

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 Tested reference number	UNO-DM-X.X-TL-PLUS-XYK-JVN where X.X may be 1.2 or 2.0 or 3.3 or 4.0 where XYK may be X: "blank" or S; Y: "blank" or B or E; K: "blank" where JVN may be J: "blank" or X; V: "blank" or G ; N: "blank"		
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
Maximum / Nominal rated capacity	Connection Option		
	5.0 / 5.0 kW	kW single phase (for UNO-DM-5.0-TL-PLUS-XYK-JVN)	
	4.6 / 4.6 kW	kW single phase (for UNO-DM-4.6-TL-PLUS-XYK-JVN)	
	4.0 / 4.0 kW	kW single phase (for UNO-DM-4.0-TL-PLUS-XYK-JVN)	
	3.3 / 3.3 kW	kW single phase (for UNO-DM-3.3-TL-PLUS-XYK-JVN)	
	2.0 / 2.0 kW	kW single phase (for UNO-DM-2.0-TL-PLUS-XYK-JVN)	
1.2 / 1.2 kW	kW single phase (for UNO-DM-1.2-TL-PLUS-XYK-JVN)		
<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. 28110272 005, Determination of Electrical Properties, released by TÜV Rheinland.</p>			

Terranuova B.ni, 2017 February 03


Marcello Berlingozzi
(Leadperson Quality Control)


Cristiano Ensoli
(Manager Quality)

Extract of Test report: 28110272 005 “Determination of electrical properties”		Seite 1 von 8 Page 1 of 8																												
Appendix 4 Type Verification Test Report (G59/3)																														
Type of System:	Solar Grid tied inverter																													
System Manufacturer:	Power-One Italy S.p.A.																													
Manufacturer data:	Via S. Giorgio 642, 52028 Terranuova Bracciolini (AR) - Italy																													
Reference test report:	28110272 005 Issued by TÜV Rheinland Italia S.r.l. on 21/10/2016																													
Measuring period:	From 19/12/2016 to 20/01/2017																													
P_{acr}: <i>(Rated AC Power)</i>	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="7">UNO-DM-X.X-TL-PLUS-XYK-JVN⁽¹⁾</th> </tr> <tr> <th></th> <th>1.2</th> <th>2.0</th> <th>3.3</th> <th>4.0</th> <th>4.6</th> <th>5.0</th> </tr> </thead> <tbody> <tr> <td>P_{acr} [W] @cosφ=1</td> <td>1200</td> <td>2000</td> <td>3300</td> <td>4000</td> <td>4600</td> <td>5000</td> </tr> <tr> <td>P_{acmax} [W] @cosφ=1</td> <td>1200</td> <td>2000</td> <td>3300</td> <td>4000</td> <td>4600</td> <td>5000</td> </tr> </tbody> </table>		UNO-DM-X.X-TL-PLUS-XYK-JVN ⁽¹⁾								1.2	2.0	3.3	4.0	4.6	5.0	P_{acr} [W] @cosφ=1	1200	2000	3300	4000	4600	5000	P_{acmax} [W] @cosφ=1	1200	2000	3300	4000	4600	5000
UNO-DM-X.X-TL-PLUS-XYK-JVN ⁽¹⁾																														
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P_{acmax} [W] @cosφ=1	1200	2000	3300	4000	4600	5000																								
P_{acmax}: <i>(Maximum AC output Power)</i>																														
Software version	Bundle Firmware Update Version ⁽²⁾ : not less than 1705C ⁽³⁾ with standard selection: UK G59																													
Rated Voltage:	Single-phase device 230 V (Phase/ Neutral)																													
Remarks: (1) Model designation is made by UNO-DM-X.X-TL-PLUS-XYK-JVN where: X.X = 1.2; 2.0; 3.3; 4.0; 4.6; 5.0 XYZ = X: or blank or “S” (when the unit is natively equipped with a DC switch) Y: or blank or “B” (when the unit is natively equipped with a WLAN) or “E” (when the unit is natively equipped with a WLAN and a ETHERNET board) K: blank JVN = J: blank or “X” (when the unit is natively equipped with UNO-DM-COM KIT) V: blank or “G” (when the unit is natively equipped with a cable gland for AC connection instead of a connector) N: blank (2) “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 (from Sunday = A to Saturday=G) (3) Not less than: MICRO (Supervisor): C.0.4.0; Booster (DC-DC): A.1.1.9; Inverter (DC-AC): B.0.3.6																														

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a) Power Quality. Harmonics.

Power Quality. Harmonics.						
MODEL: UNO-DM-5.0-TL-PLUS-SB-X						
SSEG rating per phase (rpp)		5		kW		Harmonic % = Measured Value (A) x 23/rating per phase (kVA)
Harmonic	At 45-55% of rated output		100% of rated output		Mono Phase	
	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.038	0.042	0.437	0.487	1.080	
3	0.440	0.491	0.731	0.815	2.300	
4	0.008	0.009	0.065	0.072	0.430	
5	0.150	0.167	0.246	0.274	1.140	
6	0.009	0.010	0.033	0.037	0.300	
7	0.182	0.203	0.114	0.127	0.770	
8	0.006	0.007	0.019	0.021	0.230	
9	0.234	0.261	0.148	0.165	0.400	
10	0.005	0.006	0.007	0.008	0.184	
11	0.166	0.185	0.124	0.138	0.330	
12	0.005	0.006	0.010	0.011	0.153	
13	0.125	0.139	0.114	0.127	0.210	
14	0.002	0.002	0.007	0.008	0.131	
15	0.098	0.109	0.108	0.120	0.150	
16	0.004	0.004	0.014	0.016	0.115	
17	0.074	0.083	0.097	0.108	0.132	
18	0.002	0.002	0.011	0.012	0.102	
19	0.055	0.061	0.094	0.105	0.118	
20	0.003	0.003	0.014	0.016	0.092	
21	0.048	0.054	0.084	0.094	0.107	
22	0.003	0.003	0.015	0.017	0.084	
23	0.034	0.038	0.071	0.079	0.098	0.147
24	0.002	0.002	0.013	0.014	0.077	
25	0.031	0.035	0.062	0.069	0.090	0.135
26	0.003	0.003	0.013	0.014	0.071	
27	0.030	0.033	0.053	0.059	0.083	0.124
28	0.002	0.002	0.010	0.011	0.066	
29	0.024	0.027	0.043	0.048	0.078	0.117

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Power Quality. Harmonics.						
MODEL: UNO-DM-5.0-TL-PLUS-SB-X						
SSEG rating per phase (rpp)		5		kW		Harmonic % = Measured Value (A) x 23/rating per phase (kVA)
Harmonic	At 45-55% of rated output		100% of rated output		Mono Phase	
	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
30	0.003	0.003	0.012	0.013	0.061	
31	0.024	0.027	0.035	0.039	0.073	0.109
32	0.002	0.002	0.011	0.012	0.058	
33	0.026	0.029	0.027	0.030	0.068	0.102
34	0.004	0.004	0.008	0.009	0.054	
35	0.022	0.025	0.023	0.026	0.064	0.096
36	0.002	0.002	0.008	0.009	0.051	
37	0.024	0.027	0.020	0.022	0.061	0.091
38	0.002	0.002	0.009	0.010	0.048	
39	0.024	0.027	0.011	0.012	0.058	0.087
40	0.003	0.003	0.005	0.006	0.046	

b) Power Quality. Voltage fluctuations and Flicker.								
MODEL: UNO-DM-5.0-TL-PLUS-SB-X								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values at standard impedance	1.04	0	0	1.875%	0.062%	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

c) Power quality. DC injection.			
MODEL: UNO-DM-5.0-TL-PLUS-SB-X			
Test power level	10%	55%	100%
Recorded value	9.0 mA	8.0 mA	10.0 mA
as % of rated AC current	0.04 %	0.04 %	0.04 %
Limit	0.25 %	0.25 %	0.25 %

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d) Power quality. Power Factor.

MODEL: **UNO-DM-5.0-TL-PLUS-SB-X**

	216.2V	230V	253V	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	>0.999	>0.999	>0.999	
Limit	>0.95	>0.95	>0.95	

e) Protection. Frequency tests.

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	47.477	20.120	47.7Hz/ 25s	No Trip
U/F stage 2	47Hz	0,55s	46.993	0,552	47.2Hz/ 19.98s	No Trip
					46.8Hz/ 0.48s	No Trip
O/F stage 1	51.5Hz	90.05s	51.512	90.07	51.3Hz/95s	No Trip
O/F stage 2	52Hz	0.55s	52.013	0.553	51.8Hz/ 89.98s	No Trip
					52.2Hz/ 0.48s	No Trip

f) Protection. Voltage tests.

Function	Setting		Trip test		“No trip tests”	
	Voltage	Time delay	Voltage	Time delay	Voltage/Time	Confirm no trip
U/V stage 1	200.1V	2.55s	200.550	2.553	204.1V/3.5s	No Trip
U/V stage 2	184V	0.55s	184.520	0.546	188V/2.48s	No Trip
					180V/0.48s	No Trip
O/V stage 1	262.2V	1.05s	262.110	1.042	258.2V/2.0s	No Trip
O/V stage 2	273.7V	0.55s	273.610	0.539	269.7V/0.98s	No Trip
					277.7V/ 0.48s	No Trip

g) Protection. Loss of Mains test and single phase test.

MODEL: **UNO-DM-5.0-TL-PLUS-SB-X**

No.	P _{EUT} ¹⁾ (% of EUT rating)	Reactive load (% of Q _L in 6.1.d)1)	P _{AC} ²⁾ (% of nominal)	Q _{AC} ³⁾ (% of nominal)	Run on time (ms)**	P _{EUT} (W)	V _{DC} (V)	Remarks ⁴⁾	Verdict
1	100	100	0	0	395	5000	446	Test A at BL	P
2	66	66	0	0	378	3300	310	Test B at BL	P
3	33	33	0	0	324	1650	174	Test C at BL	P
4	100	100	-5	-5	143	5000	446	Test A at IB	P
5	100	100	-5	0	373	5000	446	Test A at IB	P
6	100	100	-5	+5	155	5000	446	Test A at IB	P
7	100	100	0	-5	143	5000	446	Test A at IB	P
8	100	100	0	+5	147	5000	446	Test A at IB	P
9	100	100	+5	-5	135	5000	446	Test A at IB	P
10	100	100	+5	0	293	5000	446	Test A at IB	P
11	100	100	+5	+5	149	5000	446	Test A at IB	P
12	66	66	0	-5	158	3300	310	Test B at IB	P
13	66	66	0	-4	142	3300	310	Test B at IB	P
14	66	66	0	-3	162	3300	310	Test B at IB	P
15	66	66	0	-2	178	3300	310	Test B at IB	P
16	66	66	0	-1	220	3300	310	Test B at IB	P
17	66	66	0	1	186	3300	310	Test B at IB	P
18	66	66	0	2	168	3300	310	Test B at IB	P
19	66	66	0	3	150	3300	310	Test B at IB	P
20	66	66	0	4	144	3300	310	Test B at IB	P
21	66	66	0	5	136	3300	310	Test B at IB	P
22	33	33	0	-5	148	1650	174	Test C at IB	P
23	33	33	0	-4	156	1650	174	Test C at IB	P
24	33	33	0	-3	170	1650	174	Test C at IB	P
25	33	33	0	-2	172	1650	174	Test C at IB	P
26	33	33	0	-1	194	1650	174	Test C at IB	P
27	33	33	0	1	168	1650	174	Test C at IB	P
28	33	33	0	2	146	1650	174	Test C at IB	P
29	33	33	0	3	138	1650	174	Test C at IB	P
30	33	33	0	4	124	1650	174	Test C at IB	P
31	33	33	0	5	124	1650	174	Test C at IB	P
32	100	100	-10	-10	147	5000	446	Test A at IB	P
33	100	100	-10	-5	173	5000	446	Test A at IB	P
34	100	100	-10	0	451	5000	446	Test A at IB	P
35	100	100	-10	+5	152	5000	446	Test A at IB	P

g) Protection. Loss of Mains test and single phase test.

MODEL: **UNO-DM-5.0-TL-PLUS-SB-X**

No.	P _{EUT} ¹⁾ (% of EUT rating)	Reactive load (% of Q _L in 6.1.d)1)	P _{AC} ²⁾ (% of nominal)	Q _{AC} ³⁾ (% of nominal)	Run on time (ms)**	P _{EUT} (W)	V _{DC} (V)	Remarks ⁴⁾	Verdict
36	100	100	-10	+10	132	5000	446	Test A at IB	P
37	100	100	-5	+10	126	5000	446	Test A at IB	P
38	100	100	0	+10	140	5000	446	Test A at IB	P
39	100	100	+5	+10	124	5000	446	Test A at IB	P
40	100	100	-5	-10	134	5000	446	Test A at IB	P
41	100	100	0	-10	156	5000	446	Test A at IB	P
42	100	100	+5	-10	126	5000	446	Test A at IB	P
43	100	100	+10	-10	118	5000	446	Test A at IB	P
44	100	100	+10	-5	144	5000	446	Test A at IB	P
45	100	100	+10	0	370	5000	446	Test A at IB	P
46	100	100	+10	+5	132	5000	446	Test A at IB	P
47	100	100	+10	+10	102	5000	446	Test A at IB	P

¹⁾ P_{EUT}: EUT output power

²⁾ P_{AC}: 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.

³⁾ Q_{AC}: 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

⁴⁾ 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 < 2s

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

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h) Protection. Frequency change, Stability test.

MODEL: **UNO-DM-5.0-TL-PLUS-SB-X**

	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

i) Protection. Re-connection timer.

Protection. Re-connection timer. The requirement is specified in section 5.3.4, test procedure in Annex A or B 1.3.5 (of reference document G83/2)

MODEL: **UNO-DM-5.0-TL-PLUS-SB-X**

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	22.23s	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

j) Fault level contribution.

MODEL: **UNO-DM-5.0-TL-PLUS-SB-X**

For a Inverter SSEG

Time after fault	Volts	Amps (rms)
20ms	20.02	24.80
60ms	10.65	12.31
100ms	7.59	7.78
1000ms	4.56	4.46
Time to trip	<1	In seconds

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This extract from the test report is only valid in conjunction with the test report no.: **28110272 005**

Reviewed by:

31.01.2017	Marco Piva / BFM	
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>