


## *ENA Engineering Recommendation G59/3 Type Verification Test Report*

<b>Type Approval and manufacturer/supplier declaration of compliance with the requirements of Engineering Recommendation G59/3</b>			
Type Test reference number		PVI-6000-TL-OUTD PVI-6000-TL-OUTD-S PVI-6000-TL-OUTD-W	PVI-5000-TL-OUTD PVI-5000-TL-OUTD-S PVI-5000-TL-OUTD-W
Generating unit technology		PHOTOVOLTAIC and 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
Maximum / Nominal rated capacity	Connection Option		
	6,0 / 6,0	kW single phase (for PVI-5000 series)	
	5,0 / 5,0	kW single phase (for PVI-6000 series)	
<p>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.</p> <p>Attachment: Extract of Test Report Ref. 28106411 001, Determination of Electrical Properties, released by TUEV Rheinland</p>			

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

**Phoenix, AZ, USA**  
(Place)

**2014 March 5**  
(Date)

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

<b>Type of System:</b>	Grid tied inverter											
<b>System Manufacturer:</b> <b>Manufacturer data:</b>	<b>Power-One Italy S.p.A.</b> Via S. Giorgio 642, 52028 Terranuova Bracciolini (AR) - Italy											
<b>Reference test report:</b>	<b>28106411 001</b> Issued by TÜV Rheinland Italia S.r.l. on 5 <sup>th</sup> March 2014											
<b>Measuring period:</b>	From 20 <sup>th</sup> January 2014 to 14 <sup>th</sup> February 2014											
<b>Type Test reference number:</b>  <b>Pacr / Pacmax</b> <i>(Rated AC Power / Maximum AC output Power)</i>	<table border="1"> <thead> <tr> <th><b>Models *</b></th> <th><b>Pacr / Pacmax</b></th> </tr> </thead> <tbody> <tr> <td>PVI-6000-TL-OUTD</td> <td rowspan="3">6000 W / 6000 W</td> </tr> <tr> <td>PVI-6000-TL-OUTD-S</td> </tr> <tr> <td>PVI-6000-TL-OUTD-W</td> </tr> <tr> <td>PVI-5000-TL-OUTD</td> <td rowspan="3">5000 W / 5000 W</td> </tr> <tr> <td>PVI-5000-TL-OUTD-S</td> </tr> <tr> <td>PVI-5000-TL-OUTD-W</td> </tr> </tbody> </table>		<b>Models *</b>	<b>Pacr / Pacmax</b>	PVI-6000-TL-OUTD	6000 W / 6000 W	PVI-6000-TL-OUTD-S	PVI-6000-TL-OUTD-W	PVI-5000-TL-OUTD	5000 W / 5000 W	PVI-5000-TL-OUTD-S	PVI-5000-TL-OUTD-W
<b>Models *</b>	<b>Pacr / Pacmax</b>											
PVI-6000-TL-OUTD	6000 W / 6000 W											
PVI-6000-TL-OUTD-S												
PVI-6000-TL-OUTD-W												
PVI-5000-TL-OUTD	5000 W / 5000 W											
PVI-5000-TL-OUTD-S												
PVI-5000-TL-OUTD-W												
<b>Software version:</b>	<table border="1"> <thead> <tr> <th><b>Device</b></th> <th><b>Version **</b></th> </tr> </thead> <tbody> <tr> <td>Booster (DC-DC)</td> <td>Higher than A.3.0.4</td> </tr> <tr> <td>Inverter (DC-AC)</td> <td>Higher than B.3.1.A</td> </tr> <tr> <td>MICRO (Supervisor)</td> <td>Higher than C.0.3.5</td> </tr> </tbody> </table>		<b>Device</b>	<b>Version **</b>	Booster (DC-DC)	Higher than A.3.0.4	Inverter (DC-AC)	Higher than B.3.1.A	MICRO (Supervisor)	Higher than C.0.3.5		
<b>Device</b>	<b>Version **</b>											
Booster (DC-DC)	Higher than A.3.0.4											
Inverter (DC-AC)	Higher than B.3.1.A											
MICRO (Supervisor)	Higher than C.0.3.5											
<b>Rated Voltage:</b>	2-phase devices 230 V (Phase/ Neutral)											
<b>Remarks:</b>	<p><b>Note *:</b> test performed on model PVI-6000-TL-OUTD-S and PVI-5000-TL-OUTD-S The test result found can be extended on all model of the same product family. All products are completely the same; identical software version and PCB control boards are installed; the difference is related only on output power set.</p> <p><b>Note **:</b> Country Code: UK G59</p> <p>The family product model is made by the following products:  PVI-6000-TL-OUTD-W ; PVI-6000-TL-OUTD  PVI-5000-TL-OUTD-W ; PVI-5000-TL-OUTD</p> <p>Tested model indicated in <b>bold</b> characters.</p>											

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

<b>Power Quality. Harmonics.</b>						
MODELS: PVI-6000-TL-OUTD ; <b>PVI-6000-TL-OUTD-S</b> ; PVI-6000-TL-OUTD-W						
Generating Unit rating per phase (rpp)		6		kVA		Harmonic % = Measured Value (Amps) x 23/rating per phase (kVA)
Harmonic	At 45-55% of rated output		100% of rated output		Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps	%	Measured Value (MV) in Amps	%	1 phase	3 phase
2	0,007	0,027	0,005	0,019	8,00%	
3	0,147	0,564	0,259	0,993	21,60%	
4	0,015	0,058	0,017	0,065	4,00%	
5	0,025	0,096	0,027	0,104	10,70%	
6	0,011	0,042	0,012	0,046	2,67%	
7	0,017	0,065	0,015	0,058	7,20%	
8	0,007	0,027	0,007	0,027	2,00%	
9	0,009	0,035	0,022	0,084	3,80%	
10	0,006	0,023	0,005	0,019	1,60%	
11	0,009	0,035	0,029	0,111	3,10%	
12	0,005	0,019	0,009	0,035	1,33%	
13	0,010	0,038	0,035	0,134	2,00%	
THD	1,170%	-	1,023%	-	23,00%	
PWHD	2,109%	-	1,877%	-	23,00%	

No Higher limit for odd harmonics 21 and above are applied

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

<b>Power Quality. Harmonics.</b>						
MODELS: PVI-5000-TL-OUTD ; <b>PVI-5000-TL-OUTD-S</b> ; PVI-5000-TL-OUTD-W						
Generating Unit rating per phase (rpp)		5		kVA		Harmonic % = Measured Value (Amps) x 23/rating per phase (kVA)
Harmonic	At 45-55% of rated output <sup>TEST 3</sup>		100% of rated output <sup>TEST 4</sup>		Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps	%	Measured Value (MV) in Amps	%	1 phase	3 phase
2	0,003	0,014%	0,005	0,023%	0,003	
3	0,155	0,713%	0,232	1,067%	0,155	
4	0,016	0,074%	0,016	0,074%	0,016	
5	0,045	0,207%	0,040	0,184%	0,045	
6	0,011	0,051%	0,011	0,051%	0,011	
7	0,027	0,124%	0,031	0,143%	0,027	
8	0,008	0,037%	0,005	0,023%	0,008	
9	0,023	0,106%	0,033	0,152%	0,023	
10	0,008	0,037%	0,006	0,028%	0,008	
11	0,022	0,101%	0,045	0,207%	0,022	
12	0,004	0,018%	0,007	0,032%	0,004	
13	0,023	0,106%	0,042	0,193%	0,023	
THD	1,563%	-	1,143%	-	23,00%	
PWHD	3,015%	-	2,226%	-	23,00%	

No Higher limit for odd harmonics 21 and above are applied

<b>Power Quality. Voltage fluctuations and Flicker.</b>								
MODELS: PVI-6000-TL-OUTD ; <b>PVI-6000-TL-OUTD-S</b> ; PVI-6000-TL-OUTD-W PVI-5000-TL-OUTD ; PVI-5000-TL-OUTD-S ; PVI-5000-TL-OUTD-W								
-	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values at standard impedance	1,050%	0%	0	1,050%	0%	0	0,253	0,247
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	10\10\2011			Test end date	10\10\2011			
Test location	CREI Ven S.c.a.r.l. - Corso Spagna,12 – Padova - Italy							

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

<b>Power quality. DC injection.</b>			
MODELS: PVI-6000-TL-OUTD ; <b>PVI-6000-TL-OUTD-S</b> ; PVI-6000-TL-OUTD-W			
Test power level	10%	55%	100%
Recorded value in Amps	-0,012	-0,005	-0,001
as % of rated AC current	0,046%	0,019%	0,004%
Limit	0,25 %	0,25 %	0,25 %
MODELS: PVI-5000-TL-OUTD ; <b>PVI-5000-TL-OUTD-S</b> ; PVI-5000-TL-OUTD-W			
Test power level	10%	55%	100%
Recorded value in Amps	-0,001	0,002	0,002
as % of rated AC current	0,005%	0,010%	0,010%
Limit	0,25%	0,25%	0,25%

<b>Protection. Frequency tests.</b>						
MODELS: PVI-6000-TL-OUTD ; <b>PVI-6000-TL-OUTD-S</b> ; PVI-6000-TL-OUTD-W PVI-5000-TL-OUTD ; PVI-5000-TL-OUTD-S ; PVI-5000-TL-OUTD-W						
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	47,51	20,05s	47,7Hz/ 25s	No Trip
U/F stage 2	47Hz	0,55s	47,01	0,548s	47,2Hz/ 19,98s	No Trip
					46,8Hz/ 0,48s	No Trip
O/F stage 1	51,5Hz	90,05s	51,50	90,04s	51,3Hz/95s	No Trip
O/F stage 2	52Hz	0,55s	52,00	0,548s	51,8Hz/ 89,98s	No Trip
					52,2Hz/ 0,48s	No Trip

<b>Protection. Voltage tests.</b>						
MODELS: PVI-6000-TL-OUTD ; PVI-6000-TL-OUTD-S ; PVI-6000-TL-OUTD-W PVI-5000-TL-OUTD ; <b>PVI-5000-TL-OUTD-S</b> ; PVI-5000-TL-OUTD-W						
Function	Setting		Trip test		"No trip tests"	
-	Voltage	Time delay	Voltage	Time delay	Voltage/Time	Confirm no trip
<b>U/V stage 1</b>	200,1V	2,55s	200,45	2,582s	204,1V/3,5s	No Trip
<b>U/V stage 2</b>	184V	0,55s	184,5	0,584s	188V/2,48s	No Trip
					180V/0,48s	No Trip
<b>O/V stage 1</b>	262,2V	1,05s	262,38	1,062s	258,2V/2,0s	No Trip
<b>O/V stage 2</b>	273,7V	0,55s	273,9	0,574s	269,7V/0,98s	No Trip
					277,7V/ 0,48s	No Trip

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**13.1 Generating Unit Type Test Sheet**  
**Type Tested Generating Unit (>16A per phase but ≤ 17 kW 1 phase)**
**a) Protection. Loss of Mains test and single phase test.**

Inverter tested to BS EN 62116. The following sub set of tests should be recorded in the following table.

 MODELS: PVI-6000-TL-OUTD ; **PVI-6000-TL-OUTD-S** ; PVI-6000-TL-OUTD-W

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	0,372	0,393	0,410	0,357	0,362	0,391

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	0,264	0,383	0,409	0,247	0,357	0,422

**b) Protection. Frequency change, Stability test .**

 MODELS: PVI-6000-TL-OUTD ; **PVI-6000-TL-OUTD-S** ; PVI-6000-TL-OUTD-W

-	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

Positive Vector Shift	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

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**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-6000-TL-OUTD ; <b>PVI-6000-TL-OUTD-S</b> ; PVI-6000-TL-OUTD-W MODELS: PVI-5000-TL-OUTD ; PVI-5000-TL-OUTD-S ; PVI-5000-TL-OUTD-W					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 10.5.7.1.			
20s	35s	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
Confirmation that the Generating Unit does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection

**d) Fault level contribution.**

MODELS: PVI-6000-TL-OUTD ; <b>PVI-6000-TL-OUTD-S</b> ; PVI-6000-TL-OUTD-W PVI-5000-TL-OUTD ; PVI-5000-TL-OUTD-S ; PVI-5000-TL-OUTD-W		
For Inverter Output		
Time after fault	Volts	Amps
20ms	91,75	23,29
100ms	91,05	17,15
250ms	90,84	14,12
500ms	90,20	11,41
Time to trip	0,587	In seconds

**e) Fault level contribution.**
**NA**

This extract from the test report is only valid in conjunction with the test report no.: 28106411 001.