

Extract from Test report for unit certificate: 28110633 007  
 “Determination of electrical properties”

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Extract No: 1 \_ Annex F.3 (VDE-AR-N 4105)

<b>Type of System:</b>	Grid tied inverter					
<b>System Manufacturer:</b>	POWER-ONE ITALY S.P.A. Via S. Giorgio, 642 52028 Terranuova Bracciolini, Arezzo, Italy					
<b>Manufacturer's data</b>						
<b>Type of System:</b>	PV					
<b>Reference test report:</b>	28110633 007					
<b>Measuring period:</b>	17/01/2017 - 16/06/2017					
<b>Active Power [<math>P_{E_{max}}</math>]:</b> (nominal power at reference conditions)	<table border="1"> <tr> <td><b>Model</b></td> <td><b>Pac rated [kW]</b></td> </tr> <tr> <td>TRIO-TM-50.0-400</td> <td>50.0</td> </tr> </table>		<b>Model</b>	<b>Pac rated [kW]</b>	TRIO-TM-50.0-400	50.0
<b>Model</b>	<b>Pac rated [kW]</b>					
TRIO-TM-50.0-400	50.0					
<b>Rated Voltage:</b>	230Vac (P-N) / 400Vac (P-P)					

Reactive power reference										
Active Power $P/P_n$ [%]	10	20	30	40	50	60	70	80	90	100
<b>Max. <math>\cos \varphi_{\text{underexcited}}</math></b>	0.9	0.899	0.899	0.899	0.899	0.899	0.899	0.899	0.899	0.899
<b>Max. <math>\cos \varphi_{\text{overexcited}}</math></b>	0.902	0.902	0.901	0.901	0.901	0.901	0.901	0.901	0.901	0.901

Compliance of required displacement factor $\cos \varphi$											
Default in system control	0.9 <sub>OV</sub>	0.92 <sub>OV</sub>	0.94 <sub>OV</sub>	0.96 <sub>OV</sub>	0.98 <sub>OV</sub>	1	0.98 <sub>UN</sub>	0.96 <sub>UN</sub>	0.94 <sub>UN</sub>	0.92 <sub>UN</sub>	0.9 <sub>UN</sub>
<b>Measured value at PGU terminals</b>	0.902	0.922	0.941	0.960	0.979	1.000	0.980	0.960	0.940	0.920	0.900

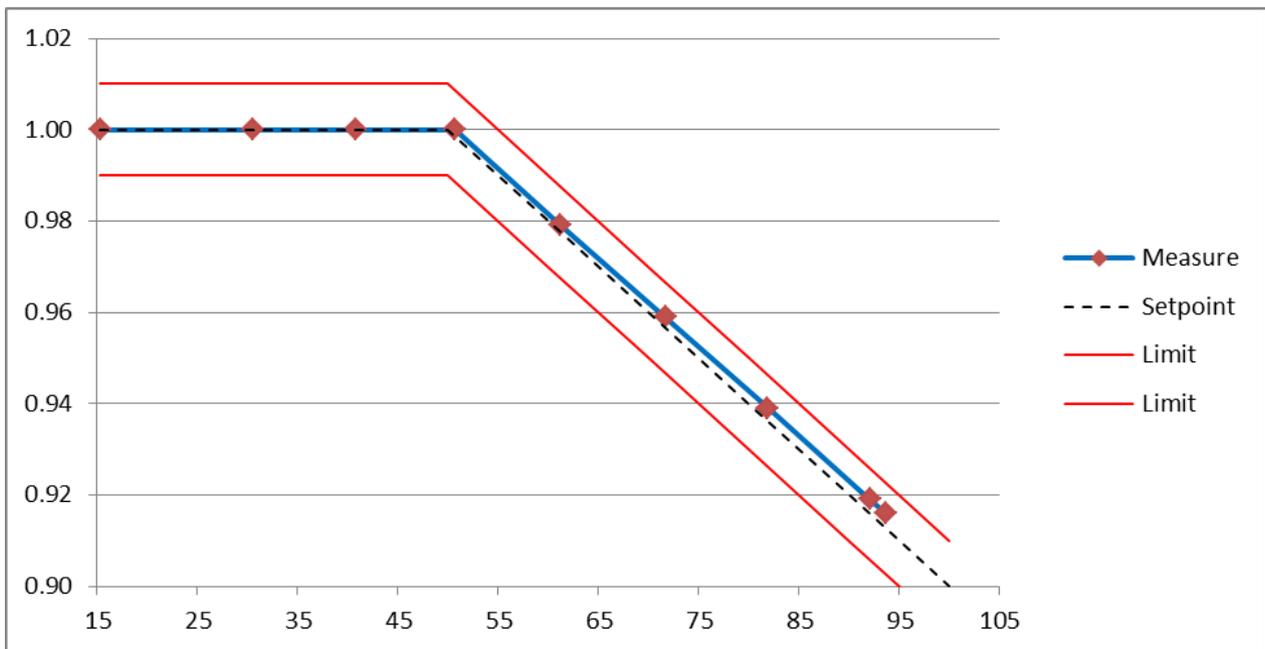
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**Reactive power transfer function – Standard  $\cos \varphi$  (P) – characteristic:**

Active Power P/P <sub>n</sub> [%]	10	20	30	40	50	60	70	80	90	100
<b>cos <math>\varphi</math></b>	-	1.000	1.000	1.000	1.000	0.979	0.959	0.939	0.919	0.916



**Switching actions:**

<b>Making operation without default</b> <i>Switch-on at 10% of rated active power</i>	k <sub>i</sub> :	0.2994
<b>Worst case at switch over of generator sections</b>	--	--
<b>Making operation at reference conditions</b> <i>Switch-on at 100% of rated active power</i>	k <sub>i</sub> :	1.3649
<b>Breaking operation at nominal power</b> <i>Switch-off at 100% of rated active power</i>	k <sub>i</sub> :	0.1594
<b>Worst-case value of all switching operations</b>	k <sub>i max</sub> :	1.3649

**Flickers:**

Angle of network impedance $\Psi_k$ <i>Worst case condition</i>	30°	50°	70°	85°
<b>Coefficient of system flicker c<sub><math>\psi</math></sub></b>	8.094	6.228	3.798	2.114

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**Harmonics:**

**Harmonics**

Maximum 10 min average values of line current harmonics based on rated current [%] up to 50th order for 11 power bins from 0% to 100% of Pn

Power Bin [%]	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105
Order	Iv/In [%]										
1	0.46	9.981	20.07	30.08	40.2	50.24	60.38	70.26	80.37	90.19	100.82
2	0.03	0.031	0.039	0.041	0.047	0.054	0.063	0.073	0.074	0.084	0.088
3	0.1	0.08	0.098	0.105	0.113	0.129	0.131	0.131	0.138	0.148	0.142
4	0.03	0.037	0.034	0.029	0.025	0.029	0.029	0.031	0.035	0.041	0.045
5	0.13	0.147	0.22	0.198	0.165	0.165	0.132	0.107	0.076	0.067	0.046
6	0.01	0.013	0.01	0.015	0.015	0.018	0.015	0.017	0.013	0.018	0.015
7	0.12	0.138	0.11	0.151	0.14	0.147	0.129	0.098	0.079	0.054	0.059
8	0.01	0.015	0.017	0.015	0.016	0.018	0.025	0.021	0.024	0.018	0.021
9	0.02	0.021	0.025	0.025	0.032	0.038	0.022	0.04	0.02	0.032	0.026
10	0.02	0.013	0.014	0.01	0.021	0.02	0.028	0.021	0.028	0.021	0.023
11	0.21	0.16	0.277	0.14	0.16	0.231	0.255	0.192	0.176	0.112	0.109
12	0.01	0.01	0.013	0.014	0.01	0.016	0.012	0.013	0.014	0.012	0.013
13	0.14	0.15	0.107	0.168	0.072	0.132	0.183	0.155	0.132	0.098	0.064
14	0.01	0.012	0.015	0.012	0.01	0.019	0.014	0.024	0.021	0.027	0.02
15	0.02	0.019	0.021	0.024	0.022	0.037	0.033	0.038	0.037	0.036	0.035
16	0.01	0.012	0.008	0.012	0.01	0.012	0.01	0.013	0.014	0.021	0.016
17	0.21	0.186	0.103	0.144	0.163	0.118	0.192	0.216	0.216	0.172	0.134
18	0.01	0.009	0.013	0.007	0.01	0.009	0.013	0.012	0.011	0.018	0.011
19	0.21	0.193	0.233	0.061	0.178	0.149	0.118	0.213	0.179	0.194	0.087
20	0.01	0.01	0.007	0.018	0.01	0.01	0.013	0.012	0.014	0.013	0.019
21	0.01	0.012	0.019	0.033	0.031	0.048	0.031	0.041	0.041	0.043	0.052
22	0.01	0.012	0.015	0.008	0.017	0.01	0.021	0.01	0.02	0.014	0.023
23	0.16	0.057	0.117	0.039	0.127	0.169	0.094	0.114	0.139	0.14	0.111
24	0.02	0.009	0.014	0.009	0.012	0.011	0.015	0.012	0.014	0.011	0.013
25	0.15	0.104	0.057	0.119	0.085	0.159	0.112	0.065	0.108	0.112	0.083
26	0.01	0.009	0.015	0.013	0.011	0.014	0.013	0.014	0.01	0.015	0.018
27	0.02	0.013	0.015	0.018	0.013	0.021	0.016	0.029	0.015	0.027	0.012
28	0.01	0.007	0.008	0.013	0.009	0.011	0.012	0.01	0.009	0.013	0.017
29	0.09	0.065	0.112	0.116	0.083	0.134	0.136	0.078	0.097	0.094	0.124
30	0.01	0.009	0.007	0.008	0.006	0.007	0.009	0.007	0.01	0.009	0.011
31	0.07	0.08	0.083	0.059	0.106	0.099	0.13	0.099	0.085	0.111	0.104

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Power Bin [%]	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105
	Iv/In										
Order	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
32	0.01	0.01	0.008	0.009	0.007	0.007	0.01	0.007	0.01	0.009	0.009
33	0.01	0.011	0.012	0.013	0.011	0.013	0.014	0.015	0.018	0.017	0.016
34	0	0.005	0.004	0.005	0.004	0.005	0.006	0.006	0.007	0.006	0.008
35	0.04	0.049	0.021	0.049	0.091	0.072	0.09	0.086	0.064	0.079	0.096
36	0	0.006	0.005	0.005	0.006	0.006	0.009	0.006	0.009	0.009	0.01
37	0.03	0.029	0.046	0.071	0.062	0.072	0.057	0.069	0.041	0.042	0.045
38	0.01	0.007	0.008	0.008	0.008	0.006	0.008	0.008	0.008	0.007	0.009
39	0.01	0.009	0.009	0.008	0.008	0.009	0.009	0.009	0.008	0.009	0.011
40	0.01	0.007	0.007	0.007	0.006	0.007	0.007	0.008	0.008	0.007	0.007
41	0.04	0.049	0.059	0.075	0.057	0.085	0.051	0.063	0.045	0.04	0.051
42	0.01	0.006	0.007	0.006	0.007	0.006	0.008	0.005	0.007	0.007	0.005
43	0.04	0.041	0.035	0.063	0.065	0.078	0.054	0.06	0.049	0.042	0.044
44	0.01	0.006	0.007	0.006	0.006	0.007	0.008	0.006	0.008	0.006	0.007
45	0.01	0.007	0.008	0.009	0.01	0.008	0.007	0.006	0.007	0.006	0.006
46	0	0.004	0.004	0.004	0.004	0.004	0.006	0.004	0.006	0.004	0.006
47	0.04	0.053	0.066	0.072	0.079	0.056	0.066	0.049	0.053	0.042	0.046
48	0	0.004	0.003	0.004	0.004	0.004	0.005	0.004	0.005	0.004	0.005
49	0.04	0.047	0.07	0.074	0.069	0.052	0.067	0.046	0.054	0.041	0.044
50	0	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.006	0.005	0.005
THC	0.51	0.44	0.52	0.45	0.46	0.52	0.52	0.49	0.45	0.42	0.36

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### Inter-harmonics

Maximum 10 min average values of line current interharmonics based on rated current [%] up to 49.5th order for 11 power bins from 0% to 100% of P<sub>n</sub>

Power Bin [%]	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105
	I <sub>v</sub> /I <sub>n</sub>										
Order	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
1.5	0.082	0.152	0.162	0.174	0.182	0.189	0.197	0.202	0.109	0.104	0.071
2.5	0.026	0.031	0.044	0.057	0.066	0.060	0.056	0.046	0.039	0.034	0.034
3.5	0.019	0.024	0.023	0.028	0.031	0.037	0.040	0.035	0.028	0.024	0.021
4.5	0.016	0.028	0.019	0.022	0.022	0.023	0.022	0.021	0.020	0.019	0.014
5.5	0.015	0.028	0.018	0.020	0.021	0.020	0.020	0.019	0.018	0.018	0.012
6.5	0.012	0.023	0.015	0.016	0.017	0.018	0.017	0.018	0.015	0.016	0.010
7.5	0.012	0.022	0.014	0.016	0.016	0.017	0.016	0.017	0.014	0.015	0.009
8.5	0.010	0.011	0.011	0.013	0.013	0.014	0.013	0.013	0.012	0.012	0.008
9.5	0.009	0.010	0.011	0.012	0.013	0.013	0.013	0.013	0.012	0.012	0.008
10.5	0.010	0.015	0.011	0.013	0.013	0.013	0.013	0.015	0.012	0.013	0.009
11.5	0.010	0.017	0.012	0.015	0.015	0.014	0.014	0.016	0.014	0.014	0.009
12.5	0.009	0.016	0.014	0.012	0.012	0.014	0.013	0.015	0.013	0.012	0.009
13.5	0.010	0.017	0.016	0.013	0.014	0.016	0.014	0.018	0.014	0.013	0.009
14.5	0.008	0.009	0.009	0.010	0.010	0.012	0.010	0.012	0.010	0.010	0.006
15.5	0.008	0.008	0.009	0.010	0.010	0.012	0.010	0.012	0.010	0.010	0.006
16.5	0.008	0.011	0.011	0.009	0.011	0.012	0.012	0.013	0.011	0.011	0.009
17.5	0.008	0.011	0.012	0.010	0.012	0.012	0.012	0.014	0.010	0.011	0.009
18.5	0.007	0.010	0.011	0.011	0.012	0.013	0.011	0.012	0.011	0.011	0.009
19.5	0.007	0.010	0.011	0.011	0.011	0.013	0.011	0.013	0.010	0.010	0.008
20.5	0.007	0.007	0.008	0.009	0.009	0.010	0.009	0.011	0.009	0.009	0.006
21.5	0.006	0.007	0.007	0.009	0.009	0.010	0.009	0.011	0.009	0.009	0.006
22.5	0.007	0.012	0.011	0.009	0.012	0.011	0.011	0.010	0.010	0.010	0.008
23.5	0.007	0.012	0.011	0.009	0.012	0.011	0.011	0.011	0.010	0.011	0.008
24.5	0.007	0.011	0.009	0.009	0.009	0.010	0.009	0.009	0.009	0.010	0.007
25.5	0.006	0.011	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.009	0.007
26.5	0.006	0.006	0.006	0.008	0.007	0.008	0.008	0.009	0.008	0.008	0.006
27.5	0.006	0.006	0.006	0.008	0.007	0.009	0.008	0.009	0.008	0.008	0.006
28.5	0.006	0.009	0.007	0.009	0.008	0.009	0.009	0.009	0.009	0.008	0.007
29.5	0.006	0.009	0.007	0.009	0.008	0.009	0.009	0.009	0.009	0.009	0.007
30.5	0.006	0.011	0.007	0.007	0.008	0.008	0.008	0.009	0.009	0.008	0.008
31.5	0.005	0.010	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.007
32.5	0.005	0.005	0.005	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.006
33.5	0.005	0.005	0.005	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.005
34.5	0.005	0.007	0.006	0.007	0.007	0.008	0.008	0.008	0.008	0.008	0.007
35.5	0.005	0.008	0.006	0.007	0.006	0.007	0.007	0.007	0.008	0.007	0.007

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Power Bin [%]	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105
	lv/ln										
Order	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
36.5	0.005	0.008	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.006
37.5	0.005	0.007	0.006	0.006	0.006	0.007	0.006	0.007	0.007	0.006	0.005
38.5	0.004	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.004
39.5	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.005	0.004
40.5	0.005	0.006	0.006	0.006	0.006	0.007	0.006	0.006	0.007	0.006	0.005
41.5	0.005	0.006	0.006	0.006	0.006	0.007	0.006	0.006	0.007	0.006	0.005
42.5	0.005	0.006	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.006	0.005
43.5	0.004	0.006	0.005	0.005	0.006	0.006	0.006	0.006	0.007	0.006	0.005
44.5	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.004
45.5	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.004
46.5	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.006	0.005
47.5	0.004	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.005	0.005
48.5	0.004	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.005	0.005
49.5	0.004	0.006	0.005	0.006	0.006	0.006	0.006	0.005	0.007	0.005	0.005

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**Maximum 10 min average values for higher frequency line current components based on rated current [%] from to 2kHz to 9kHz in 200Hz bands for 11 power bins from 0% to 100% of Pn**

Power Bin [%]	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105
	Iv/In										
Order	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
2100	0.058	0.066	0.069	0.097	0.086	0.114	0.076	0.087	0.069	0.059	0.068
2300	0.044	0.055	0.067	0.073	0.080	0.058	0.069	0.051	0.057	0.045	0.049
2500	0.044	0.050	0.070	0.073	0.078	0.058	0.070	0.048	0.057	0.044	0.049
2700	0.062	0.074	0.080	0.085	0.075	0.088	0.078	0.064	0.067	0.059	0.054
2900	0.048	0.049	0.059	0.067	0.066	0.066	0.050	0.050	0.046	0.042	0.038
3100	0.048	0.051	0.052	0.066	0.063	0.063	0.050	0.053	0.044	0.045	0.038
3300	0.061	0.066	0.075	0.073	0.071	0.078	0.083	0.074	0.062	0.061	0.053
3500	0.048	0.045	0.060	0.070	0.076	0.071	0.070	0.053	0.052	0.045	0.043
3700	0.042	0.042	0.058	0.065	0.072	0.074	0.063	0.053	0.052	0.048	0.044
3900	0.048	0.048	0.046	0.073	0.089	0.090	0.079	0.078	0.074	0.065	0.062
4100	0.031	0.031	0.044	0.048	0.061	0.057	0.064	0.058	0.058	0.046	0.051
4300	0.023	0.028	0.030	0.038	0.050	0.052	0.053	0.055	0.049	0.047	0.047
4500	0.019	0.027	0.032	0.042	0.056	0.064	0.069	0.058	0.059	0.055	0.062
4700	0.014	0.021	0.022	0.032	0.038	0.037	0.043	0.038	0.041	0.041	0.043
4900	0.015	0.018	0.023	0.028	0.038	0.029	0.031	0.028	0.025	0.027	0.028
5100	0.016	0.019	0.032	0.044	0.055	0.048	0.046	0.040	0.037	0.033	0.033
5300	0.014	0.018	0.023	0.030	0.034	0.039	0.037	0.033	0.029	0.028	0.024
5500	0.015	0.017	0.026	0.026	0.037	0.035	0.037	0.031	0.031	0.028	0.024
5700	0.018	0.019	0.025	0.036	0.038	0.036	0.036	0.034	0.031	0.029	0.025
5900	0.015	0.015	0.016	0.020	0.022	0.027	0.023	0.021	0.020	0.021	0.017
6100	0.013	0.013	0.015	0.017	0.022	0.026	0.024	0.022	0.023	0.022	0.020
6300	0.011	0.011	0.014	0.019	0.023	0.026	0.025	0.020	0.020	0.021	0.018
6500	0.011	0.010	0.010	0.012	0.015	0.016	0.017	0.016	0.013	0.014	0.015
6700	0.008	0.008	0.008	0.010	0.013	0.015	0.016	0.016	0.014	0.014	0.013
6900	0.008	0.007	0.007	0.011	0.015	0.018	0.015	0.016	0.014	0.014	0.014
7100	0.005	0.005	0.005	0.006	0.011	0.011	0.011	0.010	0.009	0.010	0.011
7300	0.005	0.005	0.004	0.007	0.010	0.011	0.011	0.010	0.010	0.009	0.010
7500	0.005	0.004	0.004	0.008	0.011	0.012	0.013	0.010	0.011	0.010	0.011
7700	0.004	0.004	0.003	0.005	0.008	0.009	0.008	0.008	0.007	0.007	0.008
7900	0.004	0.004	0.004	0.006	0.009	0.009	0.008	0.008	0.008	0.007	0.008
8100	0.004	0.004	0.004	0.006	0.009	0.011	0.010	0.010	0.009	0.009	0.009
8300	0.004	0.004	0.003	0.005	0.007	0.008	0.008	0.007	0.006	0.007	0.007
8500	0.004	0.004	0.004	0.006	0.008	0.008	0.008	0.007	0.007	0.007	0.007
8700	0.004	0.004	0.004	0.006	0.009	0.011	0.010	0.008	0.008	0.008	0.008
8900	0.003	0.004	0.004	0.005	0.007	0.008	0.008	0.007	0.007	0.007	0.007