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-12.0-I-OUTD(-S)-400 PVI-10.0-I-OUTD(-S)-400		
Generating unit technology	SOLAR 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
11.0 / 10.0 kW	kW single phase (for 10.0-I series)
12.5 / 12.0 kW	kW single phase (for 12.0-I 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. **28107125 001**, Determination of Electrical Properties,
released by TÜV Rheinland.

Terranuova B.ni, 2014 December 05

Marcello Berlingozzi
(Leadperson Quality Control)

Cristiano Ensoli
(Manager Quality)

Extract of Test report: **28107125 001**
Engineering Recommendation G59 Issue 03 (September 2013)
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:	**28107125 001** Issued by TÜV Rheinland Italia S.r.l. on 21th November 2014
Measuring period:	From 20/10/2014 to 12/11/ 2014
Type Test reference number: **Pacr / Pacmax** *(Rated AC Power / Maximum AC output Power)*	**Models *** / **Pacr / Pacmax** **PVI-12.0-I-OUTD-400** / **PVI-12.0-I-OUTD-S-400** / **10.0 / 11.0 kW** **PVI-10.0-I-OUTD-400** / **PVI-10.0-I-OUTD-S-400** / **12.0 / 12.5 kW**
Software version:	Bundle Firmware Update Version**: **not less than 1444C** standard selection: **UK G59**
Rated Voltage:	3-phase device 230 V (Phase/ Neutral)

Remarks:

Note *: test performed on models: PVI-12.0-I-OUTD-400 and PVI-10.0-I-OUTD-400
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 "–S" have got an integrated dc switch. Models with suffix "-W" for wind application.
Models of the same family:
PVI-10.0-I-OUTD-400 PVI-10.0-I-OUTD-S-400
PVI-12.0-I-OUTD-400 PVI-12.0-I-OUTD-S-400

Tested model indicated in **bold** characters.

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-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400					
Generating Unit rating per phase (rpp)			4.	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	0,148	0,853	0,142	0,817	8.00	8.00
3	0,086	0,496	0,108	0,619	21.60	Not stated
4	0,033	0,188	0,046	0,265	4.00	4.00
5	0,021	0,123	0,035	0,201	10.70	10.70
6	0,012	0,069	0,013	0,075	2.67	2.67
7	0,034	0,194	0,025	0,146	7.20	7.20
8	0,010	0,059	0,011	0,061	2.00	2.00
9	0,022	0,127	0,025	0,146	3.80	Not stated
10	0,006	0,036	0,005	0,029	1.60	1.60
11	0,056	0,324	0,195	1,121	3.10	3.10
12	0,006	0,033	0,007	0,042	1.33	1.33
13	0,032	0,186	0,145	0,836	2.00	2.00
THD	-	1,12%	-	1,86%	23.00%	13.00%
PWHD	-	0,75%	-	2,36%	23.00%	22.00%

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

Power Quality. Harmonics.						
MODELs: PVI-12.0-I-OUTD-400 **PVI-10.0-I-OUTD-400**						
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	0,157	1,076	0,156	1,076	8.00	8.00
3	0,088	0,605	0,099	0,685	21.60	Not stated
4	0,032	0,221	0,037	0,253	4.00	4.00
5	0,018	0,122	0,038	0,260	10.70	10.70
6	0,014	0,097	0,012	0,083	2.67	2.67
7	0,036	0,248	0,031	0,212	7.20	7.20
8	0,011	0,078	0,010	0,067	2.00	2.00
9	0,020	0,140	0,022	0,154	3.80	Not stated
10	0,006	0,039	0,007	0,046	1.60	1.60
11	0,031	0,216	0,131	0,902	3.10	3.10
12	0,004	0,030	0,009	0,062	1.33	1.33
13	0,014	0,097	0,096	0,660	2.00	2.00
THD	-	1,34%	-	1,98%	23.00%	13.00%
PWHD	-	1,045%	-	2,15%	23.00%	22.00%

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

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-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	2.348%	1.869%	0	2.348%	1.869%	0	0.390	0.328
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	12/05/2011			Test end date		18/05/2011		
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.			
Test 1: MODELs: **PVI-10.0-I-OUTD-400**			
Test power level	10%	55%	100%
Recorded value	-2.0 mA	6.0 mA	2.0 mA
as % of rated AC current	0.014%	0.042%	0.014%
Limit	0.25 %	0.25 %	0.25 %
Test 2: MODELs: **PVI-12.0-I-OUTD-400**			
Test power level	10%	55%	100%
Recorded value	4.0 mA	7.0 mA	-11.0 mA
as % of rated AC current	0.023%	0.040%	0.064%
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.				
Test 1: MODELs: **PVI-10.0-I-OUTD-400**				
-	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	0.9993	0.9993	
Limit	>0.95	>0.95	>0.95	
Test 2: MODELs: **PVI-12.0-I-OUTD-400**				
-	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	0,9999	0,9998	0,9999	
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-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5Hz	20.00s	47.50Hz	20.109s	47,7Hz/ 25s	No Trip
U/F stage 2	47Hz	0.52s	47.00Hz	0.521s	47.2Hz/ 19.98s	No Trip
					46,8Hz/ 0,48s	No Trip
O/F stage 1	51.5Hz	90.00s	51.50Hz	90.02s	51.3Hz/95s	No Trip
O/F stage 2	52Hz	0.52s	52.00Hz	0.510s	51.8Hz/ 89.98s	No Trip
					52.2Hz/ 0.48s	No Trip

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

Protection. Voltage tests .

MODELs: **PVI-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400

Function	Setting		Trip test		"No trip tests"	
U/V stage 1	Voltage	Time delay	Voltage	Time delay	Voltage/Time	Confirm no trip
L1-N	200.1V	2.50s	200.4V	2.552s	204.1V/3.5s	No Trip
L2-N	200.1V	2.50s	200.4V	2.560s		
L3-N	200.1V	2.50s	200.3V	2.554s		
U/V stage 2	Voltage	Time delay	Voltage	Time delay	Voltage/Time	Confirm no trip
L1-N	184V	0.50s	184.9V	0.524s	188V/2.48s	No Trip
L2-N	184V	0.50s	183.9V	0.533s		
L3-N	184V	0.50s	184.8V	0.527s	180V/0.48s	No Trip
O/V stage 1	Voltage	Time delay	Voltage	Time delay	Voltage/Time	Confirm no trip
L1-N	262.2V	1.00s	261.9V	1.037s	258.2V/2.0s	No Trip
L2-N	262.2V	1.00s	261.9V	1.039s		
L3-N	262.2V	1.00s	262.8V	1.028s		
O/V stage 2	Voltage	Time delay	Voltage	Time delay	Voltage/Time	Confirm no trip
L1-N	273.7V	0.50s	273.3V	0.532s	269.7V/0.98s	No Trip
L2-N	273.7V	0.50s	273.2V	0.534s		
L3-N	273.7V	0.50s	273.3V	0.523s	277.7V/0.48s	No Trip

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-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400

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	0.779s	0.751s	0.619s	0.775s	0.711s	0.771s

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	Open phase 0.022s	Ph2 removed	Confirm Trip in : 0.010s	Ph3 removed	Confirm Trip in: 0.025s

a) Protection. Frequency change, Stability test.				
MODELs: **PVI-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400				
	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.					
MODELs: **PVI-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
30s	58s	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.		
MODELs: **PVI-12.0-I-OUTD-400** PVI-10.0-I-OUTD-400		
For a Inverter SSEG		
Time after fault	Volts	Amps
20ms	28.66	9.15
100ms	21.18	4.22
250ms	19.73	2.65
500ms	19.28	1.91
Time to trip	0.533	In seconds

b) 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.: **28107125 001**