

ref. TRIO-27.6-TL-OUTD (UK G59/3 Type Verification Test Report)

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	TRIO-20.0-TL-OUTD-400; TRIO-20.0-TL-OUTD-S2-400; TRIO-20.0-TL-OUTD-S2X-400; TRIO-20.0-TL-OUTD-S2F-400; TRIO-20.0-TL-OUTD-S1J-400; TRIO-20.0-TL-OUTD-S2J-400; TRIO-27.6-TL-OUTD-400; TRIO-27.6-TL-OUTD-S2-400; TRIO-27.6-TL-OUTD-S2X-400; TRIO-27.6-TL-OUTD-S2F-400; TRIO-27.6-TL-OUTD-S1J-400; TRIO-27.6-TL-OUTD-S2J-400 TRIO-27.6-TL-OUTD-400-W; TRIO-20.0-TL-OUTD-400-W		
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			Web site www.abb.com/solarinverters
Maximum / Nominal rated capacity	Connection Option		
	30.0 / 27.6 kW	kW single phase (for TRIO-27.6 series)	
	22.0 / 20.0 kW	kW single phase (for TRIO-20.0 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. 28106733 001, Determination of Electrical Properties, released by TUEV Rheinland</p>			

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

Phoenix, AZ
(Place)

2014 July 15
(Date)

Extract of Test report: 28106733 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)

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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:	28106733 001 Issued by TÜV Rheinland Italia S.r.l. on 14 th July 2014																			
Measuring period:	From 22 Th May 2014 to 29 Th May 2014																			
Type Test reference number: Pacr / Pacmax <i>(Rated AC Power / Maximum AC output Power)</i>	<table border="1"> <thead> <tr> <th>Models *</th> <th>Pacr / Pacmax</th> </tr> </thead> <tbody> <tr><td>TRIO-20.0-TL-OUTD-400</td><td rowspan="6">27.6 / 30.0</td></tr> <tr><td>TRIO-20.0-TL-OUTD-S2-400</td></tr> <tr><td>TRIO-20.0-TL-OUTD-S2X-400</td></tr> <tr><td>TRIO-20.0-TL-OUTD-S2F-400</td></tr> <tr><td>TRIO-20.0-TL-OUTD-S1J-400</td></tr> <tr><td>TRIO-20.0-TL-OUTD-S2J-400</td></tr> <tr><td>TRIO-20.0-TL-OUTD-400-W</td><td rowspan="6">22.0 / 20.0</td></tr> <tr><td>TRIO-27.6-TL-OUTD-400</td></tr> <tr><td>TRIO-27.6-TL-OUTD-S2-400</td></tr> <tr><td>TRIO-27.6-TL-OUTD-S2X-400</td></tr> <tr><td>TRIO-27.6-TL-OUTD-S2F-400</td></tr> <tr><td>TRIO-27.6-TL-OUTD-S1J-400</td></tr> <tr><td>TRIO-27.6-TL-OUTD-S2J-400</td></tr> <tr><td>TRIO-27.6-TL-OUTD-400-W</td></tr> </tbody> </table>		Models *	Pacr / Pacmax	TRIO-20.0-TL-OUTD-400	27.6 / 30.0	TRIO-20.0-TL-OUTD-S2-400	TRIO-20.0-TL-OUTD-S2X-400	TRIO-20.0-TL-OUTD-S2F-400	TRIO-20.0-TL-OUTD-S1J-400	TRIO-20.0-TL-OUTD-S2J-400	TRIO-20.0-TL-OUTD-400-W	22.0 / 20.0	TRIO-27.6-TL-OUTD-400	TRIO-27.6-TL-OUTD-S2-400	TRIO-27.6-TL-OUTD-S2X-400	TRIO-27.6-TL-OUTD-S2F-400	TRIO-27.6-TL-OUTD-S1J-400	TRIO-27.6-TL-OUTD-S2J-400	TRIO-27.6-TL-OUTD-400-W
Models *	Pacr / Pacmax																			
TRIO-20.0-TL-OUTD-400	27.6 / 30.0																			
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TRIO-27.6-TL-OUTD-S2J-400																				
TRIO-27.6-TL-OUTD-400-W																				
Software version:	Bundle Firmware Update Version**: not less than 1422G standard selection: UK G59																			
Rated Voltage:	3-phase device 230 V (Phase/ Neutral)																			
Remarks: Note *: test performed on models TRIO-27.6-TL-OUTD-400 and TRIO-20.0-TL-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 option "-S2", "-S2X", "-S2F", "-S1J", "-S2J" have got different wiring box . Models with suffix "-W" are used for wind application. Tested model indicated in bold characters. Note **: "Update version" identifies the Bundle Firmware Features by a sequential code: xxxxy where: <ul style="list-style-type: none"> • 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 Saturday=G) 																				

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

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Power Quality. Harmonics.						
MODELS: TRIO-27.6-TL-OUTD-400 and derived models						
Generating Unit rating per phase (rpp)		9.2		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	0.042	0.105	0.085	0.213	8.00	8.00
3	0.046	0.116	0.045	0.114	21.60	Not stated
4	0.013	0.033	0.031	0.077	4.00	4.00
5	0.089	0.222	0.095	0.237	10.70	10.70
6	0.008	0.019	0.018	0.046	2.67	2.67
7	0.086	0.214	0.093	0.232	7.20	7.20
8	0.007	0.017	0.017	0.043	2.00	2.00
9	0.019	0.048	0.020	0.051	3.80	Not stated
10	0.008	0.020	0.014	0.035	1.60	1.60
11	0.270	0.675	0.366	0.915	3.10	3.10
12	0.007	0.017	0.008	0.020	1.33	1.33
13	0.184	0.459	0.296	0.739	2.00	2.00
THD	1.816	-	1.415%	-	23.00%	13.00%
PWHD	2.005%	-	3.020%	-	23.00%	22.00%
MODELS: TRIO-20.0-TL-OUTD-400 and derived models						
Generating Unit rating per phase (rpp)		6.7		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	0.075	0.258	0.110	0.380	8.00	8.00
3	0.024	0.083	0.024	0.084	21.60	Not stated
4	0.007	0.024	0.016	0.054	4.00	4.00
5	0.080	0.276	0.102	0.353	10.70	10.70
6	0.006	0.019	0.009	0.032	2.67	2.67
7	0.086	0.296	0.099	0.343	7.20	7.20
8	0.010	0.033	0.011	0.036	2.00	2.00

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9	0.013	0.043	0.015	0.051	3.80	Not stated
10	0.010	0.033	0.011	0.039	1.60	1.60
11	0.085	0.293	0.281	0.971	3.10	3.10
12	0.007	0.023	0.013	0.043	1.33	1.33
13	0.057	0.196	0.236	0.813	2.00	2.00
THD	1.386%	-	1.560%	-	23.00%	13.00%
PWHD	3.262%	-	2.809%	-	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: TRIO-27.6-TL-OUTD-400 and derived models (including TRIO-20.0 models)								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	1.945%	1.143%	0	1.945%	1.143%	0	0.583	0.315
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	19th January 2012			Test end date	10th April 2012			
Test location	AUSTEST Laboratories							

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

Power quality. DC injection.			
MODELS: TRIO-27.6-TL-OUTD-400 and derived models			
Test power level	10%	55%	100%
Recorded value	12.0 mA	12.0 mA	23.0 mA
as % of rated AC current	0.03 %	0.03 %	0.05 %
Limit	0.25 %	0.25 %	0.25 %
MODELS: TRIO-20.0-TL-OUTD-400 and derived models			
Test power level	10%	55%	100%
Recorded value	29.0 mA	18.0 mA	22.0 mA
as % of rated AC current	0.09 %	0.05 %	0.07 %
Limit	0.25 %	0.25 %	0.25 %

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

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Power quality. Power Factor.					
MODELS: TRIO-27.6-TL-OUTD-400 and derived models					
-	216.4V	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	0.9999	0.9999		
Limit	>0.95	>0.95	>0.95		
MODELS: TRIO-20.0-TL-OUTD-400 and derived models					
-	216.3V	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	0.9998	0.9999	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: TRIO-27.6-TL-OUTD-400 and derived models (including TRIO-20.0 models)						
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 Hz	20.05s	47,7Hz/ 25s	No Trip
U/F stage 2	47Hz	0,55s	47.0 Hz	0.55s	47,2Hz/ 19,98s	No Trip
					46,8Hz/ 0,48s	No Trip
O/F stage 1	51,5Hz	90,05s	51.50 Hz	90.03s	51,3Hz/95s	No Trip
O/F stage 2	52Hz	0,55s	52.00 Hz	0.55s	51,8Hz/ 89,98s	No Trip
					52,2Hz/ 0,48s	No Trip

Protection. Voltage tests .						
MODELS: TRIO-27.6-TL-OUTD-400 and derived models (including TRIO-20.0 models)						
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	2.55s	204.1V/3.5s	No Trip
U/V stage 2	184V	0.50s	183.20	0.53s	188V/2.48s	No Trip
					180V/0.48s	No Trip
O/V stage 1	262.2V	1.00s	262.80V	1.03s	258.2V/2.0s	No Trip
O/V stage 2	273.7V	0.50s	273.50V	0.52s	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.

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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.

TRIO-27.6-TL-OUTD-400 and derived models (including TRIO-20.0 models)

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	0.634s	0.615s	0.666s	0.642s	0.617s	0.485s

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: 0.309s	Ph2 removed	Confirm Trip in : 0.288s	Ph3 removed	Confirm Trip in: 0.238s
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b) Protection. Frequency change, Stability test.

TRIO-27.6-TL-OUTD-400 and derived models (including TRIO-20.0 models)

	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

c) Protection. Re-connection timer.

TRIO-27.6-TL-OUTD-400 and derived models (including TRIO-20.0 models)

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	25.48s	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.

TRIO-27.6-TL-OUTD-400 and derived models (including TRIO-20.0 models)

For a Inverter SSEG

Time after fault	Volts	Amps
20ms	49.42	33.59
100ms	29.61	17.61
250ms	24.62	11.31
500ms	22.77	8.18
Time to trip	>0.600	In seconds

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e) Self-Monitoring solid state switching. The requirement is specified in section 5.3.1. no specified test requirements.	N/A
Mechanical relay used.	

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