EMS Part of Energy Storage Battery Cabinet for Industrial and Commercial Use User Manual

Contents

1. About this Manual

1.1 Preface

This Manual is intended to provide readers with detailed product information and maintenance instructions for the standard version of the EMS controller.

1.2 For Readers

This manual is suitable for users who perform daily operations on the EMS energy management controller, and can be used for operation during use and debugging. Readers should have certain electrical knowledge and be familiar with the characteristics of energy storage systems. This manual does not include the electrical connection of the inverter and battery, and related safety precautions. Please refer to the corresponding user documentation.

1.3 Use of the Manual

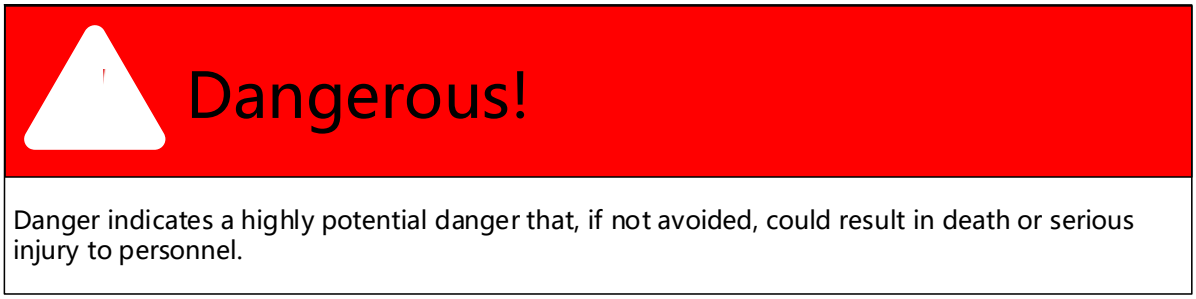
This manual contains important information on the operation of the energy storage system. Please read this manual carefully before operating and maintaining the energy storage system. Please strictly follow the operation method of the energy storage system described in the manual, or equipment damage, personal injury and property loss may occur. Please keep this manual properly for reference of the operator at any time. The content of the manual is subject to update and correction, but it is inevitable that there may be slight discrepancies or errors with the actual product. Please refer to the actual product purchased.

1.4 Use of Symbols

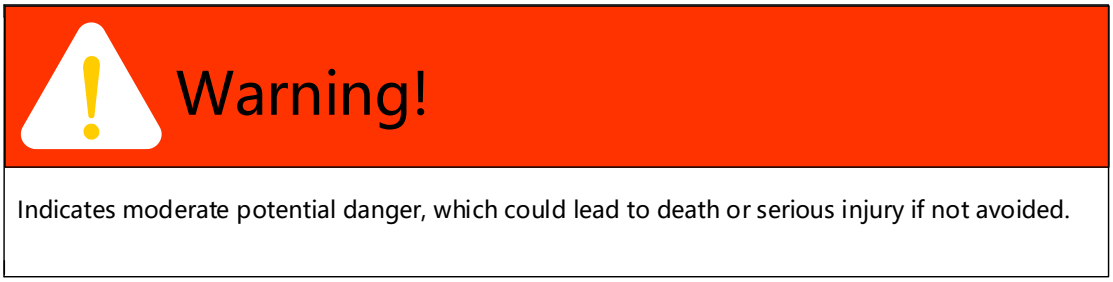
Before reading the manual, please keep in mind several types of security alert messages. As explained, it is important to get familiar with these types of messages and various signal words.

Warning instructions related to safety information include the following:

- Warning signs (symbols)
- Risk level
- Detailed information on the nature and source of the risk
- The possible consequences as a result of ignorance of the warning instructions
- Measures to avoid danger, personal injury or property loss
- Warning instructions are classified according to the following hazard levels:



Danger!
It indicates that there's a highly potential danger, and the situation of death or serious injury of personnel may occur if it is not avoided.



Warning!
It indicates that there's a moderately potential danger, and the situation of death or serious injury of personnel may occur if it is not avoided.

Attention!

Indicates a low level of potential danger that, if not avoided, may result in moderate or mild injury to personnel.

Caution!

It indicates that there's a lowly potential danger, and the situation of moderate or minor injury of personnel may occur if it is not avoided.

Please pay attention to the hazard warning signs on the machine body, including:

Symbol	Description
	This symbol indicates that there's high voltage inside the machine body, and touching it may result in the danger of electric shock.
	This symbol indicates that the temperature here is higher than the acceptable range of human body. Do not touch it to avoid injury of personnel.
	This symbol indicates that this is a protective earthing (PE) end, and it shall be grounded firmly to ensure the safety of operators.

2. Safety Instructions

This chapter mainly introduces the safety items that need to be paid attention to during the operation of the EMS controller. EMS controllers are designed and tested according to international safety requirements. However, as a power electronic product, it is necessary to strictly follow the relevant safety precautions during installation, operation and maintenance.

Operating requirements:

- Operators should be familiar with this manual
- Operators should be fully familiar with the relevant standards of the country/region where the project is located
- Operators should be familiar with the working principle of the energy storage system
- Before starting the system, carefully check the electrical status of the system and the three-phase mains and secondary power. Make sure the system is in a safe and uncorrupted state; if not, do not start the system

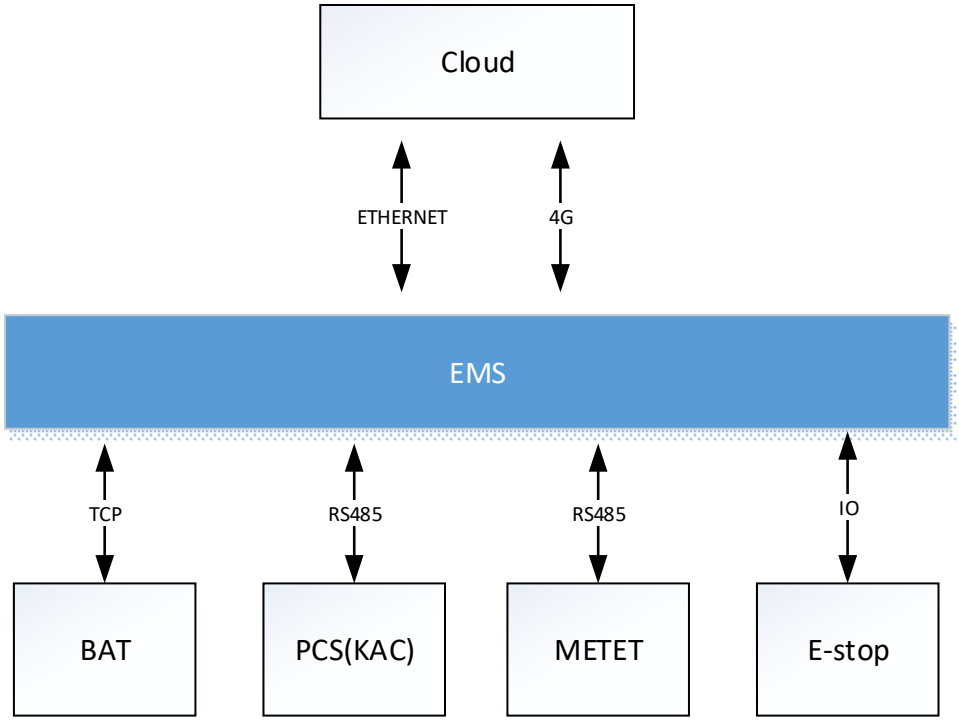
Improper use or misoperation may harm:

- The life and personal safety of the operator or third party
- EMS controllers and other property belonging to the operator or third parties

3. Product Description

3.1 Appearance

3.2 System Framework



3.3 System Features

Safe and stable:

- Complete protection functions for voltage, temperature and communication detection
- Industrial-grade processor, millisecond-level task processing
- Tested in various working conditions and adapted to different environments
- Key settings are password-authenticated

Easy to use:

- Friendly interface, all kinds of equipment and parameters are clear at a glance
- The user can simply set the policy to run
- Real-time alarms, historical alarms, system logs and other operation records

Intelligent control:

- Automatically adjust power, charge and discharge with maximum efficiency
- Intelligently adjust output power and detect power changes in real time
- Enable remote control and assign control authority

3.4 Main Functions

Note: KACs are independent of each other. When one of them can't be charged and discharged due to battery or other factors, it will not affect the work of other KACs. Prioritize PV charging and discharging during charging and discharging.

Anti backflow function: Its main function is to detect the power of the grid connection point. When the power is below the anti backflow threshold or reverse power, the energy storage system reduces the discharge power until the power exceeds the threshold, preventing it from feeding the power grid.

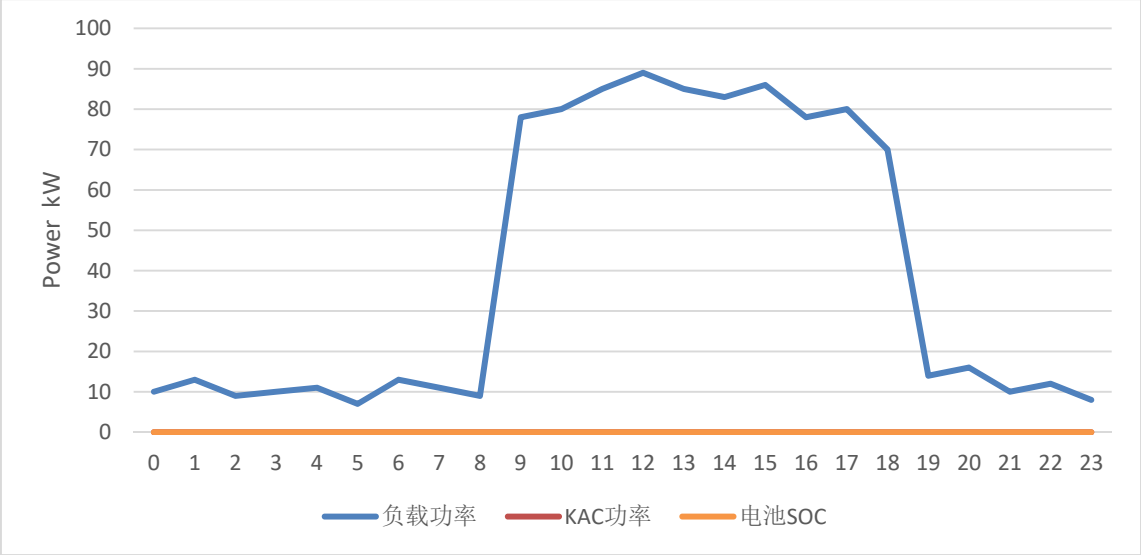
Explanation of setting a positive value for the anti backflow threshold: A positive value indicates that the power grid and energy storage system are simultaneously supplying power to the load. Due to the constant variation of load power, when the load is reduced in power, the power grid first responds to the power reduction, and then the energy storage system reduces the power. Therefore, even if the power is reduced, the energy storage system will not feed the power grid. (P_grid+P_ess=P_load)

Demand control function: Its main function is to detect the power of the grid connection point. When the power exceeds the demand control threshold, it indicates excessive power consumption, and the energy storage system reduces the charging power until the power falls below the threshold.

The power of the power grid refers to the power from the power grid to the load, usually connected to the electricity meter at the main incoming line (grid connection point), used for reverse current prevention and demand control.

The photovoltaic system always maximizes its output, supplying power to the load or battery, and limiting the photovoltaic output when the battery is fully charged (feeding PV power to the grid in spontaneous self use mode).

The figure below shows the load power curve when there is no running mode. Please note that the power curve is different in different modes.



3.4.1 Manual control

In this mode, the power on/off and operating power are manually controlled, which is convenient for the on-site staff to debug and test.

When controlling the power on and off, the EMS sends power on and off commands to all KACs; when controlling the operating power, the EMS distributes the power to each KAC equally.

3.4.2 Self sufficient

When charging time is enabled: When the set time is reached, a command will be sent to the inverter inside the energy storage system to charge the battery.

When anti-backflow is enabled: EMS detects the grid power during non-charging time, so that the power of KAC changes according to the change of load power and the grid power is always slightly higher than the anti-backflow power.

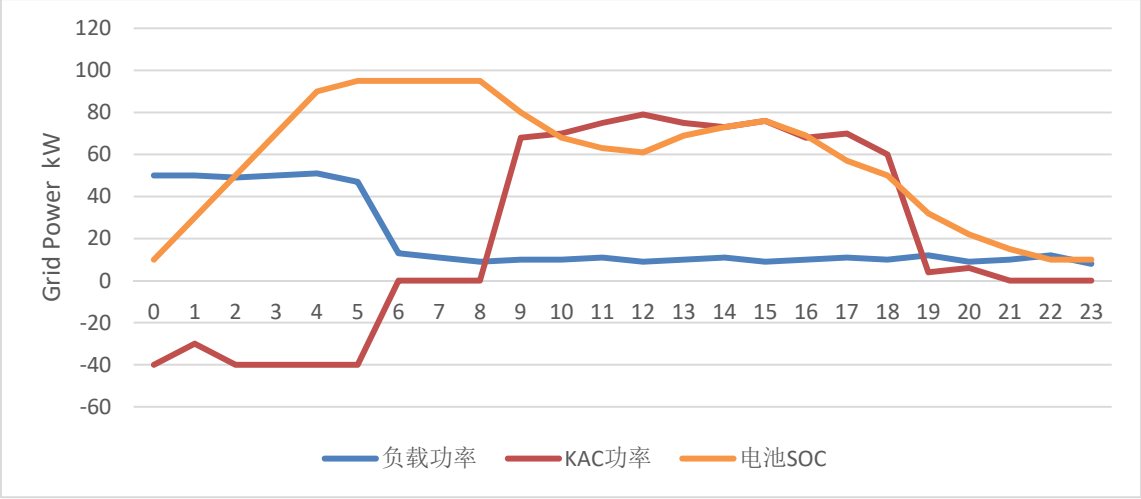
When anti-backflow is disenabled: EMS detects the battery level and PV power during non charging time, and feeds the PV power to the grid when the battery is fully charged.

When demand control is enabled: EMS detects the grid power during the charging time, so that the power of the KAC changes according to the change of the load power and the grid power is always slightly lower than the power of the demand control.

When demand control is disenabled: Charge according to the set power during the charging time.

Note: PV during the day + charging at night, anti-backflow discharge during the day.

(Blue line: load power. Red line: KAC power. Yellow line: Battery SOC)



Setting parameters: Charging time 00:00-08:00, anti-backflow power 10kW, demand control power 50kW.

During the time period of 00:00-08:00, EMS controls KAC to charge at 40kW. At “1h”, EMS detects that the load increases, so it reduces the charging power. After the load decreases, KAC returns to 40kW charging. At “6h”, EMS detects that the SOC has reached the upper limit and stops charging.

During the time period of 08:00-23:59, EMS controls KAC to change according to the change of load power, so that the grid power is always slightly higher than the anti-backflow power.

During the time period of 00:00-05:00, the battery SOC gradually rises to the upper limit due to KAC charging. During 08:00-12:00, the battery SOC gradually decreases because PV<Load. During 12:00-15:00, the battery SOC gradually increases because PV>Load. During 15:00-23:59, the battery SOC gradually decreases because PV<Load.

3.4.3 Time sharing control

The time-sharing power is set through the EMS controller, and when the set time is reached, a command is sent to the inverter inside the energy storage system to charge or discharge the battery.

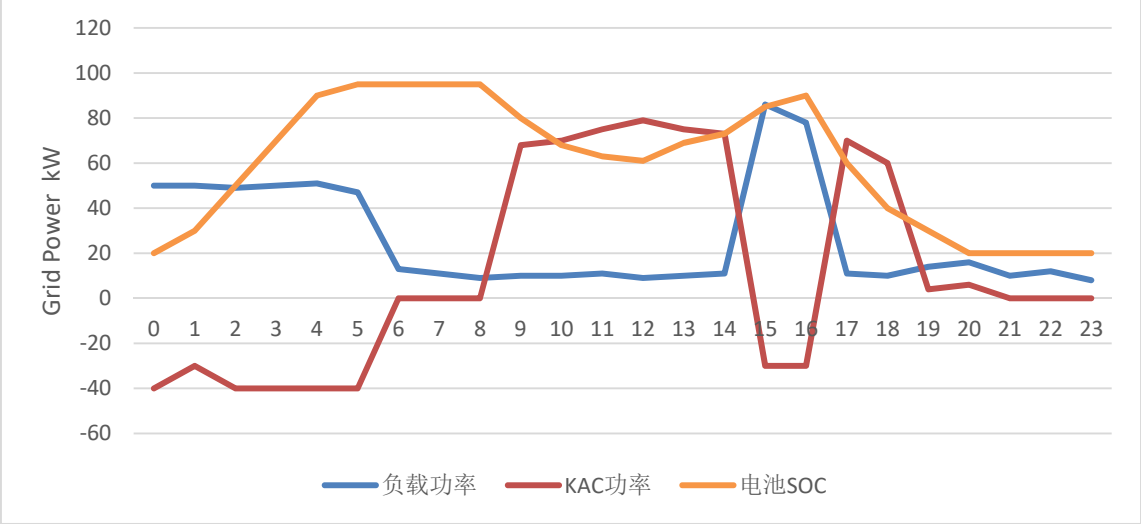
When anti-backflow is enabled: EMS detects the grid power during the discharge time period, so that the power of the KAC changes according to the change of the load power and the grid power is always slightly higher than the anti-backflow power. The power range of KAC is 0~discharge power in the current time period.

When anti-backflow is disenabled: discharge according to the set power during the discharge time.

When demand control is enabled: EMS detects the grid power during the charging period, so that the power of KAC changes according to the change of load power and the grid power is always slightly lower than the demand control power. The power range of KAC is charging power in the current time period ~0.

When demand control is disenabled: Charge according to the set power during the charging time.

(Blue line: load power. Red line: KAC power. Yellow line: Battery SOC)



Setting parameters: Charging time 00:00-08:00, 15:00-16:00, anti-backflow power 10kW, demand control power 50kW.

During the time period of 00:00-08:00, EMS controls KAC to charge at 40kW. At “1h”, EMS detects that the load increases, so it reduces the charging power. After the load decreases, KAC returns to 40kW charging. At “6h”, EMS detects that the SOC has reached the upper limit and stops charging.

During the time period of 08:00-15:00, EMS controls KAC to change according to the change of load power, so that the grid power is always slightly higher than the anti-backflow power.

During the time period of 15:00-16:00, the EMS controls the KAC to charge at 30kW.

During the time period of 16:00-23:59, EMS controls KAC to change according to the change of load power, so that the grid power is always slightly higher than the anti-backflow power.

During the time period of 00:00-05:00, the battery SOC gradually rises to the upper limit due to KAC charging. During 08:00-12:00, the battery SOC gradually decreases because PV<Load. During 12:00-16:00, the battery SOC gradually increases because PV>Load and KAC charging the battery. During 16:00-23:59, the battery SOC gradually decreases because PV<Load.

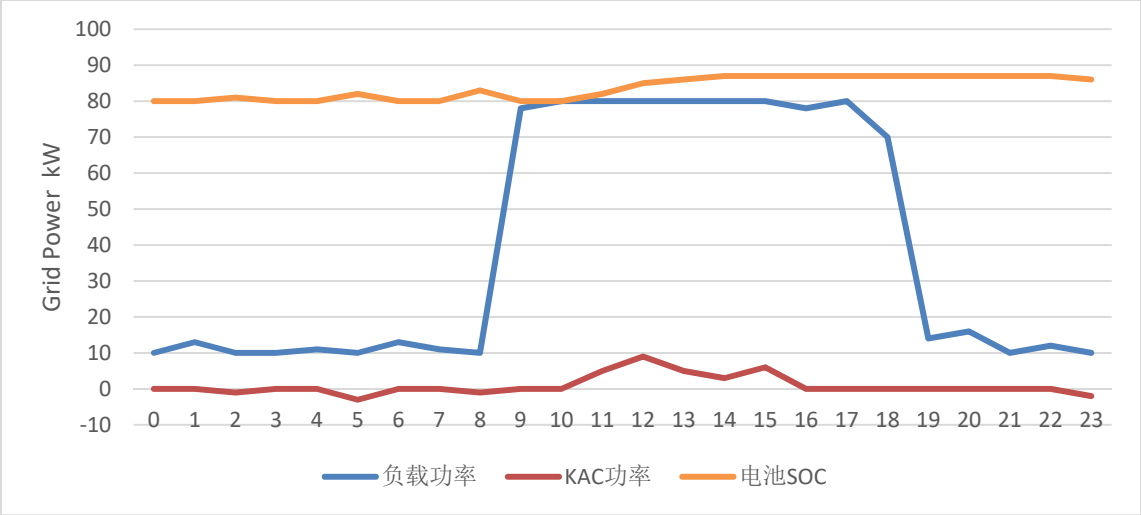
3.4.4 Peak load shifting

When the valley power is enabled: When the load power is lower than the valley power, the energy storage

system charges to make the grid power slightly higher than the valley power.

When the peak power is enabled: When the load power is greater than the peak power, the energy storage system discharges the load to make the grid power slightly lower than the peak power.

(Blue line: load power. Red line: KAC power. Yellow line: Battery SOC)



Setting parameters: Valley power 10kW, peak power 80kW.

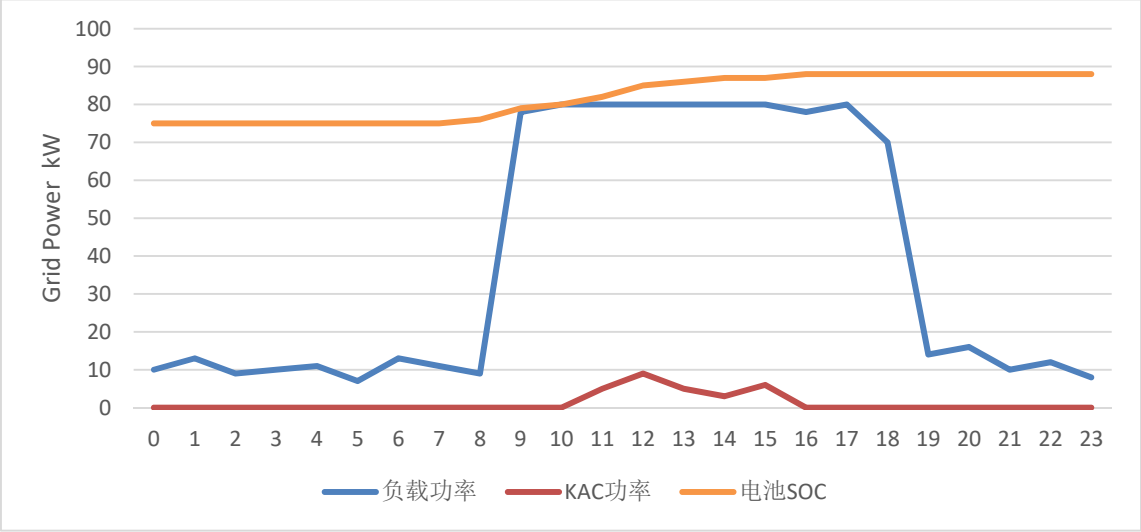
When the load power is <10kW, EMS controls KAC to charge to make the grid power >=10kW.

When the load power is >80kW, EMS controls KAC to discharge to make the grid power <=80kW.

3.4.5 Battery backup

When demand control is enabled: in the case of real-time SOC > demand SOC, when the load power is greater than the demand control power, the energy storage system discharges the load to make the grid power slightly lower than the demand control power; In the case of real-time SOC<=demand SOC, even if the grid power is greater than the demand control power, there will be no discharge, and with the control grid control not greater than the demand control, the energy storage system will charge from the grid until SOC=demand SOC.

(Blue line: load power. Red line: KAC power. Yellow line: Battery SOC)



Setting parameters: demand control 80kW.

When the grid power is >80kW, EMS controls KAC to discharge to make the grid power <=80kW.

When the load power is <80kW, EMS controls KAC to stand by.

3.5 External Interfaces

1) External IEC-104 communication network port based on TCP;

2) Four IO inputs and Six IO outputs reserved;

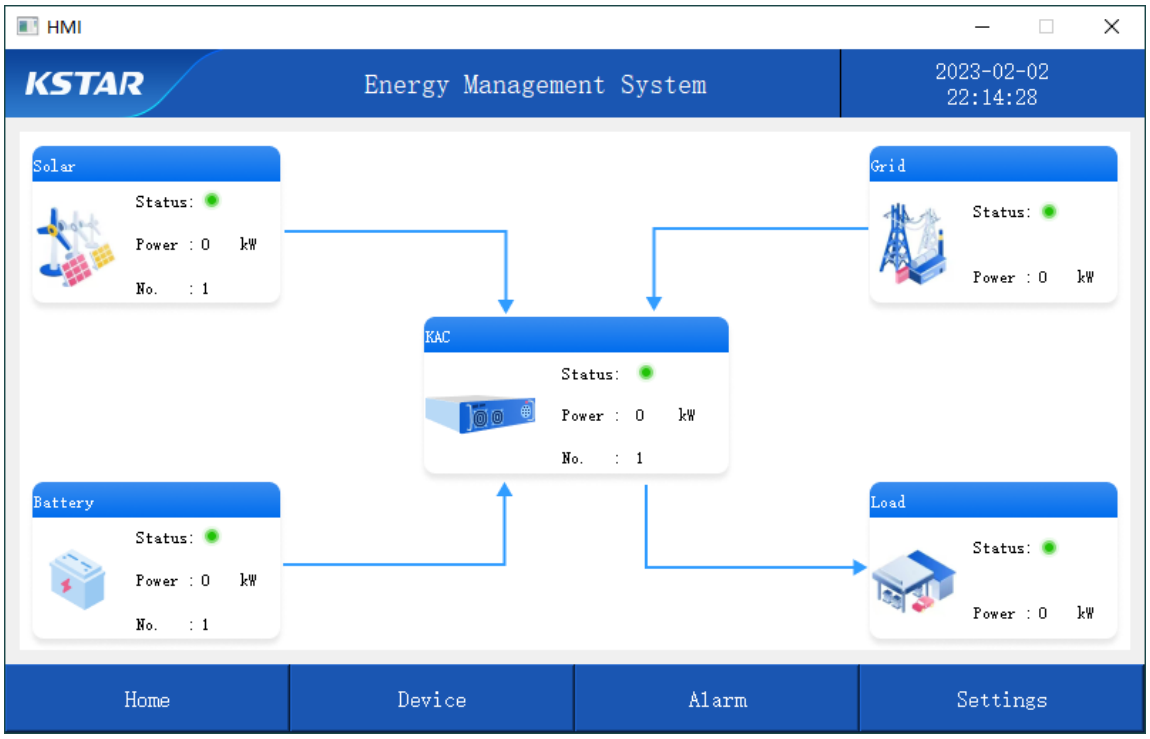
3) RS485 communication interface with anti-backflow ammeter;

4) Two RS485 communication interfaces reserved;

3.6 Display Interface

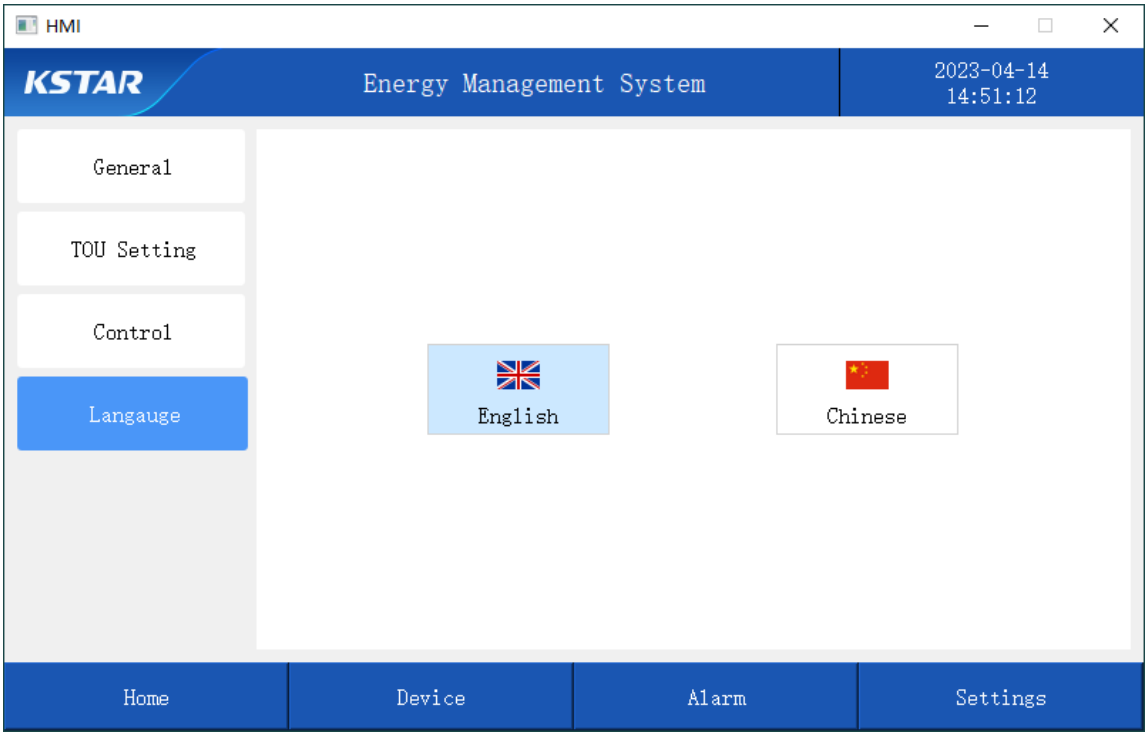
3.6.1 Home page

The home page of the EMS controller screen directly displays real-time data such as PV, KAC, battery, grid power, and load power, as shown in the figure below:



3.6.2 Language settings

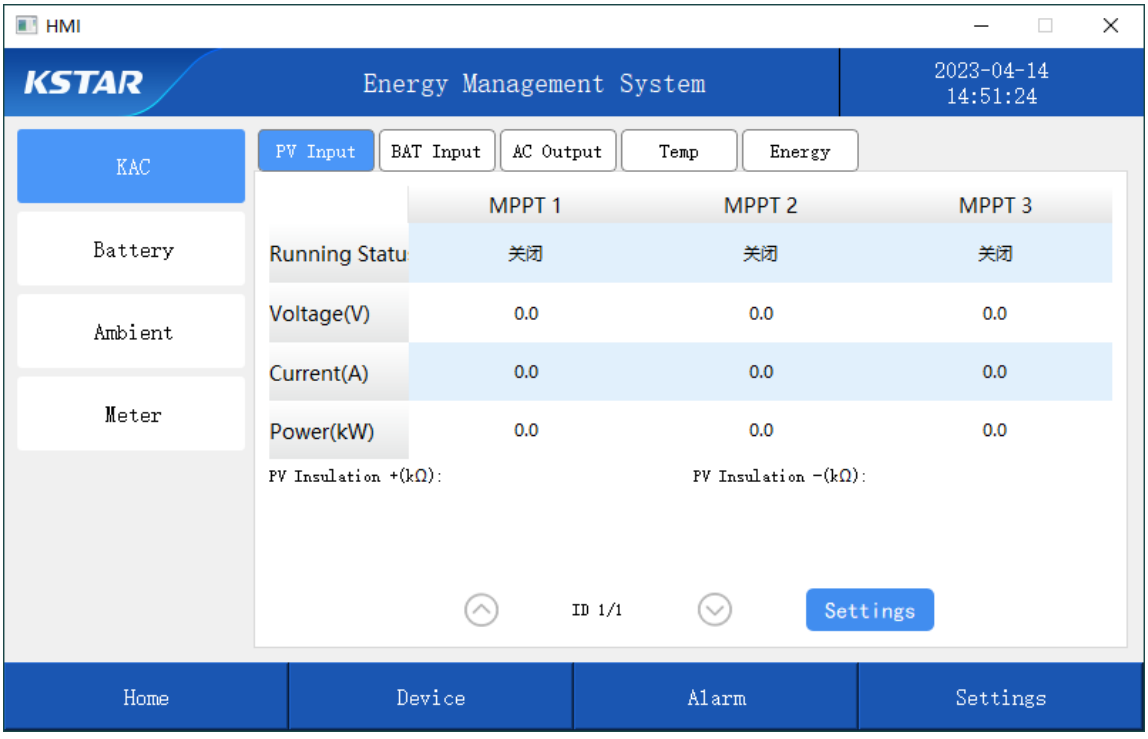
You can select Settings in the bottom navigation bar, and then select Language in the left navigation bar. The options are: English and Chinese, as shown below:



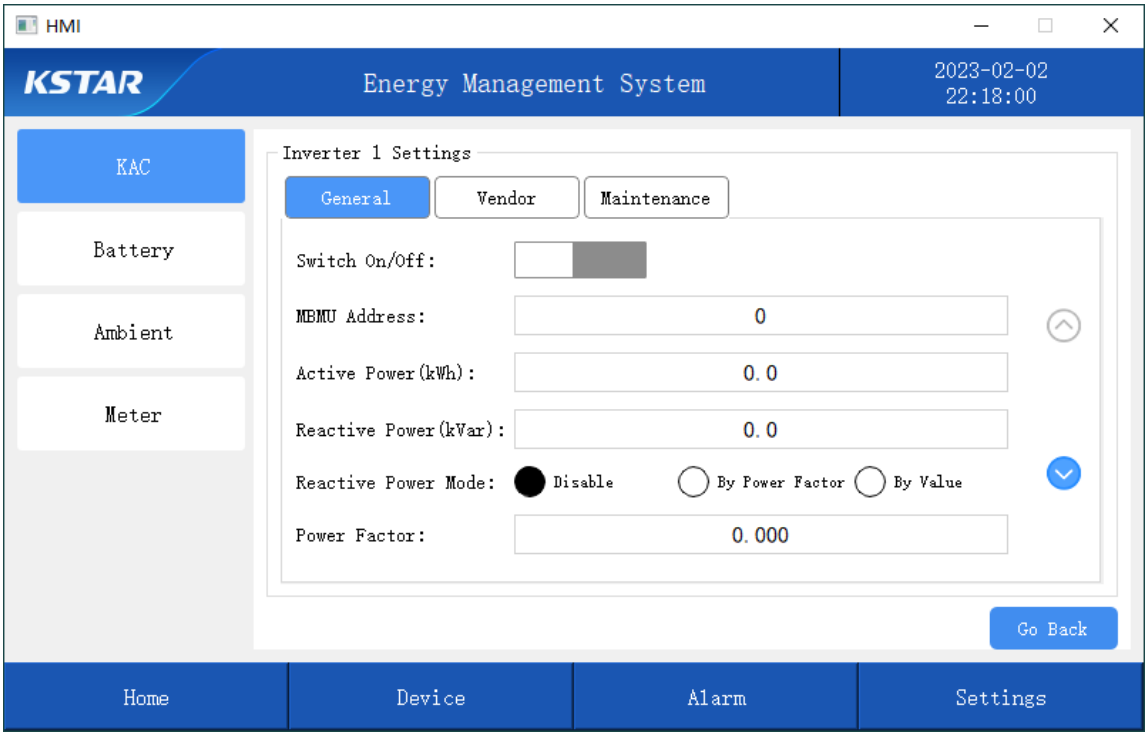
3.6.3 Real-time information of system

3.6.3.1 KAC running information

Click “KAC” to view the real-time data of each part of KAC, as shown below:

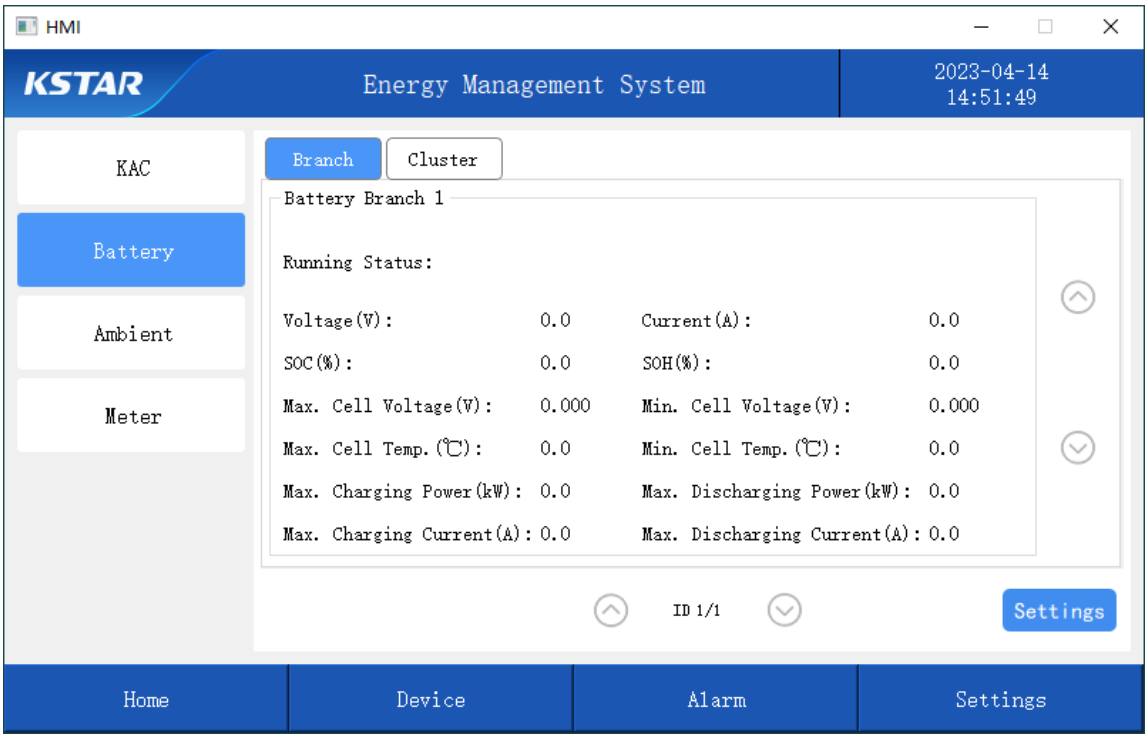


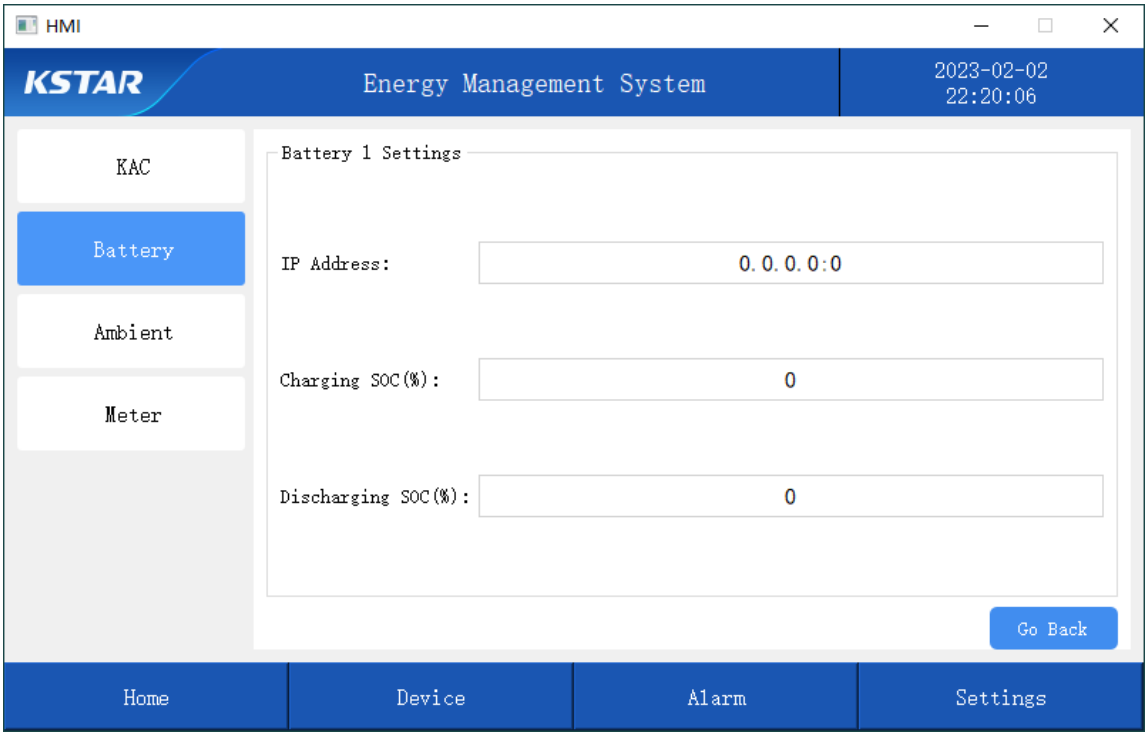
Click “Settings” to set up the KAC, and then click Inverter and Settings. On this page, important parameters such as output active power, output power factor, and output reactive power of KAC can be set, and KAC also can be manually controlled on and off, as shown below



3.6.3.2 Battery operation information

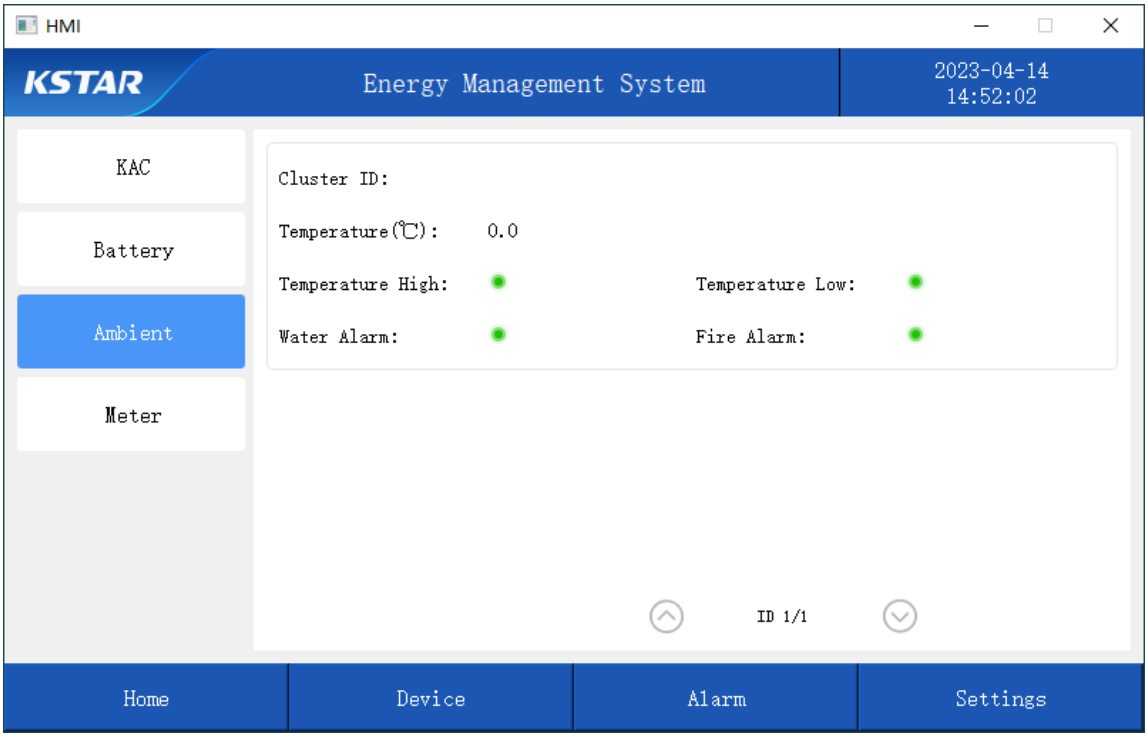
Click “Battery” to view and set the real-time data of the battery. On this page, you can set the IP address of the battery, and also set the upper and lower limits of the SOC. Simply click Settings as shown below:





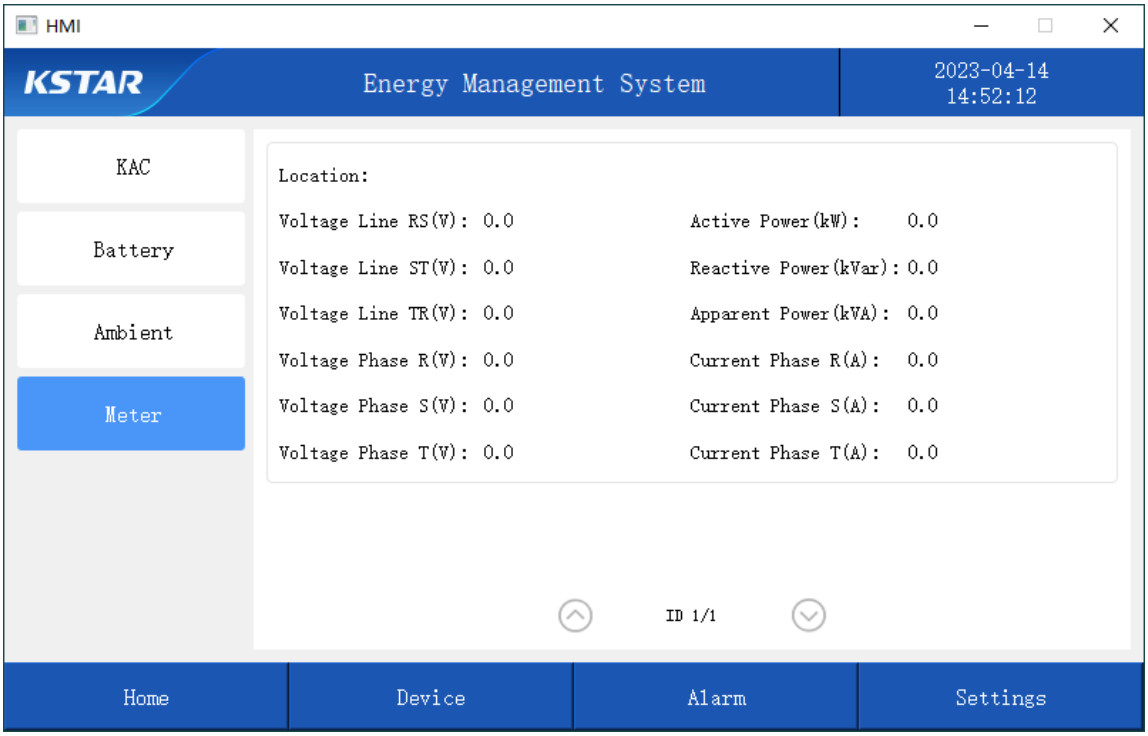
3.6.3.3 Ambient information

Click “Ambient” to view the real-time data of the environment (inside the battery cabinet).



3.6.3.4 Meter information

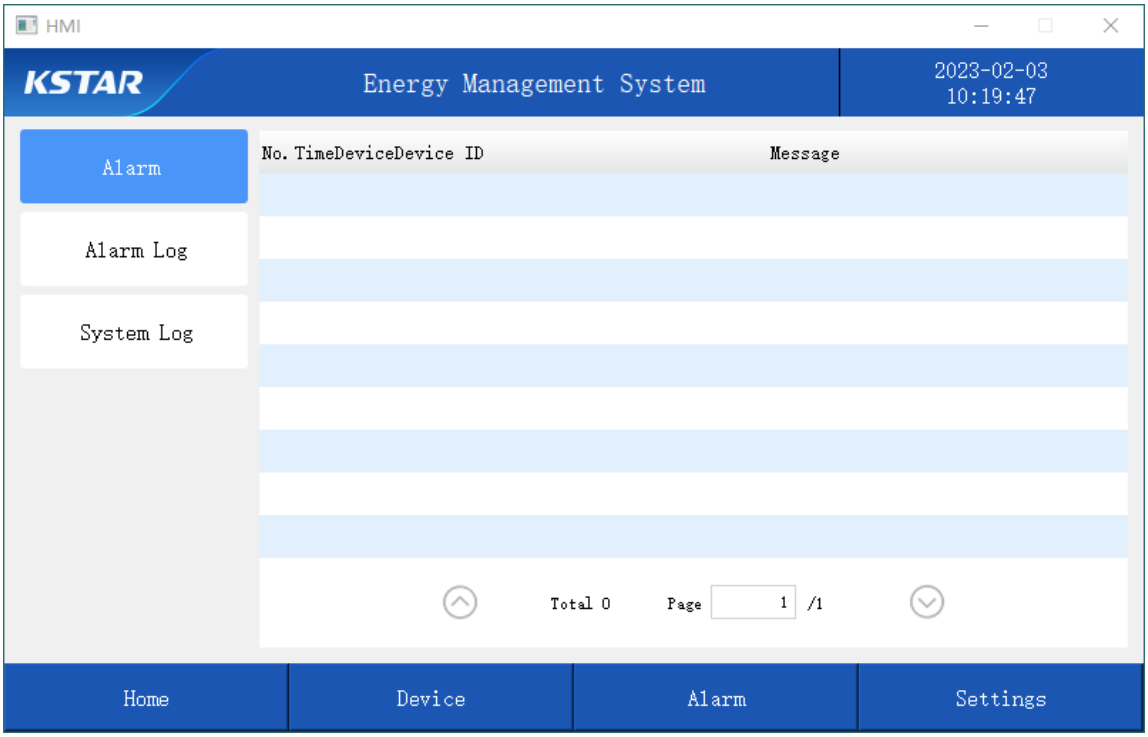
Click “Meter” to view the real-time data of the meter, as shown below:



3.6.4 System operation records

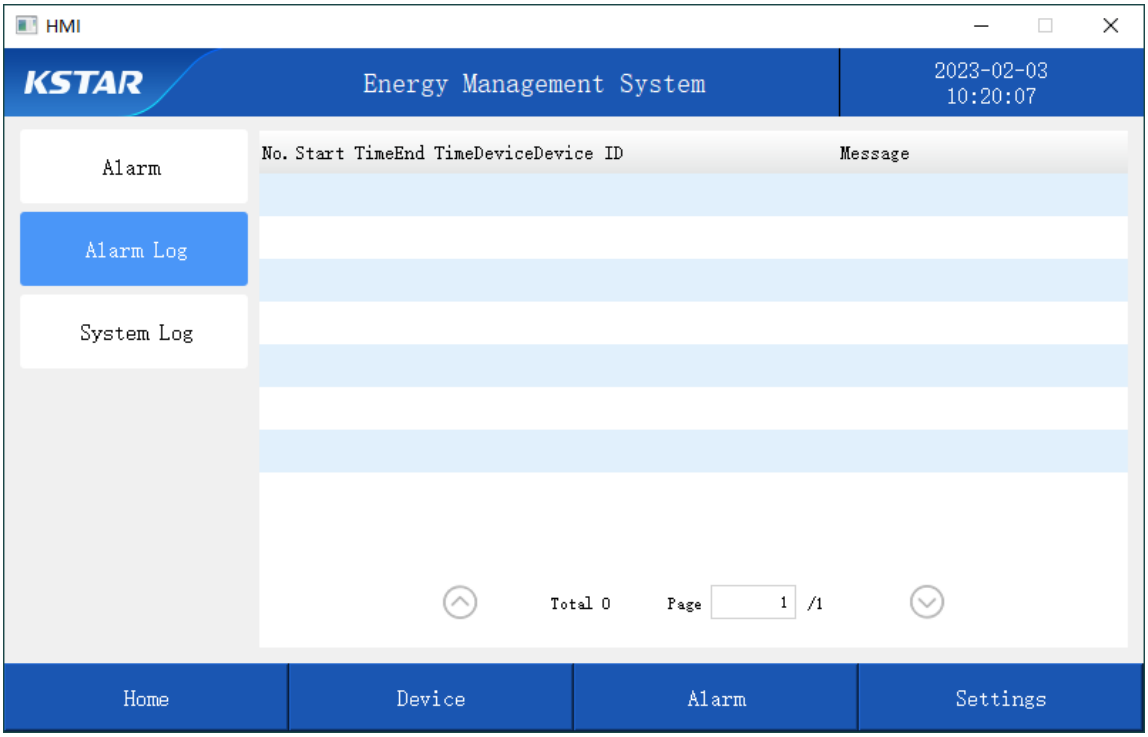
3.6.4.1 Current alarms

Click “Alarm” to view the current alarm information, and click the “Previous” and “Next” icons to turn pages, as shown below:



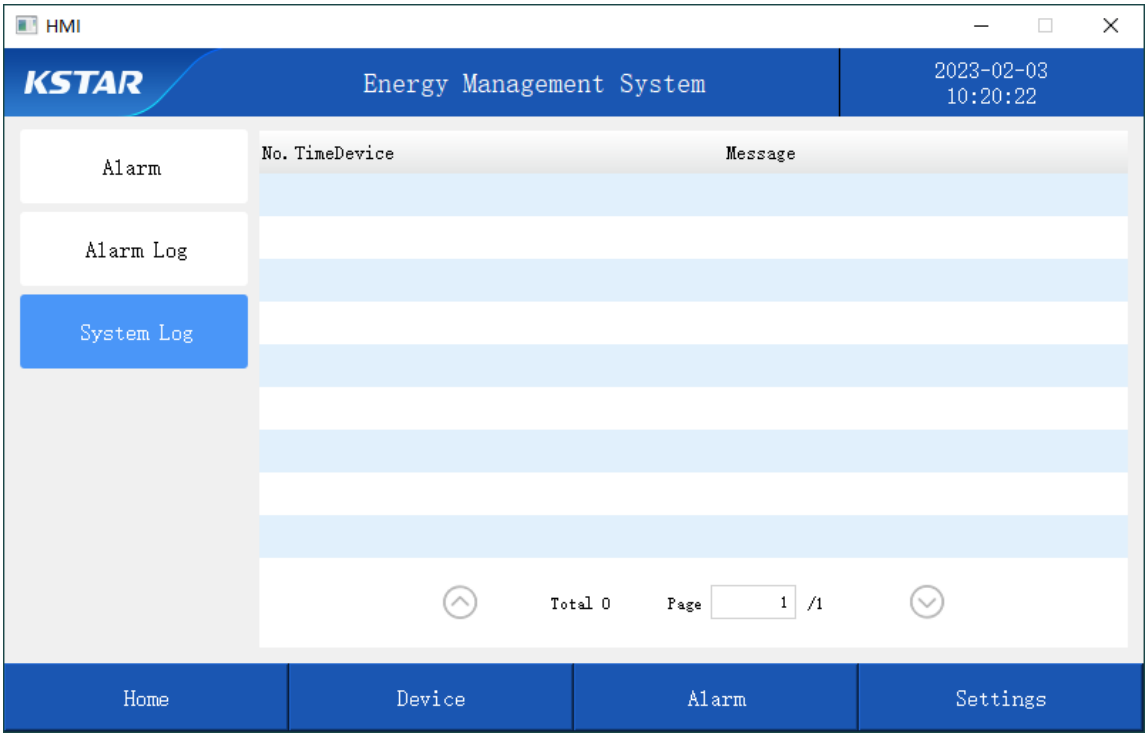
3.6.4.2 Alarm log

Click “Alarm Log” to view historical alarm information, and click the “Previous” and “Next” icons to turn pages, as shown below:



3.6.4.3 System log

Click “System Log” to view the system operation information, and click the “Previous” and “Next” icons to turn pages, as shown below:



3.6.5 System settings

3.6.5.1 Basic settings

Click “General” to view the basic information and perform setting of the system.

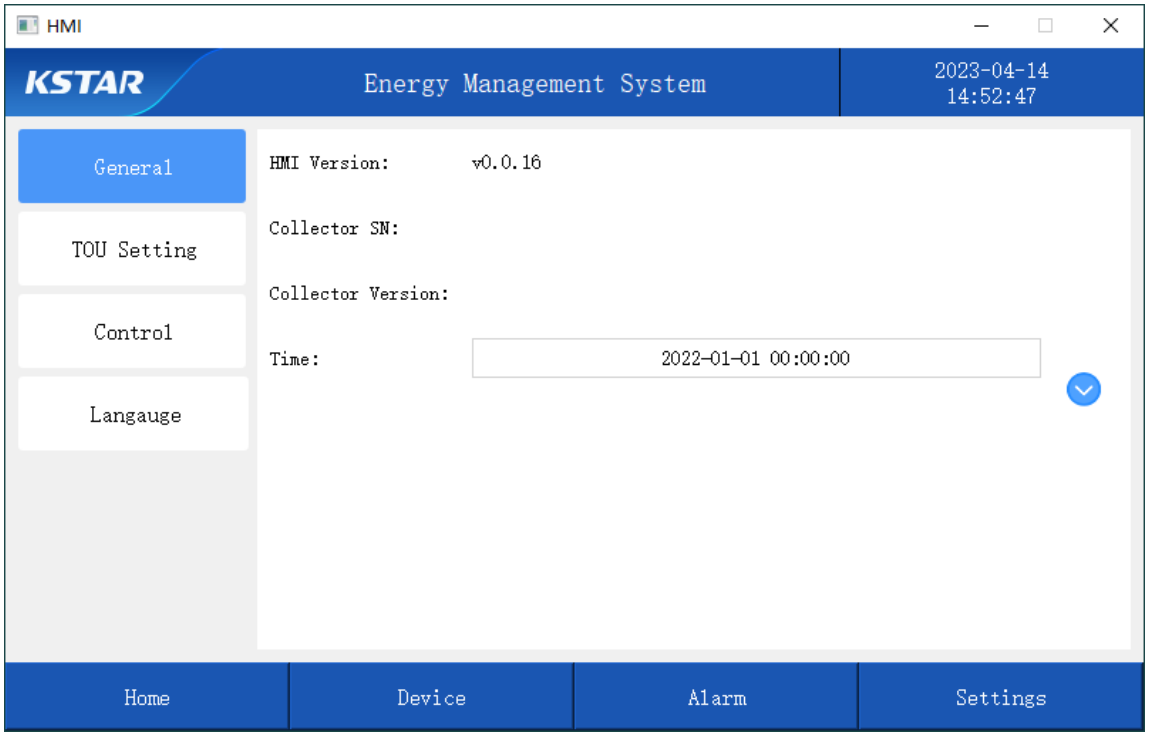
Time: EMS system time;

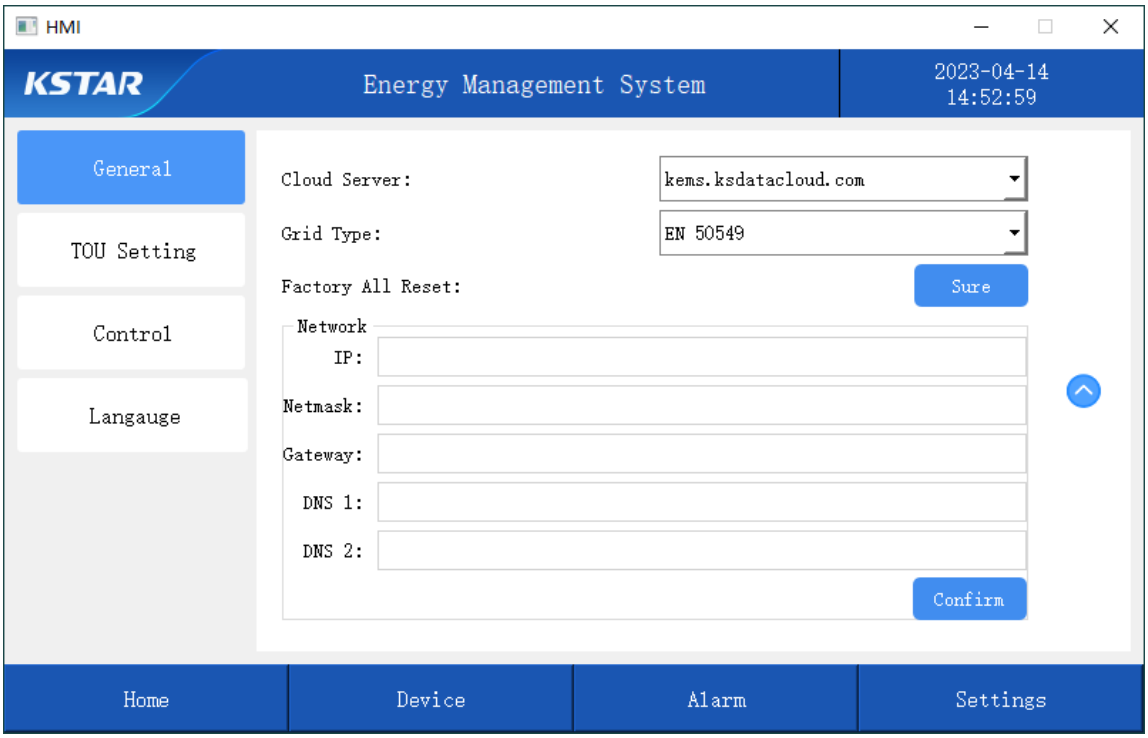
Network: EMS system network information;

Server type: The type of EMS system uploaded to domestic or foreign servers;

Power grid type: Users choose according to the local power grid situation;

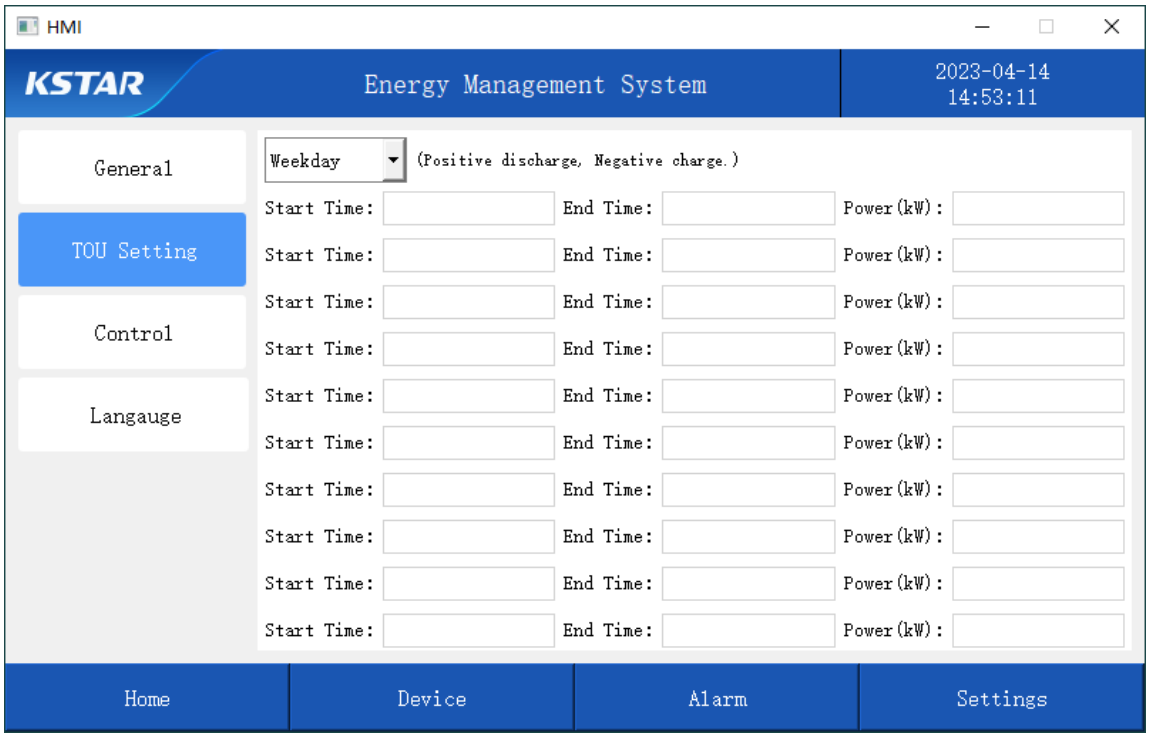
All Factory reset are restored: EMS and KAC are restored to factory settings.





3.6.5.2 Time sharing power

Click “Time Sharing Power”, which includes weekdays and weekends. The period time can be set according to the local peak and valley time, so as to realize the charge and discharge control of the system at different stages, as shown below:



3.6.5.3 Control information

Click "Control" to view the control information of this system. There are two types of active control on this page, among which the basic settings are:

4G enable: Use 4G to access the internet, disable is to use Ethernet to access the internet, and at this time, the local area network needs to maintain a network segment;

Modbus Tcp remote control enable: Level 2 EMS for control use;

Battery SOC control: Control the upper and lower limits of SOC on the battery settings page. Stop charging when real-time SOC>=SOC upper limit, and stop discharging when real-time SOC<=SOC lower limit;

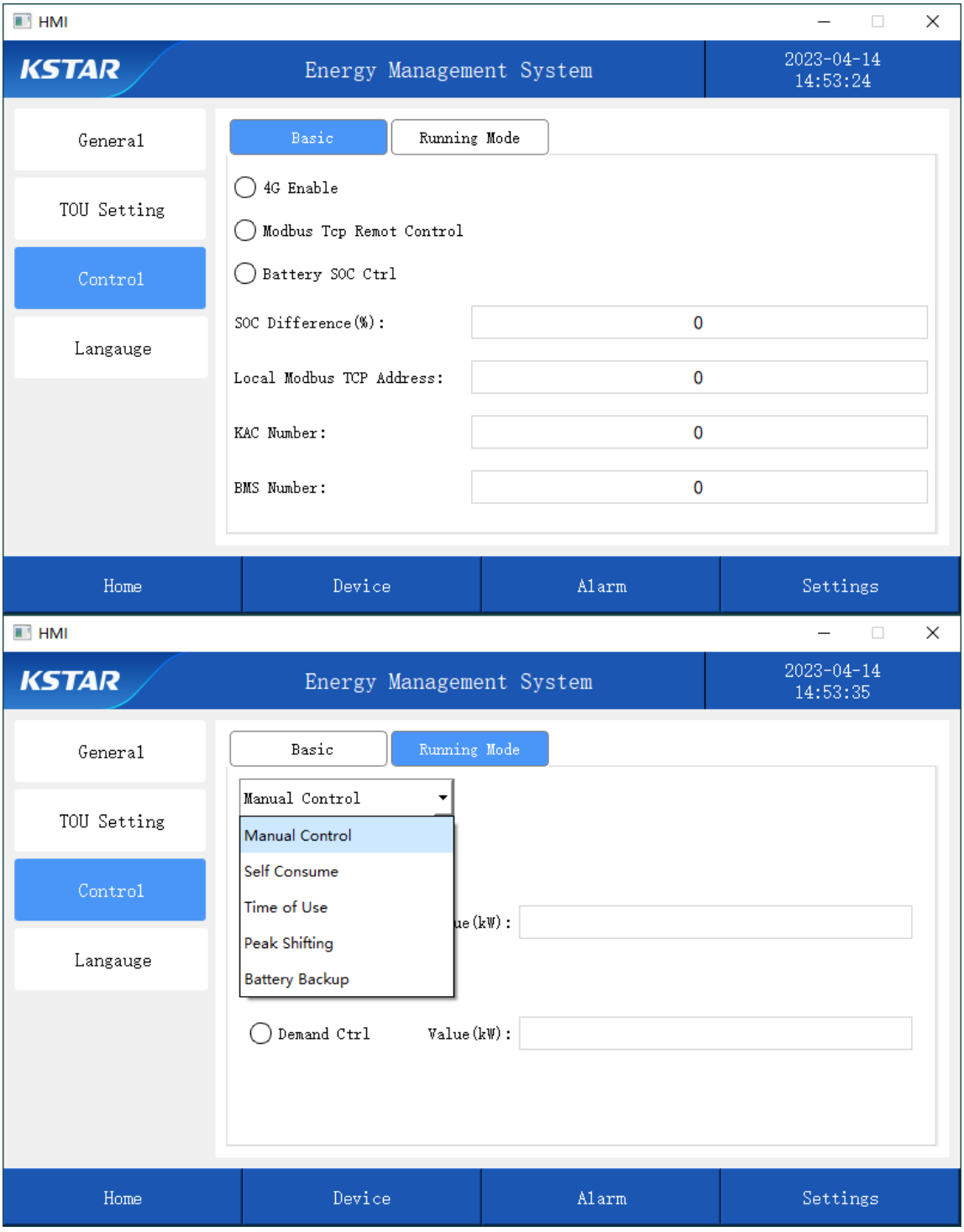
SOC return difference: In the case of anti reverse current and load power>PV power, the battery is in a discharge state. When the battery reaches the lower limit of SOC, the system will no longer discharge, and PV will charge the battery. When SOC>=(SOC lower limit+SOC return difference), the system will start to prevent reverse current discharge and reduce the number of charges and discharges.

Local ModbusTcp address: the address for Level 2 EMS connection;

Number of KAC equipment: the number of KACs in the energy storage system;

Number of battery devices: The number of BMS in the energy storage system.

The operating mode settings include: self use, time sharing control, peak shaving and valley filling, and battery backup. According to usage requirements, settings can be made on this page, as shown in the following figure:



4. Wiring Instructions

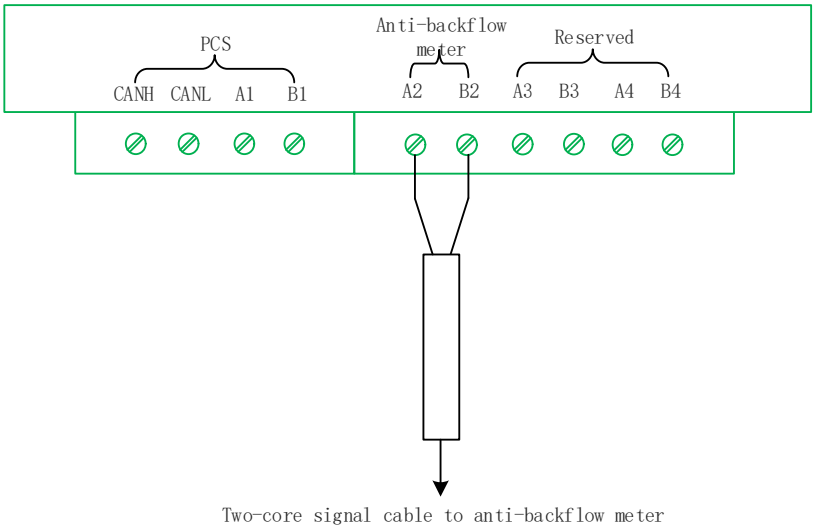
1) Network communication interface wiring

The battery cabinet has a built-in switch, which has been connected to the network port of the EMS controller.

The user needs to connect to the cloud platform or the upper monitoring system, and directly connect to the switch through a standard network cable;

2) Communication wiring of anti-backflow ammeter

The two-core signal cable is connected through the position shown below, and the other end is connected to the communication port of the ammeter



5. Trial Run

Checks before running:

- All cables are intact, well insulated, and of appropriate size
- All cables are connected correctly and securely
- The polarity of the power supply cable is correct, and the grounding cable is properly grounded.

Trial run steps:

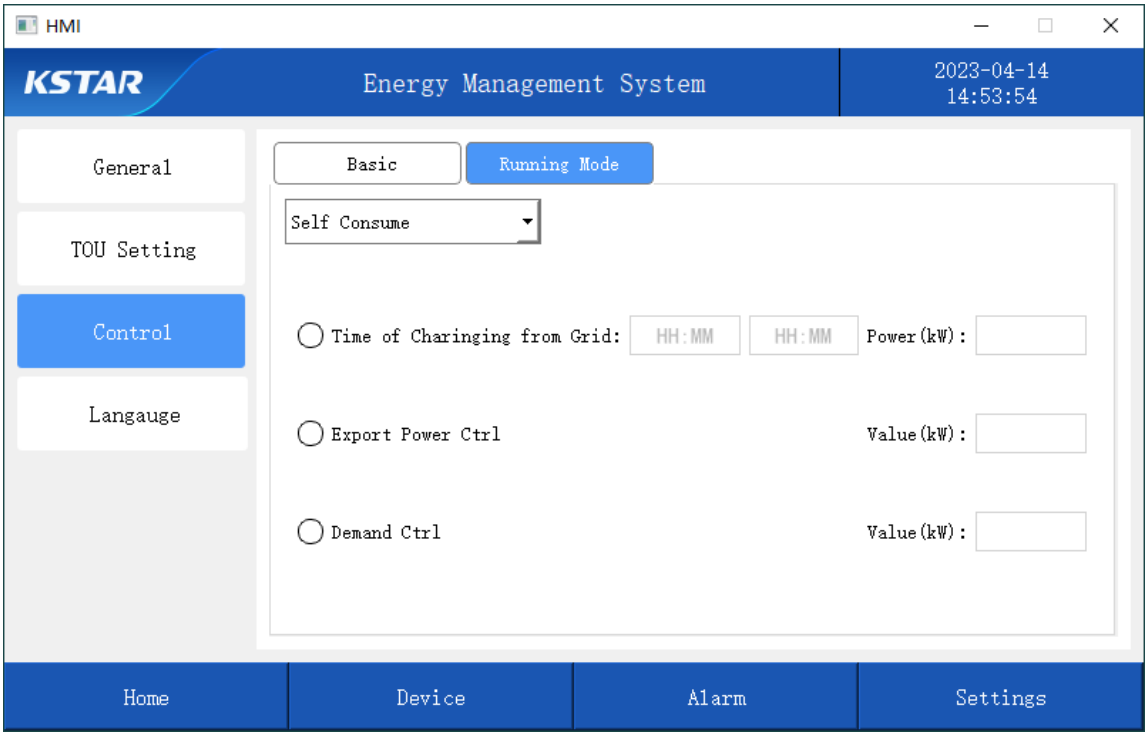
- Check before running
- Power on the EMS energy management controller
- Make sure that the communication cable between the device and the EMS controller is firmly connected
- Configure the number of KAC and battery devices on the “Control” interface
- Check whether the data of each device is displayed on the screen, whether the data is within a reasonable range, and whether there are alarms and stop-related running logs.
- Manually start KAC, try to charge and discharge, and observe whether it is normal

6. Application Case Configuration

System running modes include: self sufficient, time sharing power, peak load shifting and battery backup

6.1 Self Sufficient

1. Enter the Control interface, select the Running Mode setting, and select Self Sufficient;
2. Enable charging time, and enter charging time period and power: 00:00-07:00, -50;
3. Enable anti-backflow, and enter the anti-backflow value 10;
4. Enable demand control and enter a demand control value of 50;
5. At this moment, the system will run in self sufficient mode.



6.2 Time Sharing Power

1. Enter the Control interface, select the Running Mode setting, and select Time Sharing Power;

2. Enable anti-backflow, and enter the anti-backflow value 10;

3. Enable demand control and enter a demand control value of 50;

4. Click “Time Sharing Power” in the left navigation bar, enter the charging and discharging time period and power on weekdays and weekends respectively:

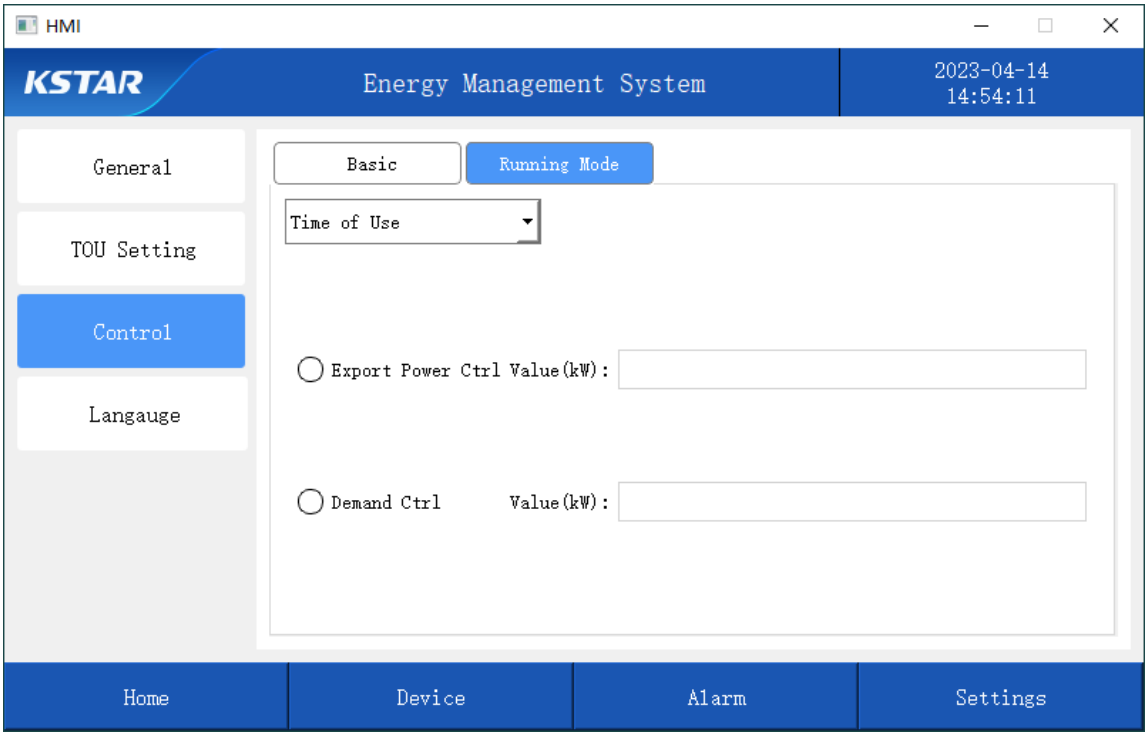
00:00-07:00, -50,

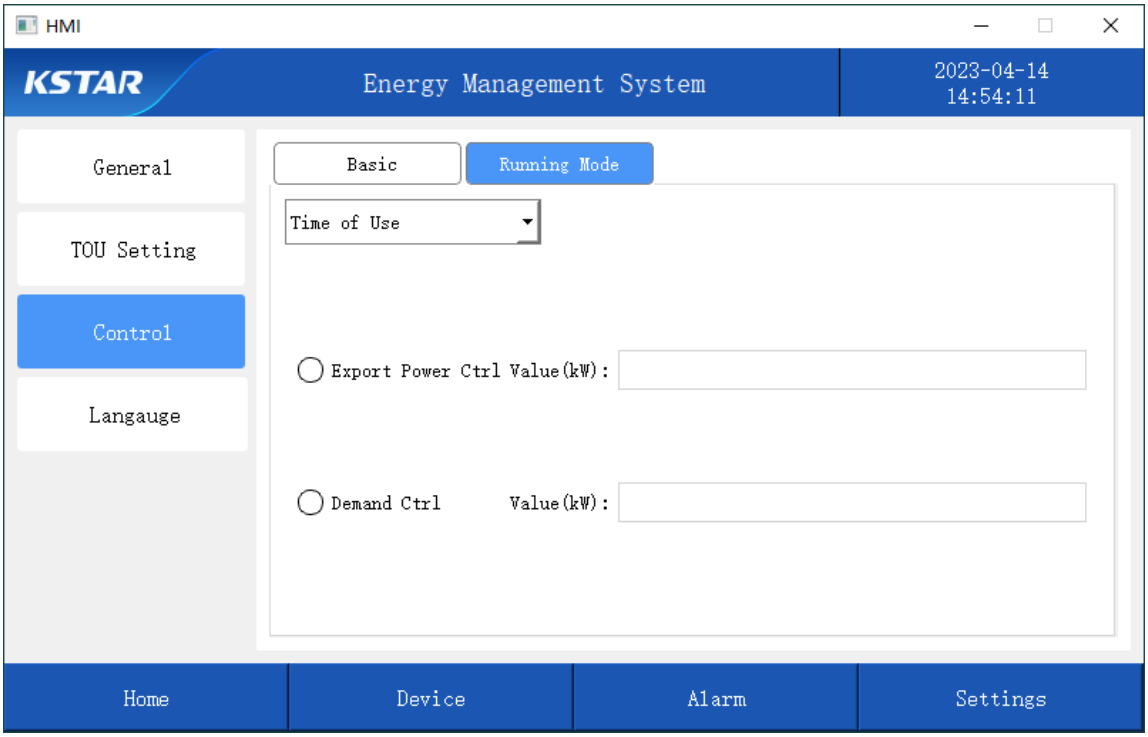
10:00-14:00, 50,

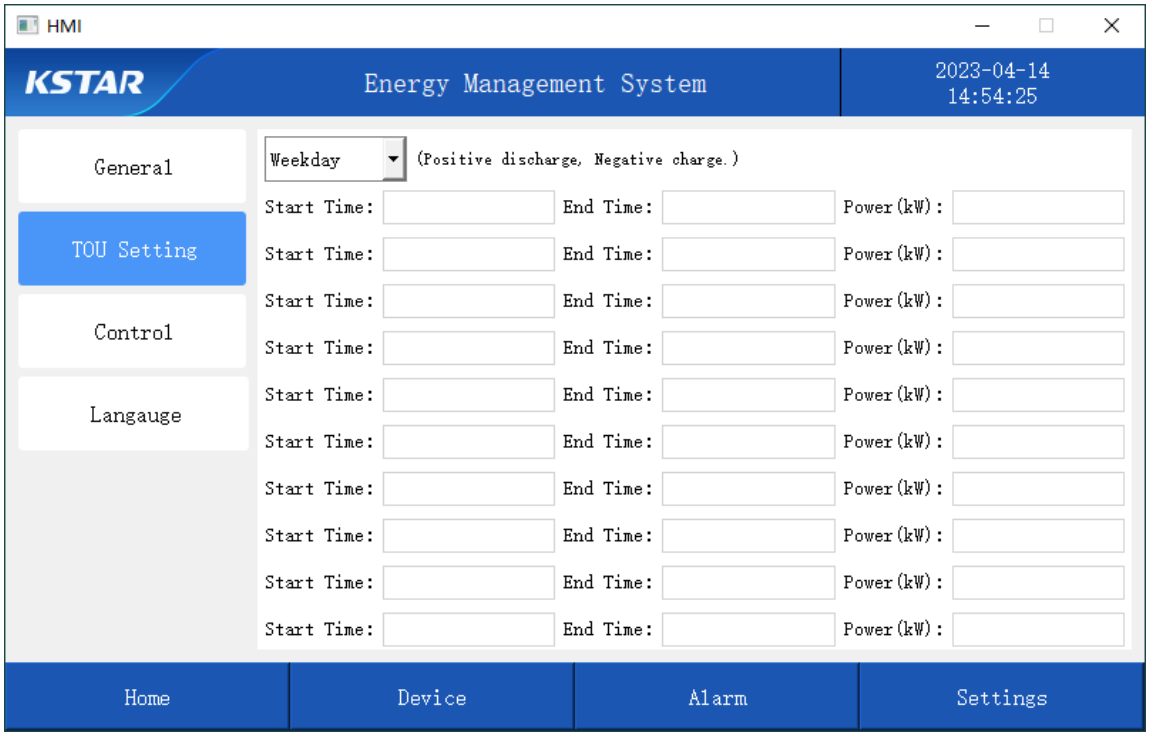
17:00-19:30, -50,

20:00-23:59, 50,

5. At this moment, the system will run in time sharing power mode.


HMI
KSTAR
Energy Management System
2023-04-14
14:54:11
General
TOU Setting
Control
Langauge
Basic
Running Mode
Time of Use
Export Power Ctrl Value(kW):
Demand Ctrl
Value(kW):
Home
Device
Alarm
Settings


HMI
KSTAR
Energy Management System
2023-04-14
14:54:11
General
TOU Setting
Control
Langauge
Basic
Running Mode
Time of Use
Export Power Ctrl Value(kW):
Demand Ctrl
Value(kW):
Home
Device
Alarm
Settings



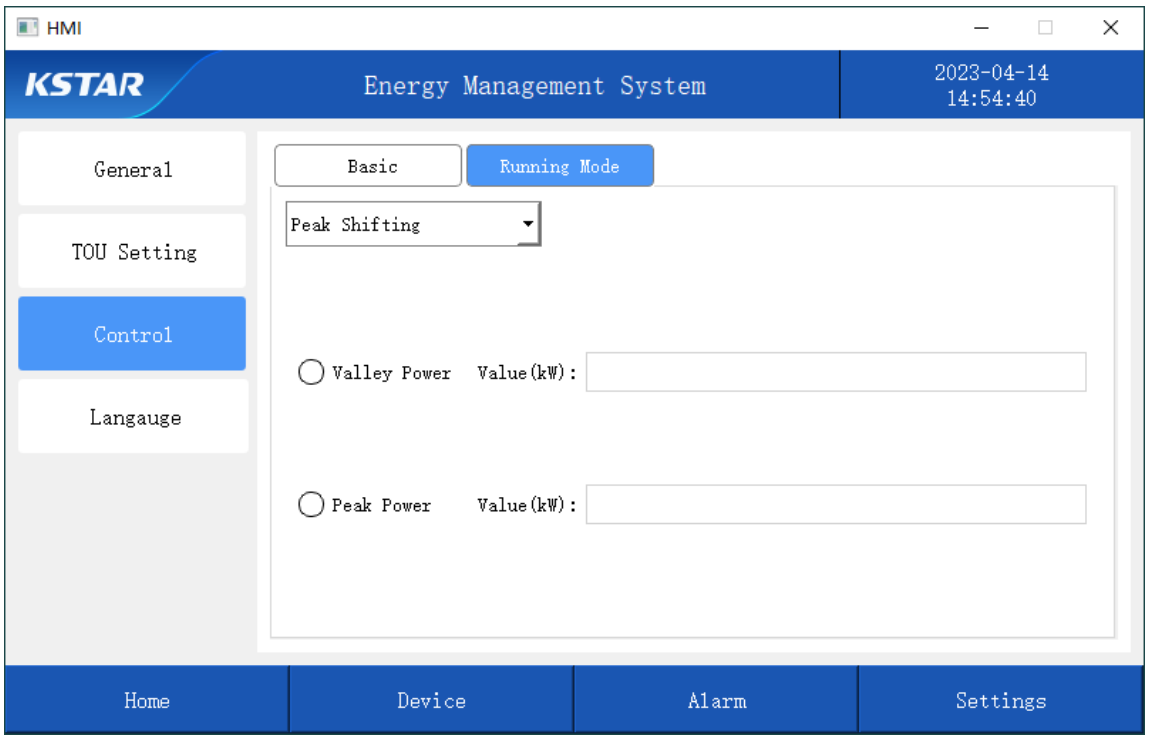
6.3 Peak Load Shifting

1. Enter the Control interface, select the Running Mode setting, and select Peak Load Shifting;

3. Enable valley power and enter a value of 10;

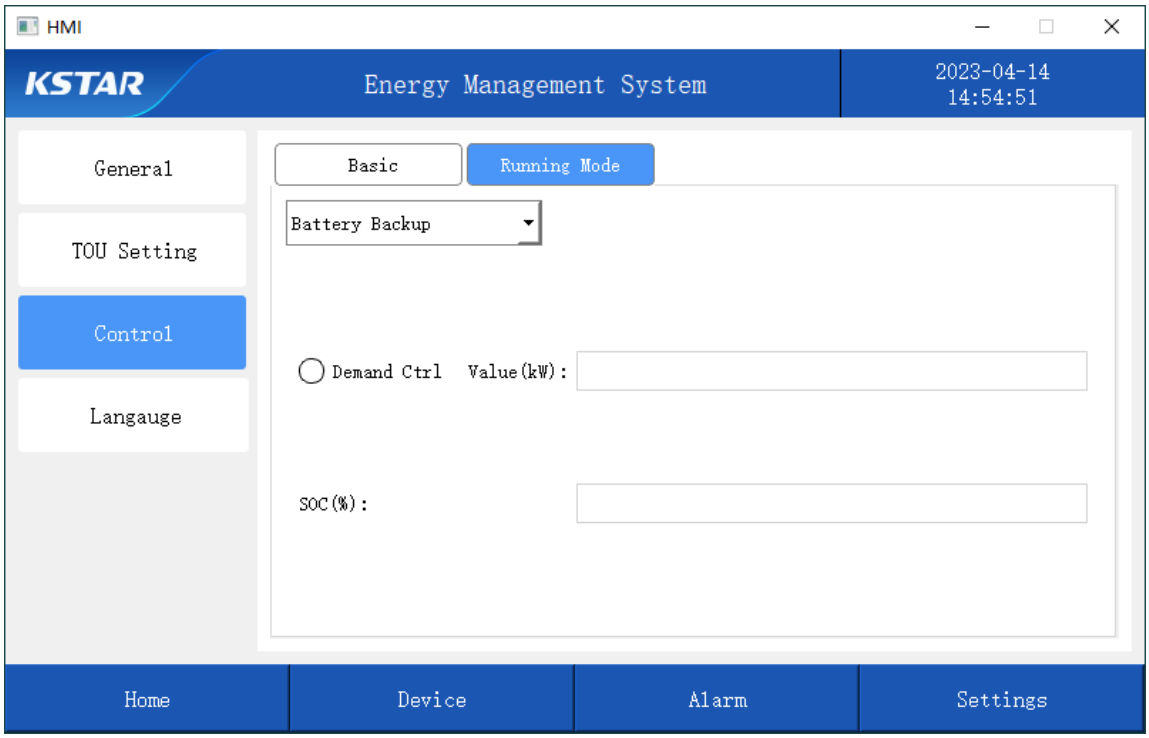
4. Enable peak power, and enter a value of 50; (if only peak clipping is required, only enable peak power, and enter a value)

3. At this moment, the system will run in peak load shifting mode.



6.4 Battery Backup

1. Enter the Control interface, select the Running Mode setting, and select Battery Backup;
2. Enable demand control, and enter demand control value of 50;
3. Enter SOC value 70;
4. At this moment, the system will run in battery backup mode.



7. Routine Maintenance

General Safety Rules:

- Only qualified and authorized personnel can perform maintenance and other operations on the EMS controller;
- When performing maintenance work, do not leave screws, washers and other metal parts in the EMS controller, or the equipment may be damaged!

Maintenance list:

- Check whether strong electromagnetic interference devices are placed around the EMS controller;
- Check whether there is a heat source around the EMS controller;
- Check whether there are corrosive substances around the EMS controller;
- Check whether the power supply voltage is normal;
- Check whether the wiring terminals are firm;
- Check whether the ground wire is well grounded;
- Check whether the casing, circuit board and components are clean;
- Check whether the vent holes are blocked by dust and foreign matters;

- Check whether the control terminal screws are loose. If yes, fasten with a screwdriver;
- Check whether the wiring copper bars or screws are oxidized and discolored;
- Check the connection of equipment terminals and cable distribution;
- Check the communication status of the device;
- Check the parameter settings of the EMS controller;
- Check the software version of the EMS controller.