ENA Engineering Recommendation G59/3
Type Verification Test Report

Type Approval and manufacturer/supplier declaration of compliance with the requirements of Engineering Recommendation G59/3			
Type Test reference number	PVI-12.5-TL-OUTD PVI-12.5-TL-OUTD-S PVI-12.5-TL-OUTD-FS PVI-12.5-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		
Generating unit technology	PHOTOVOLTAIC / WIND 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	service@power-one.com	Web site	www.power-one.com

Nominal / Maximum rated capacity	Connection Option	
	12.5 / 13.8 kW	kW single phase (for PVI-12.5 series)
	10.0 / 11.0 kW	kW single phase (for PVI-10.0 series)
	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)

We, Power-One Italy S.p.A., as manufacturer/supplier of Generating Unit, certifies that all products manufactured/supplied by the company with the above Type Test reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site modifications are required to ensure that the products meet all the requirements of G59/3.

Attachment:
Extract of Test Report Ref. **28106531 001**, Determination of Electrical Properties,
released by TUeV Rheinland

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

Phoenix, AZ, USA
(Place)

2014 April 22
(Date)

Extract of Test report: **28106531 001**

13.1 Generating Unit Type Test Sheet
Type Tested Generating Unit (>16A per phase but ≤ 17 kW 1 phase)

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:	**28106489 001** Issued by TÜV Rheinland Italia S.r.l. on 22th April 2014
Measuring period:	From 04Th March 2014 to 25Th March 2014
Type Test reference number: **Pacr / Pacmax** *(Rated AC Power / Maximum AC output Power)*	

Models *	Pacr / Pacmax
PVI-12.5-TL-OUTD	**12.5 / 13.8 kW**
PVI-12.5-TL-OUTD-S	
PVI-12.5-TL-OUTD-FS	
PVI-12.5-TL-OUTD-W	
PVI-10.0-TL-OUTD	**10.0 / 11.0 kW**
PVI-10.0-TL-OUTD-S	
PVI-10.0-TL-OUTD-FS	
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 1414B** standard selection: **UK G59**
Rated Voltage:	3-phase device 230 V (Phase/ Neutral)

Remarks:

Note *: test performed on models PVI-12.5-TL-OUTD, PVI-10.0-TL-OUTD, PVI-8.0-TL-OUTD and PVI-6.0-TL-OUTD.

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 of PVI-8.0 and PVI-6.0 series have an output current lower than 16A, for this reason they are verified in compliance with G83 too. Compliance of these models to G83/3 is showed by Test Report No.: 28106532 001 Issued by TUV Rheinland Italia on 22/04/2014.

Models of the same family:

PVI-12.5-TL-OUTD	PVI-12.5-TL-OUTD-S	PVI-12.5-TL-OUTD-FS	PVI-12.5-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	

Tested model indicated in **bold** characters.

13.1 Generating Unit Type Test Sheet
Type Tested Generating Unit (>16A per phase but ≤ 17 kW 1 phase)

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 (form Sunday = A to Monday=G)

Power Quality. Harmonics.

MODELs: **PVI-12.5-TL-OUTD** PVI-12.5-TL-OUTD-W

Generating Unit rating per phase (rpp)			4.16	kVA	Harmonic % = Measured Value (Amps) x 23/rating per phase (kVA)	
Harmonic	At 45-55% of rated output TEST 1		100% of rated output TEST 2		Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps	%	Measured Value (MV) in Amps	%	1 phase %	3 phase %
2	0.047	0.259	0.059	0.326	8.00	8.00
3	0.147	0.811	0.174	0.960	21.60	Not stated
4	0.021	0.116	0.028	0.155	4.00	4.00
5	0.084	0.464	0.103	0.569	10.70	10.70
6	0.011	0.061	0.026	0.144	2.67	2.67
7	0.036	0.199	0.038	0.210	7.20	7.20
8	0.006	0.033	0.008	0.044	2.00	2.00
9	0.012	0.066	0.018	0.099	3.80	Not stated
10	0.006	0.033	0.004	0.022	1.60	1.60
11	0.023	0.127	0.055	0.304	3.10	3.10
12	0.004	0.022	0.004	0.022	1.33	1.33
13	0.054	0.298	0.085	0.469	2.00	2.00
THD	2.126%	-	1.149%	-	23.00%	23.00%
PWHD	11.68%	-	19,27%	-	23.00%	22.00%

MODELs: **PVI-10.0-TL-OUTD**

Generating Unit rating per phase (rpp)			3.33	kVA	Harmonic % = Measured Value (Amps) x 23/rating per phase (kVA)	
Harmonic	At 45-55% of rated output TEST 1		100% of rated output TEST 2		Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps	%	Measured Value (MV) in Amps	%	1 phase %	3 phase %
2	0.047	0.259	0.059	0.326	8.00	8.00
3	0.147	0.811	0.174	0.960	21.60	Not stated
4	0.021	0.116	0.028	0.155	4.00	4.00
5	0.084	0.464	0.103	0.569	10.70	10.70
6	0.011	0.061	0.026	0.144	2.67	2.67

7	0.036	0.199	0.038	0.210	7.20	7.20
8	0.006	0.033	0.008	0.044	2.00	2.00
9	0.012	0.066	0.018	0.099	3.80	Not stated
10	0.006	0.033	0.004	0.022	1.60	1.60
11	0.023	0.127	0.055	0.304	3.10	3.10
12	0.004	0.022	0.004	0.022	1.33	1.33
13	0.054	0.298	0.085	0.469	2.00	2.00
THD	2.638%	-	1.462%	-	23.00%	13.00%
PWHD	13.653%	-	18.250%	-	23.00%	22.00%

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

Models PVI-8.0-TL-OUTD; PVI-6.0-TL-OUTD are compliant to EN 61000-6-3 See Report no.28106532 001 Generating units meeting the requirements EN 61000-3-2 will not need no further assessment with regards to harmonics.

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-12.5-TL-OUTD** PVI-12.5-TL-OUTD-W
PVI-10.0-TL-OUTD PVI-8.0-TL-OUTD PVI-6.0-TL-OUTD

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	2.583%	2.163%	0	2.583%	2.163%	0	0.345	0.278
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	04/12/2012			Test end date		04/12/2012		
Test location	CREI Ven S.c.a.r.l. - Corso Spagna,12 – Padova - Italy							

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

Power quality. DC injection.			
MODELs: **PVI-12.5-TL-OUTD** PVI-12.5-TL-OUTD-W			
Test power level	10%	55%	100%
Recorded value	9.0 mA	6.0 mA	26.0 mA
as % of rated AC current	0.05 %	0.03 %	0.14 %
Limit	0.25 %	0.25 %	0.25 %
MODELs: **PVI-10.0-TL-OUTD**			
Test power level	10%	55%	100%
Recorded value	9.0 mA	4.0 mA	23.0 mA
as % of rated AC current	0.06 %	0.03 %	0.16 %
Limit	0.25 %	0.25 %	0.25 %

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

Power quality. Power Factor.				
MODELs: **PVI-12.5-TL-OUTD** PVI-12.5-TL-OUTD-W				
-	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	0.9997	0.9999	0.9999	
Limit	>0.95	>0.95	>0.95	
MODELs: **PVI-10.0-TL-OUTD**				
-	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	0.9997	0.9998	0.9998	
Limit	>0.95	>0.95	>0.95	

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

Protection. Frequency tests.						
MODELs: PVI-12.5-TL-OUTD PVI-12.5-TL-OUTD-W PVI-10.0-TL-OUTD **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	47.443 Hz	20.063s	47.7Hz/ 25s	No Trip
U/F stage 2	47Hz	0.55s	46.948 Hz	0.557s	47.2Hz/ 19.98s	No Trip
					46.8Hz/ 0.48s	No Trip
O/F stage 1	51.5Hz	90.05s	51.545 Hz	90.045s	51.3Hz/95s	No Trip
O/F stage 2	52Hz	0.55s	52.050 Hz	0.555s	51.8Hz/ 89.98s	No Trip
					52.2Hz/ 0.48s	No Trip

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Type Tested Generating Unit (>16A per phase but ≤ 17 kW 1 phase)

Protection. Voltage tests .						
MODELs:	PVI-12.5-TL-OUTD PVI-12.5-TL-OUTD-W PVI-10.0-TL-OUTD **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	2.564s	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

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

a) Protection. Loss of Mains test and single phase test.						
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-12.5-TL-OUTD** PVI-10.0-TL-OUTD **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	0.861s	0.971s	0.861s	0.875s	0.963s	0.909s

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

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 ot the generating unit within a maximum of 1s.					
Ph 1 removed	Confirm Trip in: 0.309s	Ph2 removed	Confirm Trip in : 0.288s	Ph3 removed	Confirm Trip in: 0.238s

b) Protection. Frequency change, Stability test.				
MODELs:	PVI-12.5-TL-OUTD PVI-12.5-TL-OUTD-W PVI-10.0-TL-OUTD **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

13.1 Generating Unit Type Test Sheet
Type Tested Generating Unit (>16A per phase but ≤ 17 kW 1 phase)

c) Protection. Re-connection timer.					
MODELs:	PVI-12.5-TL-OUTD PVI-10.0-TL-OUTD	PVI-12.5-TL-OUTD-W **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

d) Fault level contribution.		
MODELs: **PVI-12.5-TL-OUTD** PVI-12.5-TL-OUTD-W		
For a Inverter SSEG		
Time after fault	Volts	Amps
20ms	123.39	20.61
100ms	82.3	10.79
250ms	73.61	7.13
500ms	70	5.15
Time to trip	0.550	In seconds
MODELs: **PVI-10.0-TL-OUTD**		
For a Inverter SSEG		
Time after fault	Volts	Amps
20ms	54.45	17.72
100ms	48.15	9.58
250ms	25.69	6.16
500ms	23.61	4.48
Time to trip	0.550	In seconds

e) 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.: **28106531 001**