

Certificate of Conformity

No. ESY 070122 0033 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.: 713254379-004

Date, 2022-09-26



(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: see next Pages

Applicable standards: EN 50549-1:2019

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EN 50549-1:2019 Certificate Annex				
Extract from test report			Report No. 713254379-002	
EN 50549-1:2019 Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network - Generating plants up to and including Type B				
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	SUNNY TRIPOWER STP 25-50
Rated values	AC: $U_n: 400 V_{AC}, f_n: 50 \text{ Hz}$			
	$P_n: 12 \text{ kW}$	$P_n: 15 \text{ kW}$	$P_n: 20 \text{ kW}$	$P_n: 25 \text{ kW}$
	$I_n: 17,4 \text{ A}$	$I_n: 21,7 \text{ A}$	$I_n: 29,0 \text{ A}$	$I_n: 36,2 \text{ A}$
	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			
Grid connection rule:	EN 50549-1:2019			
Test requirement:	EN 50549-1:2019			
Test report:	713254379-002, released 2022-08-08			
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 EN 50549-1:2019 and comply with requirements up to Type B.				

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EN 50549-1:2019 - Annex C Parameter Table					
Clause(s) / subclause(s) of this EN	Ref	Parameter	Typical value range	Value default	
4.4.2 Operating frequency range	A,B	47,0 – 47,5 Hz Duration	0 – 20 s	0 s	
	A,B	47,5 – 48,5 Hz Duration	30 – 90 min	30 min	
	A,B	48,5 – 49,0 Hz Duration	30 – 90 min	30 min	
	A,B	49,0 – 51,0 Hz Duration	not configurable	unlimited	
	A,B	51,0 – 51,5 Hz Duration	30 – 90 min	30 min	
	A,B	51,5 – 52 Hz Duration	0 – 15 min	0 s	
4.4.3 Minimal requirement for active power delivery at underfrequency	A,B	Reduction threshold	49 Hz – 49,5 Hz	49,5 Hz	
	A,B	Maximum reduction rate	2 – 10 % P _M /Hz	10 % P _M /Hz	
4.4.4 Continuous operating voltage range	n.a.	Upper limit	not configurable	110% U _c	
	n.a.	Lower limit	not configurable	90% U _c	
4.5.2 Rate of change of frequency (ROCOF) immunity	A,B	ROCOF withstand capability (defined with a sliding measurement window of 500 ms) non-synchronous generating technology: synchronous generating technology:	not defined	2 Hz/s	
				1 Hz/s	
4.5.3.2 Generating plant with non-synchronous generating technology	B	Maximum power resumption time	not defined	1 s	
	B	Voltage-Time-Diagram	see Figure 6	Time [s]	U [p.u.]
				0,0	0,2
				0,15	0,2
				1,5	0,85
				180	0,85
				180	0,9
4.5.3.3 Generating plant with synchronous generating technology	B	Maximum power resumption time	not defined	3 s	
	B	Voltage-Time-Diagram	See Figure 7	Time [s]	U [p.u.]
				0,0	0,3
				0,15	0,3
				0,15	0,7
				0,7	0,7
				1,5	0,85
				180	0,85
180	0,9				
4.5.4 Over-voltage ride through (OVRT)	n.a.	Voltage-Time-Diagram	not configurable	Time [s]	U [p.u.]
				0,0	1,25
				0,1	1,25

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EN 50549-1:2019 - Annex C Parameter Table				
Clause(s) / subclause(s) of this EN	Ref	Parameter	Typical value range	Value default
				0,1 1,20
				5,0 1,20
				5,0 1,15
				60 1,15
				60 1,10
4.6.1 Power response to overfrequency	A,B	Threshold frequency f_1	50,2 Hz – 52 Hz	50,2 Hz
	A,B	Droop	2 % – 12 %	5 %
	A,B	Power reference	P_M P_{max}	P_{max} , for synchronous generating technology and EESS P_M for other non-synchronous generating technology
	n.a.	Intentional delay	0 – 2 s	0 s
	n.a.	Deactivation threshold f_{stop}	50,0 Hz – f_1	deactivated
	n.a.	Deactivation time t_{stop}	0 – 600 s	-
	A	Acceptance of staged disconnection	yes no	Yes
4.6.2 Power response to underfrequency	n.a.	Threshold frequency f_1	49,8 Hz – 46 Hz	49,8 Hz
	n.a.	Droop	2 – 12 %	5 %
	n.a.	Power reference	P_M P_{max}	P_{max}
	n.a.	Intentional delay	0 – 2 s	0 s
4.7.2.2 Capabilities	B	Reactive power range overexcited	0 – 0,33	0,33
	B	Reactive power range underexcited	0 – 0,33	0,33
4.7.2.3 Control modes	n.a.	Enabled control mode	Q setp. Q(U) Q(P) cos φ setp. cos φ (P)	Q setpoint
4.7.2.3.2 Setpoint control modes	n.a.	Q setpoint and excitation	0 – 33 % P_D	0
	n.a.	cos φ setpoint and excitation	1 – 0,9	1
4.7.2.3.3 Voltage related control modes	n.a.	Characteristic curve	-	-
	n.a.	Time constant	3 s – 60 s	10 s
	n.a.	Min cos φ	0,0 – 1	0,9
	n.a.	Lock in power	0 % – 20 %	deactivated
	n.a.	Lock out power	0 % – 20 %	deactivated
4.7.2.3.4 Power related control mode	n.a.	Characteristic curve	-	-
4.7.4.2.1 Voltage support during faults and voltage steps -	B	Enabling	enable disable	Disabled
	B	Static voltage range overvoltage	100 % U_c – 120 % U_c	110 % U_c

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EN 50549-1:2019 - Annex C Parameter Table				
Clause(s) / subclause(s) of this EN	Ref	Parameter	Typical value range	Value default
General	B	Static voltage range undervoltage	80 % U_c – 100 % U_c	90 % U_c
	B	Insensitivity range of ΔU_{50per}	0 % – 15 %	5 %
	B	Gradient k1	0 – 6	2
	B	Gradient k2	0 – 6	2
4.7.4.2.1.2 Optional Modes	n.a	Active power priority	enable disable	Disable
	n.a	Reactive current limitation [% rated current]	0%–100%	Disable
	n.a	Zero current threshold	20 % U_c – 100 % U_c	Disable
4.7.4.2.2 Zero current mode for converter connected generating technology	n.a.	Enabling	enable disable	Disable
	n.a	Static voltage range undervoltage	20 % U_c – 100 % U_c	50 % U_c
4.9.3 Requirements on voltage and frequency protection	B	Undervoltage threshold stage 1	0,2 U_c – 1 U_c	See table below
	B	Undervoltage operate time stage 1	0,1 s – 100 s	See table below
	B	Undervoltage threshold stage 2	0,2 U_c – 1 U_c	See table below
	B	Undervoltage operate time stage 2	0,1 s – 5 s	See table below
	B	Overvoltage threshold stage 1	1,0 U_c – 1,2 U_c	See table below
	B	Overvoltage operate time stage 1	0,1 s – 100 s	See table below
	B	Overvoltage threshold stage 2	1,0 U_c – 1,3 U_c	See table below
	B	Overvoltage operate time stage 2	0,1 s – 5 s	See table below
	B	Overvoltage threshold 10 min mean protection	1,0 U_c – 1,15 U_c	See table below
	B	Underfrequency threshold stage 1	47,0 Hz– 50,0 Hz	See table below
	B	Underfrequency operate time stage 1	0,1 s – 100 s	See table below
	B	Underfrequency threshold stage 2	47,0 Hz – 50,0 Hz	See table below
	B	Underfrequency operate time stage 2	0,1 s – 5 s	See table below
	B	Overfrequency threshold stage 1	50,0 Hz – 52,0 Hz	See table below
	B	Overfrequency operate time stage 1	0,1 s – 100 s	See table below
	B	Overfrequency threshold stage 2	50,0 Hz – 52,0 Hz	See table below
	B	Overfrequency operate time stage 2	0,1 s – 5 s	See table below
	B	Positive sequence under-voltage protection threshold	20 % – 100 %	See table below
B	Positive sequence under-voltage protection operate time	0,2 s – 100 s	See table below	

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EN 50549-1:2019 - Annex C Parameter Table				
Clause(s) / subclause(s) of this EN	Ref	Parameter	Typical value range	Value default
	B	Negative sequence over-voltage protection threshold	1 % – 100 %	See table below
	B	Negative sequence over-voltage protection operate time	0,2 s – 100 s	See table below
	B	Zero sequence over-voltage protection threshold	0 % – 100 %	See table below
	B	Zero sequence over-voltage protection operate time	0,2 s – 100 s	See table below
4.10.2 Automatic reconnection after tripping	B	Lower frequency	47,0 Hz – 50,0 Hz	49,5 Hz
	B	Upper frequency	50,0 Hz – 52,0 Hz	50,2 Hz
	B	Lower voltage	50 % U_c – 100 % U_c	90 % U_c
	B	Upper voltage	100 % U_c – 120 % U_c	110 % U_c
	B	Observation time	10 s – 600 s	60 s
	B	Active power increase gradient	6 % – 3000 %/min	10 % /min
4.10.3 Starting to generate electrical power	A,B	Lower frequency	47,0 Hz – 50,0 Hz	49,5 Hz
	A,B	Upper frequency	50,0 Hz – 52,0 Hz	50,1 Hz
	A,B	Lower voltage	50 % – 100 % U_c	90 % U_c
	A,B	Upper voltage	100 % – 120 % U_c	110 % U_c
	A,B	Observation time	10 s – 600 s	60 s
	A,B	Active power increase gradient	6 % – 3000 %/min	disabled
4.11.1 Ceasing active power	A,B	Remote operation of the logic interface	yes no	No
4.11.2 Reduction of active power on set point	B	Remote operation NOTE: If yes further definition is provided by the DSO	yes no	No
4.12 Remote information exchange	B	Remote information exchange required NOTE: If yes further definition is provided by the DSO	yes no	No

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Default interface protection settings according EN 50549-1:2019					
Parameter	Min. disconn. time	Max. disconn. time	Min. operate value	Max. operate value	Standard set value
Over voltage (stage 1) ¹⁾	0,1 s	100 s	1,0 U _n	1,20 U _n	0,2 s/1,2 U _n
Over voltage (stage 2)	0,1 s	5 s	1,0 U _n	1,30 U _n	0,1 s/1,25 U _n
Over voltage (stage 3)	0,1 s	10 min	1,0 U _n	1,20 U _n	N/A (optional)
Under voltage (stage 1)	0,1 s	100 s	0,2 U _n	1,0 U _n	10 s/0,2 U _n
Under voltage (stage 2)	0,1 s	5 s	0,2 U _n	1,0 U _n	3 s/0,8 U _n
Under voltage (stage 3)	0,1 s	10 min	0,2 U _n	1,0 U _n	N/A (optional)
Over frequency (stage 1)	0,1 s	100 s	1,0 f _n	52 Hz	0,1 s/52 Hz
Over frequency (stage 2)	0,1 s	5 s	1,0f _n	52 Hz	0,1 s/52 Hz
Under frequency (stage 1)	0,1 s	100 s	47 Hz	1,0 f _n	0,1 s/47 Hz
Under frequency (stage 2)	0,1 s	5 s	47 Hz	1,0 f _n	0,1 s/47 Hz
Loss of mains according EN 62116 (LoM)	Typical value range: 0-20 s				0,5 s
Rate of change of frequency (ROCOF) (gliding 500 ms window)	Typical value range: not defined Hz/s				2 Hz/s 1 Hz/s
Permanent DC-injection	≤ 20 mA / ≤ 0,5 % I _r				
Reconnection settings for voltage (normal operational start-up)	Typical value range: lower voltage: 50-100 %U _n , upper voltage: 100-120 %U _n				0,90 U _n ≤ U ≤ 1,10 U _n
Reconnection settings for frequency (normal operational start-up)	Typical value range: lower freq.: 47-50 Hz, upper freq.: 50-52 Hz				47,5 Hz ≤ f ≤ 50,2 Hz
Reconnection time (normal operational start-up)	Typical value range: 10-600 s				≥ 60 s
Reconnection settings for voltage (automatic reconnection after tripping)	Typical value range: lower voltage: 50-100 %U _n , upper voltage: 100-120 %U _n				0,90 U _n ≤ U ≤ 1,10 U _n
Reconnection settings for frequency (automatic reconnection after tripping)	Typical value range: lower freq.: 47-50 Hz, upper freq.: 50-52 Hz				47,5 Hz ≤ f ≤ 50,2 Hz
Reconnection time (automatic reconnection after tripping)	Typical value range: 10-600 s				≥ 60 s
Active power gradient after reconnection	Typical value range: 6-3000 %P _{E_{max}} /min				10 %P _{E_{max}} /min
Reconnection settings for voltage (normal operational start-up)	Typical value range: lower voltage: 50-100 %U _n , upper voltage: 100-120 %U _n				0,85 U _n ≤ U ≤ 1,10 U _n
Active power delivery at under frequency	no active power reduction / optional active power increase				

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Default interface protection settings according EN 50549-1:2019		
Power response to under frequency (frequency / gradient / droop s)	Typical value range: Threshold: 46-49,8 Hz / gradient: 16,67-100 %P _M /Hz / droop: 2-12%	49,8 Hz / 40 %P _M /Hz / 5%
Power response to over frequency (frequency / gradient / droop s)	Typical value range: Threshold: 50,2-52 Hz / gradient: 16,67-100 %P _M /Hz / droop: 2-12%	50,2 Hz / 40 %P _M /Hz / 5%
<p>Remark: The settings of the interface protection are adjustable and password protected.</p> <p>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.</p> <p>The units stated above were tested according to the requirements in EN 50549-1:2019. 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 EN 50549-1:2019.</p> <p>¹⁾ Over voltage – stage1: 10 min-average value corresponding to EN 50160.</p>		