

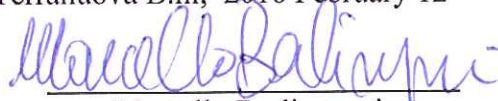
## *ENA Engineering Recommendation G59/3*

### *Appendix 4*

### *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	REACT-UNO-4.6-TL <sup>(1)</sup> REACT-UNO-3.6-TL <sup>(1)</sup> <sup>(1)</sup> : to be used in combination with Battery Unit model REACT-BATT-AP1		
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	servicer.solarinverters@it.abb.com	Web site	www.abb.com/solarinverters www.abb.com
	Connection Option		
Maximum / Nominal rated capacity	4600 / 4600 W	W single phase (for REACT-UNO-4.6-TL)	
	3600 / 3600 W	W single phase (for REACT-UNO-3.6-TL)	
<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. <b>28108830 001</b>, Determination of Electrical Properties, released by TÜV Rheinland.</p>			

Terranuova B.ni, 2016 February 12

  
Marcello Berlingozzi  
(Leadperson Quality Control)

  
Cristiano Ensoli  
(Manager Quality)

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<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>28108830 001</b> Issued by TÜV Rheinland Italia S.r.l. on 3 <sup>rd</sup> February 2016		
<b>Measuring period:</b>	From 21 <sup>th</sup> May, 2015 to 30 <sup>th</sup> June, 2015		
<b>Pacr:</b> <i>(Rated AC Power)</i> <b>Pacmax:</b> <i>(Maximum AC output Power)</i>		<b>REACT-UNO-4.6-TL</b>	<b>REACT-UNO-3.6-TL</b>
	<b>Pacr</b>	4600W	3600W
	<b>Pacmax</b>	4600W	3600W
<b>Software version</b>	Bundle Firmware Update Version*: <b>not less than 1518C</b> with standard selection: <b>UK G59</b>		
<b>Rated Voltage:</b>	Single-phase device 230 V (Phase/ Neutral)		
<p><b>Remarks:</b>  Test performed on model REACT-UNO-3.6-TL and REACT-UNO-4.6-TL.  Tested model indicated in <b>bold</b> characters</p> <p><b>Note *:</b>  “Update version” identifies the Bundle Firmware Features by a sequential code: xxxxy where:</p> <ul style="list-style-type: none"> <li>• xxxx is a number indicates Year (two digits) and Week (two digits)</li> <li>• y is a letter from A to G indicates Day (from Sunday = A to Saturday=G)</li> </ul>			

<b>Power Quality. Harmonics.</b>						
MODELS: <b>REACT-UNO-4.6-TL</b>						
Generating Unit rating per phase (rpp)		4.2	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	0.010	0.040	0.013	0.053	8.00%	
3	0.035	0.145	0.049	0.201	21.60%	
4	0.004	0.018	0.004	0.016	4.00%	
5	0.009	0.036	0.018	0.075	10.70%	
6	0.002	0.010	0.001	0.006	2.67%	
7	0.009	0.037	0.012	0.049	7.20%	
8	0.002	0.009	0.002	0.007	2.00%	
9	0.014	0.058	0.013	0.053	3.80%	
10	0.001	0.007	0.001	0.004	1.60%	
11	0.008	0.031	0.012	0.048	3.10%	
12	0.001	0.006	0.001	0.005	1.33%	
13	0.008	0.032	0.011	0.046	2.00%	
THD	0.182%	-	0.265%	-	23.00%	
PWHD	0.202%	-	0.532%	-	23.00%	

No Higher limit for odd harmonics 21 and above are applied

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Power Quality. Harmonics.						
MODELS: <b>REACT-UNO-3.6-TL</b>						
Generating Unit rating per phase (rpp)		4.2	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	0.01	0.05	0.011	0.055	8.00%	
3	0.032	0.16	0.049	0.245	21.60%	
4	0.004	0.02	0.003	0.015	4.00%	
5	0.012	0.06	0.004	0.02	10.70%	
6	0.003	0.015	0.003	0.015	2.67%	
7	0.01	0.05	0.006	0.03	7.20%	
8	0.003	0.015	0.001	0.005	2.00%	
9	0.015	0.075	0.012	0.06	3.80%	
10	0.002	0.01	0.001	0.005	1.60%	
11	0.009	0.045	0.005	0.025	3.10%	
12	0.002	0.01	0.002	0.01	1.33%	
13	0.007	0.035	0.005	0.025	2.00%	
THD	0.182%	-	0.265%	-	23.00%	
PWHD	0.202%	-	0.532%	-	23.00%	

No Higher limit for odd harmonics 21 and above are applied

Power Quality. Voltage fluctuations and Flicker.								
MODELS: <b>REACT-UNO-4.6-TL REACT-UNO-3.6-TL</b>								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values at standard impedance	1.04	0	0	1.04	0	0	0.028	0.028
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	21/05/2015			Test end date	30/06/2015			
Test location	TÜV Rheinland Italia S.r.l. via Mattei 3. Pogliano Milanese, 20010 MI, Italy							

<b>Power quality. DC injection.</b>			
<b>MODELs: REACT-UNO-4.6-TL</b>			
Test power level	10%	55%	100%
Recorded value	0.003	0.003	0.006
as % of rated AC current	0.012%	0.012%	0.024%
Limit	0.25 %	0.25 %	0.25 %
<b>MODELs: REACT-UNO-3.6-TL</b>			
Test power level	10%	55%	100%
Recorded value(A)	0.004	0.003	0.005
as % of rated AC current	0.021%	0.015%	0.026%
Limit	0.25%	0.25%	0.25%

<b>Power quality. Power Factor.</b>				
<b>MODELs: REACT-UNO-4.6-TL</b>				
	250V	340V	480V	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	0.9999	0.9999	0.9999	
Limit	>0.95	>0.95	>0.95	
<b>MODELs: REACT-UNO-3.6-TL</b>				
	250V	340V	480V	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	0.9999	0.9999	0.9999	
Limit	>0.95	>0.95	>0.95	

<b>Protection. Frequency tests.</b>						
<b>MODELs: REACT-UNO-4.6-TL REACT-UNO-3.6-TL</b>						
Function	Setting		Trip test		“No trip tests”	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
<b>U/F stage 1</b>	47.5Hz	20.05s	47.45	20.07	47.7Hz/ 25s	No Trip
<b>U/F stage 2</b>	47Hz	0.55s	46.95	0.57	47.2Hz/ 19.98s	No Trip
					46.8Hz/ 0.48s	No Trip
<b>O/F stage 1</b>	51.5Hz	90.05s	51.50	90.03	51.3Hz/95s	No Trip
<b>O/F stage 2</b>	52Hz	0.55s	52.00	0.56	51.8Hz/ 89.98s	No Trip
					52.2Hz/ 0.48s	No Trip

Protection. Voltage tests.						
MODELS: <b>REACT-UNO-4.6-TL</b> REACT-UNO-3.6-TL						
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	199.4	2.55	204.1V/3.5s	No Trip
<b>U/V stage 2</b>	184V	0.55s	183.5	0.55	188V/2.48s	No Trip
					180V/0.48s	No Trip
<b>O/V stage 1</b>	262.2V	1.05s	262.4	1.05	258.2V/2.0s	No Trip
<b>O/V stage 2</b>	273.7V	0.55s	274.7	0.54	269.7V/0.98s	No Trip
					277.7V/ 0.48s	No Trip

MODELS: <b>REACT-UNO-4.6-TL</b> REACT-UNO-3.6-TL										
No.	P <sub>EUT</sub> <sup>1)</sup> (% of EUT rating)	Reactive load (% of Q <sub>L</sub> in 6.1.d)1)	P <sub>AC</sub> <sup>2)</sup> (% of nominal)	Q <sub>AC</sub> <sup>3)</sup> (% of nominal)	Run on time (ms)**	P <sub>EUT</sub> (W)	P <sub>Battery</sub> (kW)	V <sub>DC</sub> (V)	Remarks <sup>4)</sup>	Verdict
1	100	100	0	0	690.0	4600	1.0 Char	440	Test A at BL	<b>P</b>
2	66	66	0	0	759.5	3036	1.0Disch	324	Test B at BL	<b>P</b>
3	33	33	0	0	760.4	1188	---	209	Test C at BL	<b>P</b>
4	100	100	-5	-5	667.6	4600	1.0Disch	440	Test A at IB	<b>P</b>
5	100	100	-5	0	753.6	4600	---	440	Test A at IB	<b>P</b>
6	100	100	-5	+5	647.3	4600	1.0 Char	440	Test A at IB	<b>P</b>
7	100	100	0	-5	657.3	4600	1.0Disch	440	Test A at IB	<b>P</b>
8	100	100	0	+5	644.0	4600	---	440	Test A at IB	<b>P</b>
9	100	100	+5	-5	635.2	4600	1.0 Char	440	Test A at IB	<b>P</b>
10	100	100	+5	0	882.6	4600	1.0Disch	440	Test A at IB	<b>P</b>
11	100	100	+5	+5	649.8	4600	---	440	Test A at IB	<b>P</b>
12	66	66	0	-5	682.1	3036	1.0 Char	324	Test B at IB	<b>P</b>
13	66	66	0	-4	671.1	3036	1.0Disch	324	Test B at IB	<b>P</b>
14	66	66	0	-3	693.7	3036	---	324	Test B at IB	<b>P</b>
15	66	66	0	-2	714.1	3036	1.0 Char	324	Test B at IB	<b>P</b>
16	66	66	0	-1	685.4	3036	1.0Disch	324	Test B at IB	<b>P</b>
17	66	66	0	1	721.7	3036	---	324	Test B at IB	<b>P</b>
18	66	66	0	2	663.9	3036	1.0 Char	324	Test B at IB	<b>P</b>
19	66	66	0	3	660.9	3036	1.0Disch	324	Test B at IB	<b>P</b>
20	66	66	0	4	656.1	3036	---	324	Test B at IB	<b>P</b>
21	66	66	0	5	640.2	3036	1.0 Char	324	Test B at IB	<b>P</b>
22	33	33	0	-5	675.2	1188	1.0Disch	209	Test C at IB	<b>P</b>
23	33	33	0	-4	676.8	1188	---	209	Test C at IB	<b>P</b>
24	33	33	0	-3	696.6	1188	1.0 Char	209	Test C at IB	<b>P</b>
25	33	33	0	-2	706.4	1188	1.0Disch	209	Test C at IB	<b>P</b>
26	33	33	0	-1	725.6	1188	---	209	Test C at IB	<b>P</b>
27	33	33	0	1	706.3	1188	1.0 Char	209	Test C at IB	<b>P</b>
28	33	33	0	2	694.1	1188	1.0Disch	209	Test C at IB	<b>P</b>
29	33	33	0	3	679.6	1188	---	209	Test C at IB	<b>P</b>
30	33	33	0	4	679.6	1188	1.0 Char	209	Test C at IB	<b>P</b>
31	33	33	0	5	671.8	1188	1.0Disch	209	Test C at IB	<b>P</b>

## Appendix 4 Type Verification Test Report (G59/3)

 MODELS: **REACT-UNO-4.6-TL** REACT-UNO-3.6-TL

No.	P <sub>EUT</sub> <sup>1)</sup> (% of EUT rating)	Reactive load (% of Q <sub>L</sub> in 6.1.d)1)	P <sub>AC</sub> <sup>2)</sup> (% of nominal)	Q <sub>AC</sub> <sup>3)</sup> (% of nominal)	Run on time (ms)**	P <sub>EUT</sub> (W)	P <sub>Battery</sub> (kW)	V <sub>DC</sub> (V)	Remarks <sup>4)</sup>	Verdict
32	100	100	-10	-10	639.2	4600	1.0 Char	440	Test A at IB	P
33	100	100	-10	-5	684.0	4600	1.0Disch	440	Test A at IB	P
34	100	100	-10	0	760.0	4600	---	440	Test A at IB	P
35	100	100	-10	+5	642.8	4600	1.0 Char	440	Test A at IB	P
36	100	100	-10	+10	630.4	4600	1.0Disch	440	Test A at IB	P
37	100	100	-5	+10	634.6	4600	---	440	Test A at IB	P
38	100	100	0	+10	642.4	4600	1.0 Char	440	Test A at IB	P
39	100	100	+5	+10	594.8	4600	1.0Disch	440	Test A at IB	P
40	100	100	-5	-10	651.2	4600	---	440	Test A at IB	P
41	100	100	0	-10	606.4	4600	1.0 Char	440	Test A at IB	P
42	100	100	+5	-10	622.8	4600	1.0Disch	440	Test A at IB	P
43	100	100	+10	-10	641.8	4600	---	440	Test A at IB	P
44	100	100	+10	-5	627.4	4600	1.0 Char	440	Test A at IB	P
45	100	100	+10	0	733.4	4600	1.0Disch	440	Test A at IB	P
46	100	100	+10	+5	671.5	4600	---	440	Test A at IB	P
47	100	100	+10	+10	635.4	4600	1.0 Char	440	Test A at IB	P

<sup>1)</sup> P<sub>EUT</sub>: EUT output power

<sup>2)</sup> P<sub>AC</sub>: Real power flow at S1 as in Figure 1. Positive value means the power from EUT to utility. Nominal value is the 0% test condition value.

<sup>3)</sup> Q<sub>AC</sub>: Reactive power flow at S1 as in Figure 1. Positive value means the power from EUT to utility. Nominal value is the 0% test condition value

<sup>4)</sup> BL: Balance condition, IB: Imbalance condition

\*: Needs to be measured if any of the recorded run-on times at imbalanced condition are longer than the one recorded for the rated balance condition at test condition A

\*\* “Run on time” must be &lt; 2s

The filled out switch-off time values the highest among the three phase

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

 MODELS: **REACT-UNO-4.6-TL** REACT-UNO-3.6-TL

	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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**c) Protection. Re-connection timer.**

MODELS: **REACT-UNO-4.6-TL** REACT-UNO-3.6-TL

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	22.82s	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: **REACT-UNO-4.6-TL** REACT-UNO-3.6-TL

For Inverter Output

Time after fault	Volts	Amps
20ms	38.4237	25.3920
100ms	20.3545	24.3881
250ms	13.4233	18.1949
500ms	9.8010	12.8778
Time to trip	1s	



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This extract from the test report is only valid in conjunction with the test report no.: **28108830 001**

**Reviewed by:**

03.02.2016	Marco Piva / BFM	
<b>Datum</b>	<b>Name/Stellung</b>	<b>Unterschrift</b>
<i>Date</i>	<i>Name/Position</i>	<i>Signature</i>