ENA Engineering Recommendation G83/2
Appendix 4
Type Verification Test Report

Type Approval and manufacturer/supplier declaration of compliance with the requirements of Engineering Recommendation G83/2			
SSEG (Small-Scale Embedded Generator) Type reference number	MICRO-0.3HV-I-OUTD-230; MICRO-0.3-I-OUTD-230 MICRO-0.25-I-OUTD-230; MICRO-0.25-I-OUTD-230-ACPV		
SSEG Type	PHOTOVOLTAIC GRID TIED INVERTER		
System Supplier name	Power-One Italy S.p.A.		
Address	Via S. Giorgio, 642 52028 Terranuova Bracciolini Arezzo - Italy		
Tel.	+39-055-91951	Fax	+39-055-9195248
E:mail		Web site	www.abb.com/solarinverters
Maximum / Nominal rated capacity	Connection Option		
	0.3 / 0.3	kW single phase (for MICRO-0.3HV-I-OUTD-230 and MICRO-0.3-I-OUTD-230 models)	
	0.25 / 0.25	kW single phase (for MICRO-0.25-I-OUTD-230 and MICRO-0.25-I-OUTD-230-ACPV models)	

We, Power-One Italy S.p.A., as manufacturer/supplier of Small Scale Embedded Generators, certifies that all products manufactured/supplied by the company with the above SSEG Type reference number will be manufactured and tested to ensure that they perform as stated in this Type Verification Test Report, prior to shipment to site and that no site modifications are required to ensure that the products meet all the requirements of G83/2.

Attachment:
Extract of Test Report Ref. **28106648 001**, Determination of Electrical Properties, released by TUeV Rheinland

(Manufacturer)
Robert P. White Jr.
(Director Product Compliance)

Phoenix, AZ
(Place)

2014 June 11
(Date)

Extract of Test report: **28106648 001**
"Determination of electrical properties"

Appendix 4 Type Verification Test Report (G83/2)

Type of System:	Grid tied inverter
System Manufacturer: **Manufacturer data:**	**Power-One Italy S.p.A.** Via S. Giorgio 642, 52028 Terranuova Bracciolini (AR) - Italy
Trade Mark:	**ABB**
Reference test report:	**28106648 001** Issued by TÜV Rheinland Italia S.r.l. on 10th June 2014
Measuring period:	From 10 th October 2012, 20th February 2014 to 10th May 2014
Pacr: *(Rated AC Power)* **Pacmax:** *(Maximum AC output Power)*	See table below
Software version	**DSP Firmware release:** not less than B100 for model: MICRO-0.3HV-I-OUTD-230. not less than B158 for models: MICRO-0.3-I-OUTD-230, MICRO-0.25-I-OUTD-230, MICRO-0.25-I-OUTD-230-ACPV. **MICRO (Supervisor) Firmware release:** not less than C010 for model: MICRO-0.3HV-I-OUTD-230. not less than C111 for models: MICRO-0.3-I-OUTD-230, MICRO-0.25-I-OUTD-230, MICRO-0.25-I-OUTD-230-ACPV. **Country standard selection: UK_G83-2**
Rated Voltage:	single-phase device 230 V (Phase/ Neutral)

Models *	Pacr / Pacmax
MICRO-0.3HV-I-OUTD-230	**0.3 / 0.3 W**
MICRO-0.3-I-OUTD-230	**0.3 / 0.3 W**
MICRO-0.25-I-OUTD-230	**0.25 / 0.25 W**
MICRO-0.25-I-OUTD-230-ACPV	**0.25 / 0.25 W**

Remarks:
Note *:

Models **MICRO-0.3-I-OUTD-230** and **MICRO-0.25-I-OUTD-230** are identical in construction except for firmware settings. If not differently stated all tests have been performed on model MICRO-0.3-I-OUTD-230 and are considered valid for both models.
Model **MICRO-0.25-I-OUTD-230-ACPV** is identical to MICRO-0.25-I-OUTD-230 except for the following:

1) Enclosure slightly modified in the flanges;
2) AC wiring harness provided with two connectors;
3) DC Output connectors position (+ and -) is reversed.

Model **MICRO-0.3HV-I-OUTD-230** is identical to MICRO-0.3-I-OUTD-230 except for the increase of the Input Voltage (operating voltage: from 12-60V to 15-75V; maximum voltage: from 65V to 79V) and the related components

Tested model are indicated in **bold** characters.

Power Quality. Harmonics. The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1 (of reference document G83/2)

MODELs: MICRO-0.3-I-OUTD-230 and **MICRO-0.3HV-I-OUTD-230**

SSEG rating per phase (rpp)			2.104 (7units)	kW	NV=MV*3,68/rpp	
Harmonic	At 45-55% of rated output TEST 1		100% of rated output TEST 1			
	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.028	0.049	0.061	0.107	1.080	
3	0.042	0.074	0.163	0.284	2.300	
4	0.010	0.018	0.012	0.021	0.430	
5	0.029	0.051	0.038	0.067	1.140	
6	0.008	0.014	0.006	0.010	0.300	
7	0.036	0.062	0.031	0.055	0.770	
8	0.008	0.013	0.010	0.017	0.230	
9	0.020	0.035	0.029	0.051	0.400	
10	0.006	0.011	0.004	0.007	0.184	
11	0.005	0.009	0.027	0.046	0.450	
12	0.005	0.009	0.004	0.007	0.153	
13	0.014	0.024	0.026	0.045	0.210	
14	0.005	0.008	0.005	0.009	0.131	
15	0.021	0.037	0.024	0.041	0.150	
16	0.002	0.004	0.004	0.006	0.115	
17	0.025	0.043	0.021	0.036	0.132	
18	0.002	0.004	0.006	0.010	0.102	
19	0.023	0.040	0.016	0.027	0.118	
20	0.004	0.007	0.005	0.008	0.092	
21	0.021	0.036	0.016	0.027	0.107	
22	0.003	0.005	0.004	0.007	0.084	
23	0.021	0.036	0.016	0.028	0.098	0.147
24	0.003	0.005	0.003	0.005	0.077	
25	0.018	0.032	0.022	0.038	0.090	0.135
26	0.002	0.004	0.003	0.005	0.071	
27	0.017	0.029	0.024	0.041	0.083	0.124
28	0.002	0.004	0.003	0.006	0.066	
29	0.010	0.017	0.027	0.047	0.078	0.117
30	0.002	0.004	0.002	0.004	0.061	
31	0.005	0.009	0.025	0.043	0.073	0.109

32	0.003	0.005	0.003	0.005	0.058	
33	0.004	0.007	0.024	0.041	0.068	0.102
34	0.002	0.003	0.003	0.005	0.054	
35	0.008	0.014	0.019	0.033	0.064	0.096
36	0.002	0.003	0.003	0.006	0.001	
37	0.010	0.017	0.013	0.022	0.061	0.091
38	0.003	0.004	0.003	0.006	0.048	
39	0.010	0.017	0.005	0.009	0.058	0.087
40	0.002	0.004	0.003	0.006	0.046	
MODELs:	**MICRO-0.25-I-OUTD-230** and MICRO-0.25-I-OUTD-230-ACPV					
SSEG rating per phase (rpp)			2.042 (8units)	kW	NV=MV*3,68/rpp	
Harmonic	At 45-55% of rated output TEST 1		100% of rated output TEST 2			
	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.024	0.043	0.077	0.139	1.080	
3	0.041	0.074	0.130	0.233	2.300	
4	0.009	0.015	0.020	0.036	0.430	
5	0.063	0.114	0.043	0.077	1.140	
6	0.003	0.005	0.010	0.018	0.300	
7	0.036	0.065	0.032	0.057	0.770	
8	0.004	0.007	0.011	0.019	0.230	
9	0.038	0.068	0.028	0.050	0.400	
10	0.003	0.006	0.007	0.013	0.184	
11	0.033	0.060	0.025	0.046	0.450	
12	0.005	0.009	0.007	0.013	0.153	
13	0.019	0.033	0.025	0.045	0.210	
14	0.005	0.009	0.004	0.006	0.131	
15	0.012	0.021	0.022	0.040	0.150	
16	0.002	0.004	0.006	0.010	0.115	
17	0.022	0.040	0.021	0.037	0.132	
18	0.002	0.004	0.005	0.009	0.102	
19	0.024	0.043	0.018	0.032	0.118	
20	0.003	0.005	0.007	0.012	0.092	
21	0.013	0.024	0.015	0.026	0.107	
22	0.002	0.004	0.005	0.008	0.084	
23	0.008	0.015	0.014	0.025	0.098	0.147
24	0.002	0.003	0.004	0.007	0.077	
25	0.020	0.036	0.029	0.052	0.090	0.135

26	0.003	0.006	0.003	0.005	0.071	
27	0.018	0.032	0.028	0.051	0.083	0.124
28	0.004	0.006	0.005	0.009	0.066	
29	0.012	0.022	0.027	0.048	0.078	0.117
30	0.002	0.003	0.004	0.008	0.061	
31	0.011	0.019	0.026	0.047	0.073	0.109
32	0.002	0.004	0.004	0.007	0.058	
33	0.008	0.015	0.024	0.043	0.068	0.102
34	0.002	0.004	0.003	0.005	0.054	
35	0.003	0.006	0.018	0.033	0.064	0.096
36	0.002	0.003	0.004	0.008	0.001	
37	0.011	0.020	0.016	0.028	0.061	0.091
38	0.003	0.005	0.004	0.007	0.048	
39	0.015	0.026	0.005	0.009	0.058	0.087
40	0.003	0.006	0.006	0.006	0.046	

No Higher limit for odd harmonics 21 and above are applied
TEST1 MICRO-0.3-I-OUTD-230 tested as plant of 2104W (7units)
TEST2 MICRO-0.25-I-OUTD-230 tested as plant of 2042W (8units)

Power Quality. Voltage fluctuations and Flicker. The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3

MODELs: **MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230 [TEST1]

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	0.39	0.28	0.32	1.81	0.28	0.32	0.235	0.188
Normalised to standard impedance and 3,68kW for multiple units	0.48	0.49	0.56	3.17	0.49	0.56	0.41	0.329
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1	0.65
Test start date	10/10/2012			Test end date		10/10/2012		

MODELs: MICRO-0.25-I-OUTD-230 and MICRO-0.25-I-OUTD-230-ACPV [TEST2]

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	1.22	0.47	1.08	1.94	1.68	0.47	0.47	0.309
Normalised to standard impedance and 3,68kW for multiple units	2.19	0.84	1.93	3.48	3.01	0.84	0.847	0.556
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1	0.65
Test start date	25/09/2012			Test end date		25/09/2012		
Test location	POWER-ONE ITALY S.P.A. Via S. Giorgio, 642 52028 Terranuova Bracciolini, Arezzo, Italy							

Supplementary information:
[TEST1] MICRO-0.3-I-OUTD-230 tested as plant of 2104W (7units)
[TEST2] MICRO-0.25-I-OUTD-230 tested as plant of 2042W (8units)

Power quality. DC injection. The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4			
MODELs: **MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230 [TEST1]			
Test power level	10%	55%	100%
Recorded value [A]	0.01963	0.00955	0.00276
as % of rated AC current	0.21 %	0.10 %	0.03 %
Limit	0.25 %	0.25 %	0.25 %
MODELs: **MICRO-0.25-I-OUTD-230** and MICRO-0.25-I-OUTD-230-ACPV [TEST2]			
Test power level	10%	55%	100%
Recorded value	0.01547	0.00756	0.00771
as % of rated AC current	0.17 %	0.09 %	0.09 %
Limit	0.25 %	0.25 %	0.25 %
Supplementary information: [TEST1] MICRO-0.3-I-OUTD-230 tested as plant of 2104W (7units) [TEST2] MICRO-0.25-I-OUTD-230 tested as plant of 2042W (8units)			

Power quality. Power Factor. The requirement is specified in section 5.6, test procedure in Annex A or B 1.4.2				
MODELs: **MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230				
-	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.
Measured value	0.9979	0.9974	0.9969	
Limit	>0.95	>0.95	>0.95	
MODELs: **MICRO-0.25-I-OUTD-230** and MICRO-0.25-I-OUTD-230-ACPV				
-	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.
Measured value	0.9979	0.9977	0.9969	
Limit	>0.95	>0.95	>0.95	

Protection. Frequency tests The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.3 (of reference document G83/2)						
MODELs:	**MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230 MICRO-0.25-I-OUTD-230 and MICRO-0.25-I-OUTD-230-ACPV					
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5Hz	20.0s	47.49Hz	22s	47.7Hz/ 25s	No Trip
U/F stage 2	47Hz	0.5s	46.98	0.542s	47.2Hz/ 19.98s	No Trip
					46.8Hz/ 0.48s	No Trip
O/F stage 1	51.5Hz	90.0s	51.51 Hz	92s	51.3Hz/95s	No Trip
O/F stage 2	52Hz	0.5s	52.01 Hz	0.558s	51.8Hz/ 89.98s	No Trip
					52.2Hz/ 0.48s	No Trip

Protection. Voltage tests The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2 (of reference document G83/2)						
MODELs:	**MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230 MICRO-0.25-I-OUTD-230 and MICRO-0.25-I-OUTD-230-ACPV					
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage/Time	Confirm no trip
U/V stage 1	200.1V	2.50s	199.5V	2.57s	204.1V/3.5s	No Trip
U/V stage 2	184V	0.50s	183.1V	0.558s	188V/2.48s	No Trip
					180V/0.48s	No Trip
O/V stage 1	262.2V	1.00s	261.6V	1.07s	258.2V/2.0s	No Trip
O/V stage 2	273.7V	0.50s	273.1V	0.558s	269.7V/0.98s	No Trip
					277.7V/0.48s	No Trip

Protection. Loss of Mains test. The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4 (of reference document G83/2)						
Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.						
MODELs:	**MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230					
Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5s	0.495s	0.265s	0.245s	0.301s	0.341s	0.165s
MODELs:	**MICRO-0.25-I-OUTD-230** and MICRO-0.25-I-OUTD-230-ACPV					
Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5s	0.323s	0.331s	0.315s	0.303s	0.267s	0.293s

Protection. Frequency change, Stability test The requirement is specified in section 5.3.3, test procedure in Annex A or B 1.3.6 (of reference document G83/2)				
MODELs: **MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230 MICRO-0.25-I-OUTD-230 and MICRO-0.25-I-OUTD-230-ACPV				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49.5Hz	+9 degrees		No trip
Negative Vector Shift	50.5Hz	- 9 degrees		No trip
Positive Frequency drift	49.5Hz	+0.19Hz/sec	51.5Hz	No trip
Negative Frequency drift	50.5Hz	-0.19Hz/sec	47.5Hz	No trip

Protection. Re-connection timer. The requirement is specified in section 5.3.4, test procedure in Annex A or B 1.3.5 (of reference document G83/2)					
MODELs: **MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230 MICRO-0.25-I-OUTD-230 and MICRO-0.25-I-OUTD-230-ACPV					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
20s	43.2s	At 266.2V	At 196.1V	At 47.4Hz	At 51.6Hz
Confirmation that the SSEG does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection

Fault level contribution. The requirement is specified in section 5.7, test procedure in Annex A or B 1.4.6 (of reference document G83/2)		
MODELs: **MICRO-0.3-I-OUTD-230** and MICRO-0.3HV-I-OUTD-230		
For a Inverter SSEG		
Time after fault	Volts	Amps
20ms	31.797	0.58
100ms	31.836	0.36
250ms	33.828	0.23
500ms	31.367	0.17
Time to trip	0.0874	**In seconds**
MODELs: **MICRO-0.25-I-OUTD-230** and MICRO-0.25-I-OUTD-230-ACPV		
For a Inverter SSEG		
Time after fault	Volts	Amps
20ms	33.98	0.52
100ms	34.06	0.32
250ms	31.68	0.24
500ms	33.68	0.24
Time to trip	0.238	**In seconds**

Self-Monitoring solid state switching. The requirement is specified in section 5.3.1, no specified test requirements.	P
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.	

This extract from the test report is only valid in conjunction with the test report no.: 28106648 001

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