# Test Verification of Conformity

## Verification Number: 211202348SHA-V1

On the basis of the tests undertaken, the sample<s> of the below product have been found to comply with the requirements of the referenced specification<s>/standard<s> at the time the tests were carried out. This verification is part of the full test report<s> and should be read in conjunction with it <them>.

| | |
|---|---|
| Applicant Name & Address: | Afore New Energy Technology (Shanghai)Co., Ltd.<br>Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China 201112 |
| Product Description: | Grid-connected PV inverter |
| Ratings & Principle Characteristics: | See Appendix(Specifications table) |
| Models/Type References: | See Appendix(Specifications table) |
| Brand Name: | Afore |
| Relevant Standards: | VDE-AR-N 4105:2018<br>conjunction with DIN VDE V 0124-100 :2020 |
| Verification Issuing Office Name & Address: | Intertek Testing Services Shanghai<br>Building No.86, 1198 Qinzhou Road (North), Shanghai 200233, China |
| Date of Tests: | 2021-04-29 to 2021-12-15 |
| Test Report Number(s): | 211202348SHA-001 |

Additional information in Appendix.

**Signature**

**Name: Jonny Jing**
**Position: Manager**
**Date: 2021-12-24**

# APPENDIX: Test Verification of Conformity

**This is an Appendix to Test Verification of Conformity Number: 211202348SHA-V1**

Manufacturer: Same as applicant

| Specifications table | | | | | |
|---|---|---|---|---|---|
| **Model** | HNS3000TL | HNS3600TL-1 | HNS3600TL | HNS4000TL | HNS5000TL |
| ***Input:*** | | | | | |
| Vmax PV (Vdc) | 600 | 600 | 600 | 600 | 600 |
| Isc PV (absolute Max.) (A) | 18 x 2 | 18 | 18 x 2 | 18 x 2 | 18 x 2 |
| Number MPP trackers | 2 | 1 | 2 | 2 | 2 |
| Number input strings | 1/1 | 1 | 1/1 | 1/1 | 1/1 |
| Max. PV input current(A) | 14 x 2 | 14 | 14 x 2 | 14 x 2 | 14 x 2 |
| MPPT voltage range (Vdc) | 70-550 | 70-550 | 70-550 | 70-550 | 70-550 |
| Vdc range @ full power (Vdc) | 110-550 | 265-550 | 130-550 | 145-550 | 180-550 |
| ***Output*** | | | | | |
| Normal Voltage(V) | L/N/PE, 220Vac, 230Vac, 240Vac | | | | |
| Frequency (Hz) | 50 / 60 | | | | |
| Current (normal) (A) | 13.1 | 15.7 | 15.7 | 17.4 | 21.8 |
| Current (Max. continuous) (A) | 15 | 17.5 | 17.5 | 20 | 24 |
| Power rating (W) | 3000 | 3600 | 3600 | 4000 | 5000 |
| Power Rating (VA) | 3000 | 3600 | 3600 | 4000 | 5000 |
| Power factor /rated | 1 (-0,8~+0,8 adjustable) | | | | |
| ***others*** | | | | | |
| Protective class | Class I | | | | |
| Ingress protection (IP) | IP 65 | | | | |
| Temperature (°C) | -25°C to +60°C (up 45°C derating) | | | | |
| Inverter Isolation | Non-isolated | | | | |

| Specifications table | | | | | |
|---|---|---|---|---|---|
| **Model** | HNS6000TL | HNS7000TL | HNS8000TL | HNS9000TL | HNS10000TL |
| ***Input:*** | | | | | |
| Vmax PV (Vdc) | 600 | 600 | 600 | 600 | 600 |
| Isc PV (absolute Max.) (A) | 18 x 2 | 18+35 | 18+35 | 35 x 2 | 35 x 2 |
| Number MPP trackers | 2 | 2 | 2 | 2 | 2 |
| Number input strings | 1/1 | 1/2 | 1/2 | 2/2 | 2/2 |
| Max. PV input current(A) | 14 x 2 | 14+26 | 14+26 | 26 x 2 | 26 x 2 |
| MPPT voltage range (Vdc) | 70-550 | 70-550 | 70-550 | 70-550 | 70-550 |
| Vdc range @ full power (Vdc) | 220-550 | 220-550 | 220-550 | 220-550 | 220-550 |
| ***Output*** | | | | | |
| Normal Voltage(V) | L/N/PE, 220Vac, 230Vac, 240Vac | | | | |
| Frequency (Hz) | 50 / 60 | | | | |
| Current (normal) (A) | 26.1 | 30.5 | 34.8 | 39.2 | 43.5 |
| Current (Max. continuous) (A) | 28.7 | 33.6 | 38.3 | 45 | 50 |
| Power rating (W) | 6000 | 7000 | 8000 | 9000 | 10000 |
| Power Rating (VA) | 6000 | 7000 | 8000 | 9000 | 10000 |
| Power factor /rated | 1 (-0,8~+0,8 adjustable) | | | | |
| ***others*** | | | | | |
| Protective class | Class I | | | | |
| Ingress protection (IP) | IP 65 | | | | |
| Temperature (°C) | -25°C to +60°C (up 45°C derating) | | | | |
| Inverter Isolation | Non-isolated | | | | |

**Annex E4: Verification of Conformity for power generation units**

| | | | |
|---|---|---|---|
| **Verification of Conformity for power generation units** | No: 211202348SHA-V1 | | |
| **Manufacturer** | Afore New Energy Technology (Shanghai)Co., Ltd.<br>Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China 201112 | | |
| **Type power generation unit** | Grid-connected PV inverter | | |
| **Model** | HNS3000TL, HNS3600TL-1, HNS3600TL, HNS4000TL, HNS5000TL, HNS6000TL, HNS7000TL, HNS8000TL, HNS9000TL, HNS10000TL | | |
| **Assessment values** | Max. active power PEmax (W) | 3016 | HNS3000TL |
| | | 9988 | HNS10000TL |
| | Max. apparent power SEmax (VA) | 3041 | HNS3000TL |
| | | 10042 | HNS10000TL |
| | Rated voltage | 1/N/PE~ 230Vac | |
| **Network connection rules** | **VDE-AR-N 4105 "Power generation systems connected to the low-voltage network"**<br>Technical minimum requirements for connection and parallel operation of power generation systems connected to the low voltage network | | |
| **Firmware version** | V06 | | |
| The above mentioned power generation unit meets the requirements of VDE-AR-N 4105. | | | |

## Annex E.5 Test report "Network interactions" for power generation units

**Model:** HNS3000TL

| | | | | |
|---|---|---|---|---|
| Extract from the test report on the certificate of units | | 211202348SHA-001 | | |
| Type of installation: | Grid-connected PV inverter | | Manufacturer 's data | |
| Installation manufacturer: | Afore New Energy Technology(Shanghai) Co., Ltd. | | Type of installation: Grid-connected PV inverter | |
| | | | Power of normal output in nominal conditions):3000 W | |
| | | | Rating voltage: | 230 V |
| Period of measurement: | | From 2021-04-29 to 2021-12-15 | | |
| | | | | |
| | | Maximum active Power $P_{Emax}$ 3016 W | Maximum reactive Power $S_{Emax}$ 3041 VA | |
| | | | | |
| | | Switching actions | | |
| | | Switching on without specification (to the primary energy carrier) | $k_i$ 0.136 | The limit of $k_{imax}$ is 1.0 |
| | | Most unfavorable case when switching between generator levels | $k_i$ 0.142 | |
| | | Switching on during nominal conditions (of the primary energy carrier) | $k_i$ 0.141 | |
| | | Switching off during normal output | $k_i$ 0.303 | |
| | | Worst value of all switching operations | $k_{imax}$ 0.314 | |
| Flicker | | Angle of network impedance $\Psi_k$: | 32° | |
| | | Long-term flicker strength $P_{lt}$: | 0.15 | |

**Model:** HNS3000TL

**E.5 Test report "Network interactions" for power generation units**

| Harmonic-( for the PGU and PGS<3.68kVA/phase) | | | | |
|---|---|---|---|---|
| Load current: 100 % | | | | |
| Ordinal number | Current (%) L1 | Current (%) L2 | Current (%) L3 | Limit (%) |
| 0 | 0.015 | - | - | 0.5% I |
| 1 | -- | - | - | -- |
| 2 | 0.239 | - | - | 1.08 |
| 3 | 1.185 | - | - | 2.3 |
| 4 | 0.060 | - | - | 0.43 |
| 5 | 0.519 | - | - | 1.14 |
| 6 | 0.051 | - | - | 0.30 |
| 7 | 0.173 | - | - | 0.77 |
| 8 | 0.058 | - | - | 0.23 |
| 9 | 0.200 | - | - | 0.40 |
| 10 | 0.123 | - | - | 0.184 |
| 11 | 0.253 | - | - | 0.33 |
| 12 | 0.093 | - | - | 0.153 |
| 13 | 0.215 | - | - | 0.21 |
| 14 | 0.091 | - | - | 0.131 |
| 15 | 0.344 | - | - | 0.15 |
| 16 | 0.074 | - | - | 0.115 |
| 17 | 0.084 | - | - | 0.132 |
| 18 | 0.038 | - | - | 0.102 |
| 19 | 0.163 | - | - | 0.118 |
| 20 | 0.065 | - | - | 0.092 |
| 21 | 0.107 | - | - | 0.107 |
| 22 | 0.038 | - | - | 0.084 |
| 23 | 0.040 | - | - | 0.098 |
| 24 | 0.038 | - | - | 0.077 |
| 25 | 0.077 | - | - | 0.09 |
| 26 | 0.054 | - | - | 0.071 |
| 27 | 0.049 | - | - | 0.083 |
| 28 | 0.050 | - | - | 0.066 |
| 29 | 0.051 | - | - | 0.078 |
| 30 | 0.036 | - | - | 0.061 |
| 31 | 0.054 | - | - | 0.073 |
| 32 | 0.040 | - | - | 0.058 |
| 33 | 0.036 | - | - | 0.068 |
| 34 | 0.049 | - | - | 0.054 |
| 35 | 0.062 | - | - | 0.064 |
| 36 | 0.030 | - | - | 0.051 |
| 37 | 0.040 | - | - | 0.061 |
| 38 | 0.034 | - | - | 0.048 |
| 39 | 0.033 | - | - | 0.058 |
| 40 | 0.043 | - | - | 0.046 |
| THD | 1.83 | - | - | 5 |
| PWHD | - | - | - | 22% |

## Annex E.7 Requirements to the Test Report on the NS protection

**Model:** HNS3000TL

| | |
|---|---|
| Extract from the test report for the NS protection "Determination of electric properties" | 211202348SHA-001 |

**Test report NS Protection**

| | | |
|---|---|---|
| Type of NS protection: | Integral | Further manufacturer instructions |
| Software version: | V06 | |
| Manufacturer: | Afore New Energy Technology(Shanghai) Co., Ltd. | |
| Period of measurement: | From 2021-04-29 to 2021-12-15 | |

| | Inverter(s) | | |
|---|---|---|---|
| Protective function | Set value | Tripping value | Tripping value NS protection |
| Rise-in-voltage protection U >> | 1.25 * $U_n$ | 288.0V | 0.188 s |
| Rise-in-voltage protection U > | 1.15 * $U_n$ | 264.8V | 0.191 s |
| Voltage drop protection U < | 0.8 * $U_n$ | 183.8V | 2.990 s* |
| Voltage drop protection U < | 0.45 * Un | 103.3V | 0.295 s |
| Frequency decrease protection f < | 47.5Hz | *47.48Hz* | 0.190 s |
| Frequency increase protection f > | 51.5Hz | *51.52Hz* | 0.196 s |

[a] The tripping time includes the period from the limit value violation U/f until the tripping signal to the interface switch.

When planning the power generation system, the response time of the interface switch shall be added to the maximum time value obtained as indicated above.

The disconnection time (sum of tripping time of the NS protection plus response time of the interface switch) shall not exceed 200 ms

* Longest disconnection of the rise-in-voltage protection as a moving 10-minute-average.

☒ **For integrated NS protection**

| | |
|---|---|
| Assigned to power generation unit of type | Grid-connected PV inverter |
| Type integrated interface switch | Power Relay |
| Response time of interface switch for integrated NS protection | 12ms |

Verification of the entire functional chain "integrated NS protection – interface switch" has resulted in successful disconnection.

NOTE1: Un=230V

## Annex E.5 Test report "Network interactions" for power generation units

**Model:** HNS10000TL

| | | | | |
|---|---|---|---|---|
| Extract from the test report on the certificate of units | | 211202348SHA-001 | | |
| Type of installation: | Grid-connected PV inverter | | Manufacturer 's data | |
| Installation manufacturer: | Afore New Energy Technology(Shanghai) Co., Ltd. | | Type of installation: Grid-connected PV inverter | |
| | | | Power of normal output in nominal conditions):1000 W | |
| | | | Rating voltage: | 230 V |
| Period of measurement: | | From 2021-04-29 to 2021-12-15 | | |
| | | | | |
| | | Maximum active Power $P_{Emax}$ 9988 W | Maximum reactive Power $S_{Emax}$ 10042 VA | |
| | | | | |
| | | Switching actions | | |
| | | Switching on without specification (to the primary energy carrier) $k_i$ | 0.136 | The limit of $k_{imax}$ is 1.0 |
| | | Most unfavorable case when switching between generator levels $k_i$ | 0.142 | |
| | | Switching on during nominal conditions (of the primary energy carrier) $k_i$ | 0.141 | |
| | | Switching off during normal output $k_i$ | 0.303 | |
| | | Worst value of all switching operations $k_{imax}$ | 0.314 | |
| Flicker | | Angle of network impedance $\Psi_k$: | 32° | |
| | | Long-term flicker strength $P_{lt}$: | 0.17 | |

**Model:** HNS10000TL

**E.5 Test report "Network interactions" for power generation units**

| Harmonic-( for the PGU and PGS>3.68kVA/phase) | | | | |
|---|---|---|---|---|
| Load current: 100 % | | | | |
| Ordinal number | Current (%) L1 | Current (%) L2 | Current (%) L3 | Limit (%) |
| 0 | 0.025 | - | - | 0.5% I |
| 1 | -- | - | - | -- |
| 2 | 0.284 | - | - | 8% |
| 3 | 1.967 | - | - | Not stated |
| 4 | 0.077 | - | - | 4% |
| 5 | 0.786 | - | - | 10.7% |
| 6 | 0.043 | - | - | 2.67% |
| 7 | 0.369 | - | - | 7.2% |
| 8 | 0.042 | - | - | 2% |
| 9 | 0.181 | - | - | Not stated |
| 10 | 0.046 | - | - | 1.6% |
| 11 | 0.176 | - | - | 3.1% |
| 12 | 0.088 | - | - | 1.33% |
| 13 | 0.184 | - | - | 2% |
| 14 | 0.054 | - | - | --- |
| 15 | 0.125 | - | - | --- |
| 16 | 0.062 | - | - | --- |
| 17 | 0.131 | - | - | --- |
| 18 | 0.038 | - | - | --- |
| 19 | 0.093 | - | - | --- |
| 20 | 0.045 | - | - | --- |
| 21 | 0.035 | - | - | --- |
| 22 | 0.030 | - | - | --- |
| 23 | 0.032 | - | - | --- |
| 24 | 0.036 | - | - | --- |
| 25 | 0.084 | - | - | --- |
| 26 | 0.027 | - | - | --- |
| 27 | 0.035 | - | - | --- |
| 28 | 0.043 | - | - | --- |
| 29 | 0.042 | - | - | --- |
| 30 | 0.021 | - | - | --- |
| 31 | 0.036 | - | - | --- |
| 32 | 0.022 | - | - | --- |
| 33 | 0.023 | - | - | --- |
| 34 | 0.030 | - | - | --- |
| 35 | 0.058 | - | - | --- |
| 36 | 0.034 | - | - | --- |
| 37 | 0.035 | - | - | --- |
| 38 | 0.022 | - | - | --- |
| 39 | 0.069 | - | - | --- |
| 40 | 0.046 | - | - | --- |
| THD | 2.307 | - | - | 13% |
| PWHD | 1.378 | - | - | 22% |

## Annex E.7 Requirements to the Test Report on the NS protection

**Model:** HNS10000TL

| | |
|---|---|
| Extract from the test report for the NS protection "Determination of electric properties" | 211202348SHA-001 |

**Test report NS Protection**

| | | |
|---|---|---|
| Type of NS protection: | Integral | Further manufacturer instructions |
| Software version: | V06 | |
| Manufacturer: | Afore New Energy Technology(Shanghai) Co., Ltd. | |
| Period of measurement: | From 2021-04-29 to 2021-12-15 | |

| | Inverter(s) | | |
|---|---|---|---|
| Protective function | Set value | Tripping value | Tripping value NS protection |
| Rise-in-voltage protection U >> | 1.25 * $U_n$ | 288.0V | 0.188 s |
| Rise-in-voltage protection U > | 1.15 * $U_n$ | 264.8V | 0.191 s |
| Voltage drop protection U < | 0.8 * $U_n$ | 183.8V | 2.990 s* |
| Voltage drop protection U < | 0.45 * Un | 103.3V | 0.295 s |
| Frequency decrease protection f < | 47.5Hz | *47.48Hz* | 0.190 s |
| Frequency increase protection f > | 51.5Hz | *51.52Hz* | 0.196 s |

[a] The tripping time includes the period from the limit value violation U/f until the tripping signal to the interface switch.

When planning the power generation system, the response time of the interface switch shall be added to the maximum time value obtained as indicated above.

The disconnection time (sum of tripping time of the NS protection plus response time of the interface switch) shall not exceed 200 ms

* Longest disconnection of the rise-in-voltage protection as a moving 10-minute-average.

☒ **For integrated NS protection**

| | |
|---|---|
| Assigned to power generation unit of type | Grid-connected PV inverter |
| Type integrated interface switch | Power Relay |
| Response time of interface switch for integrated NS protection | 12ms |

Verification of the entire functional chain "integrated NS protection – interface switch" has resulted in successful disconnection.

NOTE1: Un=230V

**Signature**

**Name: Jonny Jing**
**Position: Manager**
**Date: 2021-12-24**