

CERTIFICATE OF COMPLIANCE

Certificate Number 20230612-E210376
Report Reference E210376-20230612
Issue Date 2023-06-12


Issued to: SMA Solar Technology AG
Sonnallee 1
34266 Niestetal GERMANY

**This is to certify that
representative samples of**

STATIC INVERTERS, CONVERTERS AND
ACCESSORIES FOR USE IN INDEPENDENT POWER
SYSTEMS

Permanently-connected, utility Interactive, 3-phase inverter,
Models: STP 30-US-50, STP 25-US-50 and STP 20-US-50.
(which are intended for DC input from photovoltaic
modules)

Have been investigated by UL in accordance with the
Standard(s) indicated on this Certificate.



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Standard(s) for Safety: UL1741 Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.

UL 62109-1, Safety of power converters for use in photovoltaic power systems – Part 1: General requirements

IEEE 1547, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.


IEEE 1547.1, IEEE Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.

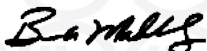
CSA C22.2 No. 62109-1 Safety of power converters for use in photovoltaic power systems - Part 1: General requirements.

CSA C22.2 No. 62109-2 Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters.

Additional Information: See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

The UL Recognized Component Mark generally consists of the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory. As a supplementary means of identifying products that have been produced under UL's Component Recognition Program, UL's Recognized Component Mark: , may be used in conjunction with the required Recognized Marks. The Recognized Component Mark is required when specified in the UL Directory preceding the recognitions or under "Markings" for the individual recognitions.



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Recognized components are incomplete in certain constructional features or restricted in performance capabilities and are intended for use as components of complete equipment submitted for investigation rather than for direct separate installation in the field. The final acceptance of the component is dependent upon its installation and use in complete equipment submitted to UL LLC.

Look for the UL Certification Mark on the product.

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Permanently-connected, Grid Support Utility Interactive inverters.

This description covers the SMA Solar Technology AG Model: STP 30-US-50, STP 25-US-50 and STP 20-US-50 (which are intended for DC input from photovoltaic modules) inverters.

The Certificate is valid for the SW-Version V2.16.3.R.

USL - Evaluated to the requirements of the UL Standard for Safety of power converters for use in photovoltaic power systems – Part 1: General requirements, UL 62109-1 First Edition, Dated July 18, 2014 including revision date 2019-04-30.


CNL - Additionally evaluated to CSA C22.2 NO. 62109-1 SAFETY OF POWER CONVERTERS FOR USE IN PHOTOVOLTAIC POWER SYSTEMS - PART 1: GENERAL REQUIREMENTS - Edition 1 - Issue Date 2016/07/01 and CSA C22.2 NO. 62109-2 SAFETY OF POWER CONVERTERS FOR USE IN PHOTOVOLTAIC POWER SYSTEMS - PART 2: PARTICULAR REQUIREMENTS FOR INVERTERS- Edition 1 - Issue Date 2016/07/01

The following is valid for models : STP 30-US-50, STP 25-US-50 and STP 20-US-50 with Firmware Processor Version SW-Version V2.16.3.R.

Additionally Evaluated to the requirements of the Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, UL 1741, Third Edition, dated September 28, 2021 including revision date October 18, 2022, . Including the requirements in UL 1741 Supplement B (SB). Testing conducted to the requirements of UL 1741 SB corresponds to the minimum requirements for CA Rule 21, 2020. An enumeration of functions tested, including complete ratings, and available certified settings for the Grid Support functions, are recorded in the appendix to this document. Test data and detailed results of compliance testing are retained in the complete UL Report for this product. Additionally evaluated to the Source Requirement Documents of HECO SRD V2.0.

IEEE 1547, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.

IEEE 1547.1, IEEE Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.



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IEEE 1547-2018 IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

IEEE 1547a-2020 IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces - Amendment 1: To Provide More Flexibility for Adoption of Abnormal Operating Performance Category III, Dated 2020-03-09

IEEE 1547-2018 - Errata to
IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces, IEEE Standards Coordinating Committee 21, IEEE Std 1547-2018, Revision of IEEE Std 1547-2003, Correction Sheet, Dated 2018-06-04



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IEEE 1547, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.

IEEE 1547.1, IEEE Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.

IEEE 1547-2018 IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

IEEE 1547.1-2020 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces

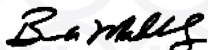
IEEE 1547-2018 - Errata to

IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces, IEEE Standards Coordinating Committee 21, IEEE Std 1547-2018, Revision of IEEE Std 1547-2003, Correction Sheet, Dated 2018-06-04

This description covers the SMA Solar Technology AG Models STP 30-US-50, STP 25-US-50 and STP 20-US-50 inverters.

USL - Evaluated to the requirements of the Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, UL 1741,

Compliance testing was conducted on samples of the products according to the test methods in UL 1741 with compliant results, and product ratings were reviewed for fulfillment of the requirements in the following SRDs:



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Detailed Testing Summary

Test Name	IEEE 1547.1-2020 (UL1741SB) Section	Fixed / Adjustable	Pass / Fail
PRIORITY OF RESPONSES	5.2	Adjustable	Pass
TEMPERATURE STABILITY	5.3	Adjustable	Pass
TEST FOR OVERVOLTAGE TRIP	5.4.2	Adjustable	Pass
TEST FOR UNDERVOLTAGE TRIP	5.4.3	Adjustable	Pass
LOW-VOLTAGE RIDE-THROUGH TESTS	5.4.4	Adjustable	Pass
TEST FOR VOLTAGE DISTURBANCES WITHIN CONTINUOUS OPERATING REGION	5.4.5	Adjustable	Pass
HIGH-VOLTAGE RIDE-THROUGH TESTS	5.4.7	Adjustable	Pass
TEST FOR OVERFREQUENCY TRIP	5.5.1	Adjustable	Pass
TEST FOR UNDERFREQUENCY TRIP	5.5.2	Adjustable	Pass
TEST FOR LOW-FREQUENCY RIDE-THROUGH	5.5.3	Adjustable	Pass
TEST FOR HIGH-FREQUENCY RIDE-THROUGH	5.5.4	Adjustable	Pass
TEST FOR RATE OF CHANGE OF FREQUENCY (ROCOF)	5.5.5	Adjustable	Pass
TEST FOR VOLTAGE PHASE-ANGLE CHANGE RIDE-THROUGH	5.5.6	Adjustable	Pass
NORMAL RAMP RATE	N/A	Adjustable	Pass
ENTER SERVICE	5.6	Adjustable	Pass
PROTECTION FROM ELECTROMAGNETIC INTERFERENCE (EMI)	5.8.1	Adjustable	Pass
SURGE WITHSTAND PERFORMANCE TEST	5.8.2	Adjustable	Pass
LIMITATION OF DC INJECTION FOR INVERTERS	5.9	Fixed	Pass



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Detailed Testing Summary (continued)			
Test Name	IEEE 1547.1-2020 (UL1741SB) Section	Fixed / Adjustable	Pass / Fail
UNINTENTIONAL ISLANDING	5.10	Adjustable	Pass
OPEN PHASE TEST	5.11	Fixed	Pass
CURRENT DISTORTION	5.12	Adjustable	Pass
LIMIT ACTIVE POWER	5.13	Adjustable	Pass
TEST FOR CONSTANT POWER FACTOR (P.F.) MODE	5.14.3	Adjustable	Pass
TEST FOR VOLTAGE-REACTIVE POWER (VOLT-VAR) MODE	5.14.4	Adjustable	Pass
TEST FOR VOLTAGE-REACTIVE POWER (VOLT-VAR) MODE (VREF TEST)	5.14.5	Adjustable	Pass
TEST FOR VOLTAGE—REACTIVE POWER (VOLT-VAR) MODE WITH AN IMBALANCED GRID	5.14.6	Adjustable	Pass
TEST FOR ACTIVE POWER-REACTIVE POWER MODE (WATT-VAR)	5.14.7	Adjustable	Pass
TEST FOR CONSTANT REACTIVE POWER (VAR) MODE	5.14.8	Adjustable	Pass
TEST FOR VOLTAGE-ACTIVE POWER (VOLT-WATT) MODE	5.14.9	Adjustable	Pass
TEST FOR VOLTAGE-ACTIVE POWER (VOLT-WATT) MODE WITH AN IMBALANCED GRID	5.14.10	Adjustable	Pass
TEST FOR FREQUENCY-DROOP (FREQUENCY-POWER OR FREQUENCY-WATT) CAPABILITY—ABOVE NOMINAL FREQUENCY	5.15.2	Adjustable	Pass
TEST FOR FREQUENCY-DROOP (FREQUENCY-POWER OR FREQUENCY-WATT) CAPABILITY—BELOW NOMINAL FREQUENCY	5.15.3	Adjustable	Pass
TEST FOR PRIORITIZATION OF DER RESPONSES	5.16.1	Adjustable	Pass
GROUND FAULT OVERVOLTAGE (GFOV) TEST	5.17.1	Adjustable	Pass
LOAD REJECTION OVERVOLTAGE (LROV) TEST	5.17.2	Adjustable	Pass



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Detailed Testing Summary (continued)

Test Name	IEEE 1547.1-2020 (UL1741SB) Section	Fixed / Adjustable	Pass / Fail
PERSISTENCE OF DER PARAMETER SETTINGS	5.19	Adjustable	Pass
INTEROPERABILITY	6	Adjustable	Pass
ENTER SERVICE TEST	6.8.2.12	Adjustable	Pass
LIMIT MAXIMUM ACTIVE POWER TEST	6.8.2.13	Adjustable	Pass



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Voltage regions equivalencies between UL1741SA and IEEE1547.1-2020/UL1741SB:

UL1741 SA Boundary	IEEE 1547.1-2020 Shall Trip
High Voltage 3 (HV3)	Not applicable
High Voltage 2 (HV2)	Over Voltage 2 (OV2)
High Voltage 1 (HV1)	Over Voltage 1 (OV1)
Low Voltage 1 (LV1)	Under Voltage 1 (UV1)
Low Voltage 2 (LV2)	Under Voltage 2 (UV2)
Low Voltage 3 (LV3)	Not applicable
Low Voltage 4 (LV4)	Not applicable

Frequency regions comparison between UL1741SA and IEEE1547.1-2020:

UL1741 SA Boundary	IEEE 1547.1-2020 Shall Trip
High Frequency 3 (HF3)	Not applicable
High Frequency 2 (HF2)	Over Frequency 2 (OF2)
High Frequency 1 (HF1)	Over Frequency 1 (OF1)
Low Frequency 1 (LF1)	Under Frequency 1 (UF1)
Low Frequency 2 (LF2)	Under Frequency 2 (UF2)
Low Frequency 3 (LF3)	Not applicable



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Inverter Firmware Version:		
UL 1998	Date	Version/Revision
Compliant	2023-04-27	2.16.3.R

Inverter Ratings - Output	All models, with individual differences as shown
Output phase configuration	3-Phase Y with N
Nominal (line to line) output voltage V ac	277 / 480
Operating voltage range V ac	244 - 305 (L-N)
Line Synchronization Characteristics	Method 2
Normal out frequency Hz	60
Rated output current (A ac)	24 / 30 / 36
Rated output power, (kW)	20 / 25 / 30
Max. Branch Circuit overcurrent protection (A ac)	60
Maximum Air Ambient (°C)	60

Other ratings:	
Max. utility backfeed current to PV input (A)	0A
Line Synchronization Characteristics / In-rush current	Method 2
Limits of accuracy of voltage measurement	1 %
Limits of accuracy of frequency measurement	+/- 0.01 Hz
Manufacturers stated accuracy of time response for voltage trips	+/- 0.1 % at nominal trip time
Manufacturers stated accuracy of time response for frequency trips	+/- 0.1 % at nominal trip time
*Enclosure Ratings	4x

INTERCONNECTION INTEGRITY TEST CATEGORIES:	
C62.42.2 Ring Wave Surge Category	B / 6.11 kV / 0.5 kA
C62.42.2 Combination Wave Surge Category	B / 6.27 kV / 3.00 kA
C37.90.1 RF Immunity - compliance	Yes
C37.90.2 Communication circuit - compliance	Yes



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<u>Magnitude and time Limits</u> - Utility interconnection voltage magnitude limits, Ride Through time limits and trip times:						
Nominal voltage	3-Phase Y with N					
	Magnitudes (% of nominal)		Ride Through (Seconds) (+)		Must Trip (Seconds)	
Boundary designation (++)	Min	Max	Min	Max	Min	Max
HV3	-	-	-	-	-	-
HV2	79.42	120	1	30	0.1	59
HV1	79.42	110	1	30	0.1	60
LV1	37.36	100	1	30	0.1	60
LV2	37.36	100	1	30	0.1	60
LV3	-	-	-	-	-	-

<u>Magnitude and time Limits</u> - Utility interconnection Frequency magnitude limits, Ride Through time limits and trip times:						
Nominal Frequency	60 Hz					
	Magnitudes (Frequency)		Ride Through (Seconds) (+)		Must Trip (Seconds)	
Boundary designation	Min	Max	Min	Max	Min	Max
HF3	-	-	-	-	-	-
HF2	50.0	66.0	10	999.0	0.1	1000.0
HF1	50.0	66.0	10	999.0	0.1	1000.0
LF1	44.0	60.0	10	999.0	0.1	1000.0
LF2	44.0	60.0	10	999.0	0.1	1000.0
LF3	-	-	-	-	-	-



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Frequency-Droop Category III:			
Nominal Frequency	60Hz		
Parameter	Default Settings	Ranges of allowable Settings	
		Min	Max
db _{OF} , db _{UF} (Hz)	0.036	0.017	1.0
k _{OF} , k _{UF}	0.05	0.02	0.05
T _{response} (small signal) (s)	5.0	0.20	10.0

SPF Specified Power Factor (INV3)	
Minimum Inductive (Underexcited) Power Factor (<0)	-0.8
Minimum Capacitive (Overexcited) Power Factor (>0)	+0.8

Volt/Var Mode (VV) extent of curve range settings				
		Qmax Values - Maximums	Qmin Values - Minimums	Units
Reactive power production setting	Q ₁	60	15	%VAR
Reactive power absorption setting at the left edge of the deadband	Q ₂	0	0	%VAR
Reactive power absorption setting at the right edge of the deadband	Q ₃	0	0	%VAR
Reactive power absorption setting	Q ₄	-60	-15	%VAR

Functional in the following priority modes: [] active power priority [X] reactive power priority (RPP)

		Maximum	Minimum	Units
The voltage at Q ₁	V ₁	97.83	92.00	%Vnom
The voltage at Q ₂	V ₂	100.00	96.00	%Vnom
The voltage at Q ₃	V ₃	104.00	100.00	%Vnom
The voltage at Q ₄	V ₄	108.00	102.17	%Vnom



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Frequency-Watt (FW) extent of curve range settings				
Settings	Frequency		Power level	
Low end of the adjustment range of the start of the curtailment function	F _{start_min}	60.1	100 %	%Watts
High end of the adjustment range of the start of the curtailment function	F _{start_max}	62.0	100 %	%Watts
Low end of the adjustment range of the endpoint of the curtailment function	F _{stop_min}	60.78	0 %	%Watts
High end of the adjustment range of the endpoint of the curtailment function	F _{stop_max}	65.5	0 %	%Watts

Volt-Watt (VW) extent of curve range settings				
Settings	Volts		Power level	
Low end of the adjustment range of the start of the curtailment function	V _{start_min}	103 %	100%	%Watts
High end of the adjustment range of the start of the curtailment function	V _{start_max}	103 %	100 %	%Watts
Low end of the adjustment range of the endpoint of the curtailment function	V _{stop_min}	106%	0 %	%Watts
High end of the adjustment range of the endpoint of the curtailment function	V _{stop_max}	110 %	0 %	%Watts



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