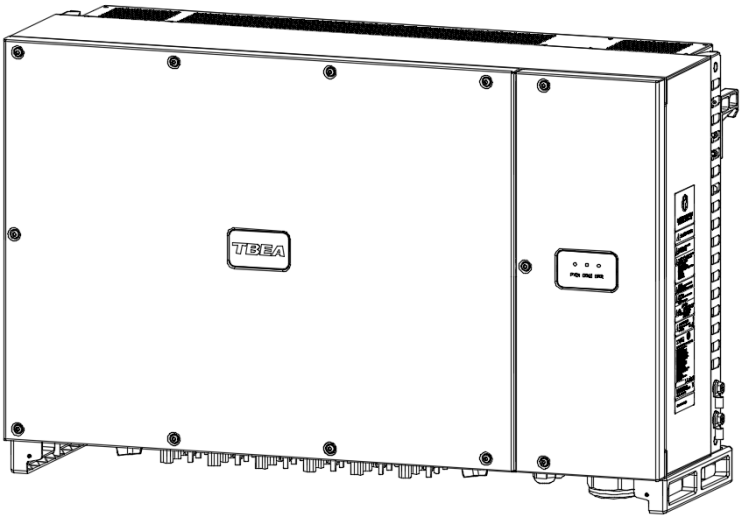
TS208/228/250KTL-HV

组串式光伏并网逆变器用户手册

User Manual of TS208/228/250KTL-HV Series String Photovoltaic Grid-connected Inverters



特变电工西安电气科技有限公司

TBEA XI'AN ELECTRIC TECHNOLOGY CO., LTD

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1 关于本手册 About this manual

1.1 符号解释 Symbol interpretation

为了更好的使用本手册，请仔细阅读以下符号说明：

In order to use this Manual better, please read the following interpretation of symbols carefully:

符号 symbols	符号名称 name of Symbols	符号含义 Symbols' meaning
	运行警告标识 Operate Warning！	此符号标识的内容，如果操作不当或不加以避免，可能会对用户的安全产生危险或对设备造成严重损害。 This warning indicates a hazardous situation which, if not avoid, could results in minor or moderate injury.
	注意标识 Notice!	此符号标识的内容，如果操作不当或不加以避免，可能会导致设备损坏、性能降低或其它不可预知的结果。 Improper operation or presence of contents marked with such symbol may damage the equipment, reduce its performance or lead to other unpredictable results.
	电击危险标识 Shock hazard mark	此符号标识的地方都是存在触电危险的部位，可能会对用户的安全产生危险，请勿随意触摸。 Electric shock hazard indicates parts with the electric shock hazard may threaten the safety of the users, do not touch!
	高温危险标识 High temperature hazard label	此符号标识的地方都是存在高温危险的部位，可能会对用户的安全产生危险，请勿随意触摸。 All the places marked by this symbol are places with high temperature danger, which may cause danger to the safety of

		users. Please do not touch them at will.
	接地标识 Grounding!	保护地线连接位置 This symbol is a protective grounding label.
	电容放电标识 Capacity Discharge	● 逆变器上电后存在高电压。所有针对逆变器的操作必须由训练有素的专业电气技术人员进行。 There is a high voltage when the inverter is powered up. All operation for the inverter must be performed by trained professional electrical technicians. ● 为防止触电，断开所有电源后 15 分钟内，严禁触摸任何带电部件。 In order to prevent electric shock, do not touch any live parts within 15 min after all power sources are disconnected.
	逆变器序列号 Inverter serial number	序列号信息 Serial number information

设备侧面贴有铭牌，铭牌上有逆变器型号及参数信息。典型铭牌信息如下所示：

There is information of product type and parameters on the nameplate which is sticked on the side of the device. Typical nameplate information is as follows：

TBEA

光伏并网逆变器 PV GRID-CONNECTED INVERTER

产品型号Model: TS208KTL-HV
最大直流输入电压Max.DC Voltage:1500Vd.c.
MPPT路数Quantity of MPPT:12
每路MPPT最大电流Max.Current per MPPT:30A
每路MPPT短路电流Isc Current per MPPT:50A
MPPT电压范围MPPT Voltage Range:500-1500Vd.c.
输出标称电压AC Nominal Voltage:3/PE 800Va.c.
额定输出频率Rated AC Frequency:50Hz/60Hz
额定输出功率Rated AC Power:208kW
最大视在功率Max.Apparent Power：250kVA
最大输出功率Max.AC Power:250kW(cosφ=1)/
238kW(cosφ=0.95)/225kW(cosφ=0.9)
最大输出电流Max.AC Current:180Aa.c.
功率因数Power Factor(cosφ):0.8(lagging)-0.8(leading)
温度范围Operating Temperature Range:-25~60℃
防护等级Enclosure:IP66
保护等级Protection Class:I
过电压类别Overvoltage Category:III(AC)II(DC)
序列号Serial Number：

特变电工西安电气科技有限公司
TBEA Xi'an Electric Technology Co.,Ltd.
中国制造　MADE IN CHINA

TBEA

光伏并网逆变器 PV GRID-CONNECTED INVERTER

产品型号Model: TS228KTL-HV
最大直流输入电压Max.DC Voltage:1500Vd.c.
MPPT路数Quantity of MPPT:12
每路MPPT最大电流Max.Current per MPPT:30A
每路MPPT短路电流Isc Current per MPPT:50A
MPPT电压范围MPPT Voltage Range:500-1500Vd.c.
输出标称电压AC Nominal Voltage:3/PE 800Va.c.
额定输出频率Rated AC Frequency:50Hz/60Hz
额定输出功率Rated AC Power:228kW
最大视在功率Max.Apparent Power：250kVA
最大输出功率Max.AC Power:250kW(cosφ=1)/
238kW(cosφ=0.95)/225kW(cosφ=0.9)
最大输出电流Max.AC Current:180Aa.c.
功率因数Power Factor(cosφ):0.8(lagging)-0.8(leading)
温度范围Operating Temperature Range:-25~60℃
防护等级Enclosure:IP66
保护等级Protection Class:I
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中国制造 MADE IN CHINA

1.2 适用范围 Application Scope

本手册包含详细的产品信息和安装使用说明，适用于特变电工西安电气科技有限公司 TS208/228/250KTL-HV 系列两级式光伏并网逆变器。

This manual provides detailed product information，installation and operation instructions for 1500V serialized two-stage inverter

TS208/228/250KTL-HV series manufactured by TBEA Xi'an Electric Technology Co., Ltd.

本手册仅供逆变器安装和操作的专业人员使用，安装和操作人员需具备相应的专业知识，能够识别电子元器件和电气原理图符号，并且具备标准电气配电经验。

This manual is prepared for the installation and operation of inverter. Personnel for installation and operation shall have corresponding professional knowledge to identify the electronic part and component and electrical schematic diagram symbols as well as experience in standard electrical power distribution.

手册内容将不断更新升级，可能存在与实物略有不符的情况，用户请以所购产品实物为准，并可通过销售渠道索取最新版本的手册资料。

This manual content will be continuously updated and revised, which may be a little different from the physical product. The user shall refer to the physical product purchased and may obtain the latest version manual from sales channel.

1.3 光伏并网发电系统简介 PV grid-connected power generation system

光伏并网发电系统如图 1-1 所示，由光伏阵列、并网逆变器、交流汇流箱、升压变压器、电网及其它辅助设备组成。太阳能通过光伏

组件转化为直流电能，再通过并网逆变器将直流电能转化为与电网同频率的正弦波电能，通过交流汇流箱汇总，最后通过升压变压器将能量馈入电网。

The PV grid-connected generation system is shown in Figure 1-1, which consists of the photovoltaic array, grid-connected inverter, AC combiner box, step-up transformer, grid and other auxiliary equipment. The solar energy is converted into direct current energy through photovoltaic modules, and then converted into sinusoidal energy with the same frequency as the power grid by grid-connected inverters. The energy is summarized by ac bus box, and finally fed into the power grid by booster transformer.

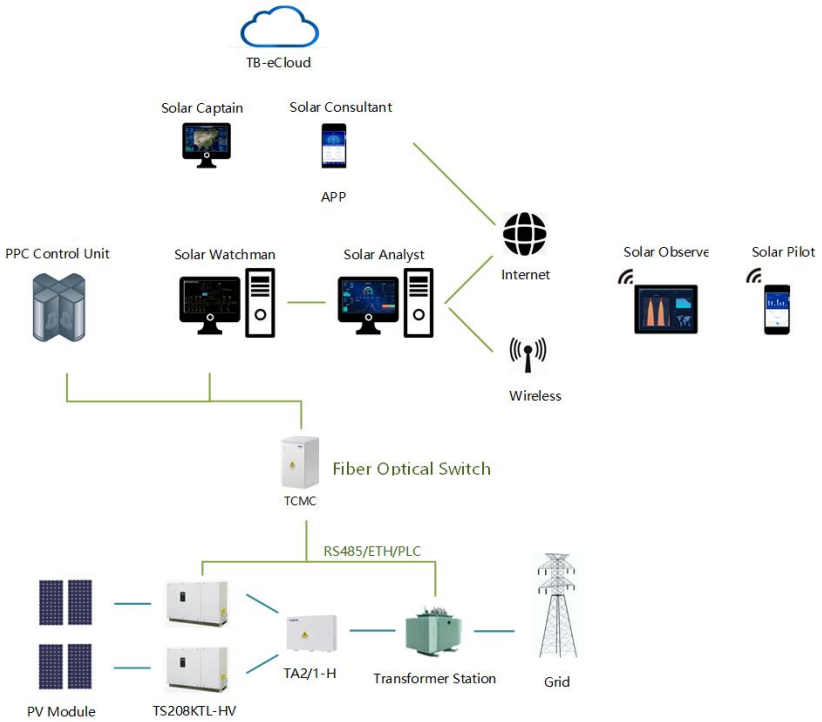


图 1-1 光伏并网发电系统

Figure 1-1 PV grid-connected generation system

1.4 安全说明 Safety Instructions

警告！Warning!

使用和操作逆变器时，请仔细阅读安全说明。

When using and operating the inverter, please read the safety instructions carefully.

- 戴橡胶手套和穿绝缘鞋。
- Wear the rubber gloves and insulated shoes.
- 摘掉戒指、手表和其他的金属物件。

- Remove the ring, watch and other metal articles.
- 使用带绝缘手柄的工具。
- Use the tool with an insulated handle.
- 不要将工具或其它金属物件放置在设备上。
- Do not place the tool or other metal articles on the equipment.
- 实施配线及维修时，请务必切断直流开关。
- When conducting wiring and maintenance, make sure to disconnect the DC switch.
- 严禁将逆变器的直流输入侧正（+）、负（-）极性接反。
- Do not reversely connect the positive (+) and negative (-) polarity on the DC input side of the inverter.
- 为防止触电危险，严禁非专业人员私自打开逆变器。
- In order to prevent the danger of electric shock, it is strictly forbidden for non-professionals to turn on the inverter privately.
- 本设备应避开火源，不能安装在易燃、易爆的环境中；也不要安装在没有防火保护设备旁边，包括汽油发电机、柴油桶或其它易燃品等。
- This equipment shall be far away from the fire source, shall not be installed in the inflammable and explosive environment; Don't install it next to non-fire protection equipment, including gasoline generators, diesel drums or other combustibles.
- 由于系统在工作时电流较大，接线时应保证所有接线柱和螺栓紧固，保证良好接触。
- Due to the high current of the system, all the connection posts and bolts should be tightened to ensure good contact.

- 设备应由专业技术人员进行操作。
- The equipment shall be operated by the professional technician.
- 即使没有外部电源输入的情况下，设备内部也可能有高电压存在，严禁触摸。
- Even though there is no external power source input, there may be high voltage in the equipment. Do not touch it!
- 不要将任何物件放入逆变器内部空洞处或打开的器件中。
- Do not put any object in the cavity or open device of the inverter.
- 即使所有的开关和断路器都关断，逆变器中的危险电压仍然存在，任何需要打开或移动的操作都只能由专业的技术人员进行实施。
- Even if all switches and circuit breakers are turned off, the dangerous voltage in the inverters still exists. Any operation that needs to be turned on or moved can only be carried out by professional technicians.

2 产品介绍 Product Introduction

2.1 产品简介 Brief Introduction of Product

2.1.1 功能介绍 Function Introduction

TS208/228/250KTL-HV 系列光伏并网逆变器是 1500V 三相组串型光伏并网逆变器，主要功能是将光伏阵列产生的直流电能转化为交流电能并馈入电网。

TS208/228/250KTL-HV series photovoltaic grid-connected Inverter is a 1500V three-phase series photovoltaic grid-connected Inverter. The main function is to convert DC power generated by photovoltaic arrays into AC power and feed it into the grid.

2.1.2 型号介绍 Type Introduction

逆变器型号说明如图 2-1 所示：

The type description of the inverter is shown in Figure 2-1:

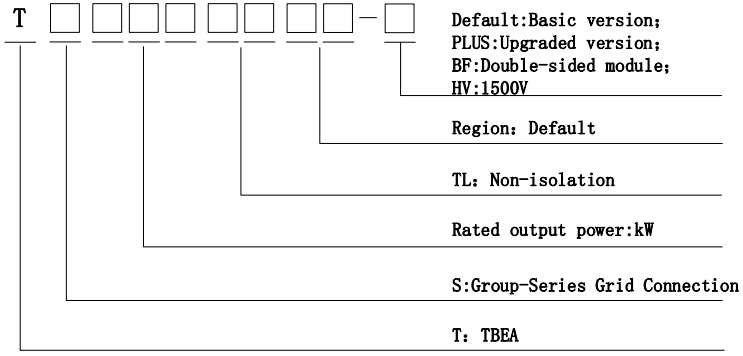


图 2-1 光伏并网发电系统

Figure 2-1 PV Grid-connected Generation System

2.1.3 电网形式 Grid Form

TS208/228/250KTL-HV 系列逆变器支持的电网连接方式为 IT 电网，如图 2-2 所示：

The connection type of the grid supported by TS208/228/250KTL-HV series inverter is the IT grid, as shown in Figure 2-2:

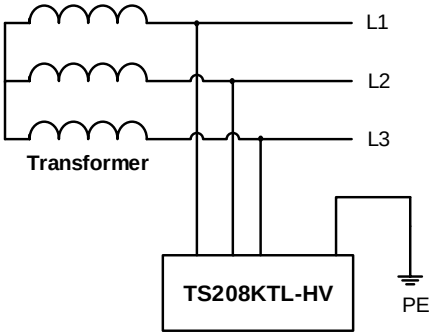
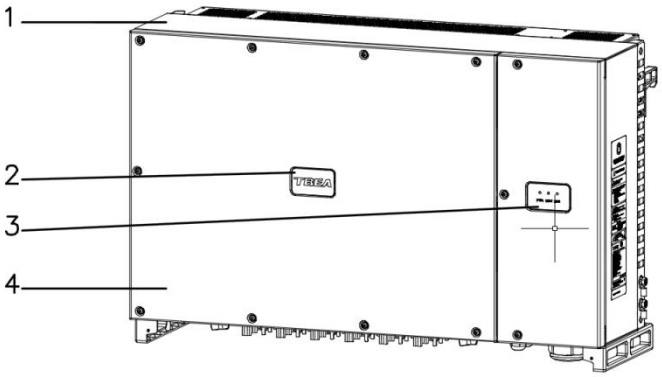


图 2-2 光伏并网发电系统

Figure 2-2 PV Grid-connected Generation System

2.2 外观介绍 Appearance Introduction



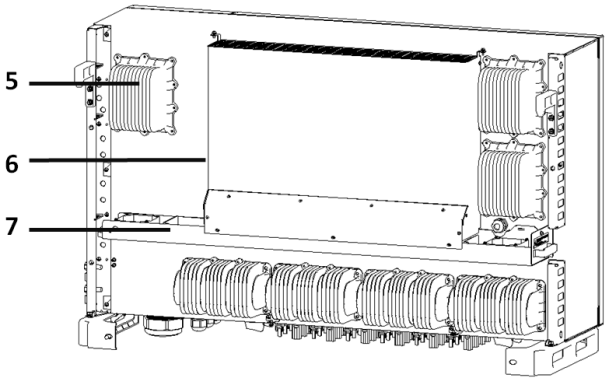


图 2-3 逆变器外观示意图

Figure2-3 Inverter Appearance

表 2-1 逆变器外观说明

Table 2-1 Instruction for Inverter Appearance

编号 Item	说明 Instruction
1	机箱 Inverter Box
2	LOGO
3	显示面板 Display Board
4	门板 Door Panel
5	电感 Electrical Inductance
6	散热器 Radiator
7	外部散热风扇组件 External Cooling Fan Assembly

2.3 逆变器外部接线端子介绍 Introduction of External Connection Terminal of Inverter

逆变器外部接线端子如图 2-4 所示：

The external connection terminal of inverter is shown as Fig.2-4

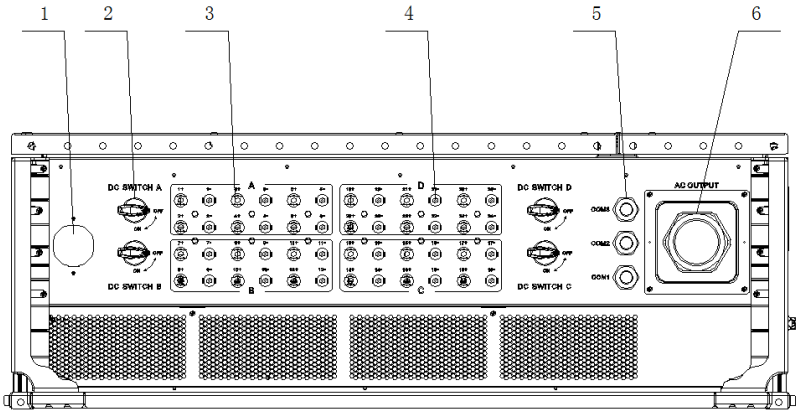


图 2-4 逆变器外部接线端子

Figure2-4 External Connection Terminal of Inverter

表 2-2 逆变器外部接线端子详细说明

Table 2-2 Description of External Connection Terminal of Inverter

编号 Item	说明 Description
1	透气阀 Ventilation valve
2	直流开关 DC switch (A\B\C\D)
3	PV+(1~24)
4	PV- (1~24)
6	通信接口 Communication interface（1~3）PG21
7	交流输出接口 AC Output interface M72

2.4 显示面板 Display Panel

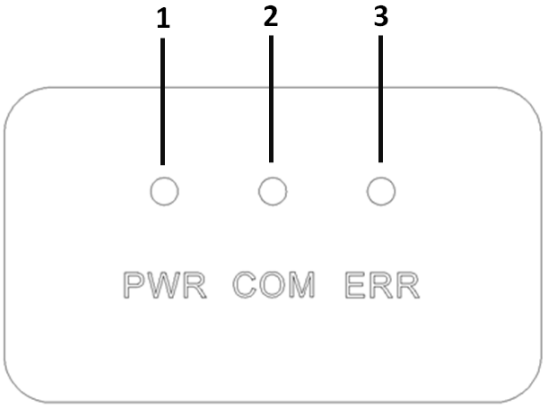


图 2-5　LED 显示面板

Figure2-5 LED Display Panel

表 2-3　LED 显示面板状态说明

Table 2-3 LED Display Panel State Description

编号 Number	名称 Name	状态 state	说明 Description
1	POWER (green)	常亮 Continuous Light up	设备并网 inverter on-grid
		200ms 闪烁 twinkle for 200ms	设备自检 inverter self-test
		1s 闪烁 twinkle for 1s	设备停机 inverter off-grid
2	COM (yellow)	100ms 闪烁 twinkle for 100ms	手机 APP 与通讯板数据交互。Mobile APP interacts with communication board.
		每间隔 1 分钟持续常亮 5s	Wifi 模块与通讯板链接中断 When the link between Wifi module

		it lasts for 5s every 1 minute	and communication board is interrupted
		通讯过程闪烁 twinkle during communication	收到正确且属于本机的报文 twinkle when receiving correct message from correct inverter
3	ERROR (red)	常亮 Continuous Light up	设备故障 Inverter failure
		常灭 Continuous go out	设备正常 operate normally
		1s 闪烁 twinkle for 1s	其他故障或者警告 other failures or warnings like communication failure

3 逆变器存储 Inverter Storage

如果逆变器不立即投入使用，则存储逆变器时需满足：

If the inverter is not immediately put into use, the storage of the inverter needs to be met these requirements:

- 请勿拆除逆变器的外包装。

Do not remove the outer packaging of the inverter.

- 存储的温度应保持在–40ºC～+70ºC；相对湿度应保持在 5% RH～95% RH。

Storage temperature shall be kept at –40 ºC ~ +70 ºC; Relative humidity should be maintained at 5% RH ~ 95% RH.

- 存放在清洁干燥的地方，并防止灰尘及水汽的侵蚀。

Store in a clean and dry place and prevent dust and water vapor from eroding.

- 最大可堆码 2 层（总层数 3）。

Maximum layers in stack is 2 (total layers 3).

- 存储期间，需要定期检查。如发现有虫蛀鼠咬，则需要及时更换包装材料。

Periodic checks are required during storage. If damaging by Rats or Verminare found, the packaging materials need to be replaced in time.

● 经过长期存放后，逆变器需经过专业人员的检查和测试才能投入使用。

After long-term storage, the inverters need to be inspected and tested by professionals before they can be put into use.

4 安装 Installation

4.1 机械安装 Mechanical Installation

4.1.1 基本安装要求 Basic installation requirements

（1）安装场地应足够坚固且确保不会晃动，能够长时间支撑逆变器的重量。

The installation site shall be strong and stable enough to support the weight of the inverter for a long time.

（2）逆变器应垂直于地面安装且连接端子位于下方。

The inverter shall be installed perpendicular to the ground and the connecting terminals shall be located below.

（3）逆变器在运行过程中局部温度（如散热器）会比较高。勿将逆变器安装在小孩可触摸到的地方，以免烫伤或触电。

The local temperature (such as radiator) of the inverter will be high during operation. Do not install the inverters in places that children can touch to avoid scalding or electric shock.

（4）勿将逆变器安装在阳光直射处，否则可能会引发逆变器过温。

Do not install the inverter in the place which is directly exposed to sunlight, otherwise it may result in inverter over-temperature.

（5）逆变器具有 IP66 的防护等级，可安装至室外。

The inverter has the protection class of IP66 and thus it can be installed outdoors.

4.1.2 安装环境要求 Installation Environment Requirements

（1）安装场地环境温度为-25℃～60℃，安装环境清洁。

Installation site environment temperature should be between -25℃ ~ 60℃, and the environment should be clean.

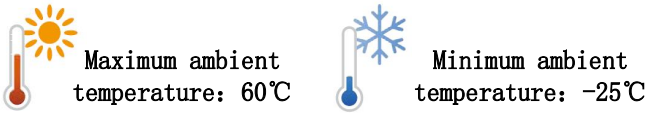


图 4-1　逆变器安装环境的温度图

Figure 4-1 Temperature Diagram of the Inverter Installation Environment

（2）避免逆变器直接受到日晒，可延长逆变器的使用寿命，带遮挡的安装地点是较好的选择，如图 4-2 所示：

Avoiding the direct sunshine of the inverters can prolong the service life of the inverters. The shielded installation location is a better choice, as shown in Figure 4-2:

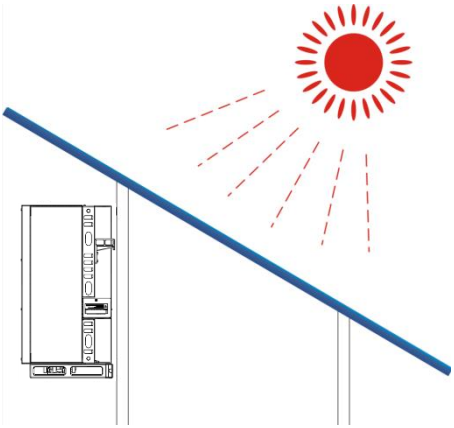


图 4-2　逆变器的安装位置

Figure 4-2 Installation Position of the Inverter

（3）安装逆变器时，需要在逆变器周围预留一定的空间距离，如图 4-3 所示，以确保散热通畅。

When installing the inverters, it is necessary to reserve a certain space distance around the inverters, as shown in Figure 4-3, to ensure the smooth heat dissipation.

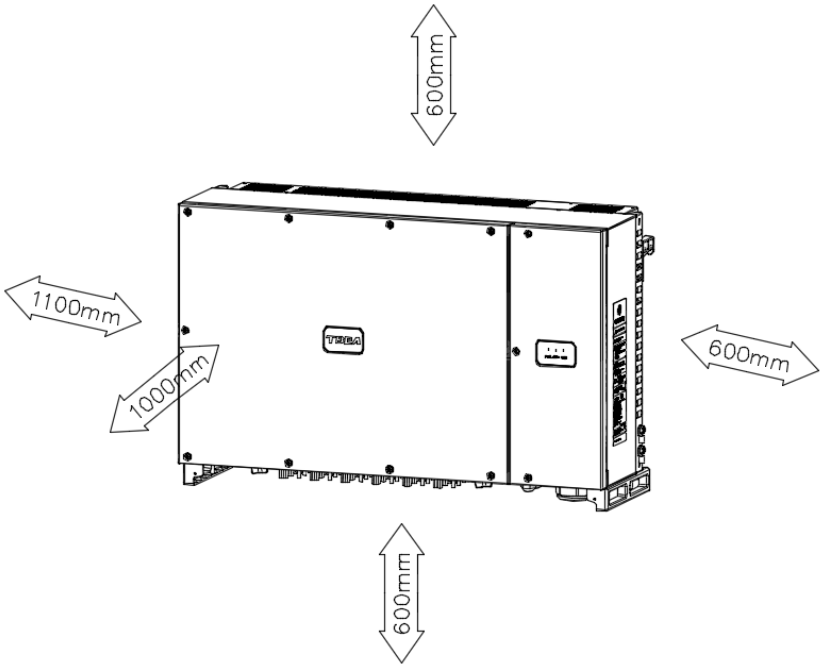


图 4-3　逆变器安装周围尺寸

Figure 4-3 Surrounding Dimension for Inverter Installation

（4）多台逆变器并排安装时应让逆变器错落安装，如图 4-4 所示：

When installing multiple inverters side by side, the inverters should be installed staggeringly, as shown in Figure 4-4:

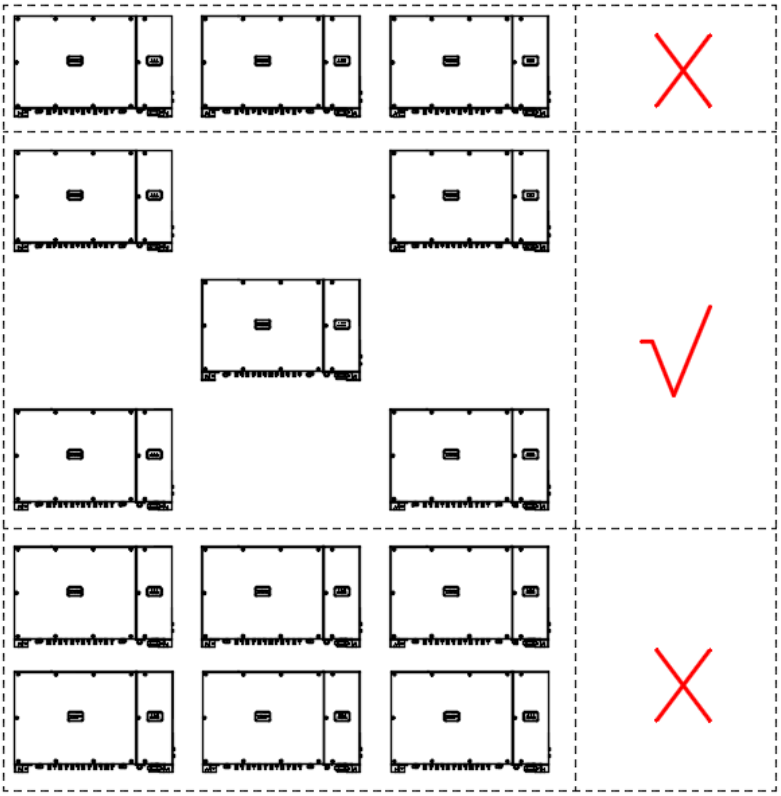


图 4-4　多台逆变器安装位置

Figure 4-4 Installation Location of Several Inverters

（5）逆变器外部风扇维护空间如图 4-5 所示，外部风扇维护拉出至少需要 1150mm，请注意此区间无立柱、墙等遮挡，否则风扇维护时无法拉出。

Maintenance space of external fan requires is shown in Figure 4-5: the maintenance of the external fan requires at least 1150mm. Please note

that there is no column, wall, etc. in this section, otherwise the fan cannot be pulled out during maintenance.

警告！ Warning!

逆变器外部风扇维护至少需要 1150mm 空间，在电站前期设计施工时务必注意。

The maintenance space of the external fan requires at least 1150mm, which must be paid attention to during the preliminary design and construction of the power station.

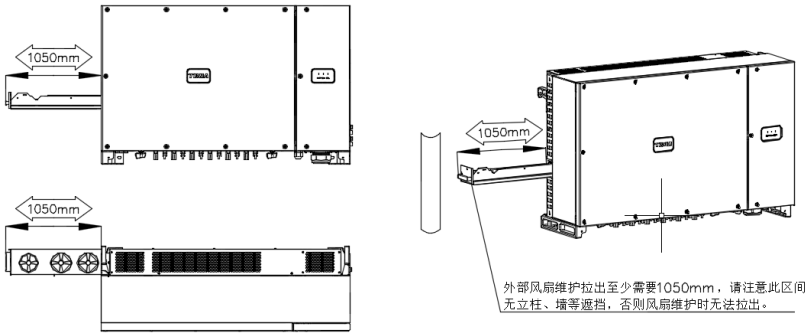


图 4-5 逆变器外部风扇维护空间要求

Figure 4-5 Maintenance of external fan space requires

4.1.3 安全说明 Safety Instructions

作为电子产品，触摸到带电部分都存在危险。本产品直流侧最高电压达到1500V，交流侧电压为800V，最高可到920V。

As an electronic product, touching the live part is dangerous. The maximum voltage of the product is 1500V on the DC side, 800V on the

AC side and 920V on the AC side.

警告！ Warning!

安装和维护前保证交流和直流侧均不带电。

Before installation and maintenance, ensure that AC and DC sides are not live.

注意！Notice!

本装置必须请专业电工进行安装。

This device must be installed by a professional electrician.

4.1.4 安装需求 Installation Requirements

- **安装流程说明 Installation Process Description**

  逆变器的安装流程如图 4-6 所示。

  The installation process of the inverter is shown in Figure 4-6.

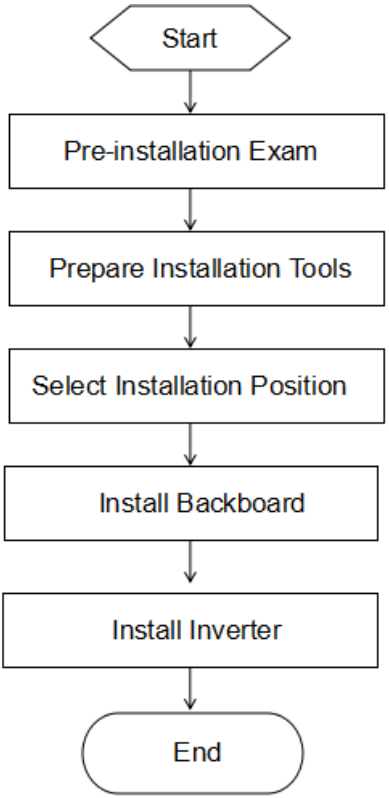


图 4-6　安装流程

Figure 4-6 Installation Process

表4-1 安装流程说明

Table 4-1 Installation Process Installation Process Description

步骤 Steps	操作 Operation	说明 Description
1	安装前检查 Pre-installation exam	在开箱之前，需要检查外包装有无破损；开箱后，需要检查交付件是否齐备，有无任何明显的外部损坏。 Before opening the case, it is necessary to check whether

		the outer packing is damaged or not; after opening the case, it is necessary to check whether the deliverables are ready and whether there is any obvious external damage.
2	准备安装工具 Prepare installation tools	在安装逆变器之前，需要准备相应工具，以便顺利安装和接线。 Prior to installation of the inverter, prepare the corresponding tools for successful installation and wiring.
3	选择安装位置 Select the installation position	需要选择适当的位置安装逆变器，以保证逆变器能够正常、可靠地工作。 Inverters need to be installed at appropriate locations to ensure that the inverters can work normally and reliably.
4	安装背板 Install the backboard	在安装逆变器之前，需要先安装随设备提供的背板，以便逆变器可以稳固地安装在墙壁上。 Prior to installation of the inverter, the backboard provided along with the equipment shall be installed first, so that the inverter may be firmly installed on the wall.
5	安装逆变器 Install inverter	将逆变器安装在背板上，并用螺栓固定。 Install the inverter on the backboard and secure it with bolts.

- **安装前检查 Pre-installation Exam**

安装前请检查附件是否齐全，如图 4-7 所示。

Check if the installation accessories are complete before installation, shown in

figure 4-7:

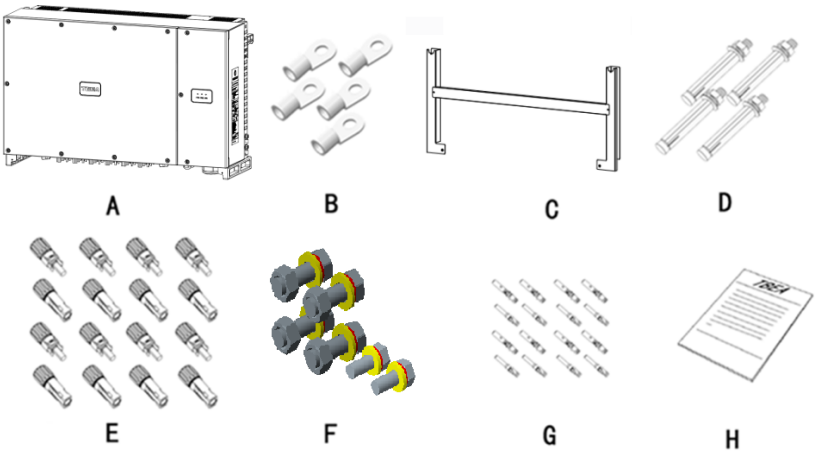


图 4-7　安装前检查项目

Figure 4-7 Check Items prior to Installation

表4-2 安装前检查项目

Table 4-2 Check Items prior to Installation

编号 No.	名称 Name	说明 Description
A	逆变器 Inverter	TS208/228/250KTL-HV系列产品 TS208/228/250KTL-HV Series
B	冷压端子 Cold-pressed terminals	用于固定交流输出线缆，具体个数以装箱清单为准 Used to fix AC output cable. The specific number is based on the packing list.
C	安装背板 Install backboards	用于支撑固定逆变器，1套 1, for supporting and fastening the inverter

D	膨胀螺栓（客户自备） Expansion bolts(Customer-provided)	用于将安装板固定在混凝土墙上，4套 4 sets for fastening the mounting plate onto the concrete wall
E	直流端子 DC terminals	用于连接直流输入，24对 24 pairs for connecting the DC input
F	紧固件 Fasteners	用于将安装板固定在金属框架上，4套M10组合螺栓及螺母； 用于固定安装挂件与逆变器，2套M8组合螺栓 4 sets of M10 assembling bolts and nuts for fastening the mounting plate onto the metal framework; 2 sets of M8 assembling bolts for fastening the installation pendants and inverter
G	金属端子 Metal terminals	用于固定直流输入线缆，24对 24 pairs for fastening the DC input cable
H	文档 Documents	其他文档资料 Other documents

注意！Notice!

如果以上相关项目缺失，请及时与供应商或厂家联系。

If the above-mentioned relevant items are lost, please timely contact the supplier or manufacturer.

- **安装工具准备Prepare Installation Tools**

安装需要使用的工具如表 4-3 所示：

Tools required for installation are shown in Table 4-3:

表 4-3 安装工具清单

Table 4-3 List of Installation Tools

序号 No.	工具 Tools	型号 Type	用途 Application
1	冲击钻（墙面安装） Percussion drilling(Wall installation)	钻头⌀10 Drill ⌀10	墙面打孔 Wall punching
2	活动扳手（墙面安装） Monkey wrench(Wall installation)	开口≥32mm Opening≥32mm	紧固膨胀螺栓 Fastening the expansion bolt
3	内梅花扳手 Inner box spanner	M6	交流和通信接线时打开门板 Open the door sheet in case of AC and communication wiring.
4	十字螺丝刀 Cross screwdriver	M10	地线紧固 Fasten the grounding wire
5	套筒 Sleeve	M10	交流线缆紧固 Fasten the AC cable
6	一字螺丝刀 Straight screwdriver	M2.5	通信线缆紧固 Fasten the communication cable
7	斜口钳 Diagonal pliers	-	剪扎线带 Cut the cable tie

8	剥线钳 Stripper	-	剥离线缆表皮 Peel off the cable epidermis
9	橡胶锤（墙面安装） Rubber Hammer(Wall installation)	-	将膨胀螺栓敲入孔中 Strike the expansion bolt into the hole
10	工具刀 Utility Knife	-	拆包装等 Unpacking etc
11	剪线钳 Wire Cutter	-	剪断电源线缆 Cut the power supply cable
12	压线钳 Crimping Pliers	-	压线 Press the cable
13	吸尘器 Vacuum Cleaner	-	墙面打孔后，清理现场灰尘 Clean the on-site dust after punching on the wall
14	万用表（可测量电压大于1500V） Multimeter（Measureable voltage greater than 1500V）	-	测试接地连接等是否正确 Testing the correctness of grounding connection, etc.
15	记号笔 Mark Pen	直径≤10mm Diameter≤10mm	标注记号 Label a mark
16	钢卷尺 Steel Tape	-	测量距离 Measuring distance

17	水平尺 Level	-	保证挂板水平安装 Guarantee Horizontal Installation of Hanging Plate
18	防静电手套 Anti-static gloves	-	安装设备时操作者佩戴 Operator wears when installing equipment
19	防护镜 safety goggles	-	打孔时操作者佩戴 Operator wears when punching
20	防尘口罩 Dust Mask	-	打孔时操作者佩戴 Operator wears when punching

- **安装位置要求 Requirements for Installation Position**

警告！ Warning!

1. 逆变器的表面温度可达到80℃。请勿与易燃材料安置在一起！

   The surface temperature of inverter can reach 80℃, please don't put it with flammable material!

2. 勿将本产品安装在含有可燃性气体的空间里(如电池室、燃料存储室等)。

   Please don't install this product in the space where contains the flammable gas (for example Battery Room, Fuel Storage Room, etc.)

注意！Caution!

安装位置不得妨碍断开设备电源。

Installation position shall not prevent disconnection of equipment power supply

在选择安装地点时，需要考虑以下要求：

The following should be considered when choosing installation location:

- 逆变器的防护等级为IP66，室内和室外均可安装；

  The protection level of the inverter is IP66, and it can be installed indoor and outdoor.

- 请保证安装墙壁或者支架的强度满足逆变器的承重要求；

  Please ensure the strength of installation wall or support can comply with load-bearing requirement of the inverter.

- 逆变器的安装位置应便于电气连接和维护；

  The installation location of the inverter should be convenient for electrical connection and maintenance.

- 逆变器应为竖直安装，其倾角不大于15°，以便于散热；

  The inverter should be installed vertically with an inclination of no more than 15° to facilitate heat dissipation.

- 逆变器应安装在通风的环境下，以便于良好的散热；

The inverter should be installed in a ventilated environment to facilitate good heat dissipation.

- 多台逆变器水平线安装时应该留一定的空间，其间隙建议值如图4-8所示；

  Space should be left when installing multiple inverters in horizontal lining, and the suggested space value is showed as Figure 4-8.

- 另外逆变器前方应留有足够间隙便于观察数据及维护。

  There should be enough space in front of the inverter to facilitate data observation and maintenance.

- 若逆变器固定在支架上，请忽略膨胀螺栓及固定膨胀螺栓所使用的工具。

  If the inverter is installed on the support, please ignore the expansion bolts and tools which are used for fixing expansion bolt.

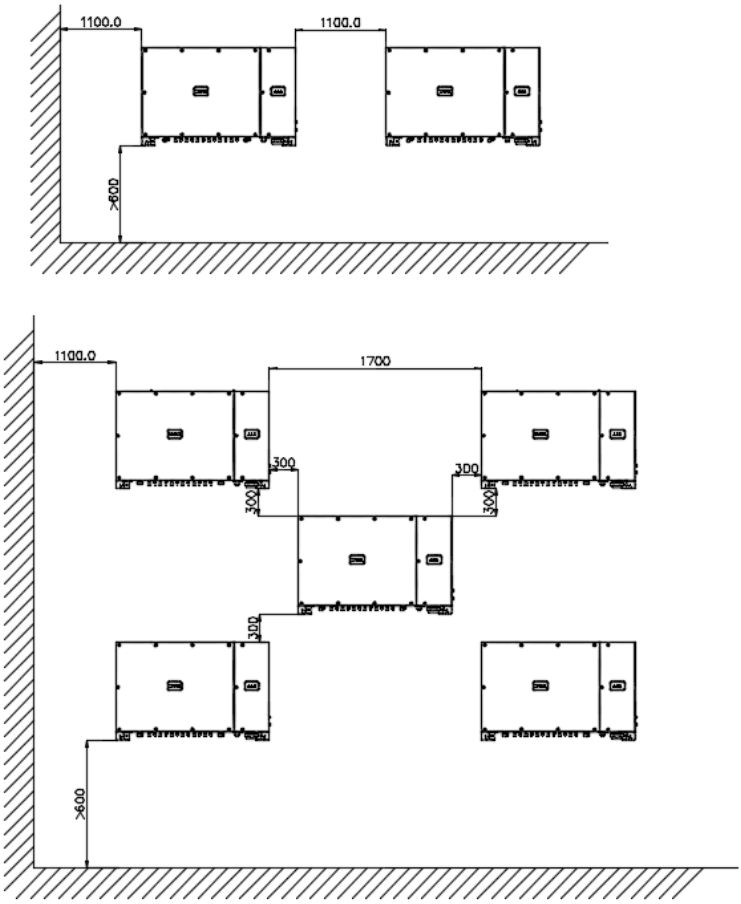


图4-8 逆变器安装位置间隙图(单位：mm)

Figure 4-8 Inverter Installation Position Clearance Figure (unit: mm)

- **安装背板 Installation Backboard**

根据所选安装墙面的材质以及实际壁挂要求不同，以下将详细讲述如何利用所提供的安装配件进行逆变器安装。背板安装方式业主可根据自己的实际情况选择墙面安装或支架安装两种方式。

According to different materials of the installation wall selected and actual wall hanging requirements, how to use the installation accessories provided to install the inverter will be elaborated in detail below. Backplane installation method Owners can choose wall installation or bracket installation according to their actual situation.

- **墙面安装方式 Wall Installation Mode**

安装载体要求：Installation Carrier Requirement:

- 逆变器安装载体必须具备防火性能；

Inverter installation carrier must have fire resistance property

- 请勿在易燃的建筑材料上安装逆变器；

Please don't install the inverter on the flammable construction materials.

- 逆变器的重量为110kg，请保证安装表面坚固，达到安装逆变器的承重要求；

The weight of the inverters is 110kg. Please ensure that the installation surface is strong enough to meet the requirements of the installation of the inverters

- 在居住区域中，请勿将逆变器安装在石膏板墙壁或类似隔音不良的墙壁上，以免其工作时发出的噪音对生活区域中的居民产生干扰。

In residential areas, do not install the inverters on gypsum board

walls or walls with similar poor sound insulation, so as to avoid the noise generated by the inverters when they work disturbing the residents in the living areas.

安装步骤：Installation Step:

步骤1：确认下墙面的承重要求,取出安装板并将其水平放置于墙面上，高度保证逆变器的显示面板位置与眼平齐。

Step 1: Confirm the bearing requirement of the wall, Take out the mounting plate and place it on the wall horizontally, and its height shall ensure that the display panel position of the inverter is aligned with the hole.

步骤2：根据安装支架的开孔，标注钻孔位置如图4-9所示，并使用冲击钻在标注的钻孔位置钻孔，墙面推荐钻孔直径10.0mm，深度80mm。

Step 2: According to the trepanning of the mounting bracket, mark the position of drilling hole as shown in drawing 4-9, and use a percussion drill to drill holes in the marked position. The recommended drill holes on the wall is 10.0mm in diameter and 80mm in depth.

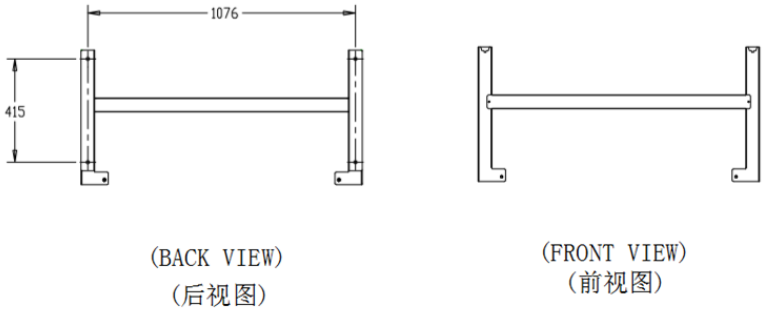


图 4-9 安装孔位图(单位：mm)

Figure 4-9 Installation Hole Location (unit: mm)

步骤3：利用膨胀螺栓将安装支架固定于墙面上(若安装到金属支架上使用4套M10组合螺栓及弹平垫螺母)，锁紧螺母，紧固力矩为12N·m，如图4-10所示：

Step 3: Mount the mounting plate to the wall with the expansion bolts (if it is mounted onto a metal bracket, use 4 sets of M10 assembling bolts and spring flat gasket nuts) and lock the nuts, with the tightening torque of 12N·m, as shown in Figure 4-10:

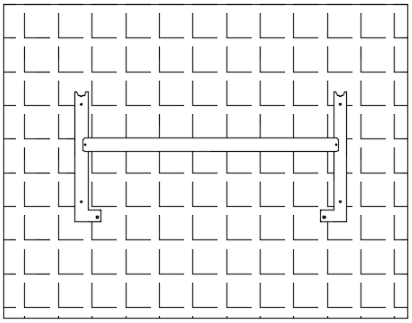


图 4-10 逆变器安装支架安装示意图

Figure 4-10 Installation Diagram of Inverter Mounting Plate

表4-4　安装视图编号说明

Table 4-4 Installation View No. Description

编号 **Number**	说明 Description
1	膨胀螺钉 Expansion screw
2	墙体 wall
3	安装支架 Mounting bracket

- **支架安装方式 Bracket installation method**

步骤1：取出安装支架并将其水平放置于指定的金属支架上，高度保证逆变器显示面板位置与眼平齐。

Step 1: Take out the mounting plate and place it on the designated metal framework horizontally, and its height shall ensure that the display panel position of the inverter is aligned with the hole.

步骤2：根据安装支架的开孔，在金属支架上标注钻孔位置如4-11所示，并使用冲击钻在标注的钻孔位置钻孔，推荐钻孔直径12mm。（若金属框架的形状和位置与安装板不匹配，根据所选的框架安装支架在合适的位置重新钻孔。）

Step 2: According to the trepanning of the mounting bracket, mark the drilling position on the metal bracket as shown in figure 4-11, and use a percussion drill to drill holes in the marked drilling position, with the recommended drilling diameter of 12mm. (if

the shape and position of the metal frame do not match the mounting plate, re-drill the hole in the appropriate position according to the frame mounting bracket which is selected.)

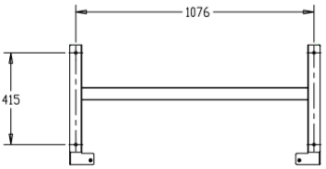


图 4-11 安装孔位图(单位：mm)

Figure 4-11 Installation Hole Location (unit: mm)

步骤3：利用4套M10x70组合螺栓(若长度无法满足安装要求，请自备M10组合螺栓)及弹平垫螺母将安装板固定于金属支架上锁紧螺母紧固力矩为12N·m，如图4-12所示：

Step 3: Use 4 sets of M10x70 combination bolts (if the length cannot meet the installation requirements, please prepare the M10 combination bolts) and spring flat washer nut to fix the mounting plate on the metal support, and tighten the nut with torque 12N•m, as shown in drawing 4-12:

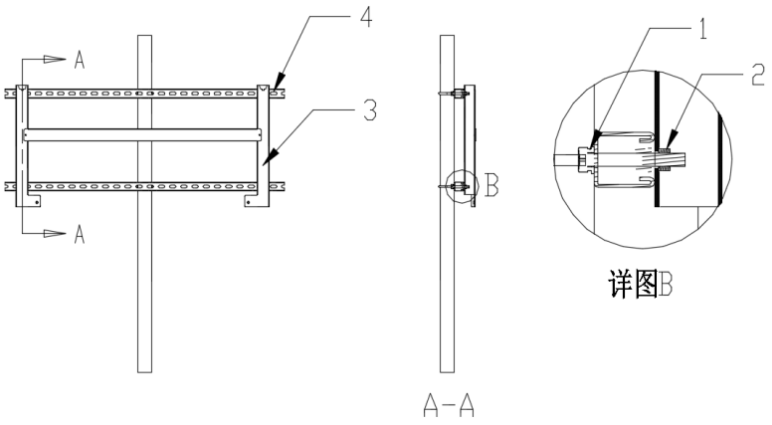


图 4-12 逆变器安装板安装示意图

Figure 4-12 Installation Diagram of Inverter Mounting Plate

表4-5 安装视图编号说明

Table 4-5 Instruction of Installation View Number

编号 Number	说明 Description
1	M10 螺栓 M10 bolt
2	螺母 Nut
3	安装支架 Mounting bracket
4	金属支架(客户自备) Metal bracket(Customer-provided)

- **安装逆变器 Install the Inverter**

（1） 将逆变器挂到固定到墙面上的安装支架上，使用2个M8

的组合螺栓紧固，紧固力矩为7N・m，如图4-13所示。

Hanging and fixing the inverter to the installation bracket of the wall with 2 pcs M8 assembling bolts, the tightening torque is 7N・m, shown as 4-13 figure.

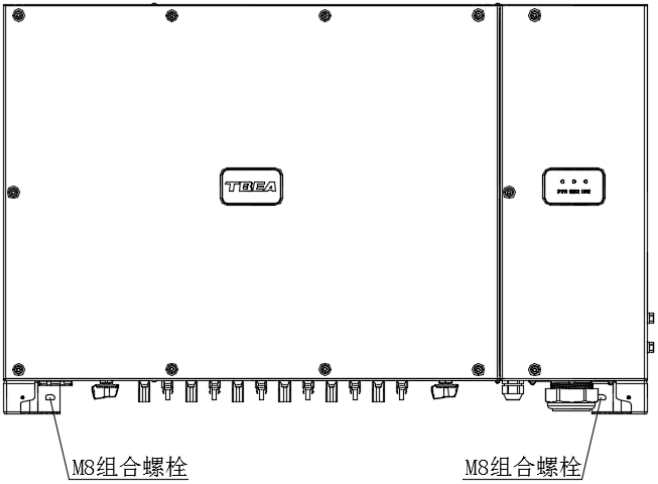


图 4-13 逆变器安装示意图

Figure 4-13 Inverter Installation Instruction

（2） 安装完毕。

The installation is completed.

4.2 电气连接 Electrical Connection

4.2.1 输入输出要求 In-put & Out-put Requirements

所有输入、输出及通讯均采用逆变器自带或标配防水端子进行连接，如果采用其他连接端子与逆变器连接，所产生的一切后果由客户自行承担。

All inputs, outputs and communications are connected by inverters with or with standard waterproof terminals. If other terminals are used to connect with inverters, all consequences will be undertaken by customers themselves.

4.2.2 配电部分介绍 Power Distribution Introduction

将逆变器门板打开，可见逆变器的配电部分，如图4-14所示：

Open the door sheet of the inverter to see its power distribution part, as shown in Figure 4-14:

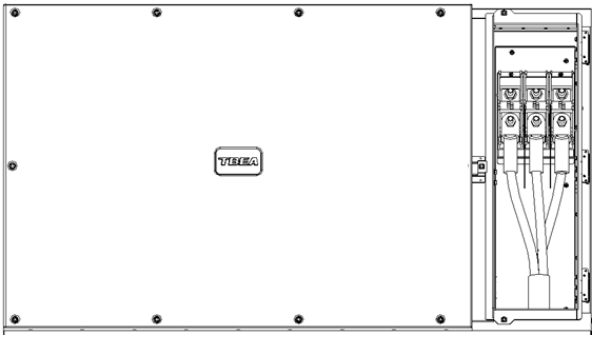


图 4-14 逆变器配电部分

Figure 4-14 Inverter Distribution Part

逆变器配电部分的详细介绍如图4-15所示：

The detailed introduction of inverter distribution part is showed as figure 4-15:

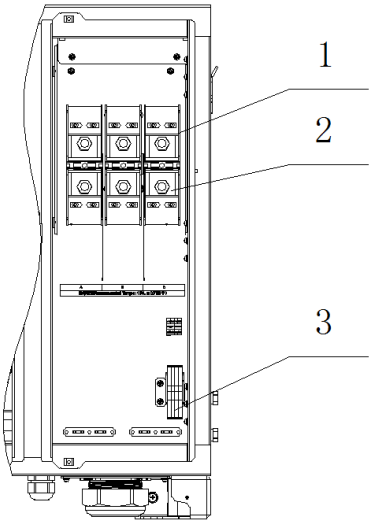


图 4-15 逆变器配电部分

Figure 4-15 Inverter Distribution Part

表4-6 逆变器配电部分详细说明

Table 4-6 Detailed Introduction of Inverter Distribution Part

编号 No.	说明 Description
1	交流输出接线端子 AC out-put connecting terminal
2	通讯线接线位置（选配） Communication wire connection terminal (optional)
3	PLC 接线端子（选配） PLC connecting terminal (optional)

4.2.3 直流侧接线 DC Side Connecting

警告！ Warning!

必须用1500V以上的万用表测量直流电压，否则会造成人身伤害或损坏设备；

DC voltage must be measured with a multimeter above 1500V, otherwise it will cause personal injury or damage to the equipment.

警告！ Warning!

阵列开路电压不应超过1500V，否则会损坏设备，连接前一定要用万用表测量光伏阵列开路电压。

Array open-circuit voltage can’t exceed 1500V, or the facility will be damaged; please measure the open-circuit voltage of the Photovoltaic Array with multimeter before connecting.

警告！ Warning!

光伏阵列的电压正负极不能接反，否则会损坏设备，必须用万用表测量确认。

The voltage positive and negative electrode of the PV array shall not be connected reversely, otherwise the equipment will be damaged. A multimeter must be used for

measurement and confirmation.

- 断开直流开关，保证直流侧接线不带电；

  Cutting off the DC switch to ensure the DC side is electrically neutral;

- 用万用表测量光伏阵列的开路电压，保证开路电压不超过1500V；

  Measuring the open-circuit voltage of the photovoltaic array with multimeter to ensure the open-circuit voltage is no more than 1500V;

- 组件的正极和负极不能对地短路，连接前一定要用1500V万用表测量。

  The positive and negative electrodes of the photovoltaic module can not be short-circuited to the ground, and must be measured with a 15 00V multimeter before connecting;

- 光伏阵列的正极连接器通过连接线插入逆变器底端相应的接线端子“PV+”；

  The positive anode connector of the photovoltaic array insert to the connection terminal “PV+”of inverter bottom through the connection wire;

- 光伏阵列的负极连接器通过连接线插入逆变器底端相应的接线端子“PV-”；

The negative anode connector of the photovoltaic array insert to the connection terminal “PV-”of inverter bottom through the connection wire;

- 请确认所有接线牢固。

  Please confirm all connection wire is firm.

注意！Notice!

逆变器的输入接线在输入端口处应该留一定的余量，以避免PV接线端子因受到引线的拉力而影响其连接的可靠性。

The input wiring of the inverter should leave a certain margin at the input port in order to avoid the influence of the tension of the lead on the reliability of the PV wiring terminal.

线缆要求与连接线制作 ：Cable Requirements and Connection Wire Manufacturing:

表4-7 线径规格表

Table 4-7 Cable Diameter Specification Table

线缆类型 Cable Type	推荐线径（mm） Recommended cable diameter	推荐截面积（mm2） Recommended cross-sectional area	推荐线号（AWG） Recommended Line No.
满足 1500V 标准的光伏线缆 1500V PV cable	4.5~6.5	4.0	AWG12
注：外部线缆尽可能选择多芯电缆以确保逆变器可靠连接；可兼容AWG10规格			

线缆。

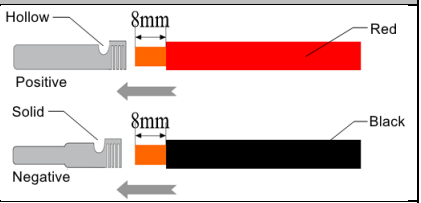
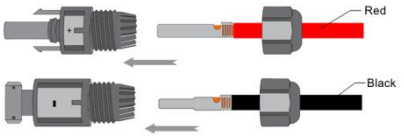
Note: The multi-core cable shall be selected for the external cable as much as possible to ensure that the inverter is connected reliably; compatible with AWG10 cables.

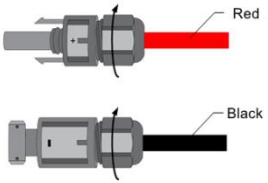
按照线缆要求选择红（正）、黑（负）色线缆各一根后（长度根据接线需要选择），按照表4-8中的步骤制作连接线。

After select a red (positive) and black (negative) cable respectively according to the cable requirements (the length shall be selected according to the wiring requirements), produce the connecting wire according tothe steps in Table 4-8.

表4-8 线缆连接线制作步骤详细说明

Table4-8 Detailed Description of Cable Connection Line Production Steps

步骤 Steps	操作说明 Operation instructions	具体操作视图 Specific Operation View
1	将线缆一端剥线8mm Strip 8mm of one end of the cable	
2	将红、黑色线分别按照图中对应关系连接到管型端子并压紧，在承受390N以上的拉力，端子与线缆不得松动和脱落 Connect the red and black wires to the tubular terminals	

	according to the corresponding relationship in the figure and press them. The terminals and cables shall not be loosened or dropped under the tension above 390N	
3	将管型端子和插头安装在一起，将紧固护套拧紧 Install the tubular terminal and plug together and tighten the fastening sheath	

注意！ Notice!

正极金属端子和负极金属端子分别与正极连接器和负极连接器包装在一起，请拆开包装时分开放置，以免混淆极性，给接线造成不便。

Positive and negative metal terminals are packaged together with positive connectors and negative connectors respectively. Please open them when unpacking so as not to confuse polarity and cause inconvenience to wiring

4.2.4 交流侧接线 AC side wiring

警告！ Warning!

连接交流电网时，将交流侧配电保护装置断开，保证交流侧的接线端子不带电。否则有触电的危险。

When connecting to the AC grid, disconnect the AC side distribution protection device to ensure that the terminals on the AC side are not energized. Otherwise there is a danger of electric shock.

- 断开交流侧和直流侧保护装置，同时用万用表确认交流侧的接线端子不带电；
- Disconnect the AC side and DC side protection devices, and use a multimeter to confirm that the terminals on the AC side are not energized;
- 制作线缆，并压接合适的端子；
- Make cables and crimp the appropriate terminals;
- 将线缆穿过逆变器底部的AC接线防水接头；
- Pass the cable through the AC wiring waterproof connector at the bottom of the inverter;
- 紧固交流输出线缆和地线。
- Tighten the AC output cable and ground wire.

线缆要求及连接线制作：

Cable requirements and cable production:

表4-9 线径规格表

Table 4-9 Wire Diameter Specification Table

线缆规格（mm）Cable specification	**铜芯线缆（mm^2）**	**铜包铝/铝合金线缆（mm^2）**

		Copper core cable	Copper clad aluminum/aluminum alloy cable
导线横截面积（mm2） Cross sectional area of the wire（mm^2）	范围 Range	50-120	120-300
	推荐值 Recommended value	95	150
AC OUTPUT 接头支持的线缆外径（mm） Cable outer diameter for AC OUTPUT connector	范围 Range	51-57	
	推荐值 Recommended value	51	
注：外部线缆尽可能选择多芯电缆以保证逆变器可靠连接。 Note: The multi-core cables shall be selected for the external cable as much as possible to ensure that the inverter is connected reliably.			

（1）将线缆铠装层拨开200mm，并将拨掉铠装层的线缆使用剥线钳剥去绝缘层10mm；松开交流输出接口锁紧螺母，将线缆穿过交流输出接口，如图4-16所示：

Remove the cable armor layer by 200mm, and use the wire stripper to remove the insulation layer by 10mm. Loosen the AC output interface lock nut and thread the cable through the AC output interface. As shown in 4-16:

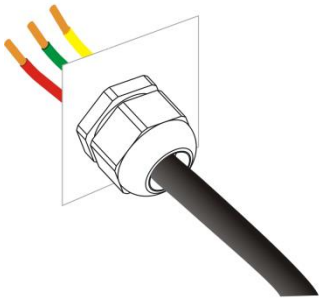


图4-16 交流线缆穿线图

Figure 4-16 Threading diagram of the AC cable

（2）将剥去绝缘层的线芯穿入OT端子压接区内，用压线钳压紧，并用绝缘胶带或热缩套管将OT端子压接区保护好，如图4-17所示：

Insert the core stripped with the insulation layer into the OT terminal crimping area, press it with the crimping pliers, and protect the OT terminal crimping area with insulating tape or heat shrinkable sleeve, as shown in Figure 4-17:

图4-17 线缆连接图

Figure 4-17 Cable connection diagram

（3）将L1、L2、L3线缆固定到机箱内部交流输出端子内，拧紧螺钉，所用螺母及紧固力矩见下表：

序号 Serial	接线端子品牌	接线端子照片 Photo	螺母 Nut	紧固力矩 Tightenting

number	Brand			torque
1	菲尼克斯/ 魏德米勒 Phoenixcontact/Weidmuller		M12	15 N • m
2	航同 Huntec		M10	15 N • m
3	合璧 Hoppy		M12	15 N • m

如图4-18所示：

Fix the L1, L2, and L3 cables to the internal AC output terminals of the chassis, and tighten the screws. The nut used is M10 or M12 and the tightening torque is 15N·m, as shown in Figure 4-18.

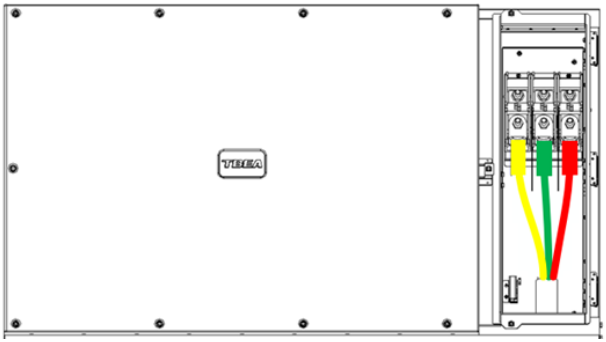


图4-18 线缆紧固图

Figure4-18 Cable fastening diagram

（4）锁紧交流输出接口的锁紧螺母。

Lock the lock nut of the AC output interface.

4.2.5 接地线连接 Connection of Grounding Wire

警告！ Warning!

保护接地线必须正确连接，否则将损坏设备。

The protective earth line must be properly connected, otherwise the equipment may be damaged.

在光伏发电系统中，所有非载流金属部件和设备的外壳都应该接至大地（PE），如光伏阵列的支架，逆变器外壳等。推荐使用的地线（黄绿色，铜线）的线径如表4-10所示：

In photovoltaic power generation systems, all non-current-carrying metal components and equipment casings shall be connected to the ground (PE), such as photovoltaic array supports, inverter casings, etc. Recommended earth line (yellow-green, copper) diameters are shown in table 4-10:

表4-10 接地线线径规格表

推荐线径（mm）	截面积（mm^2）	线号（AWG）
5.0~10.0	50	AWG1
注：地线线径不小于50mm^2。		

Table 4-10 Earth Line Diameter Specification Table

Recommended diameter（mm）	Cross-sectional area（mm^2）	Line number（AWG）
5.0~10.0	50	AWG1
Note: The diameter of earth line shall not be less than 50mm^2.		

我们采用机壳内和机壳外接地的方式，用户可根据现场需要选择接地方式，地线的连接方法如下：

We adopt the grounding method of inside the casing and outside the casing. The user can choose the grounding method according to the site needs. The connection method of earth line is as follows:

机箱外壳有两个接地点如图4-19所示，其中一个为备用接地点。直接将OT端子用螺栓紧固到接地点处即可，扭矩为14N·m。

The casing has two grounding points as shown in figure 4-19, one of which is the standby grounding point. Directly bolt the OT terminal to the grounding point, and the torque is 14N•m.

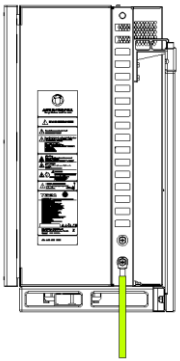


图4-19 机壳外接地点

Figure 4-19 Grounding Point outside the Casing

为了提高接地端子的防腐性能，建议在接地线缆安装完成后，在接地端子外部涂抹硅胶或刷漆进行防护。

In order to improve the anti-corrosion performance of the grounding terminal, it is recommended to apply silicone or paint on the outside of the grounding terminal for protection after the installation of the grounding cable.

4.2.6 通讯连接 Communication Connection

TS208/228/250KTL-HV系列光伏并网逆变器提供RS485或PLC（电力线

载波）通讯方式。用户可根据需要选择相应的通信方式，对逆变器的运行状态进行远程监控。

TS208/228/250KTL-HV series photovoltaic grid-connected inverter provides RS485 or PLC (power line carrier) communication mode. The user can select the corresponding communication mode according to the need and monitor the inverter remotely.

- **RS485通信 RS485 Communication**

A、单机接线方式 Connection of A Single Machine

单台逆变器通过RS485端口与上位机通信，将逆变器的RS485端口通过RS485通讯线与上位机连接，如图4-20所示：

A single inverter communicates with the upper computer through the RS485 port, and connects the RS485 port of the inverter with the upper computer through the RS485 communication line, as shown in figure 4-20:

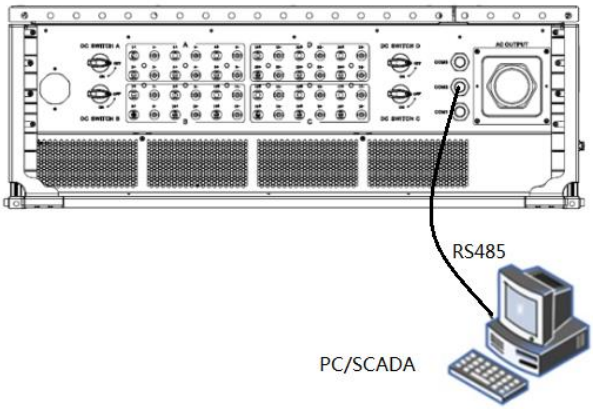


图4-20 RS485单机通讯接线图

Figure 4-20 RS485 Single Machine Communication Connection Figure

B、多机接线方式 Wiring Mode of Several Inverters

多台逆变器通过 RS485 与上位机通信，其中相邻两台逆变器上的 RS485 端口使用 RS485 通讯线连接，连接方式如图 4-21 所示：

Several inverters communicate with an upper computer through RS485 and RS485 ports of two neighboring inverters are connected with RS485 communication line, with the wiring mode shown in Figure 4-21:

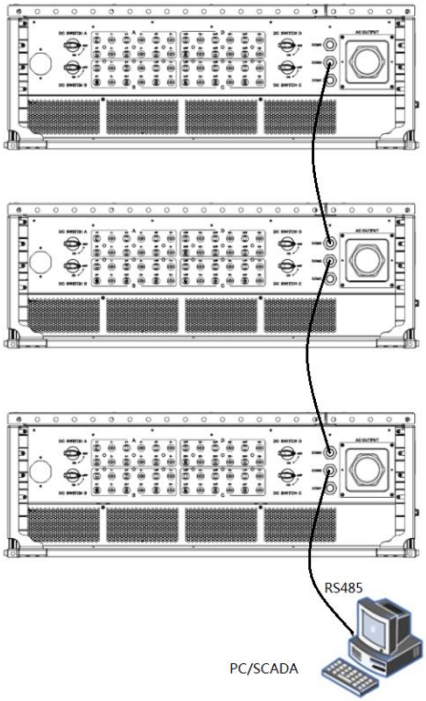


图 4-21 多机通讯接线图

Figure 4-21 Communication Wiring Diagram of Several Inverters

C、RS485接线方法 RS485 Connection Method

（1） 将线缆铠装层拨开60mm，并将拨掉铠装层的线缆使用剥线钳剥去绝缘层10mm；松开COM接口锁紧螺母，将RS485输入输出

线缆穿过COM接口如图4-22所示：

Pull out the cable armor layer for 60mm, and use wire strippers to strip its insulation layer for 10mm; Loosen the locknut of the COM interface, and pass the RS485 input and output cables through the COM interface, as shown in figure 4-22:

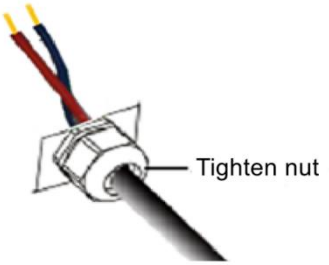


图 4-22 通信线缆穿线示意图

Figure 4-22 Communication Cable Threading

（2） 将输入输出线缆固定到机箱内部通信板上的端子内，

a) 使用一字螺丝刀插入端子上方方孔内；

b）把通讯线缆插入端子上方圆孔内；

c）从方孔内取出螺丝刀；

d）拉动线缆确保线缆牢固接入端子内。

如图4-23所示：

Fix the input and output cables into the terminals on the communication board inside the crate,

A) Insert the slotted screwdriver into the square hole above the terminal;

B) Insert the communication cables into the round holes on the

terminal;

C) Remove the screwdriver from the square hole;

D) Pull the cables to ensure that they are firmly connected into the terminal.

As shown in figure 4-23:

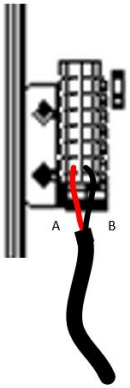


图 4-23 通信线缆接线示意图

Figure 4-23 Communication Cables Connection

（3） 锁紧COM接口的锁紧螺母。

Lock the lock nut of the COM interface.

注意！ Notice!

1、RS485 通信线缆为屏蔽双绞线；

2、单条RS485菊花链上设备数量不能超过32台；

3、RS485菊花链长度不能超过1000米，推荐500m以内；

4、多台逆变器连接时，需要在菊花链的终端安装120Ω的匹配电阻。

1.The RS485 communication cable is a shielded twisted pair cable;

2. The number of devices on a single RS485 daisy chain cannot exceed 32 units;

3. RS485 daisy chain length can not exceed 1000 meters, recommended within 500m;

4. When several inverters are connected, 120Ω matching resistance shall be installed at the terminal of the daisy chain.

- **电力线载波（PLC）通信 Power Line Carrier (PLC) Communication Method**

电力线载波通信为选配通信方式，客户需要在购买前通知厂家，确定使用此功能。

PLC communication is optional way, customer need inform us they need this function before buy the inverter.

注意！Notice!

1、RS485通信方式为标准的通信方式；

2、电力线载波（PLC）为可选的通信方式。

1. Communication mode is the standard communication method；

2. Power line carrier (PLC) is an optional communication method。

- **确认和清理 Confirm and Clean**

（1）确认交流输出线缆、地线、通信线等连接正确并安装牢靠。

（2）确认没有工具以及其他杂物遗留在逆变器内部。

（3）关闭前门板并安装好门板上的螺丝，紧固力矩为6 N·m。

（4）清理现场。

（1）Confirm that the AC output cable, grounding wire and communication cable are connected correctly and installed firmly

（2）Confirm that no tools and others are left inside the inverter.

（3） Close the front door panel and install the screws on the door panel. The tightening torque is 6N·m.

（4）Clean up the site.

4.2.7 通讯地址设置 Setup of communication address

- **通信地址设置 Setup of communication address**

1）APP设置方式 Set up by APP

手机APP连接该逆变器的热点，选择”更多---通讯参数---设备地址”，设置页面如图4-24所示。修改逆变器的通讯地址（1-247），必须保证在方阵内唯一，修改后立即生效。

Connect the hotspot of the inverter through mobile APP, select “more-- communication parameters—device address,” the setting interface is as shown in figure 4-24. Modify the communication address (1-247), guaranteed to be unique within the arrays, effective immediately after amendment

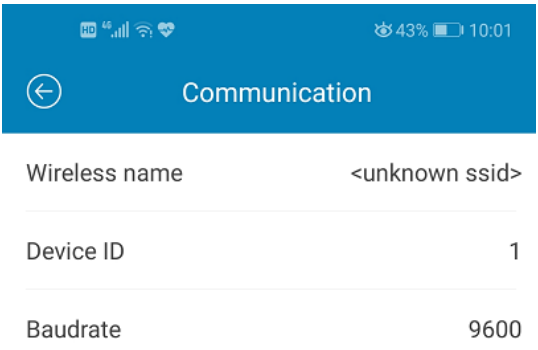


图4-24　APP通讯地址设置页面

Figure 4-24 APP Communication address setting page

2）拨码设置方式 Set by DIP switch

使用拨码开关SW1（**低位**）和SW2（**高位**）设置通讯板上RS485通信地址，拨码开关在通信板上，位置如图4-25所示：

Set the RS485 communication address in communication board through SW1 (Low bit) and SW2 (High bit), its location is shown in figure 4-25:

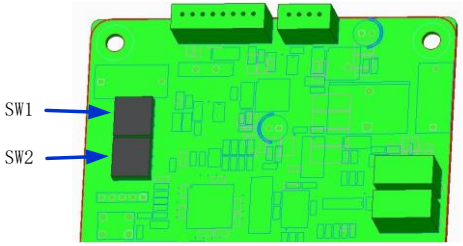


图4-25 地址拨码在通讯板的位置

Figure 4-25 DIP switch's location in communication board

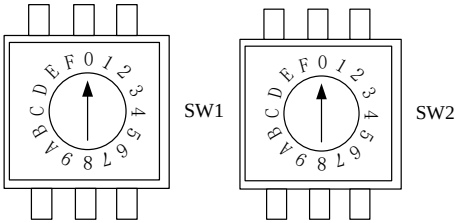


图 4-26 地址拨码开关示意图

Figure 4-26 Address DIP switch diagram

拨码设置规则如下：

The setting rules are as follow:

(1) SW1设置低位，SW2设置高位，共同组成一个十六进制的数字00~FF，换算成十进制为0~255。

SW1 set the low bit, SW2 set the high bit, together form a hexadecimal number 00~FF, convert to decimal number 0~255.

(2) 拨码调节旋钮上有箭头，箭头所指数字即为当前设定数字。

There is an arrow on the adjustment knob, and the number indicated by the arrow is the current setting number.

注意！Notice!

拨码开关设置的地址值必须大于等于1，并且小于等于247。

The address set by the DIP switch must be greater than or equal to 1, and less than or equal to 247.

5 功能说明及操作流程 Function description and operation procedures

5.1 功能说明 Function description

5.1.1 工作模式 Operating Mode

- 停机状态 Outage status

系统接收到停机命令、发生不可恢复故障后，停止并网工作的状态。

State of the system which stops the grid-connection work after the system receives the stop instruction or the unrecoverable fault occurs.

- 待机状态 Standby Status

系统停止工作，等待满足开机条件的状态。

This state represents that the system stops working and waits for meeting the start conditions.

- 等待状态 Waiting Status

根据不同的关机原因和并网规范，并网工作之前的延迟确认计时状态。

According to different cause of shutdown and grid-connection standards, the inverter will be on the waiting state and confirm the condition before on-grid.

- 自检状态 Self-inspection Status

逆变器开始并网运行前对自身硬件进行检测的状态，该状态需要检测：PV 绝缘阻抗、直流电压采样、交流电压采样等关键量。

This state indicates that the inverter is testing its hardware before the inverter starts grid-connected operation; key factors need to be tested under this state, including PV insulation resistance, DC voltage sampling and AD voltage sampling.

- 运行状态 Running status

在此状态下，逆变器处于并网运行状态，将光伏阵列的直流电能变换为交流电并入电网，并且逆变器始终以最大功率跟踪方式向电网输送最大电能。

Under this state, the inverter is in a grid-connected operation state, and converts the DC electric energy of the PV array into the AC electric energy injected into the grid in the maximum power tracking mode.

5.1.2 模式转换 Mode Conversion

The operating mode switch of the system is shown in Figure 5-1.

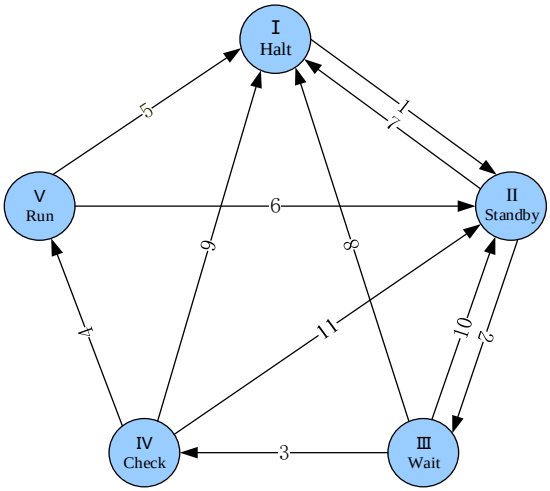


图 5-1　系统状态切换图

Figure 5-1 System State Switching Figure

表5-1 系统状态切换说明

Table 5-1 System State Switching Description

序号 SN	切换说明 Switching description
1	停机命令消除或人为清除故障 Stop command eliminating or man-made troubleshooting
2	接收到开机命令 Receive a start command
3	开机延迟时间 Start delay time
4	检测 PV 电压、电网电压、电网频率、PV 对地阻抗等检测电路都是正常 Detection circuit such as the PV voltage, grid voltage, grid frequency and PV earth impedance, etc. are normal.
5	停机命令或发生不可恢复故障 Stop command or unrecoverable fault occurs.

6	关机命令或不满足并网条件 The shutdown command issues or the grid-connection conditions is not satisfied
7	停机命令 Stop command
8	停机命令或不可恢复故障 Stop command or unrecoverable fault
9	停机命令 Stop command
10	关机命令或不满足等待条件 The shutdown command issues or the waiting conditions is not satisfied
11	关机命令或不满足开机条件 The shutdown command issues or the start conditions is not satisfied

5.2 逆变器操作说明 Operation Instructions of Inverter

逆变器在安装、运行和维护中的各种操作说明如表 5-2 所示：

Various operation instructions of the inverter during installation, operation and maintenance are shown in Table 5-2:

表5-2 流程说明

Table 5-2 Process Instructions

操作 Operation	操作说明 Operation instructions
并网准备操作 Grid-connection preparation	● 按照接线说明连接好输入输出线路； ● Connect the input and output lines according to the wiring instructions;

operation	● 闭合直流开关； ● Turn on the DC switch; ● 闭合逆变器与电网之间的交流断路器。 ● Turn on the AC breaker between the inverter and grid.
并网操作 Grid-connection operation	并网逆变器的输入电压达到逆变器的启动电压范围，系统会自动启动并网，逆变器处于并网发电状态；否则逆变器会报故障。 When the input voltage of the grid-connected inverter reaches its start voltage range, the system will automatically start the grid-connection and the inverter is in a grid-connected generation state; otherwise the inverter will give out a fault warning.
停机操作 Stop operation	如果系统正常运行中需要停机，可以通过以下两种方式进行停机： If the system needs to be shut down in normal operation, it can be shut down in the following two ways: ● 可通过远程控制停机； ● Stop may be controlled from a remote place; ● 在紧急情况下，断开直流开关（不推荐）。 ● Under emergency cases, disconnect the DC switch (not recommended).
故障解除操作 Fault removal operation	● 系统在运行中出现故障，逆变器立即停机； ● In case of fault during operation of the system, the inverter immediately stops; ● 在系统出现故障期间，指示面板的故障灯会常亮报警，通过上位机可以读取相应的故障信息；

	● During fault of the system, the fault light of the indication panel will light up to give an alarm and the corresponding fault information may be read via an upper computer; ● 在进行故障排除前，应将直流开关关闭，并且断开逆变器与电网之间的断路器，根据 5.3 节中的方法进行故障排除。 ● Prior to troubleshooting, the DC switch shall be turned off and the breaker between the inverter and grid shall be disconnected. Troubleshooting shall be performed according to the method in Section 5.3.

5.3 逆变器温度降额曲线设计 Design of Inverter Temperature Reduction Curve

逆变器的正常运行需要一定的温度条件。在环境温度高于最低温度降额点时，输出功率随着温度的升高而线性下降；如果环境温度大于逆变器允许的最高运行温度时，逆变器则关机。当温度降低到温度降额点时，机器恢复正常工作。

A certain temperature condition is required for the inverter to operate normally. When the external ambient temperature is above the minimum temperature derating point, the output power decreases linearly with increasing temperature; The inverter is shut down when the ambient temperature is greater than the maximum operating temperature allowed by the inverter. When the temperature drops to the temperature derating point, the inverter resumes the normal operation.

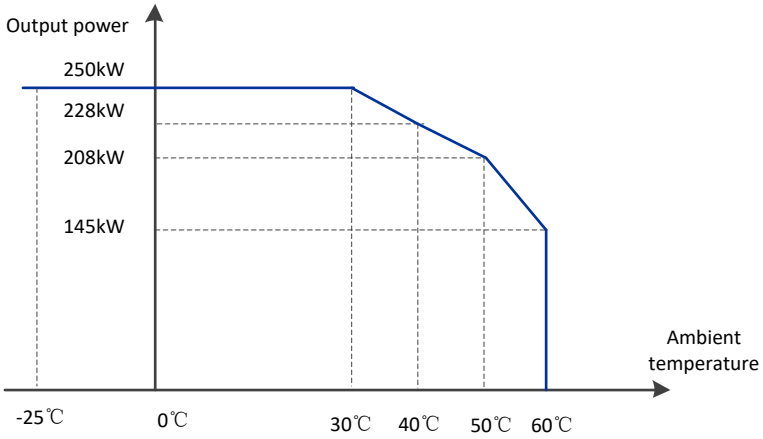


图 5-2 外部环境温度降额曲线

Figure 5-2 External ambient Temperature Derating Curve

6 系统维护 System maintenance

6.1 日常维护 Daily maintenance

为了保障逆变器能够长期良好运行，建议按照本章节的描述对其进行日常维护。

In order to ensure long-term good operation of the inverter, it is recommended to carry out routine maintenance according to the description in this section.

注意！Notice!

请在系统清洁、电气连接、接地可靠性等维护时，先将直流侧的“DC SWITCH”置于“OFF”，再将逆变器与电网之间的交流断路器断开。断电后，请等待至少 5 分钟，再进行操作。

Before wiping the gill, checking the electrical connections, grounding reliability maintenance, please switch the “DC SWITCH” on the DC side to “OFF” and disconnect the AC breaker between the inverter and grid. After powering off, please wait for at least 5min before swiping the gill.

如需在雨雪天气打开维护腔门，请做好防护措施，防止雨雪进入机箱，如果不能防止雨雪进入箱体，请勿在雨雪天气打开柜门。

If it is necessary to open the cabinet door in the rainy and snowy weather, please make sure the safeguard procedures and prevent the rain and snow coming into the machine. If you can't make it, please don't

open the cabinet door.

表 6-1 维护列表

Table 6-1 Maintenance list

检查内容 **Check list**	**检查方法** **Check's method**	**维护周期** **Maintenance period**
系统清洁 System clearance	定期检查散热片有无遮挡及灰尘脏污。 Check the radiator for obstruction and dust periodically	每半年至一年 1 次 Once every six months to one year
系统运行状态 System operation status	1.观察逆变器外观是否有损坏或者变形。 Whether the outline of machine have damage and deformation; 2.听逆变器在运行过程中是否有异常声音。 Hear the exceptional noise when the machine is running; 3.在逆变器运行时，检查逆变器各参数是否设置正确。 Check the machine's parameters and make sure they're right.	每半年 1 次 Once time per half of one year
电气连接 Electrical connection	1.检查线缆连接是否脱落、松动。 Whether the cable is fallen off or loosen; 2.检查线缆是否有损伤，着重检查电缆与金属表面接触的表皮是都有割伤痕迹。 Whether the cables have damages, the key point is the connection between the cables and metal terminals.	首次调试后半年，以后每半年到一年 1 次 First time is in the half of one year after first working, then once time per

	3.检查未使用的 COM、无线通讯接口、ACOUTPUT 等端口的防水盖，是否处于锁紧状态。 Check whether the waterproof covers of COM, wireless communication ports and ACOUTPUT are locked tightly.	half of one year or one year
接地可靠性 Reliability of ground connection	检查接地线缆是否都可靠接地 Check the reliability of ground connection.	首次调试后半年，以后每半年到一年 1 次 First time is in the half of one year after first working, then once time per half of one year or one year

6.2 外部风扇更换 External Fan Replacement

当外部有风扇损坏或寿命到期后，需马上更换风扇，更换步骤如下（参考图 6-1）：

When the external fan is damaged or the service life expires, it should be replaced immediately. The steps are as follow (reference to figure 6-1):

1. 松开左侧固定风扇支架的 1 颗 M4 组合螺钉；
   Loosen the one M4 combined screw of the fan fixed bracket in left side;
2. 将风扇固定支架缓慢拉出约 15cm,此时可以看到捆扎在风扇支架上的 7 对对插端子，依次将对插端子分开；
   Pull the bracket out for about 15cm slowly, then, you can see 7

pairs sockets, please separate them in turn;

3. 继续拉动风扇支架直至完全抽出；

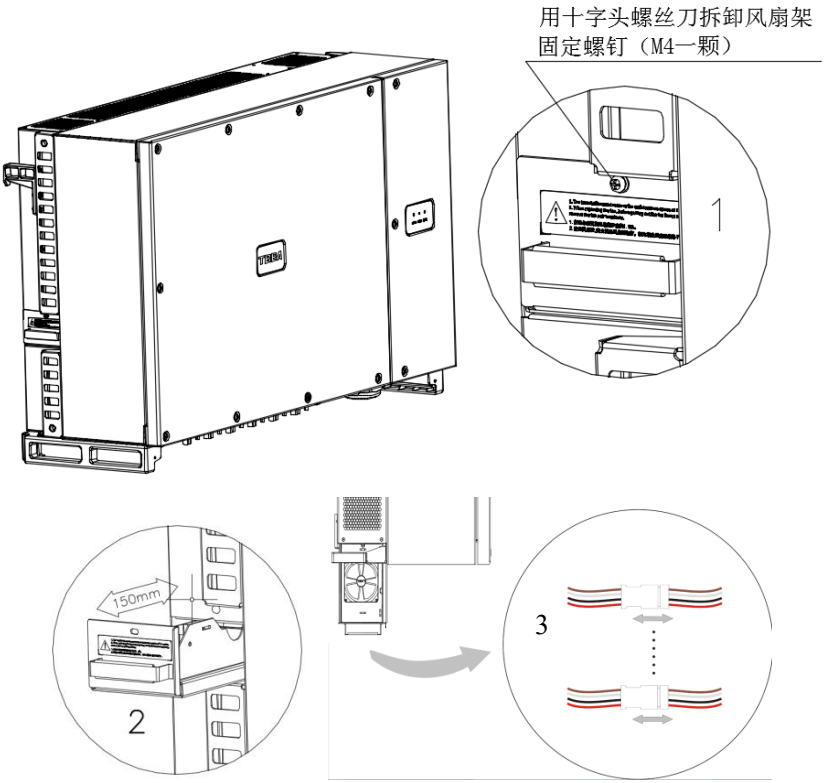
   Pull the fan bracket until it is fully pulled out;

4. 松开风扇支架上的螺钉，将损坏的风扇取出更换，更换时注意风扇的风向；

   Loosen the screw on the fan bracket and replace the damaged fan, please pay attention to fan direction when replacing;

5. 按上述步骤反向装回完成更换

   Refer to the above steps and follow the opposite steps to install it back, then the replacement is complete.



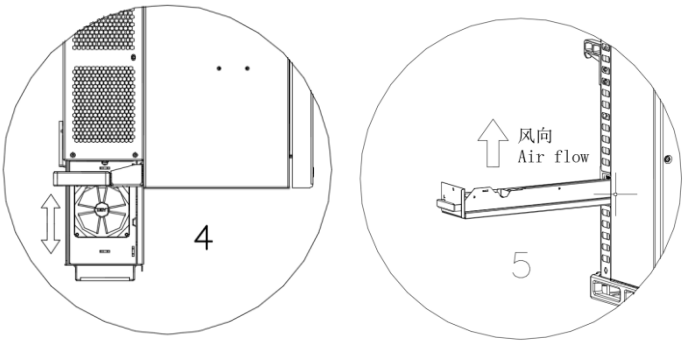


图 6-1 风扇更换步骤

Figure 6-1 Fan replacement steps

6.3 故障原因 Fault causes

系统故障一般有以下几个原因：

System fault causes are listed as follows:

- 外电网连接故障（如：交流线没有连接好）；
- Connection fault of external grid (such as poor connection of cable A, B or C or incorrect phase sequence connection);
- 光伏阵列超出工作电压范围；
- PV array exceeds the working voltage range;
- 电网欠压（$U_{AC} < U_{AC,min}$）；
- Grid undervoltage（U_{ac}<“$U_{ac,\ min}$”）
- 电网过压 ($U_{AC}>U_{AC,max}$)；
- Grid overvoltage (U_{ac}>“$U_{ac\ ,max}$”)；
- 电网频率过低 ($f_{AC}<f_{AC,min.}$)；

- Grid frequency is too low (f_{ac}<"$f_{ac,min}$");
- 电网频率过高 (f_{AC}>$f_{AC,max.}$);
- Grid frequency is too high (f_{ac}>"$f_{ac,\ max}$");
- 输出短路;
- Output short circuit;
- 逆变器过温故障。
- Inverter over temperature fault.

当逆变器出现故障时，请先确认逆变器的接线是否脱落或是否停电，如故障无法排除，请联系专业技术人员。

Conform whether the ordinary power outage occurs or not, and whether the inverter output cables are disconnected or not when fault occurs .Please contact the professional technician if the fault cannot be eliminated.

6.4 故障诊断 Fault diagnosis

针对系统运行中出现的各种故障，系统故障对应的一般诊断方式如下：

In view of various faults occurring in the operation of the system, the general diagnostic methods corresponding to system faults are as follows:

表 6-2　故障对照表

Table 6-2 Comparison table for system faults

序号 No.	故障信息 Fault information	故障类型 Fault types	故障原因 Fault causes	处理方式 Solutions	备注 Remarks

1	交流防雷故障 AC lighting protection failure	交流防雷故障 AC lighting protection failure	交流防雷器或防雷板损坏 The AC-side surge protection module or board fails	更换交流防雷器或防雷板 Replace the AC-side surge protection module or board	
2	直流防雷故障 DC lighting protection failure	直流防雷故障 DC lighting protection failure	交流防雷器或防雷板损坏 The DC-side surge protection module or board fails	更换交流防雷器或防雷板 Replace the DC-side surge protection module or board	
3	PV启机电压异常 PV Starting voltage failure	PV启机电压高 PV starting voltage is high	PV电压高于逆变器限制 PV voltage is higher than inverter limit	减小阵列串联数量 Reduce the number of the series arrays	

		PV启机电压低 PV starting voltage is low	PV电压低于逆变器限值 PV voltage is lower than inverter limit	增加阵列串联数量或者等待恢复正常 Increase the number of the series arrays or waiting for recovery	恢复正常后自动并网 Automatically connected to the grid after recovery
4	PV运行电压异常 PV operation voltage abnormal	PV运行电压高 PV operation voltage is high	PV运行电压高于逆变器的限制 PV operating voltage is higher than inverter limit	等待恢复正常或联系厂家 waiting for normal recovery or contact the manufacturer	恢复正常后自动并网 Automatically connected to the grid after recovery
		PV运行电压低 operation voltage is low	PV运行电压低于逆变器的限制 PV operating voltage is lower than inverter limit	等待恢复正常或联系厂家 waiting for normal recovery or contact the manufacturer	恢复正常会自动并网 Automatically connected to the grid after recovery

5	电网线电压AB/BC/CA异常 Grid line voltage AB/BC/CA abnormal	电网线电压高 Grid line voltage is high	电网电压高于标准要求 Grid voltage exceeds the standard requirements	检查电网或联系厂家 Check the grid or contact the manufacturer	电网恢复后自动重新启动 Automatically connected to the grid after recovery
		电网线电压低 Grid line voltage is low	电网电压低于标准要求 Grid voltage is below the standard requirements	检查电网或联系厂家 Check the grid or contact the manufacturer	电网恢复后自动重新启动 Automatically connected to the grid after recovery
6	电网频率异常 Grid frequency is abnormal	电网频率高 Grid frequency is high	电网频率高于标准要求 Grid frequency exceeds the standard requirements	检查电网或联系厂家 Check the grid or contact the manufacturer	电网恢复后自动重新启动 Automatically connected to the grid after recovery

		电网频率低 Grid frequency is low	电网频率低于标准要求 Grid frequency is below the standard requirements	检查电网或联系厂家 Check the grid or contact the manufacturer	电网恢复后自动重新启动 Automatically connected to the grid after recovery
7	环境温度过温 Environment temperature over-temperature	环境温度过高 Environment temperature is too high	逆变器运行环境温度超过限值 The operation environment temperature exceeds the limit	逆变器自动停机，等待环境温度正常 The inverter automatically stop, waiting for normal environment temperature	
8	输入绝缘阻抗保护 Input insulation impendence protection	输入绝缘阻抗异常 Input insulation impendence abnormal	输入绝缘阻抗低于标准要求 Input insulation impendence under the standard requirement	检查阵列对地情况或联系厂家 Check the grounding of the array or contact the manufacturer	

			s		
9	输出电流过流保护 Output current is overcurrent protection	输出电流过大 Output current is too large	逆变器输出电流超过限制 Output current exceeds the limit	逆变器自动停机，等待恢复正常或联系厂家 The inverter automatically stop, waiting for normal recovery or contact the manufacturer	
10	漏电流故障 Leakage current fault	输出漏电流过大 Output leakage current is too large	逆变器输出漏电流超过限值 Output leakage current exceeds limit	逆变器自动停机，重新自检或联系厂家 The inverter automatically stop, re-inspect or contact the manufacturer	
11	继电器故障 Relay fault	输出继电器故障 Output relay fault	逆变器交流输出端的交流继电器故障 AC output relay fault at the AC side of the	等待重启或者联系厂家 Waiting re-start or contact the manufacturer	

			inverter		

7 技术参数 Technical Parameter

7.1 技术特性 Technical Characteristics

- 25 年设计寿命。
- Full thin-film capacitor design to ensure the design service life of 25 years.
- 智能风冷散热，延长器件寿命，工作更可靠。
- Intelligent air-cooled heat dissipation, prolong the life of device, more reliable work status.
- 高功率密度。
- High power density.
- 输入支路电流监测。
- Input branch current monitoring.
- 集成汇流、交直流侧均具有防雷功能。
- There are anti-thunder functions on the integration junction, AC and DC sides.
- 高容配比，降低 LCOE。
- High capacity ratio, low LCOE.
- 多种通讯接口可选，支持 RS485、电力载波 PLC

- Several communication interfaces are optional, which support RS485, the power line communication.
- 具备低电压穿越（LVRT）功能。
- Have the low voltage rid through (LVRT) function.
- 具备高电压穿越（HVRT）功能。
- Have the high voltage rid through (HVRT) function.
- 防护等级 IP66，适应多雨、多尘的严酷户外环境。
- The protection class is IP66, applicable to the harsh outdoor environment with more rain and dust.
- 并网电流 THDi<3%。
- Grid-connected current THDi<3%.

7.2 技术参数 Technical parameters

型号 Type	TS208KT L-HV	TS228KT L-HV	TS250KTL -HV
直流侧参数 DC side parameters			
最大输入功率（kW） Max. input power (kW)	350		
启动电压（V） Starting voltage (V)	500		
额定输入电压（V） Rated input voltage	1170		
最大直流输入电压（V） Max. DC input voltage (V)	1500		

PV 输入电压运行范围（V） PV input operating voltage range（V）	500~ 1500		
满载 MPPT 电压范围（V） Full-load MPPT voltage range (V)	880~ 1300		
最大输入电流（每路 MPPT）（A） Max. input current（per MPPT）(A)	30		
独立 MPPT 跟踪路数 Number of independent MPPT tracking lines	12		
最大输入路数 Max. number if inputs	24（Y+1 时最大支持 36） 24（Max support for 36 lines in Y+1 mode）		
PV 输入最大短路电流（A） Isc PV (A)	50		
交流侧参数 AC side parameters			
额定输出功率（kW） Rated output power (kW)	208	228	250
最大输出功率（kW） Max. output power (kW)	250	250	250
最大视在输出功率（kVA） Max. apparent output power (kVA)	250	250	250
额定输出电流（A） Rated output current (A)	150	165	180
最大输出电流（A） Max. output current (A)	180	180	180
额定电网电压（Vac） Rated grid voltage (Vac)	3/PE /800		

电网电压范围（Vac） Grid voltage range (Vac)	680-920
额定电网频率（Hz） Rated grid frequency (Hz)	50/60
电网频率范围（Hz） Grid frequency range (Hz)	45-55/55-65
直流分量 Branch component	<0.5%Inorm
功率因数调节范围 Power factor control range	0.8（超前）-0.8（滞后）连续可调 0,8 ind. to 0,8 cap. continuously adjustable
电流总谐波畸变率 THD(%) Total harmonic distortion of current THD (%)	<3
系统参数 System parameters	
最大效率（%） Max. efficiency (%)	99
中国效率（%） Chinese Efficiency (%)	98.45
欧洲效率（%） European efficiency (%)	98.75
运行温度范围（℃） Operating temperature range (℃)	-25～+60
运行湿度范围（%） Operating humidity range (%)	0～100（无凝露） 0～100（without condensation）
运行海拔范围 Operating altitude range	4000m
防护级别 Protection class	I
防护等级 Protection Level	IP66
污染等级 Pollution degree	外部 PD3，内部 PD2 Outside PD3, Inside PD2

过电压等级 Overvoltage category (OVC)	II (PV), III (Grid)
隔离类型 Isolation type	非隔离 Non-isolation
夜间自耗电（W） self-power consumption at night (W)	<3
冷却方式 Cooling	智能风冷 Intelligent air-cooled
噪音（dB） Noise (dB)	<80，1m
保护功能 Protection functions	
防孤岛保护 Anti-islanding protection	具有 Yes
低电压穿越 Low voltage ride through	具有 Yes
高电压穿越 High voltage ride through	具有 Yes
直流开关 DC switch	具有 Yes
直流保险丝 DC fuse	无 NO
PV 绝缘阻抗检测保护 PV insulation impedance inspection protection	具有 Yes
交流侧短路保护 AC side short circuit protection	具有 Yes
过电流保护 Overcurrent protection	具有 Yes
电网电压频率保护 Grid voltage and frequency	具有 Yes

protection	
支路电流检测 Branch current inspection	具有 Yes
防雷失效检测 SPD failure detection	具有 Yes
机械参数 Mechanical parameters	
（宽×高×深）mm (Width* height*depth) mm	1100×700×360(本体) 1100*700*360 (Inverter)
重量（kg） Weight (kg)	≤110
直流端子 Branch terminal	MC4
安装方式 Installation mode	抱杆安装/壁挂安装 Pole installation/Wall hanging
通讯与显示 Communication and display	
通讯接口 Communication interface	RS485/WIFI / PLC（选配）/GPRS（选配） RS485/WIFI / PLC（optional）/ GPRS（optional）
显示 Display	LED 指示灯 LED indicator light
通讯规约 Communication protocol	Modbus_RTU
产品认证 Product certification	
TUV、新能标 NB/T32004、低压穿越、高压穿越 TUV、NB/T32004、LVRT、HVRT	

8 附录 Appendix

8.1 质量保证 Quality assurance

本产品在质保期内均可享受免费维护。以下情况出现，本公司有权不进行质量保证：

This product can enjoy the free maintenance within the warranty period. When the following situations occur, the company has the right not to undertake quality assurance:

- 不正确地安装；
- Incorrect installation;
- 不正确地改装；
- Incorrect modification;
- 不正确地使用；
- Incorrect use;
- 任何超出相关国际标准规定安装和使用范围；
- Any installation and range of application exceeding the relevant international standard specifications;
- 非正常自然环境引起的损坏。
- Damages caused by the non-normal natural environment.

8.2 联系我们 Contact us

如果对本产品有任何问题请与我们联系，详细联系方式如下：

If you have any questions on this product, please contact us, the contact details are as follows:

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Company name: TBEA Xi'an Electric Technology Co., Ltd.

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