CERTIFICATE OF COMPLIANCE

Certificate Number	20240213-E210376
Report Reference	E210376-20240213
Issue Date	2024-02-13

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

This is to certify that representative samples of STATIC INVERTERS, CONVERTERS AND ACCESSORIES FOR USE IN INDEPENDENT POWER SYSTEMS

PV/Battery/Hybrid utility interactive inverter with grid support functionality,
Models: SBSE3.8-US-50; SBSE4.8-US-50; SBSE5.8-US-50; SBSE7.7-US-50

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

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Standard(s) for Safety:

UL 62109-1, Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General Requirements, Edition 1, Revision Date 11/28/2023.

UL 1741, Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, Edition 3, Revision Date 10/18/2022.

IEEE 1547, Interconnection and Interoperability of Distributed Energy Resources (DERs) with Associated Electric Power Systems (EPSs) Interfaces, Issue Date 02/15/2018.

IEEE 1547.1, Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces, Issue Date 03/05/2020.

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.

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.

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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.

PV/Battery/Hybrid utility interactive inverter with grid support functionality.

This description covers the SMA Solar Technology AG Model: SBSE3.8-US-50; SBSE4.8-US-50; SBSE5.8-US-50; SBSE7.7-US-50

The Certificate is valid for the SW-Version CONT Application: 2.24.4.R CONT Bootloader: 2.24.3.R

USL - Evaluated to the requirements of the UL Standard: UL 62109-1, Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General Requirements, Edition 1, Revision Date 11/28/2023

The following is valid for models : SBSE3.8-US-50; SBSE4.8-US-50; SBSE5.8-US-50; SBSE7.7-US-50, with Firmware vSW-Version CONT Application: 2.24.4.R CONT Bootloader: 2.24.3.R

Additionally Evaluated to the requirements of the

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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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 May 19, 2023. Including the requirements in UL 1741 Supplement B (SB). 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.

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 SBSE3.8-US-50; SBSE4.8-US-50; SBSE5.8-US-50 and SBSE7.7-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-THOUGH	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 (*V*REF 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
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

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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	2023-11-30	CONT Application: 2.24.4.R CONT Bootloader: 2.24.3.R

Model(s)	SBSE3.8-US-50	SBSE4.8-US-50	SBSE5.8-US-50	SBSE7.7-US-50
DC Ratings – PV Input				
Maximum input voltage (Vdc)	600	600	600	600
Range of input operating voltage (Vdc)	60 - 480	60 - 480	60 - 480	60 - 480
Minimum input voltage for full power operation (Umpp) Vdc (1 string / 2 strings / 3 strings)	273 / 137 / 91	337 / 169 / 112	408 / 204 / 136	541 / 271 / 180
Maximum input voltage for full power operation (Umpp) Vdc	550	550	550	550
Startup input voltage (Vdc)	66	66	66	66
Maximum Input (operating) current (A)	15	15	15	15
Maximum input short circuit current (A dc)	30	30	30	30
Circuit combiner on input?	No	No	No	No
Overvoltage category (according to IEC 60664-1)	II	II	II	II
DC Ratings – Battery Input				
Maximum input voltage (Vdc)	500	500	500	500
Range of input operating voltage (Vdc)	90 - 500	90 - 500	90 - 500	90 - 500
Range of input voltage for full power operation (Umpp) Vdc	134 – 500	169 – 500	204 – 500	271 - 500
DC Input Start Range (Vdc)	90	90	90	90
Maximum charging current (A dc)	30	30	30	30
Maximum discharge current (A dc)	30	30	30	30
Circuit combiner on input?	No	No	No	No
Maximum battery charge power AC + PV(W)	11400	14400	15000	15000
Maximum discharge power (W	3840	4800	5760	7680

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ac)				
Battery Type	Li-Ion	Li-Ion	Li-Ion	Li-Ion
Number of independent input	1	1	1	1
Overvoltage category (according to IEC 60664-1)	II	II	II	II
AC Ratings – Output				
Output – Grid configuration(s) allowed for product connection.	1 phase	1 phase	1 phase	1 phase
Nominal (line to line/Line-Neutral) output voltage (Vac)	240 / 208	240 / 208	240 / 208	240 / 208
Operating voltage range (Vac)	240 V (211 V to 264 V) or 208 V (183 V to 229 V)	240 V (211 V to 264 V) or 208 V (183 V to 229 V)	240 V (211 V to 264 V) or 208 V (183 V to 229 V)	240 V (211 V to 264 V) or 208 V (183 V to 229 V)
Operating frequency range or single frequency (Hz)	55 / 66	55 / 66	55 / 66	55 / 66
Normal out frequency Hz	60.0	60.0	60.0	60
Maximum continuous output current (A)	16	20	24	32
Maximum continuous output power @ 25 °C, (kW)	3.84	4.8	5.76	7.68
Maximum continuous output power @ 60 °C, kW	3.84 @ 480 Vdc	4.8 @ 480 Vdc	5.76 @ 480 Vdc	7.46 @ 480 Vdc
Maximum continuous output power @ 240 V, 60 Hz,(W)	3840	4800	5760	7680
Maximum continuous output power @ 208 V, 60 Hz,(W)	3328	4160	4992	6656
Max. output (VA)	3840	4800	5800	7680
Output Power Factor leading or lagging	0.8/ – 0.8	0.8/ – 0.8	0.8/-0.8	0.8/-0.8
Max. Branch Circuit overcurrent protection (A)	50	50	50	50
Overvoltage category (according to IEC 60664-1)	IV	IV	IV	IV

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Other ratings	
Limits of accuracy of frequency measurement	+/- 0.01 Hz
Limits of accuracy of time measurement	+/- 0.1 % at nominal trip time
Maximum Air Ambient (°C)	60 °C with derating, 45 °C max. output power
Enclosure Ratings	IP 65 / UL Type 3R
Shipping temperature range	-40 °C to +60 °C
Operating Temperature range	-25 °C to +60 °C
Maximum altitude rating	4000 m
Wet locations classification	Outdoor
Pollution degree classification for the intended external environment	PD3
Relative humidity ratings	100 %, condensing
Product type Class	I
Overvoltage category	Input: OVC II Output: OVC IV

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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Magnitude and time Limits - Utility interconnection voltage magnitude limits, Ride Through time limits and trip times:						
Nominal voltage	1 Phase					
	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	-	-	-	-	-	-

Magnitude and time Limits - 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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