Integrated Solar Power System

User's Manual

V1.0.0

Foreword

General

This manual introduces the functions and operations of the integrated solar power system (hereinafter referred to as the "System").

Models

PFM364L-D1, PFM363L-D1, PFM363L-SD1, and PFM372-L45-4S14P

Safety Instructions

The following categorized signal words with defined meaning might appear in the manual.

Signal Words	Meaning
⚠ CAUTION	Indicates a potential risk which, if not avoided, may result in property damage, data loss, lower performance, or unpredictable result.
⊙—⌐ TIPS	Provides methods to help you solve a problem or save you time.
📖 NOTE	Provides additional information as the emphasis and supplement to the text.

Revision History

Version	Revision Content	Release Time
V1.0.0	First release.	November 2020

About the Manual

- The manual is for reference only. If there is inconsistency between the manual and the actual product, the actual product shall prevail.
- We are not liable for any loss caused by the operations that do not comply with the manual.
- The manual would be updated according to the latest laws and regulations of related jurisdictions. For detailed information, refer to the paper manual, CD-ROM, QR code or our official website. If there is inconsistency between paper manual and the electronic version, the electronic version shall prevail.
- All the designs and software are subject to change without prior written notice. The product updates might cause some differences between the actual product and the manual. Please contact the customer service for the latest program and supplementary documentation.
- There still might be deviation in technical data, functions and operations description, or

errors in print. If there is any doubt or dispute, we reserve the right of final explanation.

- Upgrade the reader software or try other mainstream reader software if the manual (in PDF format) cannot be opened.
- All trademarks, registered trademarks and the company names in the manual are the properties of their respective owners.
- Please visit our website, contact the supplier or customer service if there is any problem occurring when using the device.
- If there is any uncertainty or controversy, we reserve the right of final explanation.

Important Safeguards and Warnings

This chapter describes the contents covering proper handling of the integrated solar power system, hazard prevention, and prevention of property damage. Read these contents carefully before using the System, comply with them when using, and keep it well for future reference.

Storage

- Do not drop or splash liquid onto the System, and make sure there is no object filled with liquid on the System to prevent liquid from flowing into the System.
- Do not dissemble the System.
- Transport, use and store the System under the allowed humidity and temperature conditions.
- Keep the System away from corrosive gas and liquid.
- Charge the battery every 3 months if you want to store the System for a long period.

Installation and Operation

- Install the System in a well-ventilated place.
- Before trying to install, operate and maintain the System, make sure the installation personnel has completely understood the content in the manual, and has an idea about the potential risk during installation.
- Do not install or operate the System when it is raining, damp or in strong wind.
- Keep the System in the original packing box until installing it.
- Do not install or use the System that has been damaged.
- Do not dismantle and maintain the System by yourself or non-professional personnel.

Disclaimer

The company will not be responsible for the damages resulting from the following reasons:
- Improper use, or use the System in improper scenario.
- Temperature of working environment exceeds the limit of the System's working temperature.
- Dismantling and maintenance of the System by yourself or non-professional personnel.
- Force majeure.

Table of Contents

1 Overview

1.1 Introduction

This off-grid integrated solar power system consists of solar panel, lithium battery pack, maximum power point tracking (MPPT) charge controller, and mounting bracket. The System can be used in places without power supply and network connection. Specifically, it is applicable to the following scenarios:

- Supplying power for surveillance devices installed at places such as small construction sites, mobile toilets, mobile waste stations, street vendor markets, temporary traffic control zones.
- Supplying power for surveillance devices installed at public places in parks, office areas, residential buildings, and so on to prevent potential damages to infrastructures and landscaping.

1.2 Features

- All-in-one design, easy to install, remove, and maintain.
- Aluminum alloy frame brings attractive appearance and excellent anti-corrosion performance.
- IP66 protection level.
- RS-485 communications port and standard Modbus protocol, meeting communications requirements in various scenarios.
- MPPT controller helps significantly improve the energy utilization efficiency of the System, and raise the charging efficiency by 10%–30% compared with conventional PWM method.
- Comprehensive electronic protection: Current limiting, short circuit, and reverse current protection of solar panel; reverse connection, overcurrent, overdischarge, and overtemperature protection of lithium battery; overload and short circuit protection for device that consumes power.

2 Packing List

After opening the packing box, check whether there is any obvious damage to the System, and make sure that all the items included in the packing list are provided.

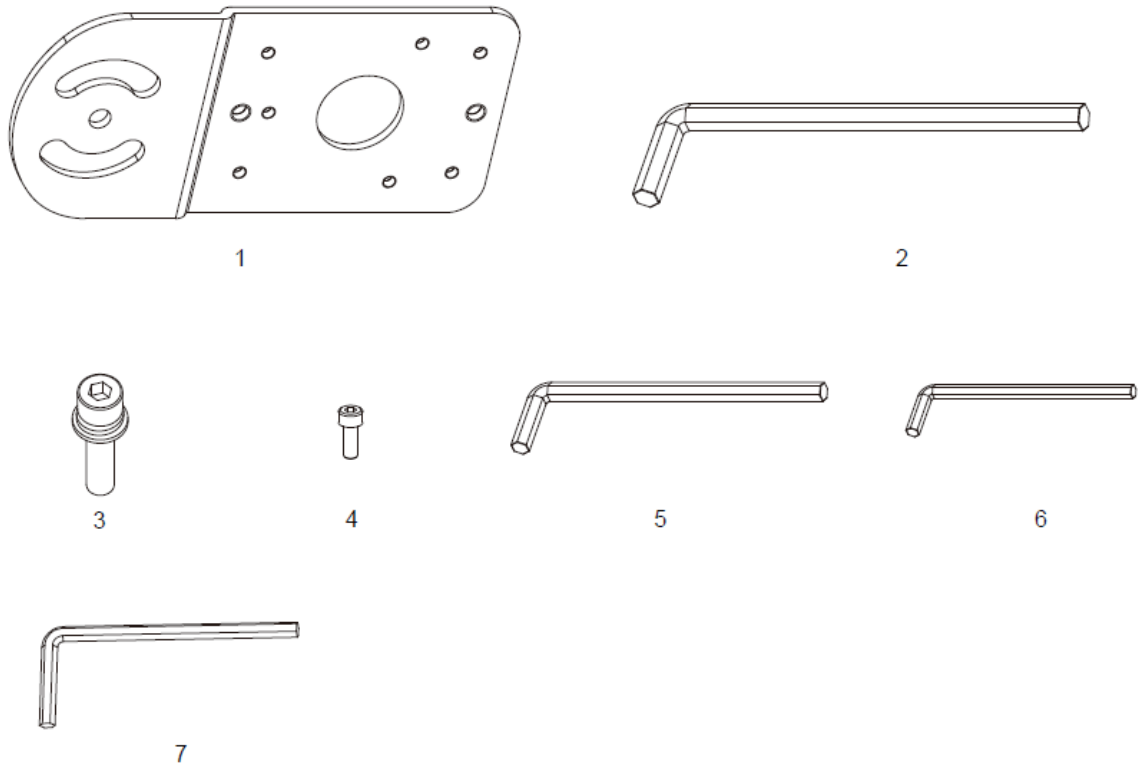Figure 2-1 Packing list (PFM364L-D1, PFM363L-D1, and PFM363L-SD1)

Table 2-1 Packing list description (1)

No.	Name	Quantity
1	Camera mounting plate	1
2	S10.0L	1
3	M8*20	2
4	M4*12	5
5	S6.0L	1
6	S3.0L	1
7	S4.0L	1

Figure 2-2 Packing list (PFM372-L45-4S14P)
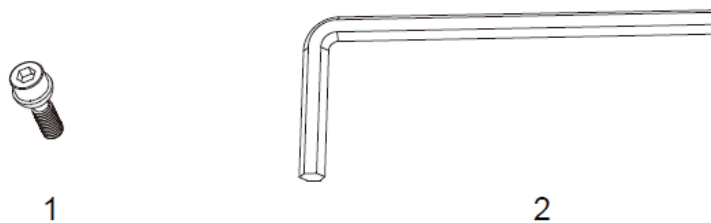
Table 2-2 Packing list description (2)

No.	Name	Quantity
1	M6*30	6
2	S5.0L	1

3 Structure

3.1 Appearance

Figure 3-1 Components (PFM364L-D1 and PFM363L-D1)
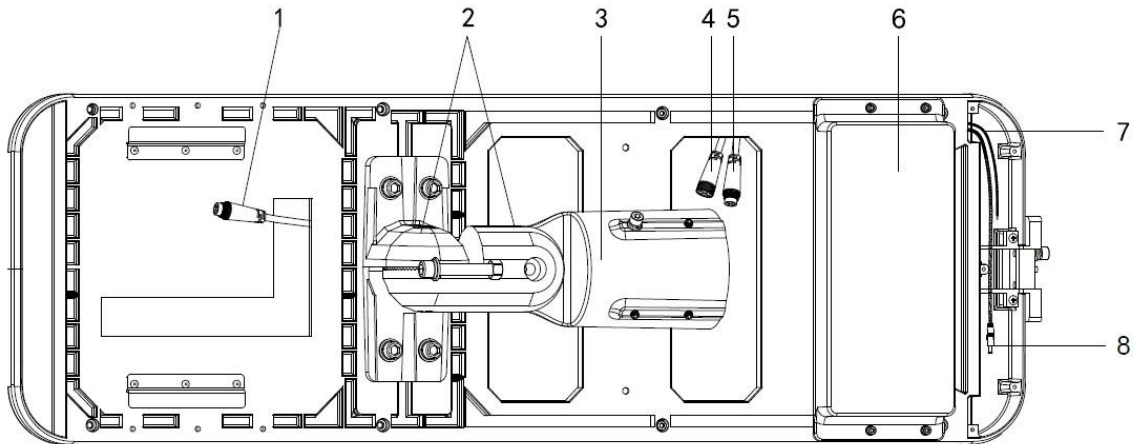
Table 3-1 Component description (PFM364L-D1 and PFM363L-D1)

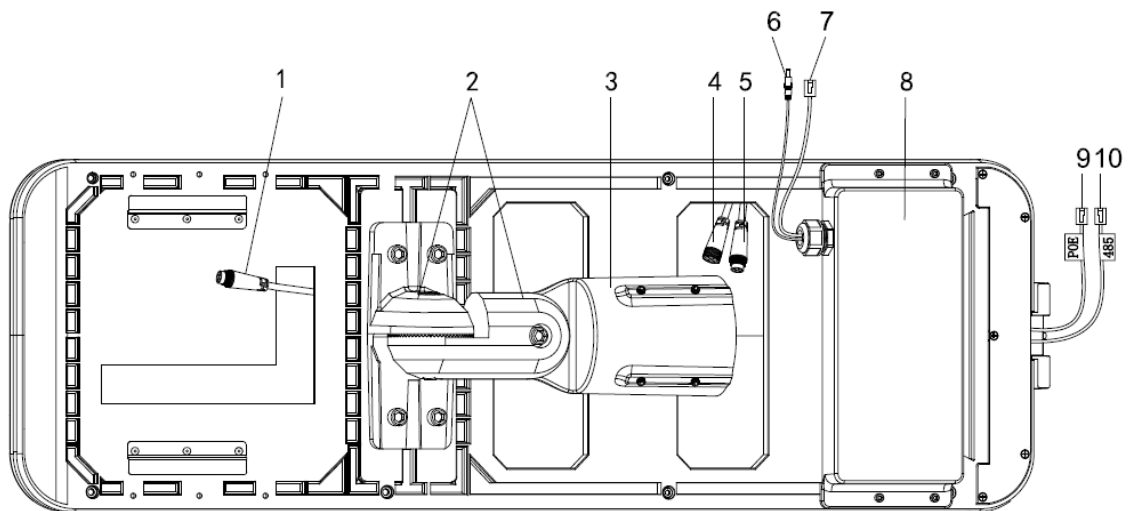| No.	Name	Description
1	Male circular connector	Connector pin.
2	Gear for adjusting angle	Gear for adjusting horizontal and vertical angles. 5 degrees will be adjusted by rotating each slot.
3	Mounting sleeve	Attach the mounting sleeve to the pole, and then tighten the sleeve.
4	Female circular connector	Connector socket.
5	Male circular connector	Connector pin.
6	Controller holder	Holds the controller.
7	RS-485 serial line	Used for communications between the System and another device.
8	Power output interface	Supplies power to another device.

Figure 3-2 Components (PFM363L-SD1)

Table 3-2 Component description (PFM363L-SD1)

No.	Name	Description
1	Male circular connector	Connector pin.
2	Gear for adjusting angle	Gear for adjusting horizontal and vertical angles. 5° will be adjusted by rotating each slot.
3	Mounting sleeve	Attach the mounting sleeve to the pole, and then tighten the sleeve.
4	Female circular connector	Connector socket.
5	Male circular connector	Connector pin.
6	Power output interface	12V DC/1A power output.
7	LAN port	Used for data transmission of surveillance device.
8	Controller holder	Holds the controller.
9	PoE output port	12 V non-standard PoE output, usually supplying power for wireless CPE (customer premises equipment) device.
10	RS-485 port (serial port to network interface)	Used for communications between the System and another device.

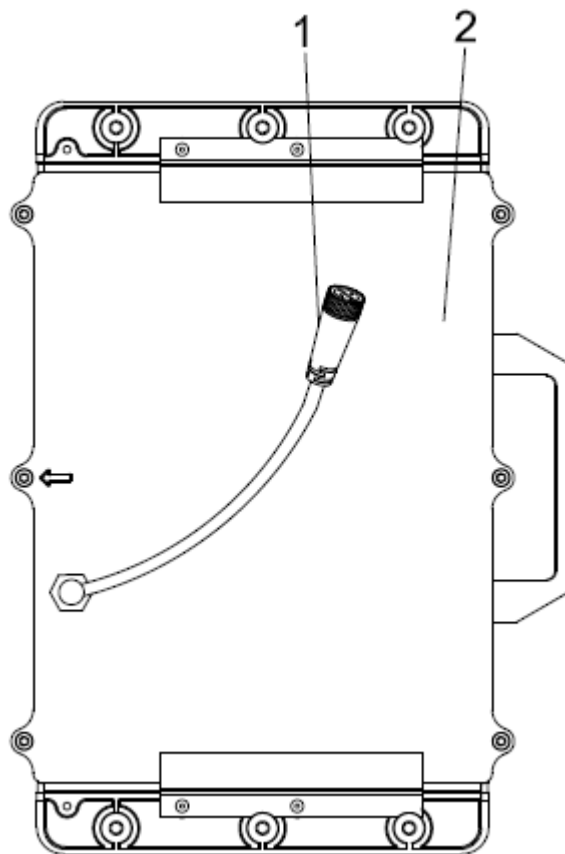Figure 3-3 Components (PFM372-L45-4S14P)

Table 3-3 Component description (PFM372-L45-4S14P)

No.	Name	Description
1	Female circular connector	Connector socket.
2	Battery box	Hold batteries.

3.2 Dimensions

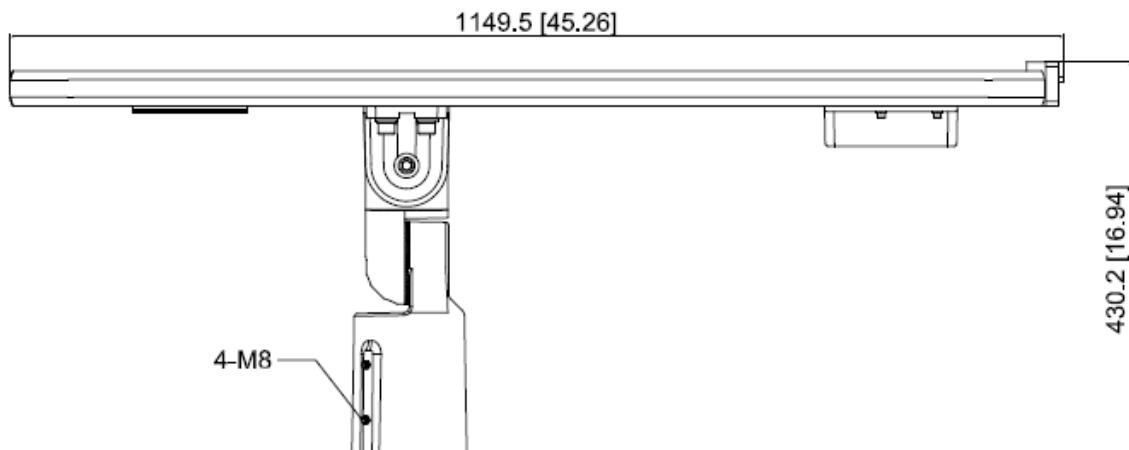## 3.2.1 PFM364L-D1

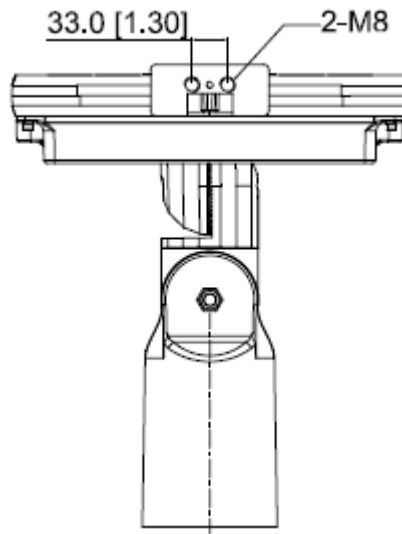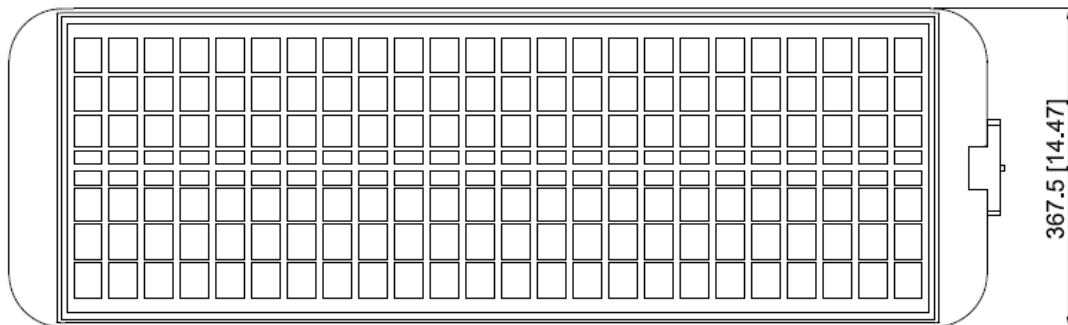Figure 3-4 Front view (mm [inch])

Figure 3-5 Side view (mm [inch])

Figure 3-6 Top view (mm [inch])

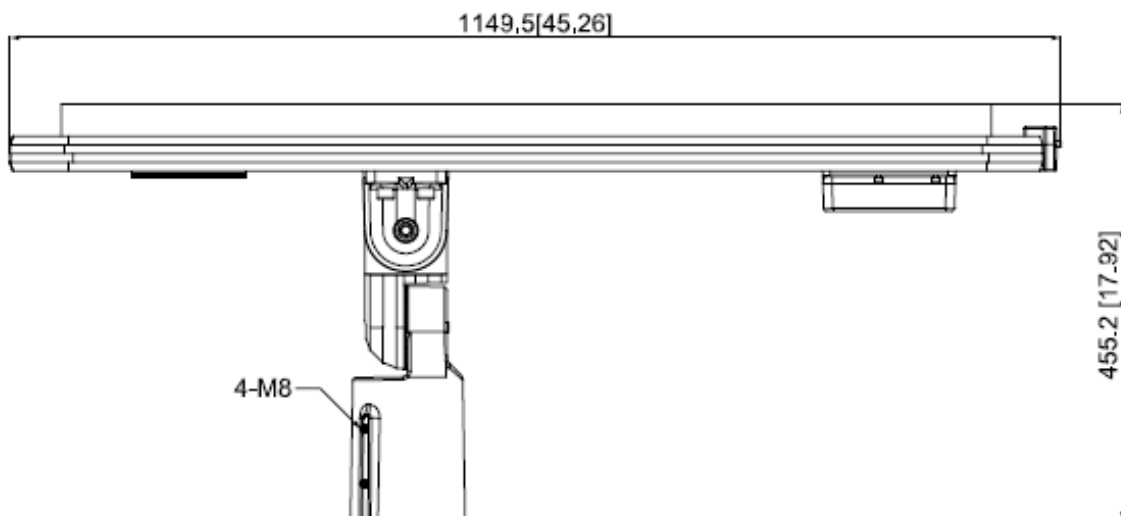## 3.2.2 PFM363L-D1 and PFM363L-SD1

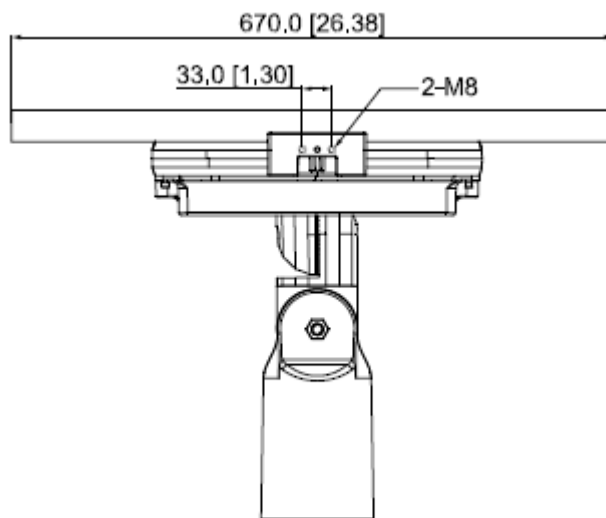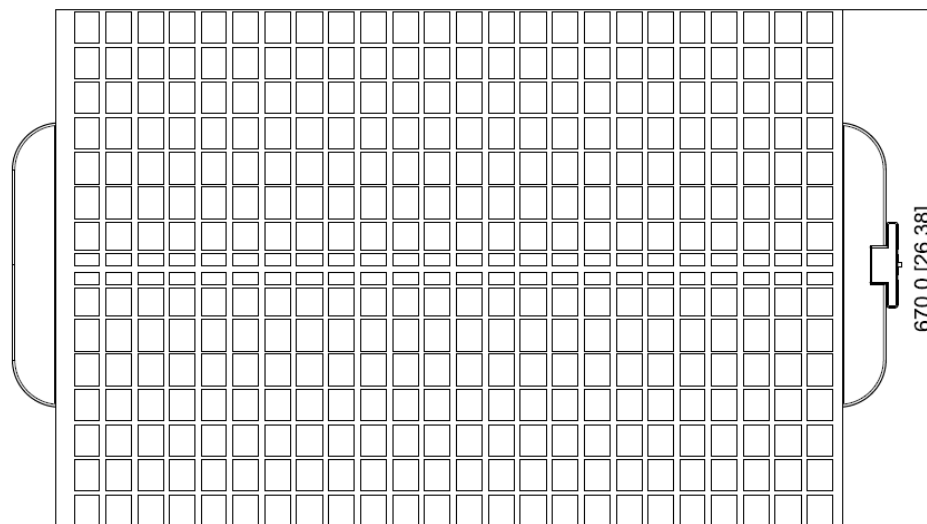Figure 3-7 Front view (mm [inch])

Figure 3-8 Side view (mm [inch])

670.0 [26.38]

33,0 [1,30]   2–M8

Figure 3-9 Top view (mm [inch])

670.0 [26.38]

3.2.3 PFM372-L45-4S14P

Figure 3-10 Front view (mm [inch])
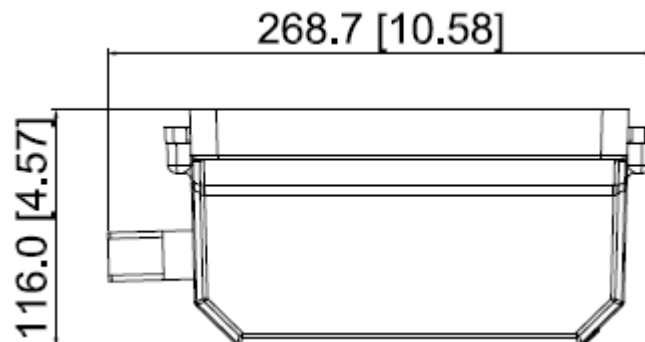
268.7 [10.58]

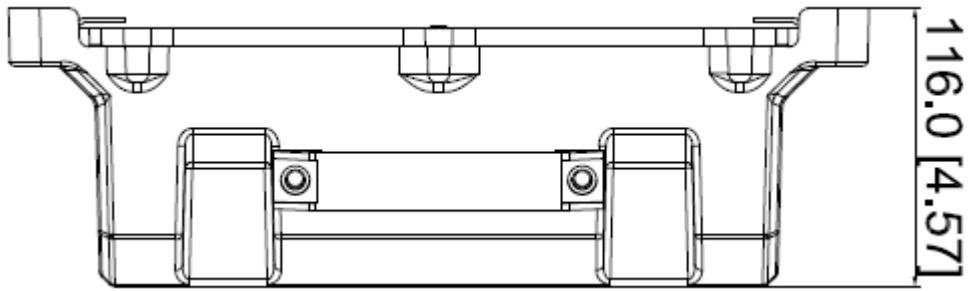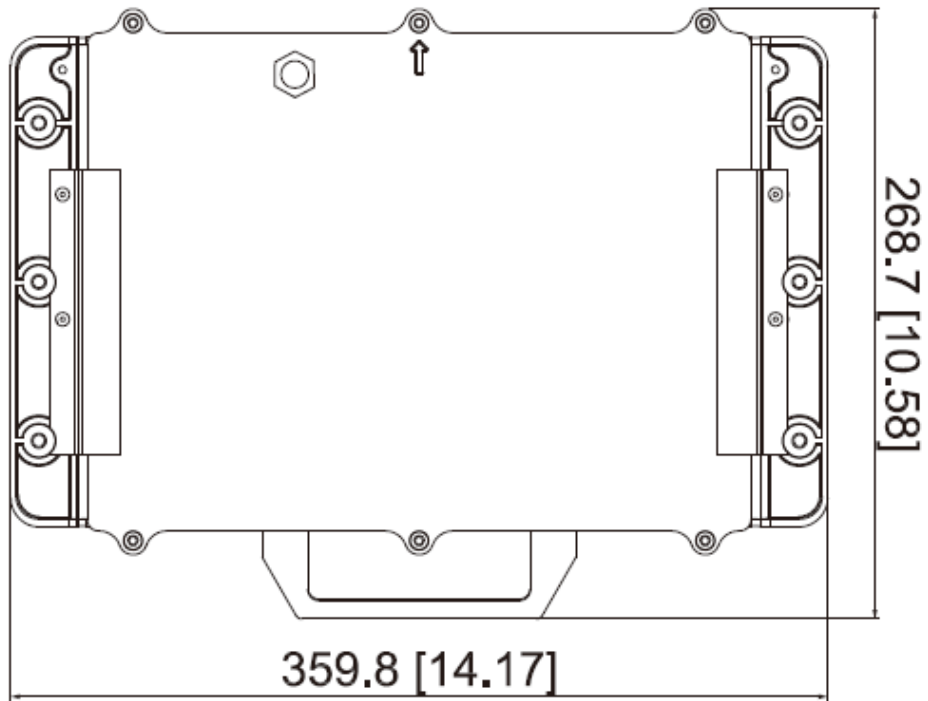116.0 [4.57]

Figure 3-11 Side view (mm [inch])

Figure 3-12 Top view (mm [inch])

4 Installation

4.1 Preparation
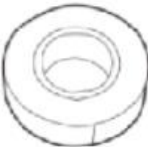
4.1.1 Installation Site Requirements
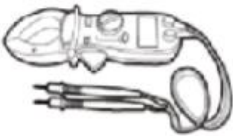
- The installation site shall meet the requirements of electrical and relevant fire prevention codes.
- Choose an installation site with sufficient sunshine all the year round, and make sure no shelter around the site to ensure natural lighting.
- If there is shelter at the installation site, make sure the lowest installation position of the System is at least 1 meter above the shelter, otherwise, it will lead to decline in power generation and battery power loss, which will finally damage the battery.
- Avoid public facilities such as underground cables, optical cables to ensure smooth installation.
- Make sure the back side of the System is well-ventilated.

4.1.2 Tools

Tools included in the packing list are provided. Besides, you need to prepare the tools shown in Figure 4-1.

Figure 4-1 Tools

Insulated gloves	Protective gloves	Clamp meter
Insulated shoes	Ladder	Compass
Screwdriver	Spirit level	Insulating tape

4.1.3 Cables

We recommend you to ground all the devices, and you need to prepare the cables for grounding connection.

Select cables that comply with requirements on cables for surveillance industry. Cable length depends on pole length and height of drilled holes. Select proper cable by referring to the following table and combining with your actual needs.

Table 4-1 Grounding cable requirements

Cable Type	Description
Grounding cable	It is recommended to use stranded bare copper flexible cable with ground impedance less than 4 Ω and cable length not more than 10 m. Use green wire with yellow stripe for the protective ground.

4.2 Installation Procedures

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Installation steps have minor differences for the three models. The manual takes installation of PFM364L-D1 and PFM372-L45-4S14P for example.

Step 1 Open the package, and place the System on a flat surface.

Step 2 Attach the lithium battery (PFM372-L45-4S14P) to the System (PFM364L-D1).

1) Align two circular connectors, and then connect them firmly.

Figure 4-2 Insert the connectors into each other
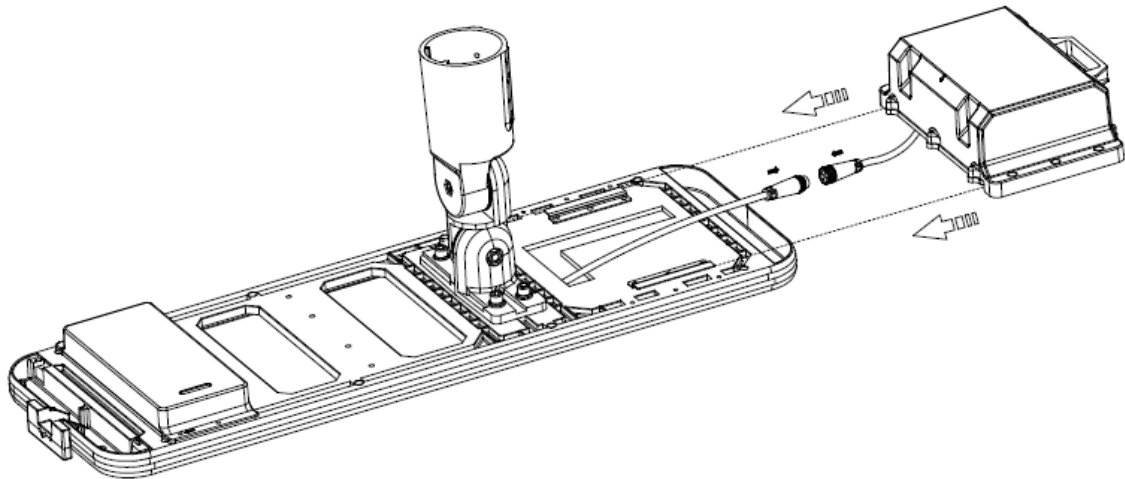
Figure 4-3 Fasten the connectors
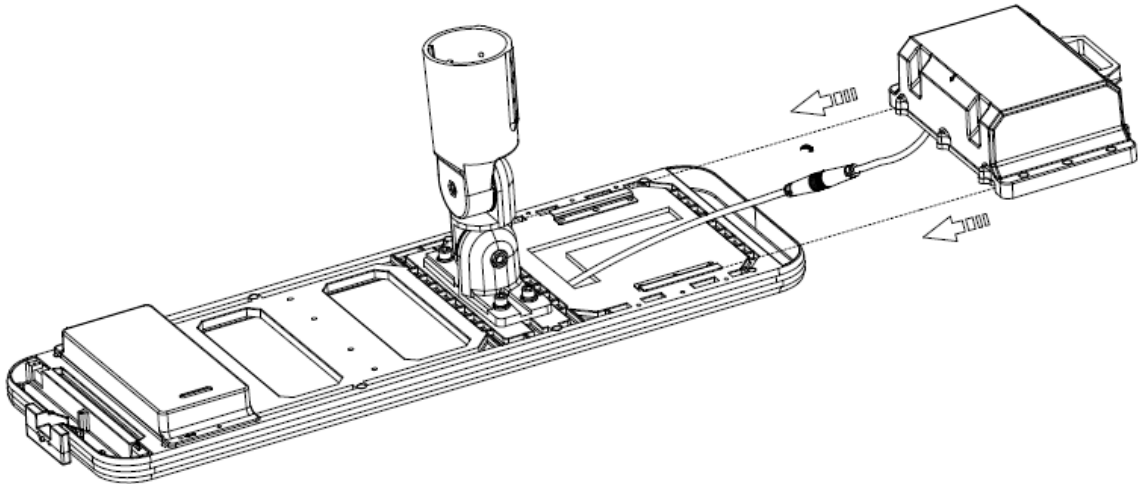
2) Place the battery onto the System, align the screws holes, and then fasten the M6 screws with a S5.0L wrench.

Figure 4-4 Install the battery
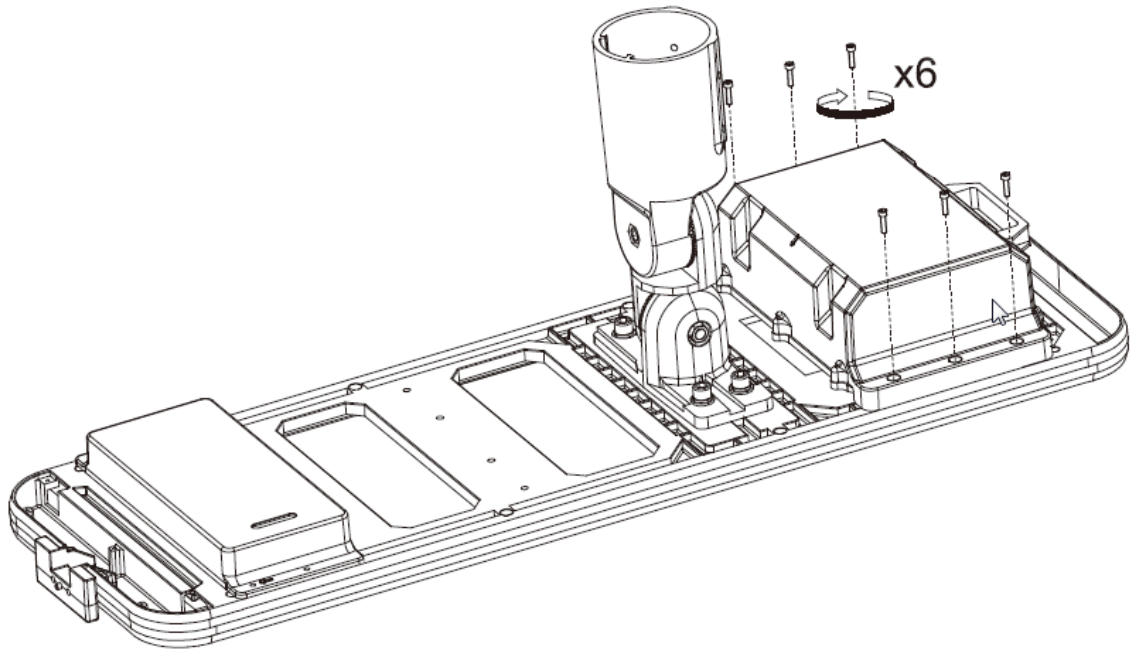
Step 3 Adjust the horizontal angle.

1) Use a S10.0L wrench to loosen M12 screw.

Figure 4-5 Installation diagram (1)
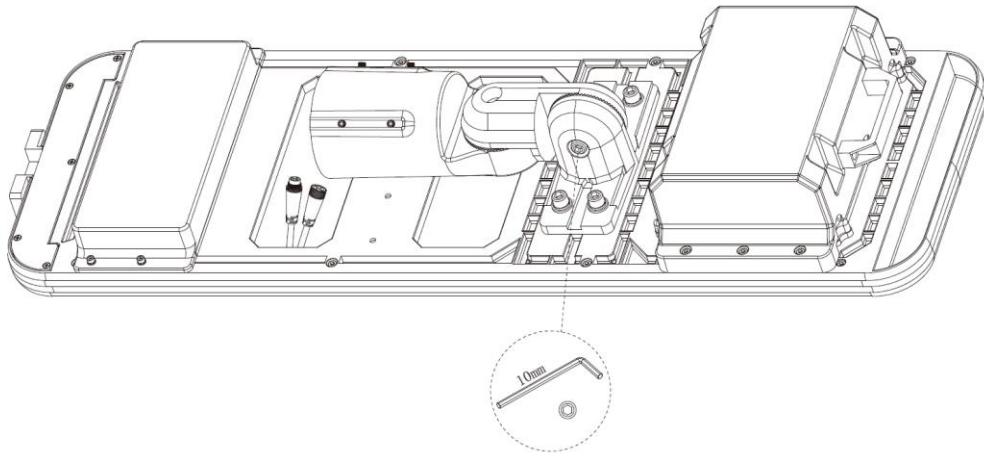
2) Rotate the mounting sleeve 90°.

Figure 4-6 Installation diagram (2)
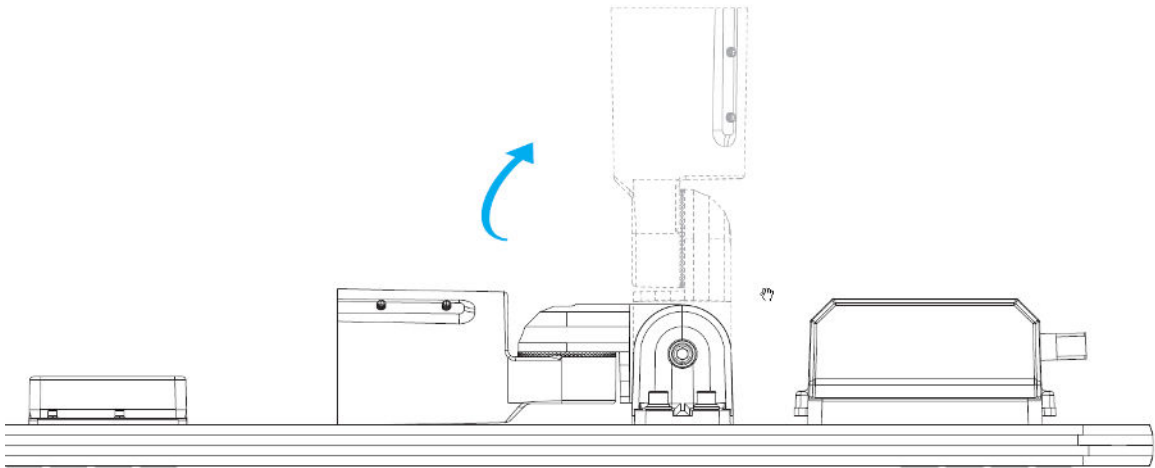
You can know the rotated angle according to the quantity of slots that have been rotated.

- 5° will be adjusted by rotating each slot.
- The System is designed with gear for adjusting horizontal or vertical angle.

Figure 4-7 Installation diagram (3)
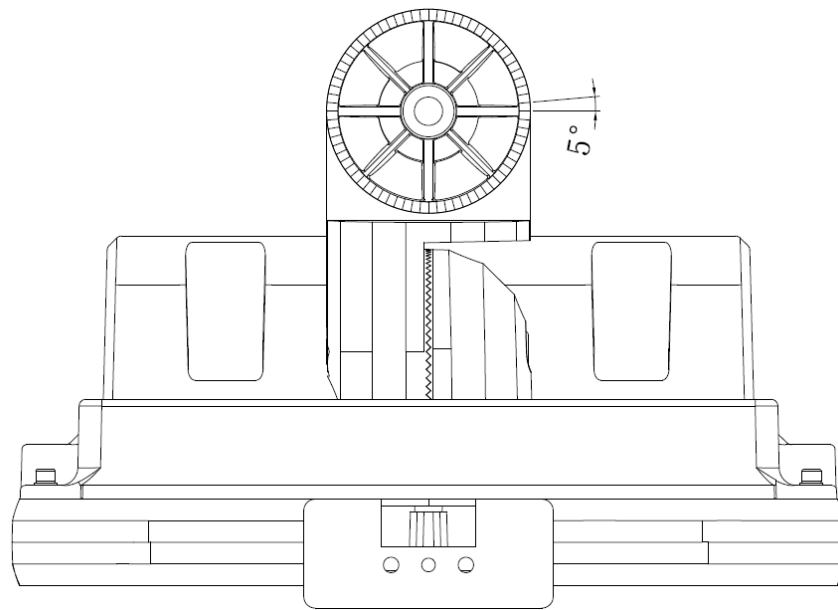
3) Use a S10.0L wrench to tighten the screw.

Step 4 Adjust the vertical angle.

1) Use a S10.0L wrench to loosen M12 screw.

Figure 4-8 Installation diagram (4)
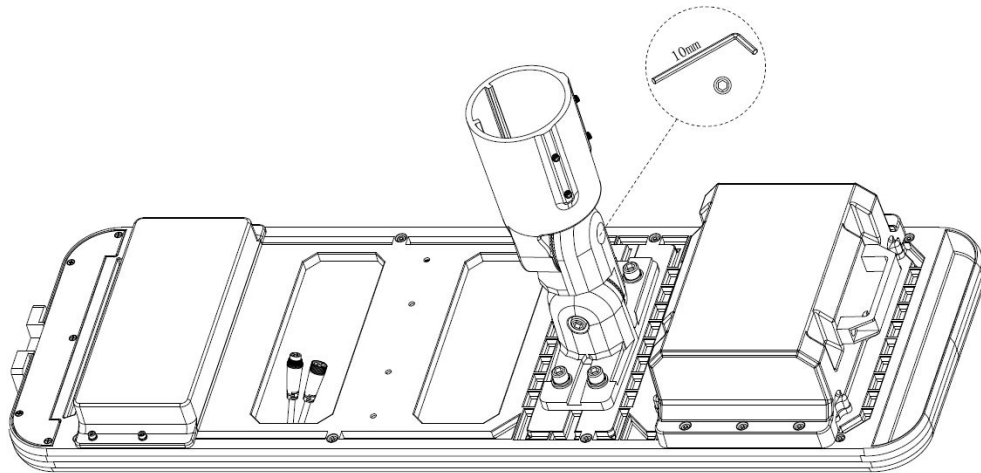
2) Adjust angle of mounting sleeve until β equals to local latitude.

Figure 4-9 Installation diagram (5)
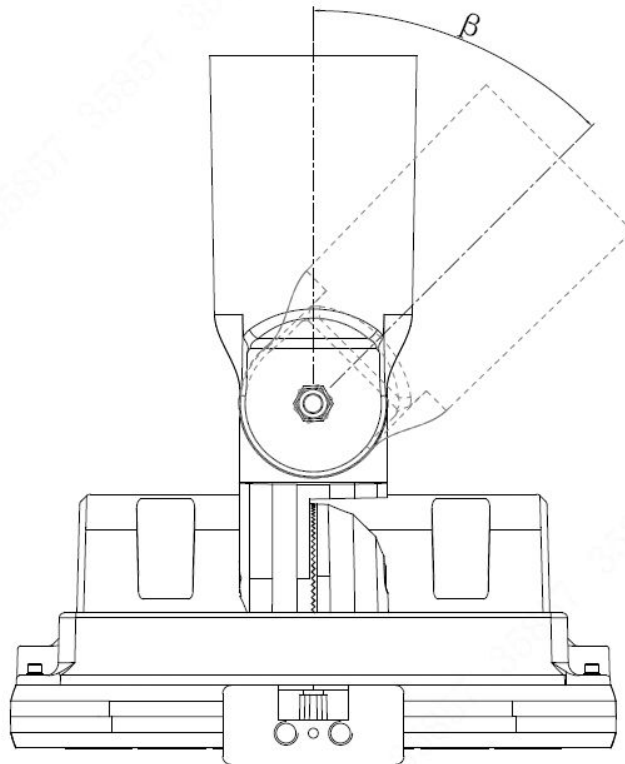
3) Use a S10.0L wrench to to tighten the screw.

Step 5　Install camera mounting plate.

Make the mounting plate parallel with the mounting sleeve, and then use a S6.0L wrench to tighten the plate.

Figure 4-10 Installation diagram (6)
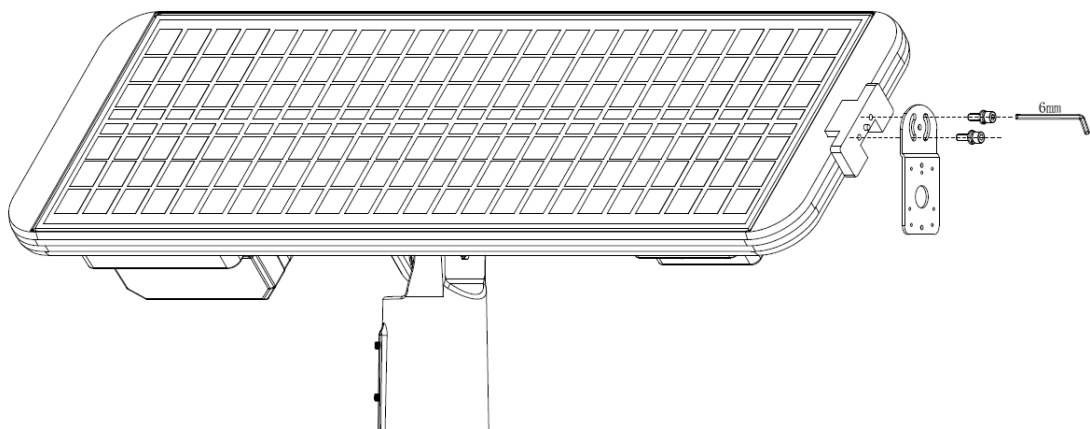
Step 6　Use a screwdriver to remove the cover of cable tray.

Figure 4-11 Installation diagram (7)
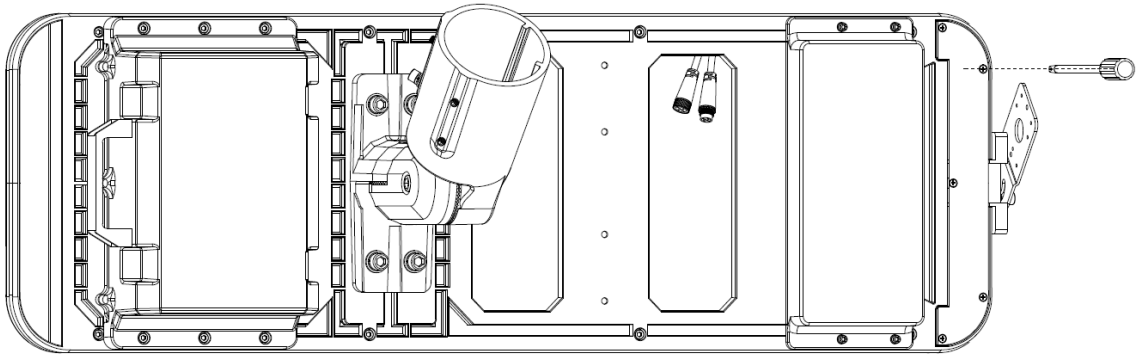
Step 7 Connect cables, and then close the cover of cable tray.
1) Wire through the cable tray, and pull the cable out of the camera mounting plate.

Figure 4-12 Installation diagram (8)
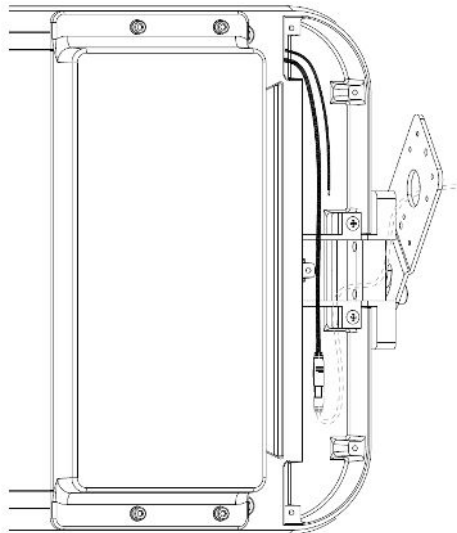
2) Connect RS-485 serial line.

Connect RS-485_A to port A of camera, and RS-485_B to port B.
3) Connect 12.8V DC power output line of the System to power input line of camera.
4) After connecting the cables, use the screwdriver to close the cover of cable tray.

Figure 4-13 Installation diagram (9)
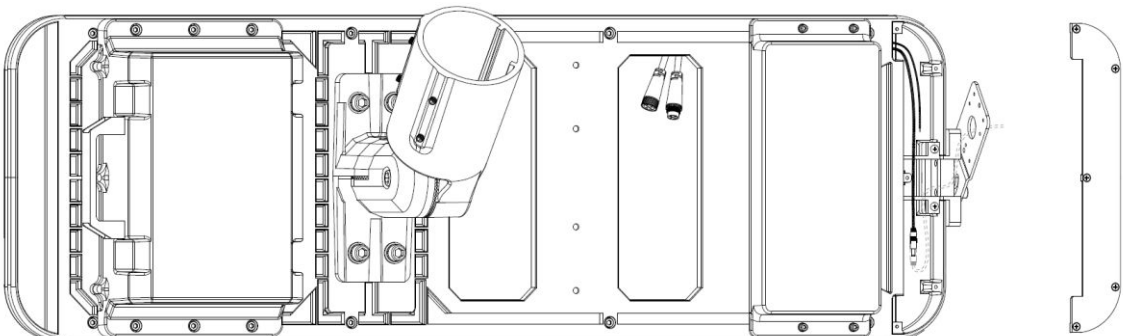
Step 8 Align the female circular connector with the male one, and then connect the connectors.

Figure 4-14 Installation diagram (10)
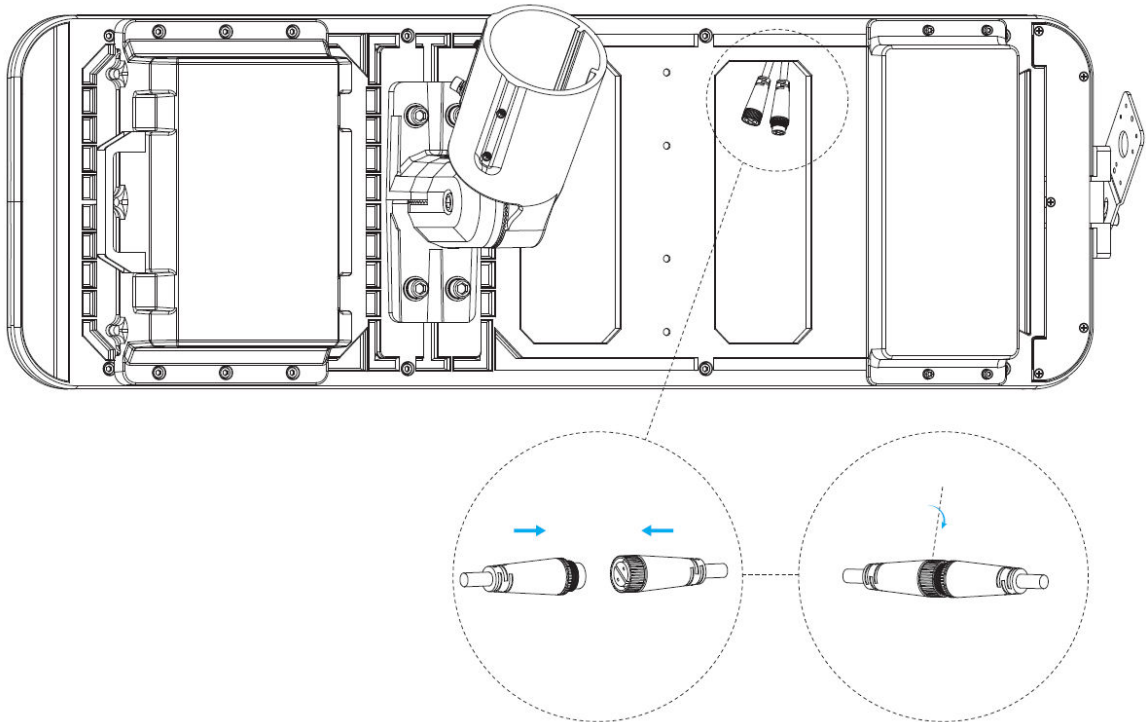
Step 9 Fix the connecter with tape, and then insert the connector into the holder for connector.

Figure 4-15 Installation diagram (11)
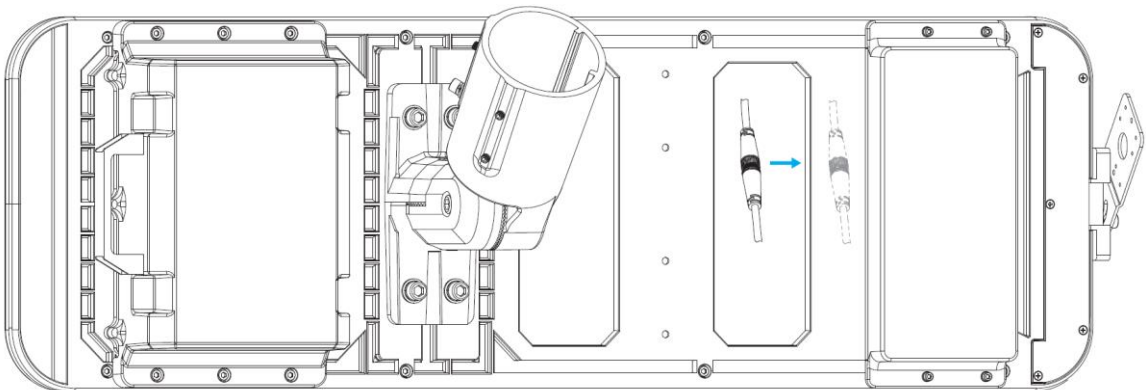
Step 10 Raise the System to mounting height, and then attach the mounting sleeve to the pole, and finally use a S6.0L wrench to tighten the sleeve.

📖

● Adjust the solar panel according to local longitude and latitude to make it face the sun.
● Make the solar panel south-facing in the northern hemisphere and north-facing in the southern hemisphere.

Figure 4-16 Installation diagram (12)
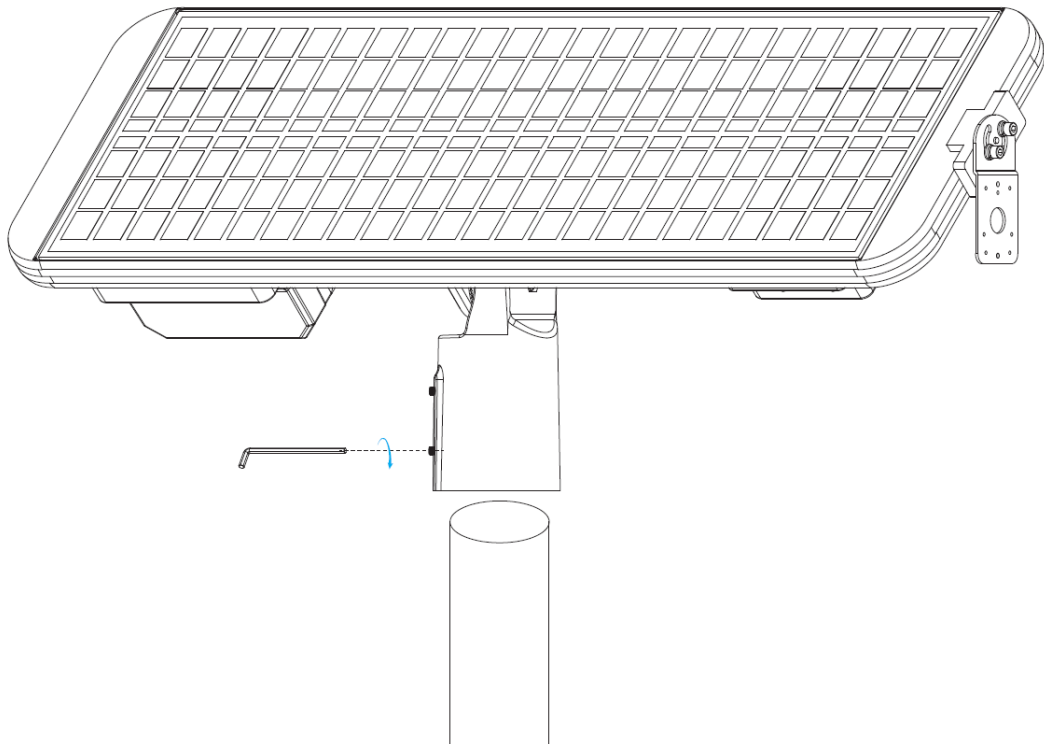
5 Daily Maintenance

5.1 Notes

- Tools: Ladder, screwdriver, multimeter, bucket, mop, and insulated gloves.
- Attention:
  ◇ Do not maintain the System when it is raining.
  ◇ Wear insulated gloves during maintenance.
- Maintenance interval: Twice a year.

5.2 Instructions

It is recommended to check the following items to keep the long-term high performance of the System:

- Check whether the insulation layers of all exposed cables have been damaged because of sunlight, contact with objects around the cable, dry rot, or destruction by insects or rats. If damaged, maintain or replace the cable immediately.
- Check whether the terminal blocks have signs of corrosion, insulation damage, burning or discoloration, and whether they are tightened.
- Check whether there is dirt, nesting insect, or corrosion. If yes, clean them in time.
- In areas with special weather conditions, it is recommended to do necessary maintenance to keep the System work properly. For dry, dusty and rainless areas, dust on the System will influence its power generation efficiency. For cold, snowy, and frozen areas, snow and ice covered on the System will lead to decline in power generated and even failure of the System. You need to clean the dust regularly, and clean up the snow in time.
- Check regularly the plants around the System. If any plant has grown to shade the System, clean it in time.
- Replace the batteries of decreased performance every 3–5 years, depending on the actual conditions of the battery.

Appendix 1 Lightning and Surge Protection

The System adopts TVS lightning protection technology. It can effectively prevent damages from various pulse signals below 6000V, such as sudden and indirect lighting strike. But, when installing the System in the outdoor environment, you still need to take necessary precaution measures while maintaining your local electrical safety code.

- The distance between the signal transmission cable and high-voltage device (or high-voltage cable) shall be at least 50 meters.
- Outdoor cable layout should go under the penthouse if possible.
- For open field, please use sealing steel tube under the land to implement cable layout and make sure that each end of the steel tube are grounded in an equipotential way. It is absolutely forbidden to set the cable overhead.
- In area of strong thunderstorm hit or near high sensitive voltage (such as near high-voltage transformer substation), additional high-power thunder protection device or lightning rod should be installed.
- The thunder protection and earth grounding of the outdoor device and cable, shall be considered based on the whole thunder protection of the building and conform to your local or industry standard.
- Equal-potential wiring should be adopted in the system. The grounding device must meet the demand of anti-jamming and also conforms to your local electrical safety code. The grounding device shall not form short circuit to N (neutral) line of high voltage power grid or be mixed with other wires. When connected to the ground alone, grounding resistance of the system shall not be more than 4Ω. And cross-sectional area of grounding cable shall be no less than 25 mm^2.

Appendix Figure 1-1 Lightning protection
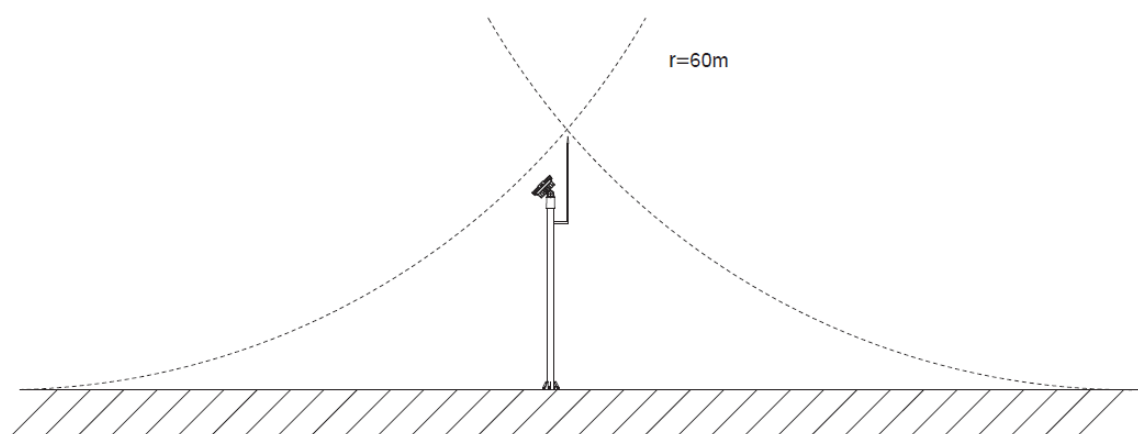
Appendix 2 Cybersecurity Recommendations

Cybersecurity is more than just a buzzword: it's something that pertains to every device that is connected to the internet. IP video surveillance is not immune to cyber risks, but taking basic steps toward protecting and strengthening networks and networked appliances will make them less susceptible to attacks. Below are some tips and recommendations on how to create a more secured security system.

Mandatory actions to be taken for basic device network security:

1. **Use Strong Passwords**

   Please refer to the following suggestions to set passwords:
   - The length should not be less than 8 characters;
   - Include at least two types of characters; character types include upper and lower case letters, numbers and symbols;
   - Do not contain the account name or the account name in reverse order;
   - Do not use continuous characters, such as 123, abc, etc.;
   - Do not use overlapped characters, such as 111, aaa, etc.;

2. **Update Firmware and Client Software in Time**

   - According to the standard procedure in Tech-industry, we recommend to keep your device (such as NVR, DVR, IP camera, etc.) firmware up-to-date to ensure the system is equipped with the latest security patches and fixes. When the device is connected to the public network, it is recommended to enable the "auto-check for updates" function to obtain timely information of firmware updates released by the manufacturer.
   - We suggest that you download and use the latest version of client software.

"Nice to have" recommendations to improve your device network security:

1. **Physical Protection**

   We suggest that you perform physical protection to device, especially storage devices. For example, place the device in a special computer room and cabinet, and implement well-done access control permission and key management to prevent unauthorized personnel from carrying out physical contacts such as damaging hardware, unauthorized connection of removable device (such as USB flash disk, serial port), etc.

2. **Change Passwords Regularly**

   We suggest that you change passwords regularly to reduce the risk of being guessed or cracked.

3. **Set and Update Passwords Reset Information Timely**

   The device supports password reset function. Please set up related information for password reset in time, including the end user's mailbox and password protection questions. If the information changes, please modify it in time. When setting password protection questions, it is suggested not to use those that can be easily guessed.

4. **Enable Account Lock**

The account lock feature is enabled by default, and we recommend you to keep it on to guarantee the account security. If an attacker attempts to log in with the wrong password several times, the corresponding account and the source IP address will be locked.

5. **Change Default HTTP and Other Service Ports**

   We suggest you to change default HTTP and other service ports into any set of numbers between 1024~65535, reducing the risk of outsiders being able to guess which ports you are using.

6. **Enable HTTPS**

   We suggest you to enable HTTPS, so that you visit Web service through a secure communication channel.

7. **MAC Address Binding**

   We recommend you to bind the IP and MAC address of the gateway to the device, thus reducing the risk of ARP spoofing.

8. **Assign Accounts and Privileges Reasonably**

   According to business and management requirements, reasonably add users and assign a minimum set of permissions to them.

9. **Disable Unnecessary Services and Choose Secure Modes**

   If not needed, it is recommended to turn off some services such as SNMP, SMTP, UPnP, etc., to reduce risks.

   If necessary, it is highly recommended that you use safe modes, including but not limited to the following services:
   - SNMP: Choose SNMP v3, and set up strong encryption passwords and authentication passwords.
   - SMTP: Choose TLS to access mailbox server.
   - FTP: Choose SFTP, and set up strong passwords.
   - AP hotspot: Choose WPA2-PSK encryption mode, and set up strong passwords.

10. **Audio and Video Encrypted Transmission**

    If your audio and video data contents are very important or sensitive, we recommend that you use encrypted transmission function, to reduce the risk of audio and video data being stolen during transmission.

    Reminder: encrypted transmission will cause some loss in transmission efficiency.

11. **Secure Auditing**
    - Check online users: we suggest that you check online users regularly to see if the device is logged in without authorization.
    - Check device log: By viewing the logs, you can know the IP addresses that were used to log in to your devices and their key operations.

12. **Network Log**

    Due to the limited storage capacity of the device, the stored log is limited. If you need to save the log for a long time, it is recommended that you enable the network log function to ensure that the critical logs are synchronized to the network log server for tracing.

13. **Construct a Safe Network Environment**

    In order to better ensure the safety of device and reduce potential cyber risks, we recommend:
    - Disable the port mapping function of the router to avoid direct access to the intranet devices from external network.

- The network should be partitioned and isolated according to the actual network needs. If there are no communication requirements between two sub networks, it is suggested to use VLAN, network GAP and other technologies to partition the network, so as to achieve the network isolation effect.
- Establish the 802.1x access authentication system to reduce the risk of unauthorized access to private networks.
- Enable IP/MAC address filtering function to limit the range of hosts allowed to access the device.