th	0,005	0,008	0,004	0,006	N/A	N/A
33th	0,004	0,006	0,005	0,007	N/A	N/A
34th	0,004	0,006	0,004	0,005	N/A	N/A
35th	0,008	0,011	0,017	0,024	N/A	N/A
36th	0,003	0,005	0,003	0,005	N/A	N/A
37th	0,009	0,012	0,014	0,020	N/A	N/A
38th	0,004	0,005	0,005	0,007	N/A	N/A
39th	0,002	0,003	0,005	0,006	N/A	N/A
40th	0,003	0,005	0,003	0,004	N/A	N/A
THD	--	1,07	--	0,68	23	13
PWHD	--	0,0010	--	0,0005	23	22

A.7.1.4.2 Power factor				P
Test:				
Output power	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.
20%	1,000	1,000	1,000	
50%	1,000	1,000	1,000	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	

Note:

The power factor capability of the SSEG shall conform to EN 50438. When operating at Registered Capacity the SSEGshall operate at apower factor within the range 0,95 lagging to 0,95 leading relative to the voltage waveform unless otherwise agreed with the DNO eg for power factor improvement.

The test set up shall be such that the Inverter supplies full load to the DNO's Distribution System via the power factor (pf) meter and the variac as shown below in figure A5. The Inverter pf should be within the limits given in 5.6, for three test voltages 230 V –6%, 230V and 230 V +10%.

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	4,79%	4,79%	0,00ms	5,81%	5,13%	0,00ms	0,15	0,12
Normalised to Standard impedance	5,58%	6,39%	0,00ms	7,74%	6,84%	0,00ms	0,20	0,16
Values for maximum impedance	3,40%	3,35%	0,00ms	3,77%	3,30%	0,00ms	0,09	0,07
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	0,15	Ω	Xl	0,15	Ω
	Z	0,21	Ω			
Normalised to Standard impedance	R	0,24	Ω	Xl	0,15	Ω
	Z	0,28	Ω			
Maximum Impedance	Rmax	0,10	Ω	Xlmax	0,06	Ω
	Zmax	0,12	Ω			

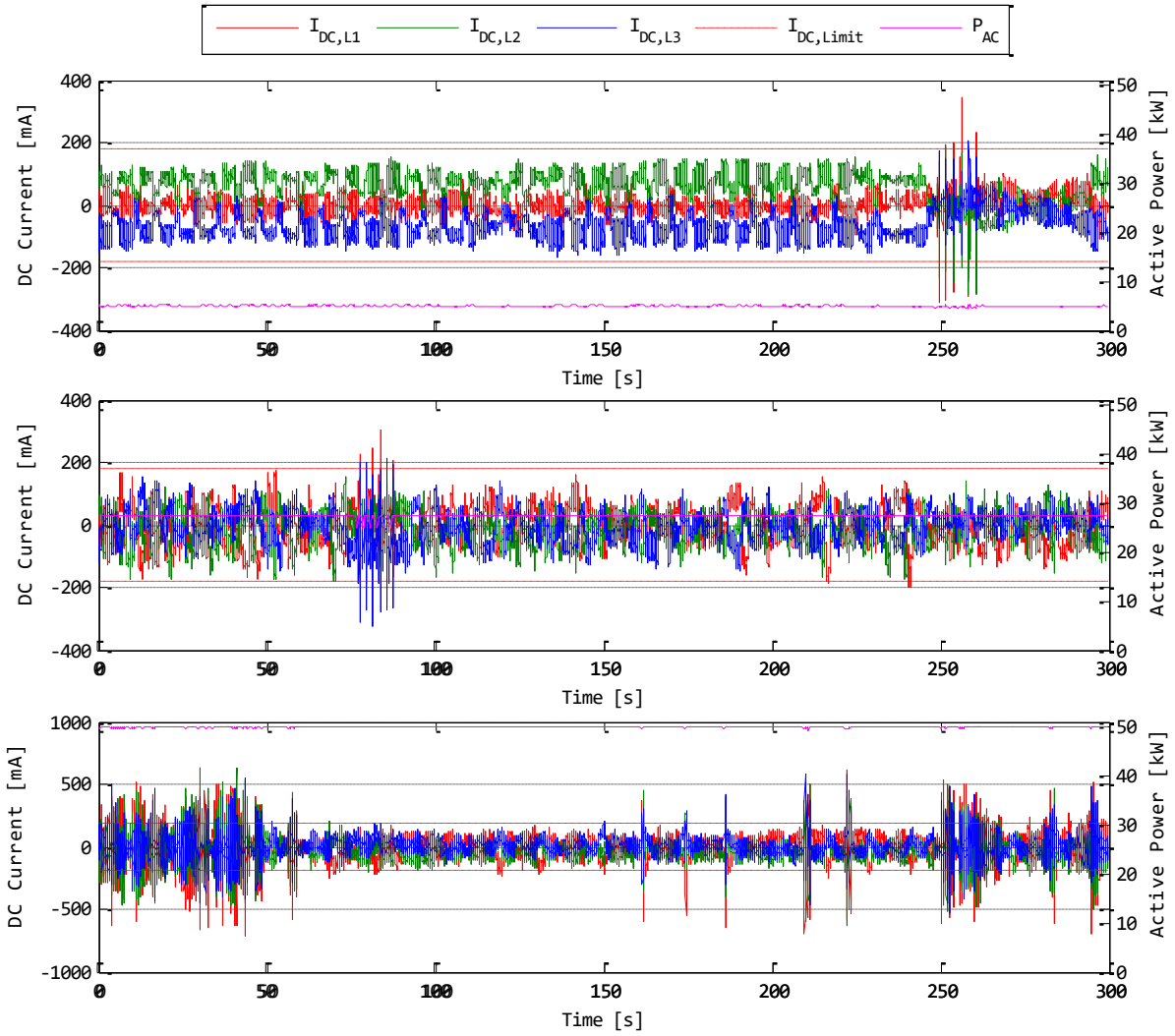
Note:
Test performed according to EN 61000-3-11 for inverter above 16A per phase.

A.7.1.4.4 DC injection

P

DCinAC Test for Britain (G99-1), DCinAC measurement in normal operation
Normative parameters: AMaxOfs in normal operation = 181.3 mA, Tolerance=0.0 mA

Power Stage [% VA_{Nom}]	10 ± 5	55 ± 5	100 ± 5
Active Power [W]	4997.8	27450.4	49969.3
Voltage [V_{RMS}] L1/L2/L3	230/230/230	230/230/230	231/231/231
Current [A_{RMS}]	7.3/7.3/7.3	39.7/39.7/39.7	72.2/72.2/72.2
Power Factor [-]	1.000	1.000	1.000
abs. DC component [mA]	21.95/66.61/66.89	42.79/38.09/38.15	45.45/43.84/35.51
rel. DC component [% I_{Nom}]	0.03/0.09/0.09	0.06/0.05/0.05	0.06/0.06/0.05



Note:
DC-injection is tested at each phase of the inverter and a limit of 0,25% per phase was used as pass criteria.

A.7.1. 5 Short Circuit Current Contribution for Inverters

P

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	20ms	229,97	80,25
Initial Value of aperiodic current	A	N/A	100ms	13,98	72,58
Initial symmetrical short-circuit current*	I_k	N/A	250ms	13,91	72,92
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	13,87	73,44
Reactance/Resistance Ratio of source*	$^X/_R$	N/A	Time to trip	2,52	In seconds

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 (Appendix 4) including the time taken for the Inverter to trip.

A7.1.6 Self Monitoring – Solid state Disconnection.	**N/A**
It has been verified that in the event of the solid state switching device failing to disconnect the SSEG, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	N/A
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 (Functional safety of the internal automatic disconnection device according to VDE 0126-1-1).	

Logic Interface (input port). Required by paragraph 11.1.3	**P**
Confirm that an input port is provided and can be used to shut down the module.	Yes
Note: A Modbus signal can be used to cease Active Power output within 5 s	

Annex No. 1

EMC test report

The complete test report is stored at Bureau Veritas Consumer Products Services Germany GmbH Türkheim in project 17TH0199.

Test Report
EMC-Testing

STP50-40-MOW

CE-MOW_Zertifizierung

Accredited According to
DIN EN ISO/IEC 17025

DAkkS Deutsche Akkreditierungsstelle D-PL-12074-01-00

This report is based on the test report template:
PB_Kopf_EMV_EN Version 14 from 05.09.2016
DHC-Vision ID 780468 Editor: Berger Niels Released by: Irmer Soeren

Revision History

Document Number STP50-40-MOW	Edition and Revision Type [1]		Annotations	Author
-510:LE2317	1.0	A	First Edition	Berger, Niels

[1] A: First Edition or minor modifications due to errors or improvements in the documentation.
Replacing former version in brackets
B: Modifications maintaining full and upward compatibility.
Replacing former version in brackets
C: Modifications limiting or excluding compatibility.
Valid only in combination with former version in brackets

Testet by	2017-06-26 X Test Engineer as representative of Niels Berger Signiert von: Andreas Rauch	**Released by**	26.06.2017 X Senior Engineer EMC & Global Certification (T 15 FS, EC) Authorized signatory Signiert von: Peter Thomae

Explanation of Symbols Used

For ensuring the understanding of this test report please note the following explanations of the symbols being used.

This symbol indicates an important comment.
For this reason read these sections carefully.

This symbol indicates an example.

This symbol indicates an opinion or an interpretation to circumstances.

Table of Contents

1 Overview on Results

Client:	Manufacturer:	Test Department and Site:
SMA Solar Technology AG Sonnenallee 1 34266 Niestetal Pinne, Julia	SMA Solar Technology AG Sonnenallee 1 34266 Niestetal	**SMA** Solar Technology AG Sonnenallee 1 EMV- und Umweltlabor (EUL) 34266 Niestetal / Germany Building 4

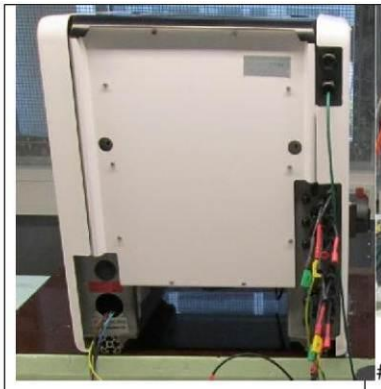
Order / Job Account:	912 / 822292
Project Title:	STP50-40-MOW_2017-04-04
Teamcenter Project:	TCP_000091
Teamcenter Object Report-ID	D_00124843|01|LOE+ EUL Test report
Test Type / Limits and Requirements:	EN61000-6-2:2005 German version EN61000-6-3:2007+A1:2011 German version ETSI EN301 489-1/-17:2017-02_V2.1.1/2017-02_V3.1.1 (European standard) EN55022:2010 Class B German version
Type of Test Item:	Photovoltaic Power Converter
Label of Test Item:	STP50-40
Test Specification:	-

Identification of the EUT: (equipment under test)

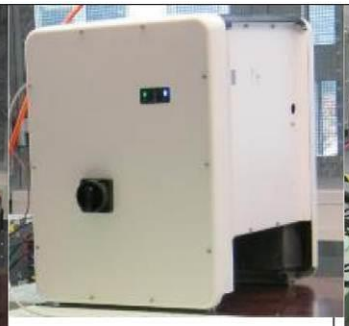
EUT-Number:	Part of EUT	Serial Number	Hardware-Version:	FA- bzw. Firmware-Version:	Remark
2844	DUT	3000137553		1.1.6.R	Main Unit
	PL-ACRLY5000-01.02	3000095700/3000132286	R2/R3	3519715/3521301	Status Mod2 / Mod6
	PL-AST5000-01.01	3000074041/0000248	R1	3519059/3504906	Status Mod2 / Mod6
	PL-DST5000-01.02	3000078492/3000078445	Q5	3519456	Status Mod2 / Mod6
	PL-DCEMV5000-01.02	3000159566/3000159563	R2	3526747	Status Mod2 / Mod6
	PL-ACFI5000.01	3000155860/3000155859	S1	-	Status Mod2 / Mod6
	PL-ACFG5000.01	3000155878/3000155879	S1	-	Status Mod2 / Mod6
	PL-BFS500.BG2	3000137553/3000080051	R2	3519716	Status Mod2 / Mod6
	KP20.BG1	0013884	R2	2.2.2.R	Status Mod2 / Mod6
	HP	3000080051	18|02	1.1.6.R	Status Mod2 / Mod6
	PL-DCY5000	-	R1	-	Status Mod2 / Mod6
	PL-LED5000-01.01	0000146	P3	-	Status Mod2 / Mod6
2839	DUT	3000137550		1.1.6.R	Main Unit
	PL-ACRLY5000-01.02	3000095677	R3?	-3519715	
	PL-AST5000-01.02	3000074030	R1	-3519059	
	PL-DST5000-01.02	3000078463	Q5	-3919456	
	PL-DCEMV5000-01.02	3000074105	R2	-3519060	
	PL-ACFI5000-01	000073	R1	-000073	
	PL-ACFG5000-01	000097	R1	-000097	
	PL-BFS500.BG2	3000080050	R2	3519716	
	KP20.BG1	0013911	R2	--2.2.2R	
	HP			1.1.6.R	
	PL-DCY5000	Handmuster		Handmuster	
	PL-LED5000-01.02	3000095751	P3		

2849	DUT	19910000217		1.1.6.R	Main Unit
	PL-ACRLY5000-01.02	3000132260	R4	3521301	
	PL-AST5000.-01.02	3000074049	R1	3519059	
	PL-DST5000-01.02	3000078436	Q5	3519456	
	PL-DCEMV5000-01.01	0000189	R3	3504910	
	PL-ACFI5000.01	3000155858	S1	-	
	PL-ACFG5000.01	3000155881	S1	-	
	PL-BFS500.BG1	0000217	R2	3504912	
	KP20.BG1	0013888	R2	2.2.2R	
	HP	?		1.1.6R	
	PL-DCY5000	Handmuster		Handmuster	
	PL-LED5000-01.02	3000095743	P3	-	

1.1 Pictures of EUT



#2839



#2844

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Topic	Description
Standards chosen:	Tested standards were chosen together with client (see above). Correct Standards needed for declaration of conformity and normative classification of EUT obtains to client.
Validity of test results:	The results listed in this test report apply for the EUT tested only. Any modification in mechanical construction, circuitry or components used will have an effect on the results. Duplication or Copies of any excerpts from this report is not allowed without a written approval of the test department.
Other standards:	Within this project no inquiry were made to point out further standards required for this type of equipment tested (e.g. ETSI-standard or similar). It's the responsibility of the customer finding different relevant standards.
Priority of other standards:	In case of testing according EN55024 please be advised, that there are additional standards (e.g. ETSI harmonised standards), that cover the immunity requirements for telecommunication applications and which must be preferred

An overview on the measurement uncertainty values can be found in file:" measurement uncertainty overview "

1.1 Emission

test and selected standard	equipment under test (EUT no.)	requirement	
		standard	additional
		modification | remarks	
Requirements according EN61000-6-3:2007+A1:2011			
Radiated emission according to: EN55016-2-3:2006	2844	passed	not tested
		2+3+4+5 | -	
Discontinuous disturbance according to: EN55014-1:2006+A1:2009	2849	passed	not tested
		none | -	
Conducted emissions according to: EN55022:2010	2844	passed	failed
		2+3+4+5+6 | -	
Requirements according ETSI EN301 489-1/-17:2017-02_V2.1.1/2017-02_V3.1.1			
Radiated emission according to: EN55032:2015	2844	passed	not tested
		2+3+4+5 | -	
Conducted emissions according to: EN55016-2-1:2009	2844	passed	failed
		2+3+4+5+6 | -	
Requirements according EN55022:2010 Class B			
Radiated emission according to: EN55016-2-3:2006	2844	passed	passed
		2+3+4+5+6 | -	
Conducted emissions according to: EN55022:2010	2844	passed	failed
		2+3+4+5+6 | -	
test summary*		**standard requirement / remarks**	**additional requirement / remarks**
Requirements according EN61000-6-3:2007+A1:2011		passed	failed
Requirements according ETSI EN301 489-1/-17:2017-02_V2.1.1/2017-02_V3.1.1		passed	failed
Requirements according EN55022:2010 Class B		passed	failed

For all appropriated EN standards, the German version (DIN EN) was applied.

* only valid with the specified remarks.

1.2 Immunity

test and selected standard	equipment under Test (EUT no.)	requirement	
		standard	additional
		modification | remarks	
Requirements according EN61000-6-2:2005			
Fast transient / burst according to: EN61000-4-4:2004	2844	passed	passed
		1 | -	
Radiated immunity according to: EN61000-4-3:2002	2844		
		1+2 (+3+4+5+6 non-active WIFI) | -	
Electrostatic discharge according to: EN61000-4-2:1995	2839	passed	not tested
		1 | -	
Conducted RF disturbance according to: EN61000-4-6:2014	2839		
		none | -	
Voltage dips and interruptions according to: EN61000-4-11:2004	2844	passed	not tested
		1+2 | -	
Surge according to: EN61000-4-5:1995	2844	passed	passed
		1+2 | -	
Requirements according ETSI EN301 489-1/-17:2017-02_V2.1.1/2017-02_V3.1.1			
Fast transient / burst according to: EN61000-4-4:2012	2844	passed	passed
		1 | -	
Radiated immunity according to: EN61000-4-3:2006 + A1:2008 + A2:2010	2844		
		1+2 (+3+4+5+6 non-active WIFI) | -	
Electrostatic discharge according to: EN61000-4-2:2009	2839	passed	not tested
		1 | -	
Conducted RF disturbance according to: EN61000-4-6:2009	2839		
		none | -	
Voltage dips and interruptions according to: EN61000-4-11:2004	2844	passed	not tested
		1+2 | -	
Surge according to: EN61000-4-5:2006	2844	passed	passed
		1+2 | -	
test summary*		**standard requirement / remarks**	**additional requirement / remarks**
Requirements according EN61000-6-2:2005		passed	passed
Requirements according ETSI EN301 489-1/-17:2017-02_V2.1.1/2017-02_V3.1.1		passed	passed

For all EN standards used, the German version (DIN EN) was applied.

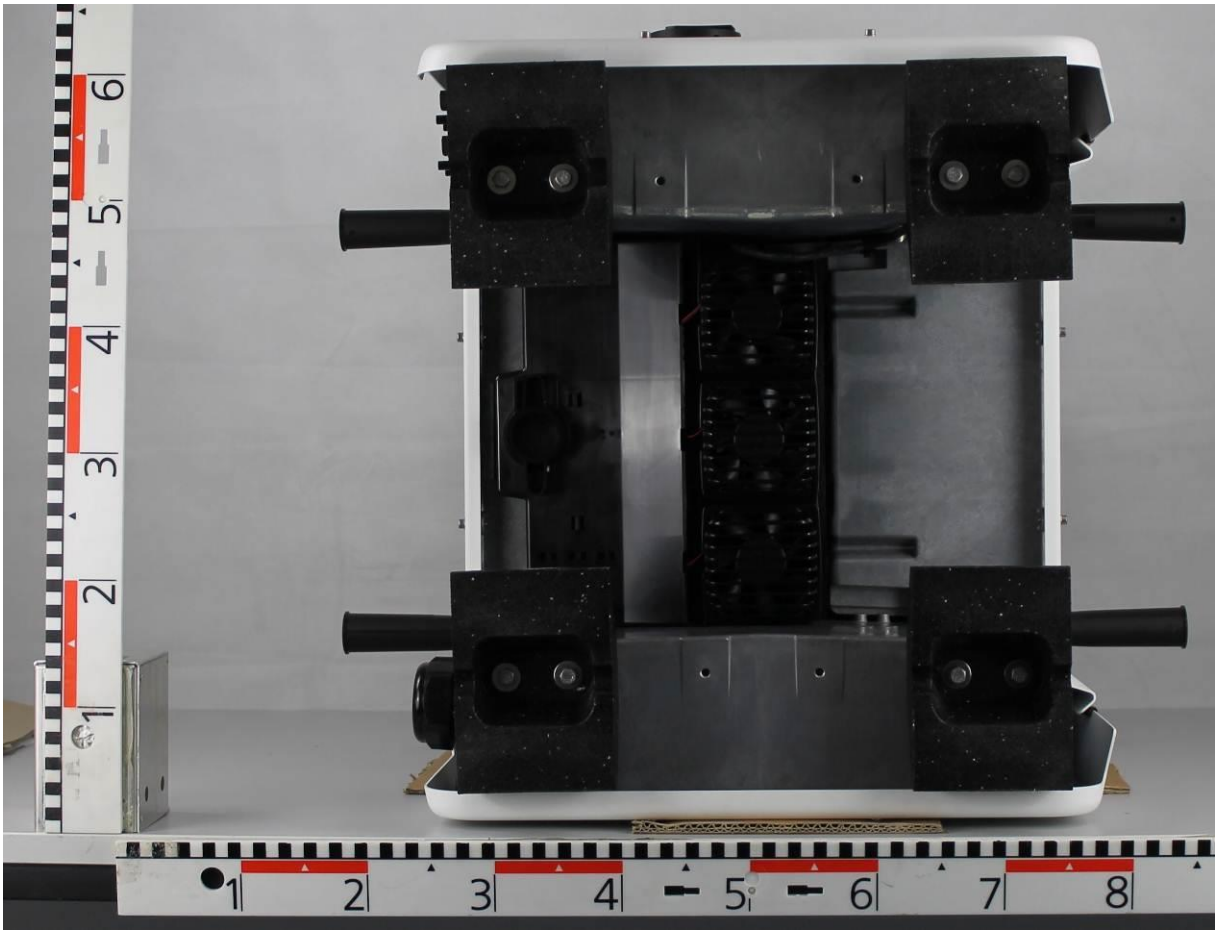
* only valid with the specified remarks.

Important note for the test report:

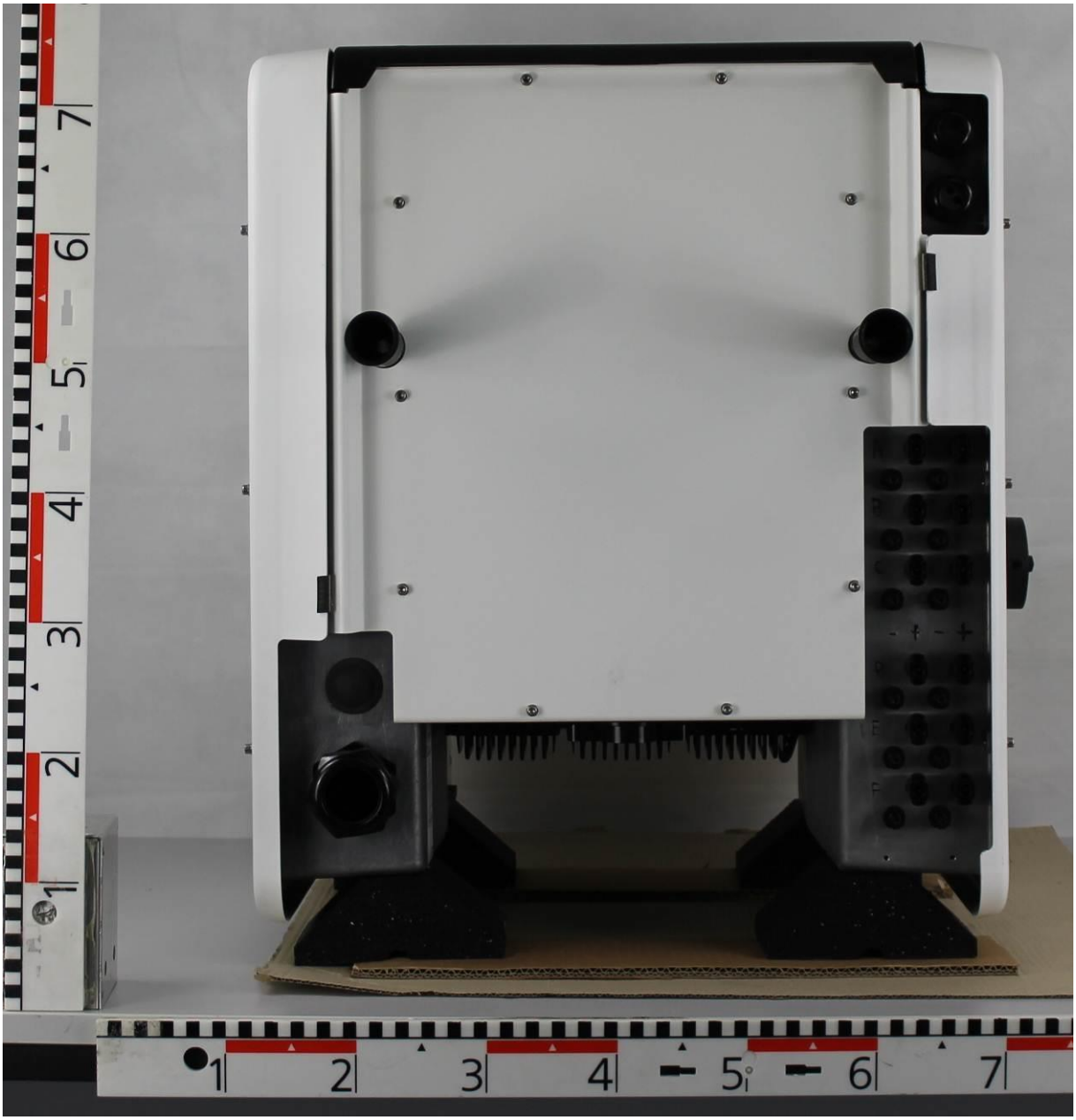
Annex No. 2
Pictures of the unit

Enclosure front view

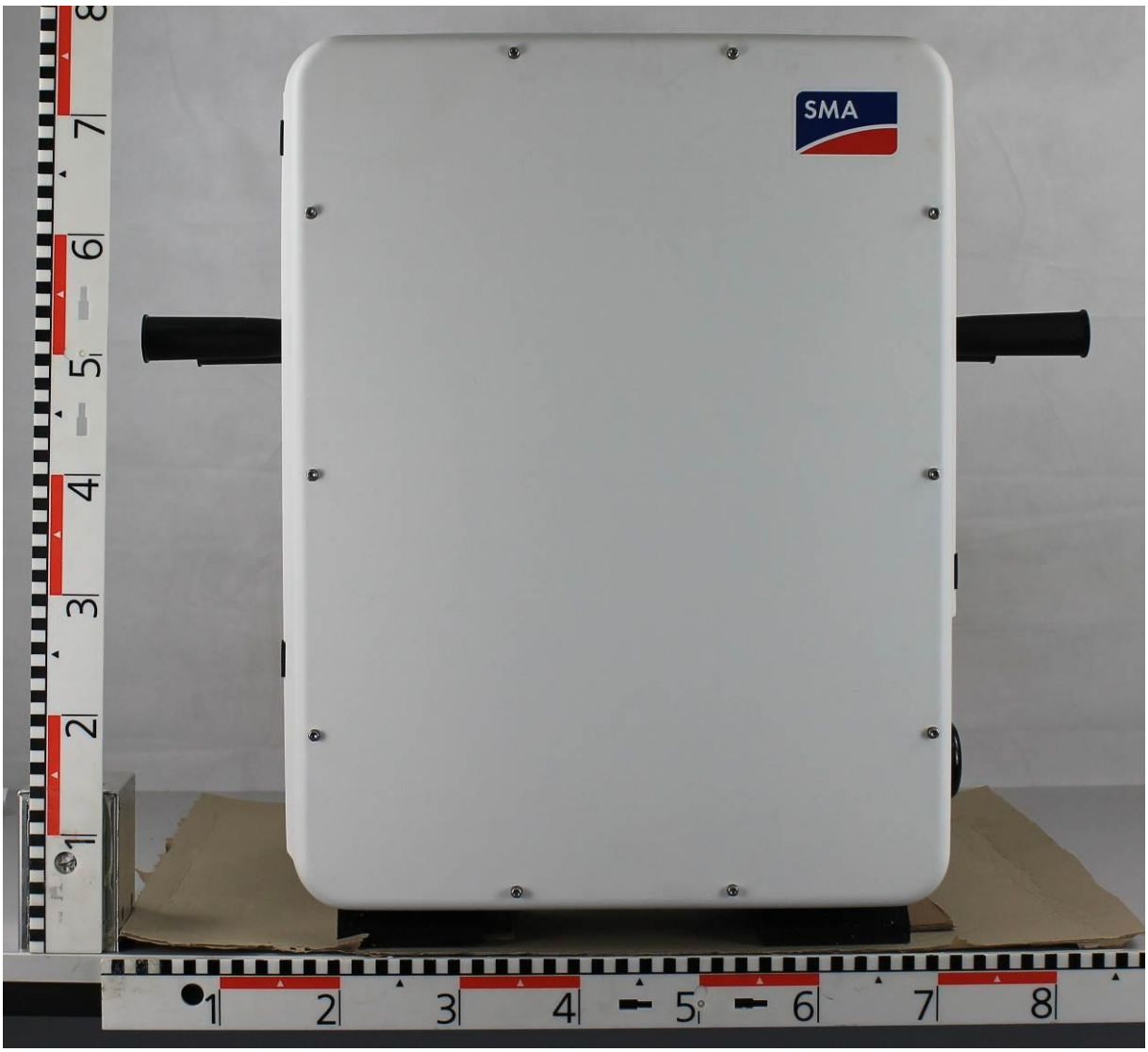
Enclosure bottom view



Enclosure side view



Enclosure rear view



Annex No. 3
Test Equipment list

Date(s) of test performance: 2019-04-16 to 2019-04-18

Equipment	Internal no.:	Manufacturer:	Type:	Serial no.:	Last calibration
Spitzenberger & Spies Test system for PV- inverter	1091	Spitznberger & 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 and current modules	12130573, 56121690	Aug-18
Hygro-/ Thermo- / Barometer	1073	Geisinger	GFTB 100	90258040	Mar-19
Current transducer	1096	LEM Danfysik	IT 400-S	1131010011	Aug-18
Current transducer	1097	LEM Danfysik	IT 400-S	1131010012	Aug-18
Current transducer	1098	LEM Danfysik	IT 400-S	1131010013	Aug-18

Date(s) of test performance: 2019-08-29 to 2019-09-02

Equipment	Internal No.	Manufacturer	Type	Serial No.	Last Calibration
EM Test	6603067	Ametek	Netwave 90.3	P1848224738	N/A
Dewetron Multi Channel Data Acquisition System	6002410	Dewetron	DEWE-800-820-SMA with voltage and current moduls	14120113	Mar-19
Current Transducer	6002214	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002208	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002209	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002210	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002204	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002205	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002206	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002200	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002201	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002326	LEM Danfysik	IT 200-S	N/A	Mar-19
Current Transducer	6002327	LEM Danfysik	IT 200-S	N/A	Mar-19
Current Transducer	6002328	LEM Danfysik	IT 200-S	N/A	Mar-19
Current Transducer	6002212	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002202	LEM Danfysik	IT 1000-S	N/A	Mar-19

Current Transducer	6002207	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002300	LEM Danfysik	IT 200-S	N/A	Mar-19
Current Transducer	6002213	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002211	LEM Danfysik	IT 1000-S	N/A	Mar-19
Current Transducer	6002203	LEM Danfysik	IT 1000-S	N/A	Mar-19
Hygro-/Thermo-/Barometer	449	Greisinger	GFTB 100	1507001	Oct-18

End Of Test Report