

Certificate of Conformity

No. ESY 070122 0036 Rev. 00

Holder of Certificate: **SMA Solar Technology AG**

Sonnenallee 1
34266 Niestetal
GERMANY

Product: **PV inverter**

This Certificate of Conformity confirms the compliance with the above listed standards on a voluntary basis. It refers only to the sample submitted to TÜV SÜD Product Service GmbH and does not certify the quality or safety of the serial products. It was issued according to TÜV SÜD Product Service certification program Photovoltaics and Grid Integration. For details see: www.tuvsud.com/ps-cert

Test report no.: 713254379-008

Date, 2022-11-17



(Kristijan Cizmar)

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Model(s):

SUNNY TRIPOWER STP 25-50
SUNNY TRIPOWER STP 20-50
SUNNY TRIPOWER STP 15-50
SUNNY TRIPOWER STP 12-50

Parameters:**SUNNY TRIPOWER STP 25-50**

Nominal active power / kW:	25
Nominal grid voltage (nominal frequency) / V_{P-P} (Hz)	400 (50)

SUNNY TRIPOWER STP 20-50

Nominal active power / kW:	20
Nominal grid voltage (nominal frequency) / V_{P-P} (Hz)	400 (50)

SUNNY TRIPOWER STP 15-50

Nominal active power / kW:	15
Nominal grid voltage (nominal frequency) / V_{P-P} (Hz)	400 (50)

SUNNY TRIPOWER STP 12-50

Nominal active power / kW:	12
Nominal grid voltage (nominal frequency) / V_{P-P} (Hz)	400 (50)

Applicable standards:

G99/1-8:2021

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G99/1-8:2021 Certificate Annex					
Extract from test report			Report No. 713254379_008		
G99/1-8:2021 Engineering Recommendation G99, Issue 1 – Amendment 8, 1 September 2021 Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019					
Manufacturer:		SMA Technology AG Sonnenallee 1 34266 Niestetal, Deutschland			
Device type:		PV inverter			
Model		SUNNY TRIPOWER STP 12-50	SUNNY TRIPOWER STP 15-50	SUNNY TRIPOWER STP 20-50	
Rated values	AC:	U _n : 400 V _{AC} , f _n : 50 Hz			
		P _n : 12 kW	P _n : 15 kW	P _n : 20 kW	P _n : 25 kW
		I _n : 17,4 A	I _n : 21,7 A	I _n : 29,0 A	I _n : 36,2 A
	DC:	206 – 800 V _{MPP PV}	257 – 800 V _{MPP PV}	340 – 800 V _{MPP PV}	430 – 800 V _{MPP PV}
Software-Version:		from 1.16.03.R (main processor)			
Measurement period:		2022-02-05 – 2022-06-04			
Test report:		713254379-008, released 2022-10-14			
The devices of the types SUNNY TRIPOWER STP 12-50, SUNNY TRIPOWER STP 15-50, SUNNY TRIPOWER STP 20-50 and SUNNY TRIPOWER STP 25-50 are in accordance with the rule G99/1-8:2021 and comply with requirements up to Type A.					

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G99/1-8:2021 - A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules – test record			
Result – Verdict (P / F / N/A)	clause	Requirement + Test	Remark (Type)
☒ P ☐ F ☐ NA	11.2.1 12.2.1 13.2.1	Operating Range	A, B, C, D
☒ P ☐ F ☐ NA	9.4.3	Power Quality – Harmonics:	A, B, C, D
☒ P ☐ F ☐ NA	9.4.2	Power Quality – Voltage Fluctuation and Flicker	A, B, C, D
☒ P ☐ F ☐ NA	9.4.6	Power Quality – DC Injection	A, B, C, D
☒ P ☐ F ☐ NA	9.4.5	Power Factor (PF)	A, B, C, D
☒ P ☐ F ☐ NA	10.6.5 10.6.6	Protection – Frequency tests	A, B, C, D
☒ P ☐ F ☐ NA	10.6.3 10.6.4	Protection – Voltage tests	A, B, C, D
☒ P ☐ F ☐ NA	10.4	Protection – Loss of Mains Test, Vector Shift Stability test, RoCoF Stability test	A, B, C, D
☐ P ☐ F ☒ NA	11.2.3, 12.2.3, 13.2.3	Output power with falling frequency	A, B, C, D
☒ P ☐ F ☐ NA	11.2.4, 12.2.4, 13.2.4	Limited Frequency Sensitive Mode – Overfrequency	A, B, C, D
☐ P ☐ F ☒ NA	13.2.5	Limited Frequency Sensitive Mode – Underfrequency (LFSM-U)	C, D
☐ P ☐ F ☒ NA	13.2.6	Frequency Sensitive Mode – (FSM)	C, D
☒ P ☐ F ☐ NA	10.3.3	Protection – Reconnection Timer	A, B, C, D
☒ P ☐ F ☐ NA	9.7	Fault Level Contribution	A, B, C, D
☒ P ☐ F ☐ NA	9.7.9	Self-monitoring Solid State Switch	A, B, C, D
☐ P ☐ F ☒ NA	15.2.1	Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)	A, B, C, D
☒ P ☐ F ☐ NA	11.1.3	Logic interface (input port)	A
☐ P ☐ F ☒ NA	12.1.3, 13.1.3	Communication interface	B, C, D
☒ P ☐ F ☐ NA	9.1.7	Cyber security	A, B, C, D
☐ P ☐ F ☒ NA	11.3, 12.3, 12.6, 13.3, 13.6	Fault Ride Through and Phase Voltage Unbalance	B, C, D
☐ P ☐ F ☒ NA	12.4, 13.4	Voltage Limits and Control	B, C, D
☐ P ☐ F ☒ NA	12.5, 13.5	Reactive capability	B, C, D
Remark: The settings of the interface protection are adjustable and password protected.			

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In case the units stated above are connected over an external protection device, the protection settings of the inverters have to be adjusted according to the manufacturer's declaration. The units stated above were tested according to the requirements in G99/1-8:2021. Any modification that affects the these results must be reported by the product manufacturer/supplier in order to ensure the product meets all of the requirements in G99/1-8:2021.					
1. Operating Range					
Condition	Voltage (V)	Active power (kW)	Frequency (Hz)	Power factor	DUT can operate under the condition?
Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz, Power Factor = 1, Period of test 20 s	195.4	21.58	47.05	1.0	Yes
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, Power Factor = 1, Period of test 90 minutes	195.4	21.58	47.50	1.0	Yes
Test 3 Voltage = 110% of nominal (253 V), Frequency = 51.5 Hz, Power Factor = 1, Period of test 90 minutes	252.9	25.11	51.50	1.0	Yes
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, Power Factor = 1, Period of test 15 minutes	252.9	25.12	51.95	1.0	Yes
Test 5 Voltage = 100% of nominal (230 V), Frequency = 50.0 Hz, Power Factor = 1, Period of test = 90 minutes	230.0	25.12	50.0	1.0	Yes
Test 6 RoCoF withstand Confirm that the Power Generating Module is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs-1 as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.				Yes	

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2. Power Quality – Harmonics														
Power Generating Module tested to BS EN 61000-3-12														
Power Generating Module rating per phase (rpp)							8.333	kVA			Harmonic % = Measured Value (A) x 23/rating per phase (kVA)			
Harmonic	At 45-55% of Registered Capacity						100% of Registered Capacity						Limit in BS EN 61000-3-12	
	Measured Value MV in Amps			Harmonic %			Measured Value MV in Amps			Harmonic %			1 phase	3 phase
	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3		
2	0.040	0.013	0.046	0.110	0.036	0.127	0.023	0.028	0.043	0.064	0.078	0.119	8%	8%
3	0.019	0.018	0.025	0.052	0.050	0.069	0.024	0.020	0.021	0.067	0.056	0.058	21.6%	Not stated
4	0.019	0.021	0.017	0.052	0.058	0.047	0.027	0.025	0.024	0.075	0.069	0.067	4%	4%
5	0.014	0.016	0.014	0.039	0.044	0.039	0.015	0.016	0.016	0.042	0.044	0.044	10.7%	10.7%
6	0.006	0.006	0.006	0.017	0.017	0.017	0.008	0.006	0.008	0.022	0.017	0.022	2.67%	2.67%
7	0.034	0.034	0.033	0.094	0.094	0.091	0.037	0.037	0.035	0.103	0.103	0.097	7.2%	7.2%
8	0.007	0.007	0.007	0.019	0.019	0.019	0.008	0.007	0.007	0.022	0.019	0.019	2%	2%
9	0.008	0.009	0.008	0.022	0.025	0.022	0.120	0.012	0.009	0.333	0.033	0.025	3.8%	Not stated
10	0.007	0.009	0.010	0.019	0.025	0.028	0.008	0.011	0.011	0.022	0.031	0.031	1.6%	1.6%
11	0.111	0.108	0.108	0.306	0.298	0.298	0.107	0.105	0.105	0.297	0.292	0.292	3.1%	3.1%
12	0.005	0.006	0.006	0.014	0.017	0.017	0.006	0.006	0.007	0.017	0.017	0.019	1.33%	1.33%
13	0.137	0.134	0.134	0.378	0.370	0.370	0.188	0.186	0.185	0.522	0.517	0.514	2%	2%
THD	--	--	--	1.375	1.339	1.354	--	--	--	0.819	0.813	0.812	23%	13%
PWHD	--	--	--	4.952	4.911	4.887	--	--	--	3.143	3.132	3.108	23%	22%

3. Power Quality – Voltage fluctuations and Flicker:									
	Starting			Stopping			Running		
	d _{max}	d _c	d _(t)	d _{max}	d _c	d _(t)	P _{st}	P _{It} 2 hours	
Measured values at test impedance	2.701	2.766	0.000	2.731	2.986	0.000	0.06	0.03	
Normalised to standard impedance	4.321	4.425	0.000	4.370	4.777	0.000	0.08	0.04	
Normalised to required maximum impedance	3.380	3.300	0.000	3.607	3.300	0.000	0.06	0.03	
Limits set under BS EN 61000-3-11	4%	3.3%	>3.3% for 500ms	4%	3.3%	>3.3% for 500ms	1.0	0.65	
Test impedance	R	0.15	Ω	XI		0.15	Ω		
Standard impedance	R	0.24 * 0.4 ^	Ω	XI		0.15 * 0.25 ^	Ω		

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Maximum impedance	R	0.18	Ω	XI	0.11	Ω			
* Applies to three phase and split single phase Power Generating Modules.									
^ Applies to single phase Power Generating Module and Power Generating Modules using two phases on a three phase system									
For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the Power Factor of the generation output is 0.98 or above.									
Normalised value = Measured value x reference source impedance/measured source impedance at test point									
Single phase units reference source resistance is 0.4 Ω									
Two phase units in a three phase system reference source resistance is 0.4 Ω									
Two phase units in a split phase system reference source resistance is 0.24 Ω									
Three phase units reference source resistance is 0.24 Ω									
Where the Power Factor of the output is under 0.98 then the XI to R ratio of the test impedance should be close to that of the Standard Impedance.									
The stopping test should be a trip from full load operation.									
The duration of these tests need to comply with the particular requirements set out in the testing notes for the technology under test. Dates and location of the test need to be noted below									
4. Power quality – DC injection:									
Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded value in Amps	0.0052	0.0019	0.0137	0.0126	0.0057	0.0167	0.0113	0.0024	0.0253
as % of rated AC current	0.01	0.01	0.04	0.03	0.02	0.05	0.03	0.01	0.07
Limit	0.25%			0.25%			0.25%		
5. Power Factor:									
Voltage	0.94U _n (216.2V)			1.0U _n (230V)			1.1U _n (253V)		
Measured value	1,000*			1,000*			1,000*		
Power Factor Limit	>0.95			>0.95			>0.95		

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6. Protection – Frequency tests:						
Function	Setting		Trip test		“No trip tests”	
	Frequency	Time delay	Frequency (Hz)	Time delay (s)	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.45	20.075	47.7 Hz 30.00 s	No Trip
U/F stage 2	47 Hz	0.5 s	46.95	0.579	47.2 Hz 19.5 s	No Trip
					46.8 Hz 0.45 s	No Trip
O/F	52 Hz	0.5 s	52.05	0.578	51.8 Hz 120.0 s	No Trip
					52.2 Hz 0.45 s	No Trip
7. Protection – Voltage tests:						

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For Type A, Type B and Type C Power Generating Modules intend to connected to LV (LV setting only suit for the $U_n=230\text{ V}$, and also if the Power Generating Modules intend to connected to High voltage grid, also should use HV setting)							
Function		Setting		Trip test		“No trip tests” All phases at same voltage	
		Voltage	Time delay	Voltage / V	Time delay / s	Voltage / time	Confirm no trip
U/V stage	L1 – N / L1-L2	$0.80 U_{L-N}$ (184V)	2.5 s	184.2	2.518	$0.80 U_n+4V$ 5.0 s	No trip.
	L2 – N / L2-L3	$0.80 U_{L-N}$ (184V)	2.5 s	184.2	2.519		
	L3 – N / L3-L1	$0.80 U_{L-N}$ (184V)	2.5 s	184.2	2.519		
	L1, L2, L3	$0.80 U_{L-N}$ (184V)	2.5 s	184.2	2.517		
						$0.80 U_n-4V$ 2.45 s	No trip.
O/V stage 1	L1 – N / L1-L2	$1.14 U_{L-N}$ (262.2V)	1.0 s	263.9	1.019	$1.14 U_n-4V$ 5.0 s	No trip.
	L2 – N / L2-L3	$1.14 U_{L-N}$ (262.2V)	1.0 s	262.8	1.021		
	L3 – N / L3-L1	$1.14 U_{L-N}$ (262.2V)	1.0 s	262.8	1.020		
	L1, L2, L3	$1.14 U_{L-N}$ (262.2V)	1.0 s	262.8	1.021		
O/V stage 2	L1 – N / L1-L2	$1.19 U_{L-N}$ (273.7V)	0.5 s	274.3	0.521	$1.19 U_n-4V$ 0.95 s	No trip.
	L2 – N / L2-L3	$1.19 U_{L-N}$ (273.7V)	0.5 s	275.5	0.521		
	L3 – N / L3-L1	$1.19 U_{L-N}$ (273.7V)	0.5 s	274.3	0.521		
	L1, L2, L3	$1.19 U_{L-N}$ (273.7V)	0.5 s	274.3	0.521		
						$1.19 U_n+4V$ 0.45 s	No trip.
8. Protection – Loss of Mains test:							
Protection – Loss of Mains test							
Test Power and imbalance	33%	66%	100%	33%	66%	100%	

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	-5% Q Test 22	-5% Q Test 12	-5% P Test 5	+5% Q Test 31	+5% Q Test 21	+5% P Test 10
Trip time Limit is 0.5s	401	390	391	395	387	388
Loss of Mains Protection, RoCoF Stability test						
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip			
49.0 Hz to 51.0 Hz	+0.95 Hzs-1	2.1 s	No trip*			
51.0 Hz to 49.0 Hz	-0.95 Hzs-1	2.1 s	No trip*			
Loss of Mains Protection, Vector Shift Stability test						
Test type	Start Frequency	Change	Confirm no trip			
Positive Vector Shift	49.5 Hz	+50 degrees	No trip*			
Negative Vector Shift	50.5 Hz	-50 degrees	No trip*			
9. Limited Frequency Sensitive Mode – Overfrequency test:						
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.					Y	
Alternatively, test results should be noted below: with default setting droop=10%, and close the FSM function						
Test sequence at Registered Capacity above 80%			100% P _{ref} (W)		25000	
Test sequence at Registered Capacity >80%	Actual frequency (Hz)	Measured Active Power Output (W)	Expected active power (W)	Calculated ΔP from standard characteristic curve (W)	Remark	
Step a) 50.00Hz ±0.01Hz	50.00	25088.38	--	--	--	
Step b) 50.45Hz ±0.05Hz	50.45	24827.6	24839.0	11.4	--	
Step c) 50.70Hz ±0.10Hz	50.70	23570.5	23589.1	18.6	--	
Step d) 51.15Hz ±0.05Hz	51.15	21306.6	21339.0	32.4	--	
Step e) 50.70Hz ±0.10Hz	50.70	23570.2	23589.0	18.8	--	
Step f) 50.45Hz ±0.05Hz	50.45	24827.5	24839.0	11.5	--	
Step g) 50.00Hz ±0.01Hz	50.00	25088.38	--	--	--	
Test sequence at Registered Capacity above 80%			50% P _{ref} (W)		12500	

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Test sequence at Registered Capacity >80%	Actual frequency (Hz)	Measured Active Power Output (W)	Expected active power (W)	Calculated ΔP from standard characteristic curve (W)	Remark
Step a) 50.00Hz ± 0.01 Hz	50.00	12521.3	--	--	--
Step b) 50.45Hz ± 0.05 Hz	50.45	12286.3	12271.9	-14.4	--
Step c) 50.70Hz ± 0.10 Hz	50.70	11029.9	11021.9	-8.0	--
Step d) 51.15Hz ± 0.05 Hz	51.15	8765.6	8771.9	6.3	--
Step e) 50.70Hz ± 0.10 Hz	50.70	11029.8	11021.9	-7.9	--
Step f) 50.45Hz ± 0.05 Hz	50.45	12285.9	12271.9	-14.0	--
Step g) 50.00Hz ± 0.01 Hz	50.00	12521.3	--	--	--
Alternatively, test results should be noted below: with default setting droop=2%, and close the FSM function					
Test sequence at Registered Capacity above 80%			100% P _{ref} (W)		25000
Test sequence at Registered Capacity >80%	Actual frequency (Hz)	Measured Active Power Output (W)	Expected active power (W)	Calculated ΔP from standard characteristic curve (W)	Remark
Step a) 50.00Hz ± 0.01 Hz	50.00	25101.7	--	--	--
Step b) 50.45Hz ± 0.05 Hz	50.45	23827.7	23855.1	27.4	--
Step c) 50.70Hz ± 0.10 Hz	50.70	17543.5	17604.7	61.2	--
Step d) 51.15Hz ± 0.05 Hz	51.15	6234.4	6355.0	120.6	--
Step e) 50.70Hz ± 0.10 Hz	50.70	17544.9	17604.9	60.0	--
Step f) 50.45Hz ± 0.05 Hz	50.45	23827.5	23855.2	27.7	--
Step g) 50.00Hz ± 0.01 Hz	50.00	25101.7	--	--	--

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Test sequence at Registered Capacity above 80%			50% P _{ref} (W)		12500
Test sequence at Registered Capacity >80%	Actual frequency (Hz)	Measured Active Power Output (W)	Expected active power (W)	Calculated ΔP from standard characteristic curve (W)	Remark
Step a) 50.00Hz ±0.01Hz	50.00	12507.2	--	--	--
Step b) 50.45Hz ±0.05Hz	50.45	11264.3	11260.6	-3.7	--
Step c) 50.70Hz ±0.10Hz	50.70	4974.8	5010.7	35.9	--
Step d) 51.15Hz ±0.05Hz	51.15	59.1	0.0	-59.1	--
Step e) 50.70Hz ±0.10Hz	50.70	4975.0	5010.2	35.2	--
Step f) 50.45Hz ±0.05Hz	50.45	11264.5	11260.7	-3.8	--
Step g) 50.00Hz ±0.01Hz	50.00	12507.2	--	--	--
10. Protection – Reconnection timer:					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
60	77,28	At 1.16 U _{n L-N}	At 0.78 U _{n L-N}	At 47.4 Hz	At 52.1 Hz
Confirmation that the Power Generating Module does not re-connect.		no reconnection	no reconnection	no reconnection	no reconnection
		At 1.12 U _{n L-N}	At 0.82 U _{n L-N}	At 47.6 Hz	At 51.9 Hz
Confirmation that the Power Generating Module Shall re-connect.		Reconnection after 75.51 s	Reconnection after 77.28 s	Reconnection after 75.73 s	Reconnection after 75.44 s
11. Fault level contribution:					
For Inverter output					
Time after fault		Volts		Amps	
20ms		118.25		39.89	
100ms		13.08		39.99	
250ms		12.90		36.82	
500ms		12.76		36.86	
Time to trip		2.50		In seconds	

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12. Self-Monitoring solid state switching:	
It has been verified that in the event of the solid state switching device failing to disconnect the Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.	NA
13. Wiring functional tests:	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA
14. Logic interface (input port):	
Confirm that an input port is provided and can be used to shut down the module	Yes
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used)	Yes
Time of logic interface to shut down the module	0,2 s
15. Cyber security:	
Confirm that the Power Generating Module has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes
Additional comments	
Different levels of access, all are password protected, only certain parameters can be changed on maintenance level. Manufacturer information provided and stored into the project. Document names: - SMA-CyberSecurity-Statement_v1.6_EN.pdf - CyberSecurity-TI-en-10.pdf	