

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	PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD	PVI-8.0-TL-OUTD-S PVI-6.0-TL-OUTD-S	PVI-8.0-TL-OUTD-FS PVI-6.0-TL-OUTD-FS
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	servicer.solarinverters@it.abb.com	Web site	www.abb.com/solarinverters www.abb.com
Nominal / Maximum rated capacity	Connection Option		
	8.0 / 8.9 kW	kW single phase (for PVI-8.0 series)	
	6.0 / 6.6 kW	kW single phase (for PVI-6.0 series)	
<p>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.</p> <p>Attachment: Extract of Test Report Ref. 28107178 001, Determination of Electrical Properties, released by TUV Rheinland</p>			

Terranuova B.ni, 2015 February 13



Marcello Berlingozzi
(Leadperson Quality Control)



Cristiano Ensoli
(Manager Quality)

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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											
Reference test report:	28107178 001 Issued by TÜV Rheinland Italia S.r.l. on 10 th February 2015											
Measuring period:	From 04/10/2013 to 10/02/2015											
Pacr: <i>(Rated AC Power)</i> Pacmax: <i>(Maximum AC output Power)</i>	<table border="1"> <thead> <tr> <th>Models *</th> <th>Pacr / Pacmax</th> </tr> </thead> <tbody> <tr> <td>PVI-8.0-TL-OUTD</td> <td rowspan="3">8.0 / 8.9 kW</td> </tr> <tr> <td>PVI-8.0-TL-OUTD-S</td> </tr> <tr> <td>PVI-8.0-TL-OUTD-FS</td> </tr> <tr> <td>PVI-6.0-TL-OUTD</td> <td rowspan="3">6.0 / 6.6 kW</td> </tr> <tr> <td>PVI-6.0-TL-OUTD-S</td> </tr> <tr> <td>PVI-6.0-TL-OUTD-FS</td> </tr> </tbody> </table>		Models *	Pacr / Pacmax	PVI-8.0-TL-OUTD	8.0 / 8.9 kW	PVI-8.0-TL-OUTD-S	PVI-8.0-TL-OUTD-FS	PVI-6.0-TL-OUTD	6.0 / 6.6 kW	PVI-6.0-TL-OUTD-S	PVI-6.0-TL-OUTD-FS
Models *	Pacr / Pacmax											
PVI-8.0-TL-OUTD	8.0 / 8.9 kW											
PVI-8.0-TL-OUTD-S												
PVI-8.0-TL-OUTD-FS												
PVI-6.0-TL-OUTD	6.0 / 6.6 kW											
PVI-6.0-TL-OUTD-S												
PVI-6.0-TL-OUTD-FS												
Software version	Bundle Firmware Update Version**: not less than 1504A standard selection: UK G83											
Rated Voltage:	3-phase device 230 V (Phase/ Neutral)											

Remarks:

Note *: test performed on models PVI-13.8-TL-OUTD and PVI-6.0-TL-OUTD.

Models of the same family:

PVI-13.8-TL-OUTD	PVI-13.8-TL-OUTD-S	PVI-13.8-TL-OUTD-FS	PVI-13.8-TL-OUTD-W
PVI-12.5-TL-OUTD	PVI-12.5-TL-OUTD-S	PVI-12.5-TL-OUTD-FS	PVI-12.5-TL-OUTD-W
PVI-11.0-TL-OUTD	PVI-11.0-TL-OUTD-S	PVI-11.0-TL-OUTD-FS	PVI-11.0-TL-OUTD-W
PVI-10.0-TL-OUTD	PVI-10.0-TL-OUTD-S	PVI-10.0-TL-OUTD-FS	
PVI-8.0-TL-OUTD	PVI-8.0-TL-OUTD-S	PVI-8.0-TL-OUTD-FS	
PVI-6.0-TL-OUTD	PVI-6.0-TL-OUTD-S	PVI-6.0-TL-OUTD-FS	

All models have the same release firmware version, electronic control boards.

Hardware differences are managed by a flash memory installed during the manufacturing process.

Models with suffix “-FS” have got an integrated dc switch and fuse board.

Models with suffix “-S” have got an integrated dc switch.

Models with suffix “-W” for wind application.

Models from PVI-13.8-TL-OUTD series to PVI-10.0-TL-OUTD series have an output current higher than 16A, for this reason are excluded from G83 scope. Compliance of these models to G59/3 is showed by Test Report No.: 28107178 001 Issued by TUV Rheinland Italia on 10/02/2015.

Note **:

“Update version” identifies the Bundle Firmware Features by a sequential code: xxxxy where:

- xxxx is a number indicates Year (two digits) and Week (two digits)
- y is a letter from A to G indicates Day (from Sunday = A to Saturday=G)

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: PVI-6.0-TL-OUTD

SSEG rating per phase (rpp)			2	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	0.098	0.135	0.117	0.161	1.080	
3	0.008	0.011	0.017	0.023	2.300	
4	0.074	0.102	0.072	0.099	0.430	
5	0.015	0.021	0.009	0.012	1.140	
6	0.007	0.010	0.007	0.010	0.300	
7	0.021	0.029	0.020	0.028	0.770	
8	0.021	0.029	0.018	0.025	0.230	
9	0.009	0.012	0.009	0.012	0.400	
10	0.007	0.010	0.013	0.018	0.184	
11	0.037	0.051	0.047	0.065	0.330	
12	0.007	0.010	0.006	0.008	0.153	
13	0.035	0.048	0.033	0.046	0.210	
14	0.004	0.006	0.006	0.008	0.131	
15	0.006	0.008	0.004	0.006	0.150	
16	0.009	0.012	0.008	0.011	0.115	
17	0.017	0.023	0.007	0.010	0.132	
18	0.006	0.008	0.004	0.006	0.102	
19	0.014	0.019	0.008	0.011	0.118	
20	0.006	0.008	0.007	0.010	0.092	
21	0.004	0.006	0.004	0.006	0.107	
22	0.004	0.006	0.004	0.006	0.084	
23	0.008	0.011	0.013	0.018	0.098	0.147
24	0.006	0.008	0.004	0.006	0.077	
25	0.004	0.006	0.012	0.017	0.090	0.135
26	0.005	0.007	0.004	0.006	0.071	
27	0.003	0.004	0.003	0.004	0.083	0.124
28	0.005	0.007	0.005	0.007	0.066	
29	0.014	0.019	0.010	0.014	0.078	0.117
30	0.005	0.007	0.004	0.006	0.061	
31	0.015	0.021	0.010	0.014	0.073	0.109

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32	0.005	0.007	0.003	0.004	0.058	
33	0.003	0.004	0.003	0.004	0.068	0.102
34	0.004	0.006	0.003	0.004	0.054	
35	0.006	0.008	0.011	0.015	0.064	0.096
36	0.004	0.006	0.004	0.006	0.051	
37	0.006	0.008	0.010	0.014	0.061	0.091
38	0.005	0.007	0.004	0.006	0.048	
39	0.003	0.004	0.003	0.004	0.058	0.087
40	0.003	0.004	0.003	0.004	0.046	
MODELS: PVI-8.0-TL-OUTD						
SSEG rating per phase (rpp)			4.6	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	0.048	0.066	0.029	0.040	4.548	
3	0.013	0.017	0.013	0.017	0.042	
4	0.088	0.121	0.111	0.153	0.135	
5	0.031	0.042	0.026	0.036	0.018	
6	0.007	0.010	0.009	0.012	0.077	
7	0.043	0.059	0.048	0.066	0.004	
8	0.076	0.104	0.098	0.135	0.032	
9	0.011	0.014	0.011	0.014	0.006	
10	0.039	0.054	0.035	0.048	0.007	
11	0.059	0.081	0.059	0.081	0.007	
12	0.005	0.007	0.008	0.011	0.038	
13	0.049	0.067	0.040	0.055	0.005	
14	0.007	0.010	0.010	0.014	0.060	
15	0.009	0.012	0.010	0.014	0.004	
16	0.012	0.017	0.013	0.018	0.010	
17	0.031	0.043	0.031	0.043	0.004	
18	0.009	0.012	0.009	0.012	0.025	
19	0.013	0.018	0.029	0.039	0.003	
20	0.010	0.013	0.005	0.007	0.026	
21	0.003	0.004	0.006	0.008	0.005	
22	0.007	0.010	0.005	0.006	0.018	
23	0.009	0.012	0.022	0.030	0.006	0.147
24	0.006	0.008	0.004	0.006	0.015	
25	0.015	0.021	0.019	0.026	0.004	0.135

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26	0.007	0.010	0.008	0.011	0.018	
27	0.006	0.008	0.004	0.006	0.008	0.124
28	0.005	0.006	0.007	0.010	0.010	
29	0.014	0.019	0.015	0.021	0.006	0.117
30	0.005	0.007	0.005	0.006	0.027	
31	0.010	0.013	0.014	0.019	0.004	0.109
32	0.007	0.010	0.007	0.010	0.031	
33	0.003	0.004	0.004	0.005	0.010	0.102
34	0.008	0.010	0.006	0.008	0.017	
35	0.006	0.008	0.011	0.014	0.009	0.096
36	0.005	0.006	0.004	0.006	0.019	
37	0.007	0.010	0.010	0.013	0.003	0.091
38	0.007	0.009	0.008	0.011	0.010	
39	0.003	0.003	0.004	0.005	0.003	0.087
40	0.004	0.005	0.005	0.006	0.005	

No Higher limit for odd harmonics 21 and above are applied

In the table above, the worst case measure of the 3 phases is reported.

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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: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Pit 2 hours
Measured Values	0.074%	0.013%	0	0.074%	0.013%	0	0.028	0.028
Normalised to standard impedance and 3,68kW for multiple units	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits set under BS EN 61000-3-2	4%	3.30%	3.3% 500ms	4%	3.30%	3.3% 500ms	1	0.65
Test start date	04/10/2013			Test end date	04/10/2013			
Test location	CREI Ven S.c.a.r.l. - Corso Spagna,12 – Padova - Italy							

Power quality. DC injection. The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4

MODELS: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD

Test power level	10%	55%	100%
Recorded value	14.0 mA	14.0 mA	14.0 mA
as % of rated AC current	0.16 %	0.16 %	0.16 %
Limit	0.25 %	0.25 %	0.25 %

(*) These data refers to model PVI-13.8-TL-OUTD as worst case, representative of whole family

Power quality. Power Factor. The requirement is specified in section 5.6, test procedure in Annex A or B 1.4.2

MODELS: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD

-	216.2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0.999	0.999	0.999	
Limit	>0.95	>0.95	>0.95	

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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: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD

Function	Setting		Trip test		“No trip tests”	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5Hz	20.05s	47.50	20.023s	47.7Hz/ 25s	No Trip
U/F stage 2	47Hz	0.55s	47.0	0.551s	47.2Hz/ 19.98s	No Trip
					46,8Hz/ 0,48s	No Trip
O/F stage 1	51.5Hz	90.05s	51.52	90.022s	51.3Hz/95s	No Trip
O/F stage 2	52Hz	0.55s	52.00	0.542s	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: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD

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	199.80	2.558s	204.1V/3.5s	No Trip
U/V stage 2	184V	0.50s	183.70	0.532s	188V/2.48s	No Trip
					180V/0,48s	No Trip
O/V stage 1	262.2V	1.00s	262.10V	1.038s	258.2V/2.0s	No Trip
O/V stage 2	273.7V	0.50s	273.50V	0.528s	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: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD

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 1,0s	0.400s	0.862s	0.939s	0.400s	0.900s	0.884s

Single phase test for multi phase Generating Units. Confirm that the removal of a single phase connection to the Generating Unit, with the remaining phases connected causes a disconnection of the generating unit within a maximum of 1s.

Ph 1 removed	Confirm Trip in: 0.688s	Ph2 removed	Confirm Trip in : 0.877s	Ph3 removed	Confirm Trip in: 0.370s
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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: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD				
	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: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD					
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	35s	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: PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD (*)		
For a Inverter SSEG		
Time after fault	Volts	Amps
20ms	31.44	17.85
100ms	25.58	8.45
250ms	24.38	5.37
500ms	23.93	3.82
Time after fault	Volts	Amps

(*) These data refers to model PVI-13.8-TL-OUTD as worst case, representative of whole family

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

N/A

Mechanical relay used.

This extract from the test report is only valid in conjunction with the test report no.: **28107178 001**