

# On-Grid PV Inverter

Installation and Operation Manual

[www.aforeenergy.com](http://www.aforeenergy.com)



Version: 03.61.01.00050113.V0.07

**Afore**

Afore New Energy Technology (Shanghai) Co., Ltd.

T 86-21-54326236 F +86-21-54326136 E info@aforeenergy.com

Ad Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China. 201112

**Afore**

Afore New Energy Technology (Shanghai) Co., Ltd.

# Contents

1.About This Manual . . . . .	1
1.1 Scope of Validity . . . . .	1
1.2 Target Group . . . . .	1
1.3 System Diagram . . . . .	1
2.Safety & Symbols . . . . .	2
2.1 Safety Precautions . . . . .	2
2.2 Explanations of Symbols . . . . .	3
3.Installation . . . . .	4
3.1 Package . . . . .	4
3.2 Product Overview . . . . .	5
3.3 Mounting Location . . . . .	6
3.4 Installation On-grid PV Inverter . . . . .	7
3.5 Electrical Connection . . . . .	8
3.5.1 PV Connection . . . . .	8
3.5.2 Grid Connection . . . . .	10
3.5.3 Communication Connection (WIFI / Ethernet / GPRS / RS485) . . . . .	12
4.Operation . . . . .	14
4.1 Control Panel . . . . .	14
4.2 Menu Structure . . . . .	15
4.3 Setting . . . . .	16
4.3.1 Startup Setting. . . . .	16
5.Commissioning . . . . .	17
6.Shut Down & Restart the Inverter . . . . .	18
6.1 Shut Down Procedures . . . . .	18
6.2 Restart the inverter . . . . .	18
7.Maintenance&Trouble Shooting . . . . .	18
7.1 Maintenance . . . . .	18
7.2 Fault Code and Trouble Shooting . . . . .	18
8.Specifications . . . . .	20

# 1. About This Manual

## 1.1 Scope of Validity

This manual describes the installation, commissioning, operation and maintenance of the following on-grid PV inverters produced by Afore New Energy:

### Single-Phase(One MPPT Tracker)

HNS1000TL-1      HNS1500TL-1      HNS2000TL-1      HNS2500TL-1  
 HNS3000TL-1

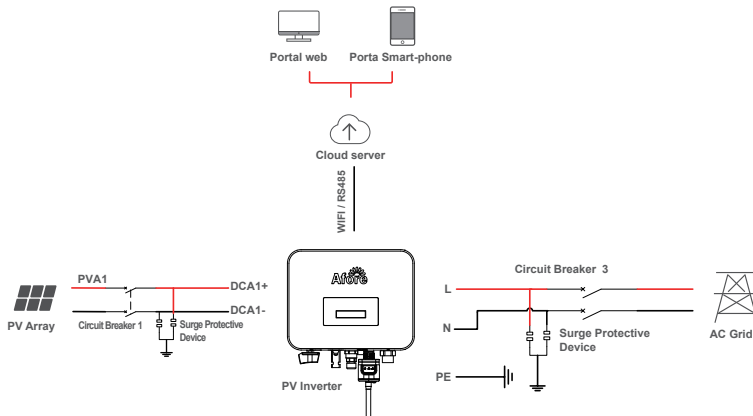
Please keep this manual all the time available in case of emergency.

## 1.2 Target Group

This manual is for qualified personnel. The tasks described in this manual must only be performed by qualified personnel.

## 1.3 System Diagram

The typical connection diagram for the entire PV system is on-grid.



Circuit Breaker and Surge Protector Recommendation:

Type	Max AC Current [A]	Rated current of AC breaker[A]
Single-Phase(One MPPT Tracker)		
HNS1000TL-1	6	16
HNS1500TL-1	9	16
HNS2000TL-1	12	20
HNS2500TL-1	13	20
HNS3000TL-1	15	25

- SPD: Lightning protection system, refer to the following options:
- AC side, nominal discharge current 20KA, second grade lightning protection, protection voltage 2.5KV
- DC side, nominal discharge current 20KA, second grade lightning protection, protection voltage 3.2KV
- The wiring distance between the inverter and the distribution box should be at least 5 meters.



**Note:**

The Inverter can be only connected to low-voltage grid. (220/230Vac, 50/60Hz).

## 2.Safety & Symbols

### 2.1 Safety Precautions

1. All work on the inverter must be carried out by qualified electricians.
2. The device may only be operated with PV panels.
3. The PV panels and inverter must be connected to the ground.
4. Do not touch the inverter cover until 5 minutes after disconnecting both DC and AC power supply.

5. Do not touch the inverter enclosure when operating, keep away from materials that may be affected by high temperatures.
6. Please ensure that the used device and any relevant accessories are disposed of in accordance with applicable regulations.
7. Afore inverter should be placed upwards and handled with care in delivery. Pay attention to waterproof. Do not expose the inverter to water, rain, snow or spray.
8. Alternative uses, modifications to the inverter not recommended. The warranty can become void if the inverter was tampered with or if the installation is not in accordance with the relevant installation instructions.

## 2.2 Explanations of Symbols

Afore inverter strictly comply with relevant safety standards. Please read and follow all the instructions and cautions during installation, operation and maintenance.



**Danger of electric shock**

The inverter contains fatal DC and AC power. All work on the inverter must be carried out by qualified personnel only.



**Beware of hot surface**

The inverter's housing may reach uncomfortably hot 60°C (140°F) under high power operation. Do not touch the inverter enclosure when operation.



**Residual power discharge**

Do not open the inverter cover until 5 minutes after disconnection both DC and AC power supply.



**Important notes**

Read all instructions carefully. Failure to follow these instructions, warnings and precautions may lead to device malfunction or damage.



Do not dispose of this device with the normal domestic waste.



**Without transformer**

This inverter does not use transformer for the isolation function.



**CE mark**

The inverter complies with the requirements of the applicable CE guidelines.



Refer to manual before service.

# 3.Installation

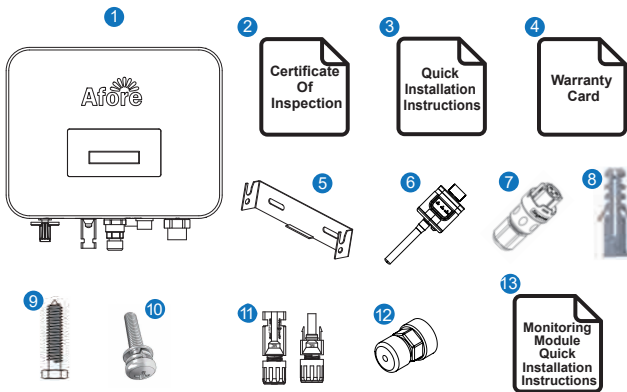
## 3.1 Package

### Unpacking

On receiving the inverter, please check to make sure the packing and all components are not missing or damaged. Please contact your dealer directly for supports if there is any damage or missing components.

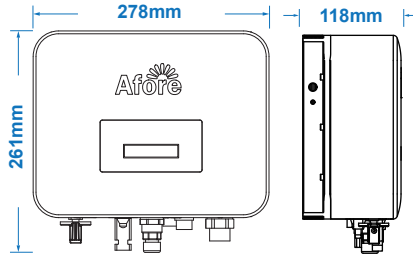
### Package List

Open the package, please check the packing list shown as below.



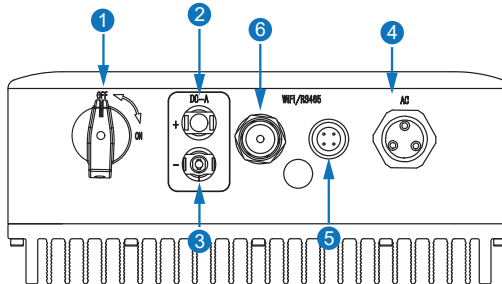
No.	Qty	Items	No.	Qty	Items
1	1	Solar Inverter	8	2	Plastic Expansion Tube
2	1	Certificate Of Inspection	9	2	Mounting Bracket Screw
3	1	Quick Installation Instructions	10	1	Security Screw
4	1	Warranty Card	11	1	DC Connector set
5	1	Wall Mounting Bracket	12	1	Zero-Injection Connector(Optional)
6	1	Monitor Module	13	1	Monitoring Module Quick Installation Instructions
7	1	AC Connector			

### 3.2 Product Overview



#### Overview of the Connection Area

The following picture shows the assignment of the individual connection areas on the bottom of the inverter.

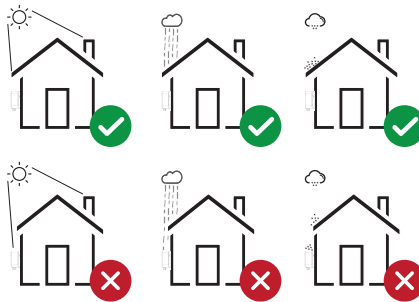


No.	Items
1	DC Switch
2	DC Connectors ( + ) For PV String
3	DC Connectors ( - ) For PV String
4	AC Connector
5	Monitor Module Port
6	Zero-Injection Port (Optional)

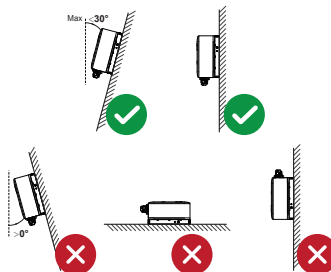
### 3.3 Mounting Location

The inverters are designed for indoor and outdoor installation (IP65), to increase the safety, performance and lifespan of the inverter, please select the mounting location carefully based on the following rules:

- The inverter should be installed on a solid surface, far from flammable or corrosion materials, where is suitable for inverter's weight and dimensions.
- The ambient temperature should be within  $-25\text{ C} \sim 60\text{ C}$  (between  $-13\text{ }^{\circ}\text{F}$  and  $140\text{ }^{\circ}\text{F}$ ).
- The installation of inverter should be protected under shelter. Do not expose the inverter to direct sunlight, water, rain, snow, spray lightning, etc.

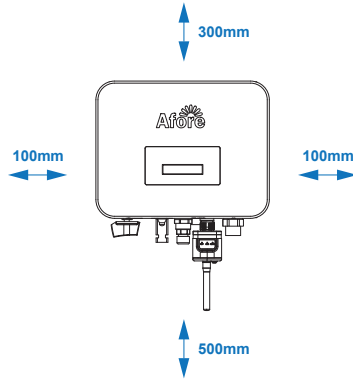


- The inverter should be installed vertically on the wall, or lean back on plane with a limited tilted angle. Please refer to below picture.



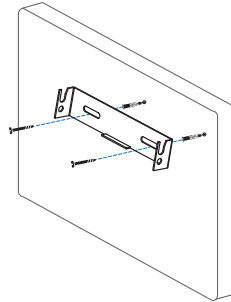
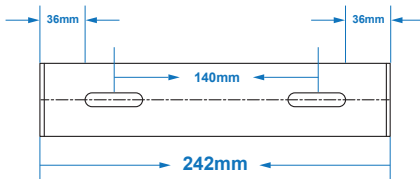


- Leave the enough space around inverter, easy for accessing to the inverter, connection points and maintenance.

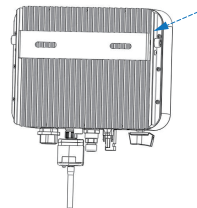
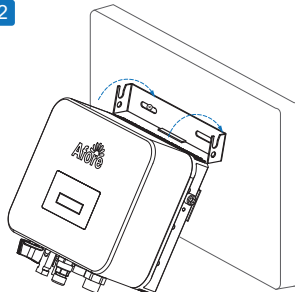


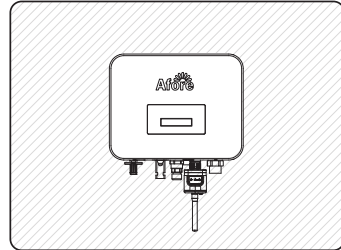
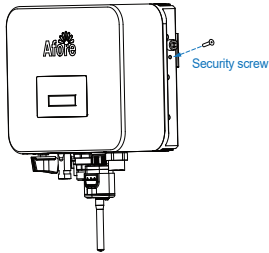
### 3.4 Installation On-grid PV Inverter

#### Step 1



#### Step 2



**Step 3**

## 3.5 Electrical Connection

### 3.5.1 PV Connection

The inverter have one MPPT channel, can be connected with one string of PV panels. Please make sure below requirements are followed before connecting PV panels / string to the inverter.

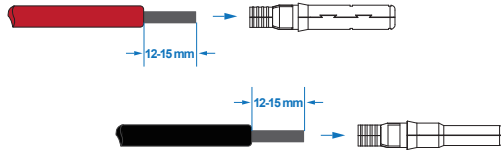
- The open-circuit voltage and short-circuit current of PV string must not exceed inverter's range
- The isolation resistance between PV string and ground must exceed 10 k $\Omega$
- The polarity from PV string are correct
- Use the DC plugs in the accessory
- The lightning protector should be equipped between PV string and inverter
- Disconnect all of the PV (DC) switch during wiring

**Warning:**

The fatal high voltage may on the DC side, please comply with electric safety when connecting.

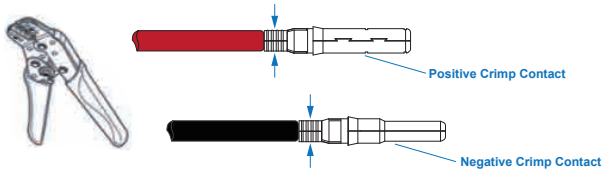
Please make sure the cable connected in correct polarity with inverter, otherwise inverter could be damaged.

Step 1



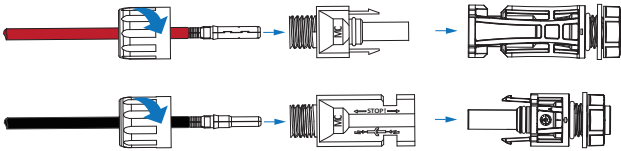
**Note:**  
PV cable suggestion  
Cross-section 4 mm<sup>2</sup>

Step 2

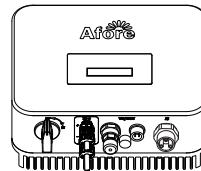


**Note:**  
Please use PV connector crimper  
to pinch the point of the arrow

Step 3



**Note:**  
You'll hear click sound when  
the connector assembly is correct



### 3.5.2 Grid Connection

The on-grid PV inverters work with grid (220/230/240 Vac, 50/60 Hz).

The external AC switch should be installed between inverter and grid to isolate from grid. Please make sure below requirements are followed before connecting AC cable to the inverter.

- The AC (grid) voltage must not exceed inverter's range
- The phase-line from AC distribution box are correctly connected
- Use the AC plugs in the accessory
- The surge protector should be equipped between grid and inverter
- Disconnect the AC (grid) switch during wiring



**Warning:**

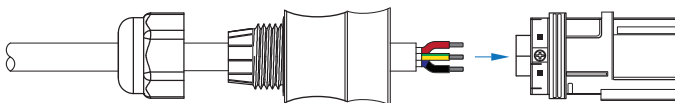
The fatal high voltage may on the AC side, please comply with electric safety when connecting. Please make sure the right line of AC grid connected with inverter, otherwise inverter could be damaged.

**Step 1**



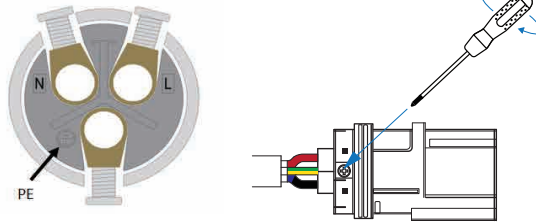
**Note:**  
AC cable suggestion  
Cross-section  
4 mm<sup>2</sup>

**Step 2**



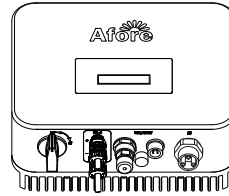
AC line goes through AC terminal waterproof head and cap

## Step 3



Connect AC line, Live line (L), Neutral line (N) and Ground Wire (PE) according to polarity.

## Step 4



1. Connect AC terminals and waterproof head, tighten the cap, make sure they clip closely together.
2. Connect AC connector to AC terminal of the inverter.
3. After making sure that it is firmly inserted, tighten the sleeve on the AC connector to the right and hear a click.



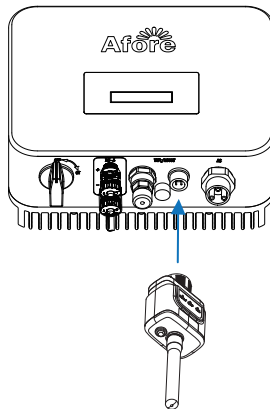
### 3.5.3 Communication Connection

The monitoring module could transmit the data to the cloud server, and display the data on the PC, tablet and smart-phone.

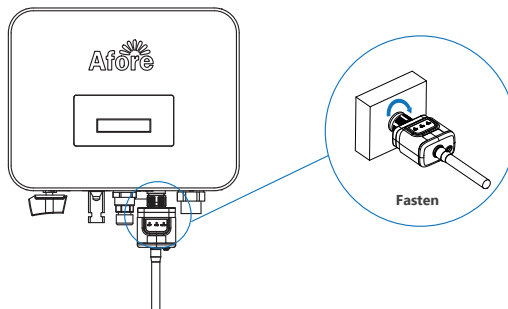
#### Install the WIFI / Ethernet / GPRS / RS485 Communication

WIFI / Ethernet / GPRS / RS485 communication is applicable to the inverter. Please refer to "Communication Configuration Instruction" for detailed instruction.

##### Step 1



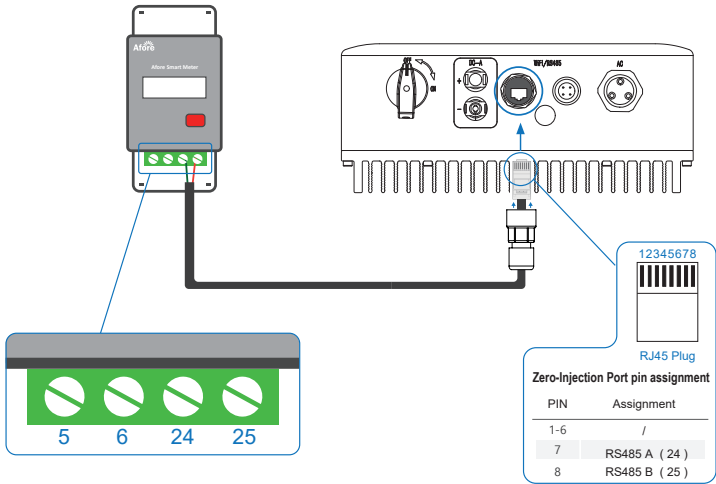
##### Step 2



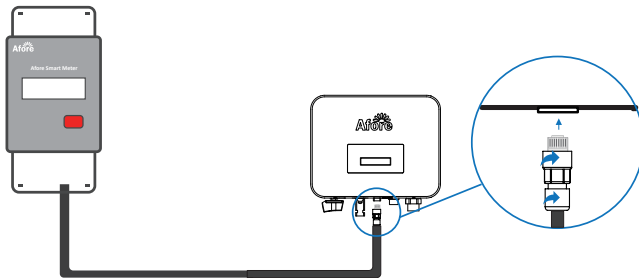
## Install the Zero Injection Smart Meter(optional)

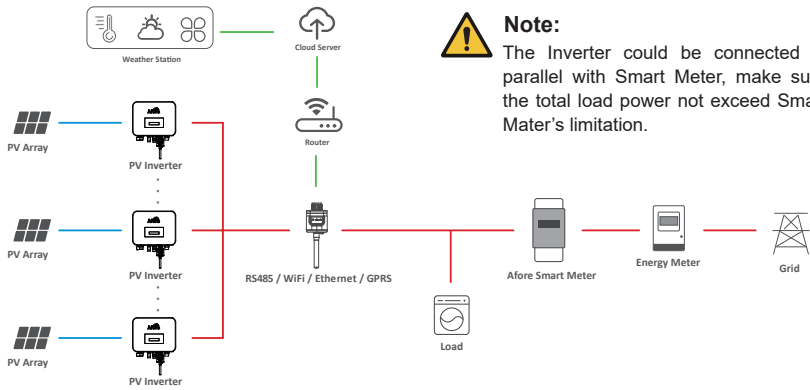
The Smart Meter is used for monitoring the power consumption of home electricity, the inverter will active export power limit function based on the monitoring data. Please refer to "Zero injection Smart Meter Instruction" for detailed instruction.

### Step 1



### Step 2



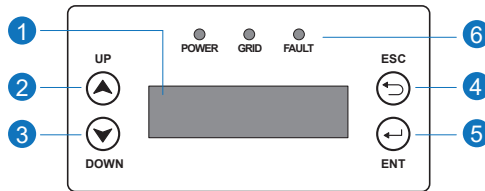


**Note:**

The Inverter could be connected in parallel with Smart Meter, make sure the total load power not exceed Smart Mater's limitation.

## 4.Operation

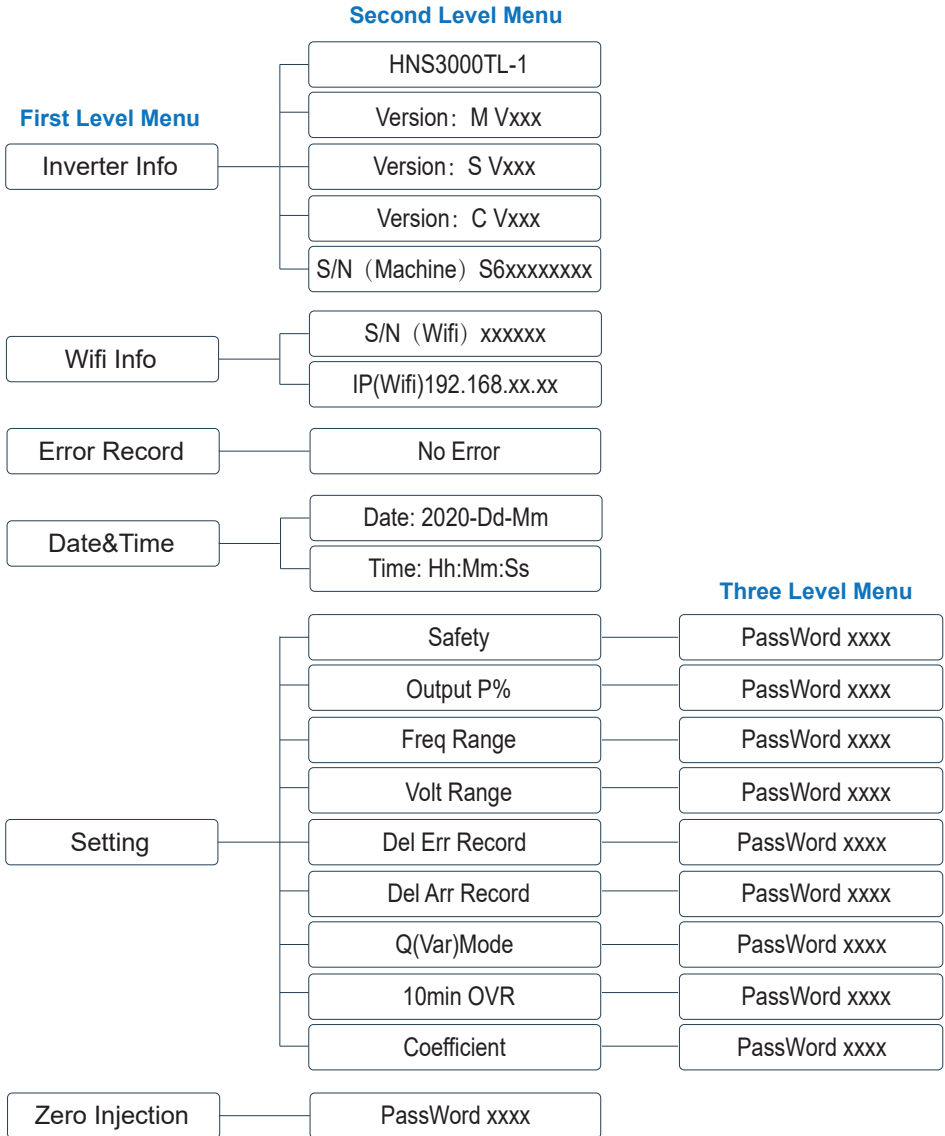
### 4.1 Control Panel



No.	Items	No.	Items
1	LCD Display	5	ENT Touch Button
2	UP Touch Button	6	POWER LED Indicator
3	DOWN Touch Button		GRID LED Indicator
4	ESC Touch Button		FAULT LED Indicator



## 4.2 Menu Structure

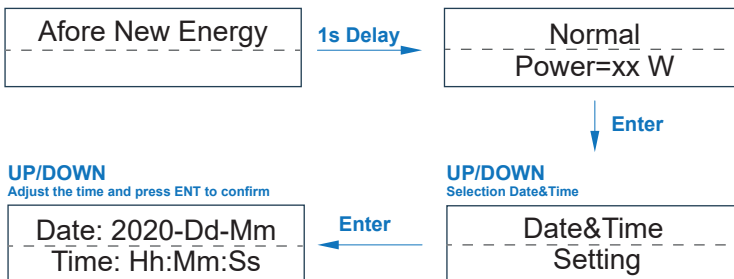


## Explanation of LCD Display Content

Nouns	Explanation
Inverter Info	Display the serial number and firmware version of inverter
Error Record	Check the error list of inverter including date and time
Wifi Info	Display the WIFI serial number and assigned IP address
Date & Time	Set date and time of the inverter
Setting	Set the protection parameters of inverter
Zero Injection	Countercurrent

## 4.3 Setting

### 4.3.1 Startup Setting



## 5. Commissioning

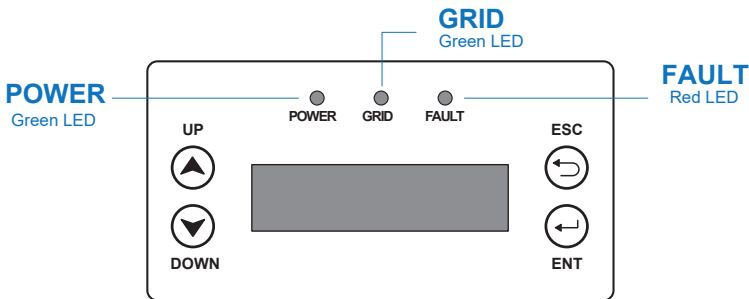
Before starting up commissioning at site, please make sure below procedures and requirements are fully meet.

- Mounting location is meet the requirements.
- All of the electrical wiring is firmly connected, including PV wiring, Grid wiring and Earth wiring.
- The inverter setting has been finished accordingly to local standards or regulations.

### Commissioning Procedures

- Turn on the AC switch between inverter output and the public grid;
- Turn on the DC switch on the inverter;
- Turn on the PV switch of the system.

### LED Indication



Sign	Power	Color	Explanation
POWER	On	Green	Power On
	Off		No Power
GRID	On	Green	Inverter is feeding power
	Off		Inverter is not feeding power at the moment
FAULT	On	Red	Fault occurred
	Off		No fault

## 6.Shut Down & Restart the Inverter

### 6.1 Shut Down Procedures

- Turn off the DC switch on the inverter;
- Turn off the PV switch of the system;
- Turn off the AC switch between inverter output and the public grid.



**Note:**

The inverter will be operable after minimum 5 minutes.

### 6.2 Restart the inverter

Follow the procedures below when the inverter needs to be restarted.

- Follow the Shut Down Procedures of Article 6 to shut down inverter;
- Follow the Commissioning Procedures of Article 5 to turn on the inverter.

## 7.Maintenance&Trouble Shooting

### 7.1 Maintenance

The inverter needs maintenance periodically, the following details should be noticed.

PV connection: check the PV connection twice a year

AC connection: check the AC connection twice a year

Earth connection: check the Earth connection twice a year

Heat sink: clean the heat sink once a year with dry towel

### 7.2 Fault Code and Trouble Shooting

The LCD and LED will report the fault when the error occurs, please follow the trouble shooting list to solve the problem.

## Trouble-Shooting List

Code	Error Display	Error Message	Possible Fault	Corrective Measure
E0	GFCI Fault	Ground Fault Circuit Interrupter	Ground Fault Circuit Interrupter fault	restart the inverter
E6/E11	Bus High Fault/Bus Fault	Bus Voltage High /Bus Fault	· PV Input voltage high · AC side poor connection	· check PV input voltage within 450Vdc(up to 3.0kw model), 500Vdc(up to 5.0kw model) · check AC connector, circuit breaker well connection
E9	No Utility	Utility loss	· utility loss · AC side circuit breaker turn off · AC side poor connection · inverter fault	· grid back to the normal, the inverter will restart automatically · replace the AC circuit breaker · check AC connector well connection · after several restart the fault remains, replace inverter
E10	Ground Current Fault	Leakage current high	1. poor earthing, leakage current high 2. PV(+) or PV(-) earthed	1. check the AC output wiring and restart the inverter 2. check PV array wiring
E13	Over Temperature Fault	Inverter too hot	· inverter enclosure too hot · temperature sensor fault	· turn off the inverter still the temperature down to the normal. Or install the inverter at a well ventilated site. · replace the temperature sensor
E15	PV Over Fault	PV input voltage high	· PV array's Voc high	· re-design the PV array configuration · measure the PV array voltage is the same as inverter displayed.
E17	M Grid Volt Fault	Grid voltage out of range	· grid voltage out of the setting range	· grid back to the normal, the inverter will restart automatically · check Country standard setting is correct
E18	Isolation Fault	Insulation Resistance high	· PV(+) or PV(-) earthed	check the resistance between PV(+) and ground, PV(-) and ground bigger than 2MΩ.
E19	Current DC Offset	DC bias high	· AC side DC bias high	restart the inverter
E12	Over Current	Over current fault	· grid fluctuate · AC side poor connection	· the inverter will restart automatically · check the AC output wiring and restart the inverter
E24	Relay 1/2 Fault	Relay fault	· inverter fault	restart the inverter
E29	MGrid Freq Fault	Grid frequency out of range	· grid fluctuate · grid frequency out of setting range	· grid back to the normal, the inverter will restart automatically · check inverter frequency setting range correct

# 8.Specifications

PV Input Data	HNS1000TL-1	HNS1500TL-1	HNS2000TL-1	HNS2500TL-1	HNS3000TL-1
Max. DC Power ( W )	1500	2250	3000	3750	4200
Max. DC Voltage ( V )	500	500	500	500	500
MPPT Voltage Range ( V )	50-500	50-500	50-500	50-500	50-500
MPPT Full Power Voltage Range ( V )	70-500	110-500	145-500	180-500	220-500
Rated Input Voltage ( V )	360				
Start-up Voltage ( V )	50				
Max. Input Current ( A )	14				
Max. Short Current ( A )	18				
No. of MPP Tracker / No. of PV String	1/1				
Input Connector Type	MC4				
AC Output Data	HNS1000TL-1	HNS1500TL-1	HNS2000TL-1	HNS2500TL-1	HNS3000TL-1
Max. Output Power ( W )	1100	1650	2200	2750	3300
Nominal Output Power ( W )	1000	1500	2000	2500	3000
Max. Output Current ( A )	6	9	12	13	15
Nominal Output Voltage ( V )	L/N/PE, 220Vac, 230Vac, 240Vac				
Grid Voltage Range	180Vac-276Vac (According to local standard)				
Nominal Output Frequency ( Hz )	50/60				
Grid Frequency Range	45-55Hz/54-66Hz (According to local standard)				
Output Power Factor	1 default (adjustable from 0.8 leading to 0.8 lagging)				
Output Current THD	<3%				
Efficiency	HNS1000TL-1	HNS1500TL-1	HNS2000TL-1	HNS2500TL-1	HNS3000TL-1
Max. Efficiency	97.50%	97.80%	98.10%	98.10%	98.13%
Euro Efficiency	96.60%	96.70%	96.80%	97.23%	97.56%
Protection	HNS1000TL-1	HNS1500TL-1	HNS2000TL-1	HNS2500TL-1	HNS3000TL-1
PV Reverse Polarity Protection	YES				
PV Insulation Resistance Detection	YES				
AC Short Circuit Protection	YES				
AC Over Current Protection	YES				
AC Over Voltage Protection	YES				
Anti-Islanding Protection	YES				
Residual Current Detection	YES				
Over Temperature Protection	YES				
Integrated DC switch	YES				
Surge Protection	Integrated (Type III)				
Smart IV Curve Scanning	YES				
Quick Arc Fault Circuit Interruption	Optional				
General Data	HNS1000TL-1	HNS1500TL-1	HNS2000TL-1	HNS2500TL-1	HNS3000TL-1
Dimensions (H x W x D, mm)	260 x 280 x 116				
Weight ( kg )	6				
Protection Degree	IP65				
Enclosure Material	Aluminum				
Ambient Temperature Range (°C)	-25 - +60				
Humidity Range	0-100%				
Topology	Transformerless				
Communication Interface	RS485 / WiFi / Wire Ethernet / GPRS (optional)				
Cooling Concept	Convection				
Noise Emission ( db )	<21				
Night Power Consumption ( W )	<0.2		<1		
Max. Operation Altitude ( m )	4000				
Certifications and Standards	HNS1000TL-1	HNS1500TL-1	HNS2000TL-1	HNS2500TL-1	HNS3000TL-1
EMC Standard	EN/IEC 61000-6-2, EN/IEC 61000-6-3, EN61000-3-2, EN61000-3-3, EN61000-3-11, EN61000-3-12				
Safety Standard	IEC 60068, UL1741, EN62109				
Grid-connection	IEEE1547, CSA C22, EN50549, VDE4105, VDE0126, RD1699, ABNT NBR16149 & 16150, AS4777.2, NB/T32004, G98/G99, IEC61727				