

Extract from the test report

Part 1: Power Quality

“Determination of the electrical properties – power quality (EMC)
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Extract No: CN23HR1H 002

“Technical guideline Part3” Reversion 26, FGW

Installation type: STP 125-70	Manufacturer's specification:
Manufacturer: SMA Solar Technology AG	Generic type of installation: Grid-Connected PV Inverter
	Rated power P_n : 125 kW
Test report: CN23HR1H 002	Period of measurement: 2023-11-10 – 2024-04-12

Rated data

Rated apparent power S_n	125 kVA	Rated current I_n	181.1 A
Rated frequency f_n	50/60 Hz	Rated voltage U_n	3~/N/PE,230/400 V

Remark: All tests were performed on the model STP 125-70.

Voltage changes and flicker during switching operations:

	Start-up at $P_{\text{available}} < 10\%P_n$			
Max. No. of switching operations N_{10}	20			
Max. No. of switching operations N_{120}	240			
Grid impedance angle	30°	50°	70°	85°
Flicker step factor $K_f (\Psi_k)$	0.0087	0.0089	0.0084	0.0081
Voltage change factor $K_u (\Psi_k)$	0.0775	0.0481	0.0201	0.0065
	Worst case of switching between generators			
Max. No. of switching operations N_{10}	--			
Max. No. of switching operations N_{120}	--			
Grid impedance angle	30°	50°	70°	85°
Flicker step factor $K_f (\Psi_k)$	--	--	--	--
Voltage change factor $K_u (\Psi_k)$	--	--	--	--
	Start-up at $P_{\text{available}} = P_n$			
Max. No. of switching operations N_{10}	1			
Max. No. of switching operations N_{120}	12			
Grid impedance angle	30°	50°	70°	85°
Flicker step factor $K_f (\Psi_k)$	0.0088	0.0086	0.0086	0.0088
Voltage change factor $K_u (\Psi_k)$	0.0861	0.0499	0.0224	0.0079
	Cut off at rated power			
Max. No. of switching operations N_{10}	1			
Max. No. of switching operations N_{120}	12			
Grid impedance angle	30°	50°	70°	85°
Flicker step factor $K_f (\Psi_k)$	0.0092	0.0090	0.0086	0.0086
Voltage change factor $K_u (\Psi_k)$	0.0874	0.0522	0.0189	0.0073

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Power peaks:

Power peaks in kW		Normalized power peaks in p.u.		Amount of 10-min data sets
$P_{0.2}$	124.60	$p_{0.2}$	1.00	2
P_{60}	124.54	p_{60}	1.00	
P_{600}	124.47	p_{600}	1.00	

Asymmetry:

P_n in %	0	10	20	30	40	50	60	70	80	90	100	Max.
U_i in %	0.80	0.38	0.30	0.28	0.26	0.25	0.23	0.23	0.24	0.24	0.27	0.80

Flicker:

P_{bin} in %	0	10	20	30	40	50	60	70	80	90	100	Max.
Network impedance phase angle, ψ_k	Flicker coefficient, $C(\psi_k, P_{bin})$											
30°	0.156	0.156	0.194	0.186	0.182	0.188	0.191	0.176	0.192	0.192	0.204	0.204
50°	0.155	0.155	0.182	0.173	0.176	0.177	0.173	0.164	0.171	0.167	0.168	0.182
70°	0.153	0.153	0.164	0.158	0.161	0.159	0.161	0.153	0.158	0.155	0.156	0.164
85°	0.153	0.152	0.155	0.153	0.158	0.159	0.155	0.153	0.149	0.152	0.149	0.159

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Harmonics(current)

Active power P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100	Max.
number	I _h / I _n [%]											
2	0.025	0.026	0.021	0.048	0.033	0.035	0.071	0.067	0.100	0.149	0.104	0.149
3	0.102	0.078	0.045	0.028	0.026	0.043	0.043	0.043	0.058	0.052	0.132	0.132
4	0.066	0.066	0.042	0.037	0.061	0.028	0.020	0.033	0.056	0.052	0.054	0.066
5	0.606	0.616	0.519	0.572	0.545	0.616	0.743	1.009	1.137	1.194	1.055	1.194
6	0.028	0.023	0.025	0.036	0.025	0.024	0.027	0.027	0.043	0.042	0.025	0.043
7	0.568	0.652	0.554	0.520	0.723	0.683	0.642	0.807	0.722	0.538	0.323	0.807
8	0.040	0.023	0.021	0.023	0.026	0.020	0.053	0.054	0.029	0.028	0.023	0.054
9	0.027	0.029	0.031	0.024	0.052	0.039	0.026	0.041	0.037	0.057	0.039	0.057
10	0.028	0.020	0.018	0.030	0.024	0.024	0.018	0.031	0.052	0.099	0.058	0.099
11	0.123	0.157	0.080	0.073	0.154	0.186	0.238	0.303	0.297	0.248	0.262	0.303
12	0.019	0.016	0.015	0.019	0.029	0.020	0.017	0.025	0.055	0.021	0.027	0.055
13	0.235	0.417	0.565	0.621	0.712	0.724	0.749	0.837	0.758	0.588	0.175	0.837
14	0.019	0.015	0.019	0.021	0.028	0.049	0.039	0.037	0.037	0.085	0.058	0.085
15	0.016	0.034	0.026	0.033	0.035	0.045	0.047	0.035	0.032	0.029	0.042	0.047
16	0.022	0.019	0.026	0.020	0.064	0.048	0.025	0.031	0.042	0.046	0.037	0.064
17	0.089	0.103	0.050	0.038	0.156	0.191	0.255	0.284	0.271	0.206	0.064	0.284
18	0.019	0.017	0.028	0.018	0.023	0.025	0.041	0.039	0.059	0.047	0.032	0.059
19	0.064	0.086	0.178	0.276	0.442	0.533	0.575	0.614	0.596	0.591	0.267	0.614
20	0.011	0.021	0.041	0.023	0.045	0.054	0.026	0.062	0.027	0.039	0.054	0.062
21	0.013	0.028	0.023	0.033	0.050	0.034	0.025	0.037	0.033	0.041	0.042	0.050
22	0.018	0.022	0.030	0.027	0.039	0.056	0.054	0.037	0.062	0.027	0.042	0.062
23	0.020	0.094	0.060	0.058	0.169	0.256	0.260	0.353	0.339	0.330	0.088	0.353
24	0.017	0.022	0.026	0.023	0.023	0.031	0.041	0.062	0.065	0.032	0.046	0.065
25	0.010	0.031	0.095	0.064	0.045	0.172	0.283	0.242	0.280	0.271	0.233	0.283
26	0.028	0.060	0.024	0.026	0.019	0.068	0.090	0.050	0.075	0.038	0.040	0.090
27	0.020	0.029	0.033	0.043	0.049	0.040	0.032	0.027	0.025	0.022	0.035	0.049
28	0.051	0.044	0.034	0.022	0.044	0.026	0.026	0.039	0.047	0.124	0.040	0.124
29	0.036	0.053	0.113	0.126	0.086	0.143	0.169	0.194	0.190	0.206	0.124	0.206
30	0.023	0.035	0.065	0.059	0.039	0.095	0.052	0.079	0.105	0.069	0.052	0.105
31	0.037	0.033	0.036	0.146	0.052	0.070	0.063	0.062	0.095	0.154	0.205	0.205
32	0.028	0.090	0.046	0.076	0.077	0.064	0.068	0.069	0.077	0.104	0.045	0.104
33	0.026	0.039	0.034	0.036	0.024	0.036	0.041	0.045	0.031	0.035	0.045	0.045
34	0.024	0.054	0.021	0.049	0.021	0.041	0.049	0.060	0.035	0.038	0.048	0.060
35	0.029	0.024	0.052	0.066	0.020	0.018	0.073	0.054	0.061	0.095	0.086	0.095
36	0.033	0.024	0.016	0.019	0.040	0.025	0.030	0.018	0.032	0.014	0.045	0.045
37	0.028	0.040	0.053	0.040	0.024	0.034	0.043	0.065	0.080	0.103	0.113	0.113
38	0.014	0.035	0.014	0.021	0.020	0.025	0.029	0.017	0.020	0.015	0.029	0.035
39	0.011	0.023	0.019	0.020	0.019	0.020	0.027	0.021	0.018	0.022	0.020	0.027
40	0.011	0.022	0.013	0.011	0.017	0.026	0.013	0.025	0.015	0.024	0.012	0.026
41	0.010	0.020	0.028	0.028	0.027	0.035	0.021	0.050	0.050	0.051	0.057	0.057
42	0.010	0.011	0.010	0.014	0.012	0.013	0.014	0.016	0.008	0.014	0.012	0.016
43	0.031	0.014	0.021	0.020	0.020	0.026	0.033	0.023	0.046	0.062	0.089	0.089
44	0.005	0.009	0.008	0.016	0.019	0.023	0.018	0.013	0.010	0.011	0.009	0.023
45	0.018	0.020	0.019	0.019	0.010	0.014	0.019	0.020	0.014	0.016	0.018	0.020
46	0.008	0.011	0.011	0.009	0.011	0.014	0.015	0.012	0.010	0.025	0.013	0.025
47	0.016	0.018	0.014	0.011	0.016	0.025	0.027	0.034	0.046	0.053	0.052	0.053
48	0.006	0.007	0.010	0.009	0.009	0.010	0.012	0.011	0.007	0.009	0.011	0.012
49	0.046	0.039	0.039	0.023	0.020	0.015	0.019	0.026	0.030	0.025	0.072	0.072
50	0.005	0.007	0.009	0.009	0.018	0.024	0.008	0.008	0.016	0.010	0.010	0.024
THC [%]	0.900	1.039	0.999	1.072	1.286	1.379	1.489	1.791	1.799	1.701	1.274	1.799

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Intern-Harmonics

P _{bin} in %	0	10	20	30	40	50	60	70	80	90	100	Max
f in Hz	I _h / I _n [%]											
75	0.021	0.026	0.027	0.043	0.048	0.040	0.046	0.055	0.054	0.046	0.066	0.066
125	0.017	0.023	0.026	0.035	0.042	0.036	0.041	0.046	0.047	0.044	0.058	0.058
175	0.018	0.023	0.026	0.033	0.042	0.035	0.040	0.047	0.046	0.042	0.052	0.052
225	0.017	0.021	0.025	0.031	0.042	0.035	0.040	0.047	0.049	0.044	0.053	0.053
275	0.017	0.022	0.025	0.031	0.043	0.035	0.039	0.045	0.045	0.042	0.048	0.048
325	0.016	0.021	0.024	0.031	0.042	0.036	0.040	0.047	0.046	0.043	0.048	0.048
375	0.016	0.021	0.024	0.031	0.043	0.036	0.038	0.043	0.045	0.042	0.049	0.049
425	0.016	0.021	0.025	0.031	0.044	0.034	0.037	0.044	0.046	0.043	0.050	0.050
475	0.016	0.020	0.026	0.031	0.046	0.035	0.038	0.044	0.046	0.044	0.052	0.052
525	0.016	0.020	0.028	0.032	0.048	0.036	0.040	0.046	0.048	0.044	0.052	0.052
575	0.016	0.021	0.028	0.032	0.050	0.036	0.041	0.046	0.048	0.044	0.052	0.052
625	0.016	0.021	0.029	0.033	0.049	0.036	0.040	0.046	0.050	0.045	0.054	0.054
675	0.016	0.021	0.029	0.033	0.049	0.037	0.042	0.047	0.050	0.046	0.054	0.054
725	0.016	0.021	0.029	0.035	0.048	0.037	0.044	0.047	0.049	0.046	0.055	0.055
775	0.016	0.021	0.028	0.035	0.048	0.038	0.046	0.047	0.050	0.046	0.055	0.055
825	0.016	0.022	0.029	0.036	0.051	0.039	0.047	0.048	0.051	0.047	0.054	0.054
875	0.017	0.023	0.030	0.037	0.050	0.041	0.046	0.050	0.051	0.047	0.054	0.054
925	0.017	0.025	0.032	0.039	0.049	0.041	0.045	0.050	0.049	0.047	0.054	0.054
975	0.018	0.028	0.035	0.040	0.048	0.043	0.048	0.051	0.047	0.047	0.056	0.056
1025	0.019	0.031	0.040	0.043	0.047	0.042	0.050	0.051	0.047	0.047	0.056	0.056
1075	0.021	0.034	0.044	0.044	0.047	0.043	0.055	0.049	0.046	0.046	0.057	0.057
1125	0.022	0.036	0.048	0.044	0.047	0.042	0.058	0.047	0.046	0.046	0.055	0.058
1175	0.024	0.037	0.045	0.045	0.046	0.042	0.057	0.045	0.044	0.045	0.053	0.057
1225	0.024	0.038	0.042	0.049	0.045	0.043	0.057	0.044	0.045	0.044	0.051	0.057
1275	0.024	0.040	0.041	0.051	0.046	0.043	0.060	0.043	0.047	0.045	0.051	0.060
1325	0.025	0.042	0.042	0.051	0.049	0.044	0.062	0.042	0.046	0.046	0.057	0.062
1375	0.028	0.046	0.051	0.048	0.057	0.046	0.066	0.043	0.047	0.048	0.070	0.070
1425	0.035	0.055	0.065	0.054	0.068	0.052	0.076	0.049	0.055	0.054	0.085	0.085
1475	0.043	0.063	0.075	0.070	0.080	0.059	0.102	0.061	0.069	0.061	0.104	0.104
1525	0.049	0.068	0.082	0.085	0.084	0.062	0.132	0.068	0.082	0.063	0.117	0.132
1575	0.048	0.063	0.076	0.082	0.077	0.056	0.128	0.066	0.077	0.055	0.115	0.128
1625	0.041	0.055	0.067	0.069	0.067	0.047	0.103	0.058	0.060	0.045	0.103	0.103
1675	0.034	0.048	0.054	0.053	0.056	0.039	0.080	0.048	0.045	0.037	0.086	0.086
1725	0.029	0.043	0.044	0.041	0.049	0.033	0.060	0.039	0.036	0.031	0.068	0.068
1775	0.024	0.039	0.036	0.036	0.043	0.030	0.044	0.033	0.030	0.028	0.052	0.052
1825	0.022	0.036	0.030	0.033	0.038	0.028	0.036	0.028	0.026	0.024	0.041	0.041
1875	0.021	0.032	0.027	0.030	0.033	0.027	0.033	0.025	0.023	0.023	0.033	0.033
1925	0.020	0.030	0.026	0.027	0.030	0.025	0.033	0.023	0.021	0.021	0.029	0.033
1975	0.019	0.026	0.025	0.025	0.028	0.024	0.033	0.022	0.020	0.020	0.026	0.033

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Higher frequency components

P_{bin} in %	0	10	20	30	40	50	60	70	80	90	100	Max.
f in kHz	I_h / I_n [%]											
2.1	0.047	0.050	0.059	0.063	0.069	0.071	0.075	0.075	0.080	0.091	0.116	0.116
2.3	0.038	0.045	0.047	0.049	0.053	0.054	0.064	0.058	0.061	0.071	0.072	0.072
2.5	0.053	0.054	0.055	0.054	0.056	0.049	0.050	0.045	0.049	0.047	0.084	0.084
2.7	0.039	0.052	0.054	0.059	0.045	0.048	0.050	0.044	0.062	0.061	0.074	0.074
2.9	0.027	0.036	0.041	0.045	0.048	0.038	0.041	0.034	0.049	0.056	0.047	0.056
3.1	0.043	0.034	0.036	0.050	0.040	0.042	0.048	0.038	0.034	0.049	0.048	0.050
3.3	0.051	0.046	0.033	0.040	0.046	0.043	0.051	0.057	0.032	0.059	0.039	0.059
3.5	0.036	0.028	0.029	0.034	0.038	0.035	0.046	0.046	0.033	0.053	0.030	0.053
3.7	0.020	0.031	0.036	0.036	0.045	0.036	0.035	0.051	0.044	0.052	0.032	0.052
3.9	0.052	0.040	0.043	0.039	0.043	0.042	0.036	0.053	0.059	0.055	0.044	0.059
4.1	0.034	0.033	0.032	0.041	0.031	0.027	0.031	0.035	0.041	0.035	0.035	0.041
4.3	0.038	0.058	0.051	0.044	0.035	0.043	0.041	0.031	0.054	0.034	0.037	0.058
4.5	0.045	0.044	0.042	0.049	0.049	0.040	0.047	0.040	0.049	0.052	0.042	0.052
4.7	0.036	0.039	0.058	0.049	0.045	0.052	0.041	0.034	0.044	0.041	0.037	0.058
4.9	0.064	0.052	0.061	0.055	0.066	0.058	0.048	0.051	0.037	0.061	0.042	0.066
5.1	0.041	0.069	0.093	0.097	0.067	0.081	0.063	0.052	0.045	0.062	0.048	0.097
5.3	0.027	0.045	0.062	0.094	0.064	0.063	0.071	0.053	0.046	0.051	0.044	0.094
5.5	0.031	0.032	0.054	0.076	0.053	0.081	0.078	0.062	0.065	0.061	0.059	0.081
5.7	0.025	0.027	0.031	0.039	0.040	0.044	0.058	0.050	0.065	0.067	0.063	0.067
5.9	0.011	0.018	0.025	0.024	0.021	0.029	0.031	0.032	0.050	0.063	0.077	0.077
6.1	0.007	0.013	0.016	0.016	0.016	0.018	0.019	0.020	0.031	0.043	0.064	0.064
6.3	0.007	0.006	0.011	0.013	0.009	0.012	0.013	0.011	0.018	0.023	0.034	0.034
6.5	0.003	0.005	0.007	0.008	0.007	0.007	0.008	0.007	0.010	0.014	0.020	0.020
6.7	0.003	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.006	0.008	0.012	0.012
6.9	0.002	0.003	0.004	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.007	0.007
7.1	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004
7.3	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003
7.5	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
7.7	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
7.9	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
8.1	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8.3	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
8.5	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.001
8.7	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.001
8.9	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.001

This extract forms the test report summarizes the results of the test report No. CN23HR1H 002

Measured by: Theo Tang

Engineer: Tobias Yang

Date: 2025-07-20



Signature



Signature

Extract from the test report

Part 2: Grid control capability

“Determination of the electrical properties

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Extract No: CN23HR1H 002

“Technical guideline Part3” Reversion 26, FGW

Installation type:	STP 125-70	Manufacturer's specification:	
Manufacturer:	SMA Solar Technology AG	Generic type of installation:	Grid-Connected PV Inverter
		Rated power P_n :	125 kW
Test report:	CN23HR1H 002	Period of measurement:	2023-11-10 – 2024-04-12 (for CN23HR1H 001 report) 2023-03-20 – 2025-03-30 (for CN23HR1H 002 report)

Rated data

Rated apparent power S_n	125	kVA	Rated current I_n	181.1	A
Rated frequency f_n	50/60	Hz	Rated voltage U_n	3P/N/PE, 230/400	V

Power peaks:

Power peaks in kW		Normalized power peaks in p.u.		Amount of 10-min data sets
$P_{0.2}$	124.60	$p_{0.2}$	1.00	2
P_{60}	124.54	p_{60}	1.00	
P_{600}	124.47	p_{600}	1.00	

Active power vs frequency:

Overfrequency	Mean power gradient at overfrequency	-39.68% P_{ref} /Hz
	Max. Setting time	1.2 s
	Power gradient after recovery of overfrequency	9.65% P_n /min
Underfrequency	Mean power gradient at underfrequency	37.57% P_{ref} /Hz
	Max. settling time	6.0 s
	Power gradient after recovery overfrequency	9.80% P_n /min

Operating power limited by grid operator

The unit is able to run at reduced power	☒ Yes	☐ No
Max. deviation of power setting	-0.65%	
Disconnection from the grid at external active power setpoints at:	No cut % P_n	
Response time of the power output after a change in setpoint with minimal gradient	$P_0 \rightarrow P_{min}$	Time: -- s
		Gradient: 0.344 % P_n /s
	$P_{min} \rightarrow P_0$	Time: -- s
		Gradient: 0.344 % P_n /s
Response time of the power output after a change in setpoint with maximum gradient	$P_0 \rightarrow P_{min}$	Time: -- s
		Gradient: 0.657 % P_n /s
	$P_{min} \rightarrow P_0$	Time: -- s
		Gradient: 0.655 % P_n /s

Extract from the test report

Part 2: Grid control capability

“Determination of the electrical properties
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“Technical guideline Part3” Reversion 26, FGW

Operating power limited by grid operator

Response time of the power output after a change in setpoint with maximum gradient	90%P _n ->10%P _n	119.5 s
	10%P _n ->90%P _n	119.4 s

Provision of primary control power

The unit is able to provide primary control power.	☒ Yes	☒ No
Max. activation time	--	
Max. duration until complete activation	--	
The unit is able to change its mode from FSM to LFSM-O.	☐ Yes	☒ No
The unit is able to change its mode from FSM to LFSM-U.	☐ Yes	☒ No

Act.power gradient following disconnect. form grid

Power gradient after disconnection	Mean gradient	0.500%P _n /s
	Max. gradient	0.509%P _n /s

Extract from the test report

Part 2: Grid control capability

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“Technical guideline Part3” Reversion 26, FGW

Control of reactive power in normal operation mode:

P/P _n in %	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Q ₀ in Kvar	0.03	0.10	0.28	0.42	0.56	0.69	0.82	0.94	1.05	1.17	1.28

Maximum reactive power range

P/P _n in %	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Q _{ind} in Kvar	-75.09	-75.02	-75.04	-75.07	-75.02	-75.01	-74.91	-74.85	-74.68	-53.73	-15.64
Q _{cap} in Kvar	75.02	75.00	74.97	74.98	74.93	74.97	75.00	74.81	74.62	53.52	15.19

Working points of the voltage dependent P-Q-diagram

Working point AP	AP1 ,ind	AP2 ,ind	AP1 ,cap	AP2 ,cap
U / U _n in %	109	90	109	90
P / P _n in %	100	90	100	90
Q in kVar	-1.31	-0.89	1.38	1.07

Control of reactive power through set point signal

Kind of control	☒ Power factor	☒ Reactive power
	P _{bin} at Q _{max}	60 %P _n
Longest response time	Parameter	Settling time
	t < 6s	6.96 s
	Standard time	10.0 s
	t < 60s	61.84 s
Positioning accuracy of power factor or reactive power	Set point	Measured value
	-37.5 kvar	-37.37 kvar
	0.0 kvar	0.51 kvar
	37.5 kvar	37.63 kvar
Remark:	If Q(U) and Q(P) control were tested, please see test report.	

This extract forms the test report summarizes the results of the test report No. CN23HR1H 002

Measured by: Theo Tang

Engineer: Tobias Yang

Date: 2025-07-20



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Extract from the test report

Part 3: Protection system

“Determination of the electrical properties

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Extract No: CN23HR1H 002

“Technical guideline Part3” Reversion 26, FGW

Installation type:	STP 125-70	Manufacturer's specification:	
Manufacturer:	SMA Solar Technology AG	Generic type of installation:	Grid-Connected PV Inverter
		Rated power P_n :	125/200 kW
Test report:	CN23HR1H 002	Period of measurement:	2023-11-10 – 2024-04-12

Rated data

Rated apparent power S_n	125	kVA	Rated current I_n	181.1	A
Rated frequency f_n	50/60	Hz	Rated voltage U_n	3P/N/PE,230/400	V

Disconnection of the generating unit from grid

Disconnection of the generating unit from grid		
Protection testing terminals present, tests done at protection testing terminals without disconnections of wires		Yes
Wiring check successful		Yes
Evaluation of star or delta voltage		star
Tests of entire tripping circuit resulted in a successful disconnection		Yes
Inherent delay of disconnection device		20ms
Tests on loss of auxiliary power supply resulted in a undelayed disconnection (opional)		N/A
	Requirement	Fulfillment
Overvoltage protection	>0.98	Yes
Undervoltage protection	<1.02	Yes

Test result for proection
☒ The test of the whole trip circuit led to a successful shut down.

Function	Settings		Measurement			
			3ph	U1	U2	U3
Overvoltage $U>$	Min. threshold	1.00Un	1.01	1.00	1.00	1.00
	Max. Time	180s	179.90	179.90	179.93	179.91
	Max. threshold	1.30Un	1.29	1.30	1.30	1.30
	Min. Time	10ms	2.01	6.03	8.04	8.55
	Typ. threshold	--	--	--	--	--
	Typ. time	--	--	--	--	--
Overvoltage $U>>$	Min. threshold	1.00Un	1.00	1.00	1.00	1.00

Extract from the test report

Part 3: Protection system

“Determination of the electrical properties

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	Max. Time	100ms	66.58	79.70	69.87	82.13
	Max. threshold	1.30Un	1.30	1.30	1.30	1.30
	Min. Time	10ms	2.68	9.39	2.62	4.56
	Typ. threshold	1.25Un	1.25	1.25	1.25	1.24
	Typ. time	100ms	83.89	65.66	72.47	82.62
Undervoltage U<	Min. Threshold	0.10Un	0.09	0.10	0.10	0.09
	Min. Time	10ms	59.51	68.46	69.31	85.43
	Max. Threshold	1.00Un	1.00	1.00	1.00	1.01
	Max. time	2.4s	2.35	2.35	2.34	2.36
	Typ. threshold	0.80Un	0.80	0.80	0.80	0.80
	Typ. time	2.4s	2372	2369	2388	2387
Undervoltage U<<	Min. Threshold	0.10Un	0.09	0.10	0.10	0.09
	Min. Time	10ms	74.99	71.16	59.44	87.01
	Max. Threshold	1.00Un	1.00	0.99	1.00	1.00
	Max. time	800ms	779.16	781.02	764.64	787.69
	Typ. threshold	0.3Un	0.30	0.29	0.30	0.30
	Typ. time	800ms	766	788	774	781
Over frequency f>	Min. Threshold	50.0Hz	50.00	--	--	--
	Max. time	5s	4.95	--	--	--
	Max. Threshold	55.0Hz	55.00	--	--	--
	Min. time	10ms	86.29	--	--	--
	Typ. threshold	51.5Hz	51.50			
	Typ. time	5s	4.956			
Over frequency f>>	Min. Threshold	50.0Hz	49.99	--	--	--
	Max. Time	100ms	90.81	--	--	--
	Max. Threshold	55.0Hz	55.00	--	--	--
	Min. Time	10ms	95.39	--	--	--
	Typ. threshold	52.5Hz	52.50	--	--	--
	Typ. time	100ms	70.05	--	--	--

Extract from the test report

Part 3: Protection system

"Determination of the electrical properties
Extract No: CN23HR1H 002

"Technical guideline Part3" Reversion 26, FGW

Under frequency f<	Min. Threshold	45.0Hz	45.00	--	--	--
	Min. Time	10ms	84.08	--	--	--
	Max. Threshold	50.0Hz	50.01	--	--	--
	Max. time	100ms	90.35	--	--	--
	Typ. threshold	47.5Hz	47.49	--	--	--
	Typ. time	100ms	88.23	--	--	--

This extract forms the test report summarizes the results of the test report No. CN23HR1H 002

Measured by: Theo Tang

Engineer: Tobias Yang

Date: 2025-07-20



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Extract No: CN23HR1H 002

"Technical guideline Part3" Reversion 26, FGW

Installation type: STP 125-70	Manufacturer's specification:
Manufacturer: SMA Solar Technology AG	Generic type of installation: Grid-Connected PV Inverter
	Rated power P_n : 125 kW
Test report: CN23HR1H 002	Period of measurement: 2023-11-10 – 2024-04-12

Rated data

Rated apparent power S_n	125 kVA	Rated current I_n	181.1 A
Rated frequency f_n	50/60 Hz	Rated voltage U_n	3P/N/PE, 230/400 V

Test results cut-in conditions without prior protection tripping (acc. to VDE-AR-N 4110)

Undervoltage		Overvoltage		Underfrequency		Overfrequency	
Change stages [% U_n]	Connect to the grid ?	Change stages [% U_n]	Connect to the grid ?	Change stages [Hz]	Connect to the grid ?	Change stages [Hz]	Connect to the grid ?
87%	No	113%	No	47.3	No	50.4	No
88%	No	112%	No	47.4	No	50.3	No
89%	No	111%	No	47.5	Yes	50.2	No
90%	No	110%	No	47.6	Yes	50.1	Yes
91%	Yes	109%	Yes	47.7	Yes	50.0	Yes
92%	Yes	108%	Yes				
93%	Yes	107%	Yes				

Test results cut-in conditions without prior protection tripping (acc. to VDE-AR-N 4120)

Undervoltage		Overvoltage		Underfrequency		Overfrequency	
Change stages [% U_n]	Connect to the grid ?	Change stages [% U_n]	Connect to the grid ?	Change stages [Hz]	Connect to the grid ?	Change stages [Hz]	Connect to the grid ?
87%	No	113%	No	47.3	No	51.2	No
88%	No	112%	No	47.4	No	51.1	No
89%	No	111%	No	47.5	Yes	51.0	Yes
90%	No	110%	No	47.6	Yes	50.9	Yes
91%	Yes	109%	Yes	47.7	Yes	50.8	Yes
92%	Yes	108%	Yes				
93%	Yes	107%	Yes				

Test results cut-in conditions after protection tripping (acc. to VDE-AR-N 4110,4120)

Undervoltage		Overvoltage		Underfrequency		Overfrequency	
Change stages [% U_n]	Connect to the grid ?	Change stages [% U_n]	Connect to the grid ?	Change stages [Hz]	Connect to the grid ?	Change stages [Hz]	Connect to the grid ?
92.5%	No	--	--	49.85	No	50.15	No
93.5%	No	--	--	49.87	No	50.13	No
94.5%	No	--	--	49.89	No	50.11	No
95.5%	Yes	--	--	49.91	Yes	50.09	Yes
				49.93	Yes	50.07	Yes

Undervoltage				
Step		Holding time		Connection
1	93%Un	t1	≥ 30s	No
2	96%Un	t2-t1	≥ 60s	No
3	93%Un	t3-t2	≥ 30s	No
4	96%Un	t4-t3	≥ 5min	Yes

Reconnection is not possible within the permissible voltage and frequency range without an enable signal(acc. to VDE-AR-N 4120)	P
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This extract forms the test report summarizes the results of the test report No. CN23HR1H 002
 Measured by: Theo Tang
 Engineer: Tobias Yang
 Date: 2025-07-20



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Extract from the test report

Part 5: Test conditions

“Determination of the electrical properties
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Extract No: CN23HR1H 002

“Technical guideline Part3” Reversion 26, FGW

Installation type: STP 125-70	Manufacturer's specification:
Manufacturer: SMA Solar Technology AG	Generic type of installation: Grid-Connected PV Inverter
	Rated power P_n : 125 kW
Test report: CN23HR1H 002	Period of measurement: 2023-11-10 – 2024-04-12

Point of measurement:

Point of measurement	☐ Medium-voltage side
	☒ Low-voltage side
Short circuit ratio at point of measurement	Grid simulator

Data medium-voltage system (if applicable)

Short circuit power	--	MVA
Network impedance phase angle	--	MVA
Agreed service voltage U_c	--	kV

Transformer data (if existing):

Nominal power of transformer	--
Rel. short-circuit voltage of transformer	--
Tap position of transformer	--

Additional impedance

Medium-voltage side	--
Low-voltage side	--

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Measured by: Theo Tang

Engineer: Tobias Yang

Date: 2025-07-20



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