# CERTIFICATE OF COMPLIANCE

| | |
|---|---|
| **Certificate Number** | 20190404-E210376 |
| **Report Reference** | E210376-20190328 |
| **Issue Date** | 2019-APRIL-04 |

**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

Permanently-connected, utility Interactive, 3-phase inverter, Models: SHP 150-US-20, SHP 125-US-20. (which are intended for DC input from photovoltaic modules)

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

Bruce Mahrenholz, Director North American Certification Program

UL LLC

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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: SHP 150-US-20, SHP 125-US-20. (which are intended for DC input from photovoltaic modules) inverters.

The Certificate is valid for the HP-Version V02.02.29.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.
Additionally evaluated to the requirements in UL 1741 Supplement SA (Second Edition, dated January 28, 2010, and revision dated February 15, 2018)– Grid Support Utility Interactive Inverters and Converters, Second Edition, dated September 7, 2016, which also fulfills the Source Requirement Documents of California Public Utilities Commission Rule 21 for grid support utility interactive inverters: the Generating Facility Interconnections of PG&E (Pacific Gas and Electric Company, Cal. P.U.C. Sheet No. 36812-E), SCE (Southern California Edison, Cal. PUC Sheet No. 60550-E) and SDG&E (San Diego Gas & Electric Company, Cal. P.U.C. Sheet No. 28143-E) and HECO SRD-UL-1741-SA-V1.1, 2017-09-22.

Additionally evaluated to the requirements in IEEE 1547 INTERCONNECTING DISTRIBUTED RESOURCES WITH ELECTRIC POWER SYSTEMS- Edition 1 - Revision Date 2014/05/16 and IEEE 1547.1 IEEE STANDARD CONFORMANCE TEST PROCEDURES FOR EQUIPMENT INTERCONNECTING DISTRIBUTED RESOURCES WITH ELECTRIC POWER SYSTEMS - Edition 1 - Revision Date 2015/03/26

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

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Components covered by this certificate provide functionality in compliance with UL 1741 Supplement A (SA) when used in a UL Listed end product which has been evaluated by UL for it's intended purpose. Compliance testing was conducted on samples of the products according to the test methods in the following sections of UL 1741 with compliant results:

| (+) | Certified functions. Cross Reference table – UL 1741 SA to SRD | Source Requirement Document(s) | Test Standard(s) and Section(s) | Report Date |
|---|---|---|---|---|
| | ANTI-ISLANDING PROTECTION - UNINTENTIONAL ISLANDING WITH GRID SUPPORT FUNCTIONS ENABLED | N/A | UL 1741 SA 8 | 2019-03-28 |
| | LOW/HIGH VOLTAGE RIDE-THROUGH | SRD 14H V1.1: Part II.C. Table 4 | UL 1741 SA 9 | 2019-03-28 |
| | LOW/HIGH FREQUENCY RIDE-THROUGH | SRD 14H V1.1: Part II.D.1 Table 5 | UL 1741 SA10 | 2019-03-28 |
| | RAMP RATES | SRD 14H V1.1: Part II.G.1 | UL 1741 SA 11 | 2019-03-28 |
| | RECONNECT BY "SOFT START" | SRD 14H V1.1: Part II.G.2 | UL 1741 SA 11 | 2019-03-28 |
| | SPECIFIED POWER FACTOR | SRD 14H V1.1: Part II.A.1 | UL 1741 SA 12 | 2019-03-28 |
| | DYNAMIC VOLT/VAR OPERATIONS | SRD 14H V1.1: Part II.A.2 Table 2, Figure 2 | UL 1741 SA 13 | 2019-03-28 |
| | FREQUENCY-WATT | SRD 14H V1.1: Part II.F Table 7 | UL 1741 SA 14 | 2019-03-28 |
| | VOLT-WATT | SRD 14H V1.1: Part II.B Table 3, Figure 3 | UL 1741 SA 15 | 2019-03-28 |

(+) – Self Certification

Testing conducted to the requirements of UL 1741 SA corresponds to the minimum requirements for SRD-UL-1741-SA-V1.1. 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.

Bruce Mahrenholz, Director North American Certification Program

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# CERTIFICATE OF COMPLIANCE

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**Report Reference** E210376-20190328
**Issue Date** 2019-APRIL-04

## Appendix

| Detailed Testing Summary | Test Standard(s) and Section(s) | Fixed / Adjustable | Pass / Fail |
|---|---|---|---|
| UNINTENTIONAL ISLANDING WITH GRID SUPPORT FUNCTIONS ENABLED | UL 1741 SA 8 | Adjustable | Pass |
| HIGH VOLTAGE RIDE-THROUGH DURATION | UL 1741 SA 9.1 | Adjustable | Pass |
| HIGH VOLTAGE RIDE-THROUGH / MUST TRIP MAGNITUDES | UL 1741 SA 9.2 | Adjustable | Pass |
| HIGH VOLTAGE MUST TRIP CLEARING TIMES | UL 1741 SA 9.2 | Adjustable | Pass |
| LOW VOLTAGE RIDE-THROUGH DURATION | UL 1741 SA 9.1 | Adjustable | Pass |
| LOW VOLTAGE RIDE-THROUGH / MUST TRIP MAGNITUDES | UL 1741 SA 9.2 | Adjustable | Pass |
| LOW VOLTAGE MUST TRIP CLEARING TIMES | UL 1741 SA 9.2 | Adjustable | Pass |
| HIGH FREQUENCY RIDE-THROUGH DURATION | UL 1741 SA10.1 | Adjustable | Pass |
| HIGH FREQUENCY RIDE-THROUGH / MUST TRIP MAGNITUDES | UL 1741 SA10.2 | Adjustable | Pass |
| HIGH FREQUENCY MUST TRIP CLEARING TIMES | UL 1741 SA10.2 | Adjustable | Pass |
| LOW FREQUENCY RIDE-THROUGH DURATION | UL 1741 SA10.1 | Adjustable | Pass |
| LOW FREQUENCY RIDE-THROUGH / MUST TRIP MAGNITUDES | UL 1741 SA10.2 | Adjustable | Pass |
| LOW FREQUENCY MUST TRIP CLEARING TIMES | UL 1741 SA10.2 | Adjustable | Pass |
| NORMAL RAMP RATE | UL 1741 SA 11.2 | Adjustable | Pass |
| "SOFT START" RAMP RATE | UL 1741 SA 11.4 | Adjustable | Pass |
| SPECIFIED POWER FACTOR | UL 1741 SA 12 | Adjustable | Pass |
| VOLT/VAR MODE (Q(V)) | UL 1741 SA 13 | Adjustable | Pass |
| FREQUENCY-WATT (FW) | UL 1741 SA 14 | Adjustable | Pass |
| VOLT-WATT (VW) | UL 1741 SA 15 | Adjustable | Pass |

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# CERTIFICATE OF COMPLIANCE

**Certificate Number** 20190404-E210376
**Report Reference** E210376-20190328
**Issue Date** 2019-APRIL-04

| Inverter Firmware Version: | | |
|---|---|---|
| UL 1998 | Date | Version/Revision |
| Compliant or N/A | 2019-March-28 | V02.02.29.R |

| Inverter Ratings - Output | All models, with individual differences as shown |
|---|---|
| Output phase configuration | 3-Phase Delta |
| Nominal (line to line) output voltage V ac | 480V / 600V |
| Operating voltage range V ac | 422V – 528V / 480V – 690V |
| Line Synchronization Characteristics | Method 2 |
| Normal out frequency Hz | 60Hz |
| Rated output current (A ac) | 145A / 151A |
| Rated output power, (kW) | 125KW / 150KW |
| Max. Branch Circuit overcurrent protection (A ac) | 250A |
| Maximum Air Ambient (°C) | 60°C |

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

| INTERCONNECTION INTEGRITY TEST CATEGORIES: | |
|---|---|
| C62.42.2 Ring Wave Surge Category | B1 - / 5.87 kV / 0.5 kA |
| C62.42.2 Combination Wave Surge Category | B1 - Comb. Wave 6.27 kV @ 3.06 kA |
| C37.90.1 RF Immunity - compliance | Yes |
| C37.90.2 Communication circuit - compliance | Yes |

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**Complete all fields highlighted in red.**

| GENERAL | | |
|---|---|---|
| **VALUE** | **INFORMATION** | **NOTES** |
| Manufacturer | SMA Germany | |
| Model # | STP 125-US-20 | List Applicable Model(s) |
| Firmware version | V02.02.29.R or higher | Provide applicable firmware |
| Certification / Self-Certification | Certified | Choose 1 |
| NRTL Name | UL | |
| Certificate # | 20190328-E210376-A | |
| SA Certification Date | 28-03-2019 | |
| Responsible Engineer | Christian Henss | |
| Report # | E210376-2019-03-28 | |

| MANUFACTURER's STATED ACCURACY | | | | | | |
|---|---|---|---|---|---|---|
| **VALUE** | **UNITS** | **RANGE** | **RATING** | | | **DESCRIPTION** |
| Model | unitless | - | SHP 125-US-20 | - | - | Provide MSA for each model represented |
| Voltage, RMS | Volts | 50 % < V ≤ 120 % | 1% | - | - | |
| Current, RMS | Amps | 100 % | 1% | - | - | |
| Frequency | Hz | 50 to 66 Hz | 0.05 | - | - | |
| Active Power | Watts | 20 % < P ≤ 100 % | 5% | - | - | |
| Reactive Power | VAR | 20 % < Q ≤ 100 % | 5% | - | - | |
| Power Factor | Displacement | 20 % < P ≤ 100 % | 0.01 | - | - | |
| Time | s | 100 ms to 600 s | 0.001 | - | - | |

| INVERTER DC (INPUT) SIDE |
|---|

| VALUE | RATING Min | RATING Max | UNITS | DESCRIPTION |
|---|---|---|---|---|
| $V_{DC\text{- rating}}$ | 705 | 1500 | Volts | DC voltage rating |
| $V_{MPPT\text{-}RANGE}$ | 705 | 1450 | Volts | Maximum power point track range |
| $I_{DC\ max}$ | 325 | | Amps | Max input short-circuit current per MPPT |

| INVERTER AC (OUTPUT) SIDE | | | | | |
|---|---|---|---|---|---|
| VALUE | RATING | | | UNITS | DESCRIPTION |
| $V_{AC\text{-}NOMINAL(Phase\text{-}neutral)}$ | 277 | - | - | Volts | Nominal Voltage Phase-neutral (if neutral available) |
| $V_{AC\text{-}NOMINAL(Phase\text{-}phase)}$ | **480** | - | - | Volts | Nominal Voltage Phase-phase |
| Number of Phases | 3 | | - | Number | Number of electrical phases |
| $P_{OUT}$ | **125000** | | | VA | Rated Power Output |
| $I_{NOMINAL\text{-}OUTPUT}$ | **151** | | | Amps | Nominal current per phase |
| $I_{MAXIMUM\text{-}OUTPUT\ (at\ Vlow)}$ | **151** | | | Amps | Maximum output current at lowest operating voltage |

| FIXED POWER FACTOR | | 480 Min | 480 Max | - Min | - Max | - Min | - Max | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| >15 kW | Underexcited, Inductive, Absorbing | -80 | 100 | | | | | % | -85% to 100% | Y | Capacitive (var injection) power factor to Reactive (var absorption) power factor range. RULE 14H Default PF = -0.95 (Absorbing) for self certification purposes. |
| | Overexcited, Capacitive, Injecting | 100 | 80 | | | | | % | 100% to 85% | Y | |
| <=15 kW | Underexcited, Inductive, Absorbing | NA | NA | | | | | % | -90% to 100% | - | Capacitive (var injection) power factor to Reactive (var absorption) power factor range. RULE 14H Default PF = -0.95 (Absorbing) for self certification purposes. |
| | Overexcited, Capacitive, Injecting | NA | NA | | | | | % | 100% to 90% | - | |

| VOLTAGE RIDE-THROUGH | | 480 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max | | | | |
| OV2 | $I_{RMS\_MAX@VRT(V = 120\%)}$ | 125.29 | | | | | | Amps | - | - | Maximum RMS current when voltage goes above to 120% before trip |
| | $t_{TRIP (V > 120\%)}$ | 0.1 | 59.00 | | | | | Sec. | 0.16 | Y | Trip time |
| OV1 | $I_{RMS\_MAX@VRT(V = 110\%)}$ | 136.68 | | | | | | Amps | - | - | Maximum RMS current when voltage is between 110% and 120% before trip |
| | $t_{RIDE-THROUGH (110\% < V \leq 120\%)}$ | 0.10 | 30 | | | | | Sec. | 0.92 | Y | Ride through time |
| | $t_{TRIP (110\% < V \leq 120\%)}$ | 0.10 | 60.0 | | | | | Sec. | 1 | Y | Trip time |
| Nominal | $I_{RMS\_MAX@(V = 109\%)}$ | 137.94 | | | | | | Amps | - | - | Maximum RMS current when voltage is 109% |
| | $I_{RMS@(V = 100\%)}$ | 151.00 | | | | | | Amps | - | - | RMS current when voltage is 100% |
| | $I_{RMS\_MIN@(V = 90\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is 90% |
| UV1 | $I_{RMS\_MIN@VRT(V = 75\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is between 70% and 88% before trip |
| | $t_{RIDE-THROUGH (70\% \leq V < 88\%)}$ | 0.1 | 30 | | | | | Sec. | 20 | Y | Ride through time |
| | $t_{TRIP (70\% \leq V < 88\%)}$ | 0.1 | 60.0 | | | | | Sec. | 21 | Y | Trip time |
| UV2 | $I_{RMS\_MIN@VRT(V = 70\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is between 50% and 70% before trip |
| | $t_{RIDE-THROUGH (50\% \leq V < 70\%)}$ | 0.10 | 30 | | | | | Sec. | 10-20 | Y | Ride through time |
| | $t_{TRIP (50\% \leq V < 70\%)}$ | 0.10 | 60.0 | | | | | Sec. | 11-21 | Y | Trip time |
| UV3 | $I_{RMS\_MIN@VRT(V = 50\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is below 50% before trip |
| | $t_{RIDE-THROUGH (V < 50\%)}$ | 0.10 | 30 | | | | | Sec. | - | - | Ride through time |
| | $t_{TRIP (V < 50\%)}$ | 0.10 | 60.0 | | | | | Sec. | 2 | Y | Trip time |

| FREQUENCY RIDE-THROUGH | | 480 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max | | | | |
| OF2 | $I_{RMS\_MAX@FRT(f = 64Hz)}$ | 151.00 | | | | | | Amps | - | - | Maximum RMS current when the frequency is above 64 Hz before trip |
| | $t_{TRIP (f > 64 Hz)}$ | 0.10 | 1000.00 | | | | | Sec. | 0.16 | Y | Trip time |
| OF1 | $I_{RMS\_MAX@FRT(63 Hz < f \leq 64Hz)}$ | 151.00 | | | | | | Amps | - | - | Maximum RMS current when the frequency is between 63 and 64 Hz before trip |
| | $t_{RIDE-THROUGH (63 Hz< f \leq 64 Hz)}$ | 0.10 | 999 | | | | | Sec. | 20 | Y | Ride Through Time |
| | $t_{TRIP (63 Hz < f \leq 64 Hz)}$ | 0.1 | 1000.0 | | | | | Sec. | 21 | Y | Trip time |
| Nominal | $I_{RMS\_MAX@ f = 63 Hz}$ | 151.00 | | | | | | Amps | - | - | Maximum RMS current when the frequency is 63 Hz |
| | $I_{RMS@ f = 60 Hz}$ | 151.00 | | | | | | Amps | - | - | RMS current when the frequency is 60 Hz |
| | $I_{RMS\_MIN@ f = 57 Hz}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when the frequency is 57 Hz |
| UF1 | $I_{RMS\_MIN@FRT(56 Hz \leq f < 57 Hz)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when the frequency is between 56 and 57 Hz before trip |
| | $t_{RIDE-THROUGH (56 Hz \leq f < 57 Hz)}$ | 0.10 | 999 | | | | | Sec. | 20 | Y | Ride Through Time |
| | $t_{TRIP (56 Hz \leq f < 57 Hz)}$ | 0.1 | 1000.0 | | | | | Sec. | 21 | Y | Trip time |
| UF2 | $I_{RMS\_MIN@FRT(f < 56 Hz)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when the frequency is below 56 Hz before trip |
| | $t_{TRIP (f < 56 Hz)}$ | 0.1 | 1000 | | | | | Sec. | 0.16 | Y | Trip time |

| VOLT-VAR, Q(V) | 480 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| V1, $UV_{Volt\text{-}Var\_MIN}$ | 70 | 100 | | | | | % $V_{NOMINAL}$ | 94 | Y | Lowest voltage where Volt-VAr starts at undervoltage |
| % Q1, $VArs_{@UV\_Volt\text{-}Var\_MIN}$ | -100 | 100 | | | | | % Q (Var Injection) | 44 | Y | VArs at lowest undervoltage Volt-VAR point (-53% for aggregate generating facility >15 kW, -44% for aggregate generating facility <= 15 kW) |
| V2, $UV_{Volt\text{-}Var\_MAX}$ | 70 | 100 | | | | | % $V_{NOMINAL}$ | 97 | Y | Highest voltage where Volt-VAr finish at undervoltage |
| % Q2, $VArs_{@UV\_Volt\text{-}Var\_MAX}$ | -100 | 100 | | | | | % Q (0 VAr) | 0 | Y | VArs at highest undervoltage Volt-VAR point |
| V3, $OV_{Volt\text{-}Var\_MIN}$ | 100 | 120 | | | | | % $V_{NOMINAL}$ | 103 | Y | Lowest voltage where Volt-VAr starts at overvoltage |
| % Q3, $VArs_{@OV\_Volt\text{-}Var\_MIN}$ | -100 | 100 | | | | | % Q (0 VAr) | 0 | Y | VArs at lowest overvoltage Volt-VAR point |
| V4, $OV_{Volt\text{-}Var\_MAX}$ | 100 | 120 | | | | | % $V_{NOMINAL}$ | 106 | Y | Highest voltage where Volt-VAr finish at overvoltage |
| % Q4, $VArs_{@OV\_Volt\text{-}Var\_MAX}$ | -100 | 100 | | | | | % Q (Var Absorption) | -44 | Y | VVArs at highest overvoltage Volt-VAR point (53% for aggregate generating faility >15 kW, 44% for aggregate generating facility <= 15 kW) |
| Response Time | 0 | 1000 | | | | | Sec. | 10 | Y | Response time (if non-adjustable range, place default value in MIN) |
| Power Priortity | reactive | | | | | | Unitless | Reactive | Y | Power Priority |

| POWER RAMP RATE | 480 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| Connect/Reconnect $RAMP_{RATE}$ | 0.16 | 166 | | | | | % $P_{RATED}$/sec. | 100 | Y | Percentage of nominal generated power per second "Ramp Rate" |
| Soft Start $RAMP_{RATE}$ | 0.016 | 166 | | | | | % $P_{RATED}$/sec. | 0.33 | Y | Percentage of nominal generated power per second "Ramp Rate" |

| VOLT-WATT | 480 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| Power Rate | 0 | 100 | | | | | % $P_{PRATED}$/V | -25 | Y | Percentage of power reduction per volt "Volt-Watt rate" |
| Start voltage | 100 | 120 | | | | | % Vnom | 106 | Y | Power reduction starting voltage |
| Stop voltage | 100 | 120 | | | | | % Vnom | 110 | Y | Power reduction endpoint voltage |
| Response Time | 0 | 1000 | | | | | Sec. | 10 | Y | Response tiem (If non-adjustable range, place default value in MIN) |
| Power Reference | $P_{pre}$ | | | | | | unitless | $P_{rated}$ or $P_{pre\text{-}disturbance}$ | Y | Active power output |

| FREQUENCY-WATT | 480 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| $FW_{RATE}$ | 28.6 | 130 | | | | | %$P_{rated}$/Hz | ~42 | Y | Minimum percentage of power reduction per hertz "frequency-watt rate" (based on kOF = 0.04) |
| Freq adjustment range at Start frequency | 60.01 | 62 | | | | | Hz | 60.04 | Y | Power reduction Starting Frequency (Based on dbOF = 0.036 Hz) |
| Response Time | 3 | 3 | | | | | Sec. | 0,5 - 3 | Y | Response tiem (if non-adjustable range, place default value in MIN) |
| Power Reference | $P_{pre}$ | | | | | | unitless | $P_{rated}$ or $P_{pre\text{-}disturbance}$ | Y | Active power output |

| METHODS FOR APPLYING SETPOINTS |
|---|

Verify installed firmware version 02.02.29.R or higher
a. If necessary, download and install latest firmware version for SHP 125-US-20 and SHP 150-US-20 from SMA website

2. Set inverter operating parameters to comply with HECO Rule 14H GSUI requirements by manual parameter adjustments as described in SMA Technical Note US_TN_HECO_Rule_14H_SHP_US-20_PEAK3

**Complete all fields highlighted in red.**

| GENERAL | | |
|---|---|---|
| **VALUE** | **INFORMATION** | **NOTES** |
| Manufacturer | SMA Germany | |
| Model # | STP 150-US-20 | List Applicable Model(s) |
| Firmware version | V02.02.29.R or higher | Provide applicable firmware |
| Certification / Self-Certification | Certified | Choose 1 |
| NRTL Name | UL | |
| Certificate # | 20190328-E210376-A | |
| SA Certification Date | 28-03-2019 | |
| Responsible Engineer | Christian Henss | |
| Report # | E210376-2019-03-28 | |

| MANUFACTURER's STATED ACCURACY | | | | | | |
|---|---|---|---|---|---|---|
| **VALUE** | **UNITS** | **RANGE** | **RATING** | | | **DESCRIPTION** |
| Model | unitless | - | SHP 150-US-20 | - | - | Provide MSA for each model represented |
| Voltage, RMS | Volts | 50 % < V ≤ 120 % | 1% | - | - | |
| Current, RMS | Amps | 100 % | 1% | - | - | |
| Frequency | Hz | 50 to 66 Hz | 0.05 | - | - | |
| Active Power | Watts | 20 % < P ≤ 100 % | 5% | - | - | |
| Reactive Power | VAR | 20 % < Q ≤ 100 % | 5% | - | - | |
| Power Factor | Displacement | 20 % < P ≤ 100 % | 0.01 | - | - | |
| Time | s | 100 ms to 600 s | 0.001 | - | - | |

| INVERTER DC (INPUT) SIDE |
|---|

| VALUE | RATING Min | RATING Max | UNITS | DESCRIPTION |
|---|---|---|---|---|
| $V_{DC\text{- rating}}$ | 880 | 1500 | Volts | DC voltage rating |
| $V_{MPPT\text{-}RANGE}$ | 880 | 1450 | Volts | Maximum power point track range |
| $I_{DC\ max}$ | 325 | | Amps | Max input short-circuit current per MPPT |

| INVERTER AC (OUTPUT) SIDE | | | | | |
|---|---|---|---|---|---|
| VALUE | RATING | | | UNITS | DESCRIPTION |
| $V_{AC\text{-}NOMINAL(Phase\text{-}neutral)}$ | 346 | - | - | Volts | Nominal Voltage Phase-neutral (if neutral available) |
| $V_{AC\text{-}NOMINAL(Phase\text{-}phase)}$ | **600** | - | - | Volts | Nominal Voltage Phase-phase |
| Number of Phases | 3 | | - | Number | Number of electrical phases |
| $P_{OUT}$ | **150000** | | | VA | Rated Power Output |
| $I_{NOMINAL\text{-}OUTPUT}$ | **145** | | | Amps | Nominal current per phase |
| $I_{MAXIMUM\text{-}OUTPUT\ (at\ Vlow)}$ | **151** | | | Amps | Maximum output current at lowest operating voltage |

| FIXED POWER FACTOR | | 600 Min | 600 Max | - Min | - Max | - Min | - Max | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| >15 kW | Underexcited, Inductive, Absorbing | -80 | 100 | | | | | % | -85% to 100% | Y | Capacitive (var injection) power factor to Reactive (var absorption) power factor range. RULE 14H Default PF = -0.95 (Absorbing) for self certification purposes. |
| | Overexcited, Capacitive, Injecting | 100 | 80 | | | | | % | 100% to 85% | Y | |
| <=15 kW | Underexcited, Inductive, Absorbing | NA | NA | | | | | % | -90% to 100% | - | Capacitive (var injection) power factor to Reactive (var absorption) power factor range. RULE 14H Default PF = -0.95 (Absorbing) for self certification purposes. |
| | Overexcited, Capacitive, Injecting | NA | NA | | | | | % | 100% to 90% | - | |

| VOLTAGE RIDE-THROUGH | | 600 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max | | | | |
| OV2 | $I_{RMS\_MAX@VRT(V = 120\%)}$ | 120.28 | | | | | | Amps | - | - | Maximum RMS current when voltage goes above to 120% before trip |
| | $t_{TRIP (V > 120\%)}$ | 0.1 | 59.00 | | | | | Sec. | 0.16 | Y | Trip time |
| OV1 | $I_{RMS\_MAX@VRT(V = 110\%)}$ | 131.22 | | | | | | Amps | - | - | Maximum RMS current when voltage is between 110% and 120% before trip |
| | $t_{RIDE-THROUGH (110\% < V \leq 120\%)}$ | 0.10 | 30 | | | | | Sec. | 0.92 | Y | Ride through time |
| | $t_{TRIP (110\% < V \leq 120\%)}$ | 0.10 | 60.0 | | | | | Sec. | 1 | Y | Trip time |
| Nominal | $I_{RMS\_MAX@(V = 109\%)}$ | 132.42 | | | | | | Amps | - | - | Maximum RMS current when voltage is 109% |
| | $I_{RMS@(V = 100\%)}$ | 145.00 | | | | | | Amps | - | - | RMS current when voltage is 100% |
| | $I_{RMS\_MIN@(V = 90\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is 90% |
| UV1 | $I_{RMS\_MIN@VRT(V = 75\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is between 70% and 88% before trip |
| | $t_{RIDE-THROUGH (70\% \leq V < 88\%)}$ | 0.1 | 30 | | | | | Sec. | 20 | Y | Ride through time |
| | $t_{TRIP (70\% \leq V < 88\%)}$ | 0.1 | 60.0 | | | | | Sec. | 21 | Y | Trip time |
| UV2 | $I_{RMS\_MIN@VRT(V = 70\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is between 50% and 70% before trip |
| | $t_{RIDE-THROUGH (50\% \leq V < 70\%)}$ | 0.10 | 30 | | | | | Sec. | 10-20 | Y | Ride through time |
| | $t_{TRIP (50\% \leq V < 70\%)}$ | 0.10 | 60.0 | | | | | Sec. | 11-21 | Y | Trip time |
| UV3 | $I_{RMS\_MIN@VRT(V = 50\%)}$ | 151.00 | | | | | | Amps | - | - | Minimum RMS current when voltage is below 50% before trip |
| | $t_{RIDE-THROUGH (V < 50\%)}$ | 0.10 | 30 | | | | | Sec. | - | - | Ride through time |
| | $t_{TRIP (V < 50\%)}$ | 0.10 | 60.0 | | | | | Sec. | 2 | Y | Trip time |

| FREQUENCY RIDE-THROUGH | | 600 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max | | | | |
| OF2 | $I_{RMS\_MAX@FRT(f = 64Hz)}$ | 145.00 | | | | | | Amps | - | - | Maximum RMS current when the frequency is above 64 Hz before trip |
| | $t_{TRIP (f > 64 Hz)}$ | 0.10 | 1000.00 | | | | | Sec. | 0.16 | Y | Trip time |
| OF1 | $I_{RMS\_MAX@FRT(63 Hz < f \leq 64Hz)}$ | 145.00 | | | | | | Amps | - | - | Maximum RMS current when the frequency is between 63 and 64 Hz before trip |
| | $t_{RIDE-THROUGH (63 Hz< f \leq 64 Hz)}$ | 0.10 | 999 | | | | | Sec. | 20 | Y | Ride Through Time |
| | $t_{TRIP (63 Hz < f \leq 64 Hz)}$ | 0.1 | 1000.0 | | | | | Sec. | 21 | Y | Trip time |
| Nominal | $I_{RMS\_MAX@ f = 63 Hz}$ | 145.00 | | | | | | Amps | - | - | Maximum RMS current when the frequency is 63 Hz |
| | $I_{RMS@ f = 60 Hz}$ | 145.00 | | | | | | Amps | - | - | RMS current when the frequency is 60 Hz |
| | $I_{RMS\_MIN@ f = 57 Hz}$ | 145.00 | | | | | | Amps | - | - | Minimum RMS current when the frequency is 57 Hz |
| UF1 | $I_{RMS\_MIN@FRT(56 Hz \leq f < 57 Hz)}$ | 145.00 | | | | | | Amps | - | - | Minimum RMS current when the frequency is between 56 and 57 Hz before trip |
| | $t_{RIDE-THROUGH (56 Hz \leq f < 57 Hz)}$ | 0.10 | 999 | | | | | Sec. | 20 | Y | Ride Through Time |
| | $t_{TRIP (56 Hz \leq f < 57 Hz)}$ | 0.1 | 1000.0 | | | | | Sec. | 21 | Y | Trip time |
| UF2 | $I_{RMS\_MIN@FRT(f < 56 Hz)}$ | 145.00 | | | | | | Amps | - | - | Minimum RMS current when the frequency is below 56 Hz before trip |
| | $t_{TRIP (f < 56 Hz)}$ | 0.1 | 1000 | | | | | Sec. | 0.16 | Y | Trip time |

| VOLT-VAR, Q(V) | 600 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| V1, $UV_{Volt\text{-}Var\_MIN}$ | 70 | 100 | | | | | % $V_{NOMINAL}$ | 94 | Y | Lowest voltage where Volt-VAr starts at undervoltage |
| % Q1, $VArs_{@UV\_Volt\text{-}Var\_MIN}$ | -100 | 100 | | | | | % Q (Var Injection) | 44 | Y | VArs at lowest undervoltage Volt-VAR point (-53% for aggregate generating facility >15 kW, -44% for aggregate generating facility <= 15 kW) |
| V2, $UV_{Volt\text{-}Var\_MAX}$ | 70 | 100 | | | | | % $V_{NOMINAL}$ | 97 | Y | Highest voltage where Volt-VAr finish at undervoltage |
| % Q2, $VArs_{@UV\_Volt\text{-}Var\_MAX}$ | -100 | 100 | | | | | % Q (0 VAr) | 0 | Y | VArs at highest undervoltage Volt-VAR point |
| V3, $OV_{Volt\text{-}Var\_MIN}$ | 100 | 120 | | | | | % $V_{NOMINAL}$ | 103 | Y | Lowest voltage where Volt-VAr starts at overvoltage |
| % Q3, $VArs_{@OV\_Volt\text{-}Var\_MIN}$ | -100 | 100 | | | | | % Q (0 VAr) | 0 | Y | VArs at lowest overvoltage Volt-VAR point |
| V4, $OV_{Volt\text{-}Var\_MAX}$ | 100 | 120 | | | | | % $V_{NOMINAL}$ | 106 | Y | Highest voltage where Volt-VAr finish at overvoltage |
| % Q4, $VArs_{@OV\_Volt\text{-}Var\_MAX}$ | -100 | 100 | | | | | % Q (Var Absorption) | -44 | Y | VVArs at highest overvoltage Volt-VAR point (53% for aggregate generating faility >15 kW, 44% for aggregate generating facility <= 15 kW) |
| Response Time | 0 | 1000 | | | | | Sec. | 10 | Y | Response time (if non-adjustable range, place default value in MIN) |
| Power Priortity | reactive | | | | | | Unitless | Reactive | Y | Power Priority |

| POWER RAMP RATE | 600 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| Connect/Reconnect $RAMP_{RATE}$ | 0.16 | 166 | | | | | % $P_{RATED}$/sec. | 100 | Y | Percentage of nominal generated power per second "Ramp Rate" |
| Soft Start $RAMP_{RATE}$ | 0.016 | 166 | | | | | % $P_{RATED}$/sec. | 0.33 | Y | Percentage of nominal generated power per second "Ramp Rate" |

| VOLT-WATT | 600 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| Power Rate | 0 | 100 | | | | | % $P_{PRATED}$/V | -25 | Y | Percentage of power reduction per volt "Volt-Watt rate" |
| Start voltage | 100 | 120 | | | | | % Vnom | 106 | Y | Power reduction starting voltage |
| Stop voltage | 100 | 120 | | | | | % Vnom | 110 | Y | Power reduction endpoint voltage |
| Response Time | 0 | 1000 | | | | | Sec. | 10 | Y | Response tiem (If non-adjustable range, place default value in MIN) |
| Power Reference | $P_{pre}$ | | | | | | unitless | $P_{rated}$ or $P_{pre\text{-}disturbance}$ | Y | Active power output |

| FREQUENCY-WATT | 600 | | - | | - | | UNITS | SRD V1.1 Range | SRD V1.1 Compliant? | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | | | | |
| $FW_{RATE}$ | 28.6 | 130 | | | | | %$P_{rated}$/Hz | ~42 | Y | Minimum percentage of power reduction per hertz "frequency-watt rate" (based on kOF = 0.04) |
| Freq adjustment range at Start frequency | 60.01 | 62 | | | | | Hz | 60.04 | Y | Power reduction Starting Frequency (Based on dbOF = 0.036 Hz) |
| Response Time | 3 | 3 | | | | | Sec. | 0,5 - 3 | Y | Response tiem (if non-adjustable range, place default value in MIN) |
| Power Reference | $P_{pre}$ | | | | | | unitless | $P_{rated}$ or $P_{pre\text{-}disturbance}$ | Y | Active power output |

| METHODS FOR APPLYING SETPOINTS |
|---|

Verify installed firmware version 02.02.29.R or higher
a. If necessary, download and install latest firmware version for SHP 125-US-20 and SHP 150-US-20 from SMA website

2. Set inverter operating parameters to comply with HECO Rule 14H GSUI requirements by manual parameter adjustments as described in SMA Technical Note US_TN_HECO_Rule_14H_SHP_US-20_PEAK3