LW005-MP
Product Specification

Version 1.0

CONTENT

1 Introduction

1.1 Overview

LW005-MP is a LoRaWAN smart plug with power and energy monitoring, the measuring accuracy can reach ±0.5%. The plug can connect to your server through LoRaWAN gateway and LoRaWAN network, so as to realize smart control, power and energy monitoring and other functions.

It is mainly used for intelligent electrical control, industrial equipment monitoring, power monitoring and energy management, etc.

1.2 Model List

LW005-MP series contains several product models, the model list is as below:

Model	Description
LW005-MP-B	US type, max current is 15A, US915(Default Frequency)
LW005-MP- G	UK type, max current is 13A, EU868(Default Frequency)
LW005-MP- F	EU type, max current is 16A, EU868(Default Frequency)
LW005-MP- E	FR type, max current is 16A, EU868(Default Frequency)

Note: All the above four models can be customized for other frequency bands:US915 / CN779 /EU433 /AU915 /CN470 /AS923 /KR920 /IN865 /RU864.

2 Features

- LoRaWAN® Class C compatible
- Remotely control
- Support wide range of voltage input(100-240VAC,50/60HZ)
- Multiple plug types (UK/US/FR/EU Type)
- Real-time voltage, current, power factor and active power measurement with ±0.5% measuring accuracy
- Locally store the daily /totally energy data
- Over-load/Over-voltage/Sag-voltage/Over-current protection, minimize the electricity risk
- Load starts/stops working notification
- Two indicators indicate device network and switch state separately
- FCC&UL&CE certified

3 Application Scenarios

Scenario 1: Intelligent industrial control
LW005-MP can be used for electrical energy monitoring and remote control of some key industrial equipment. It can report the electrical parameters (voltage, current, power) and total electrical energy data during the operation of the equipment. Data analysis can be generated on the server, so that users can find abnormal power consumption and abnormal working equipment in time to ensure power safety and optimize power distribution.
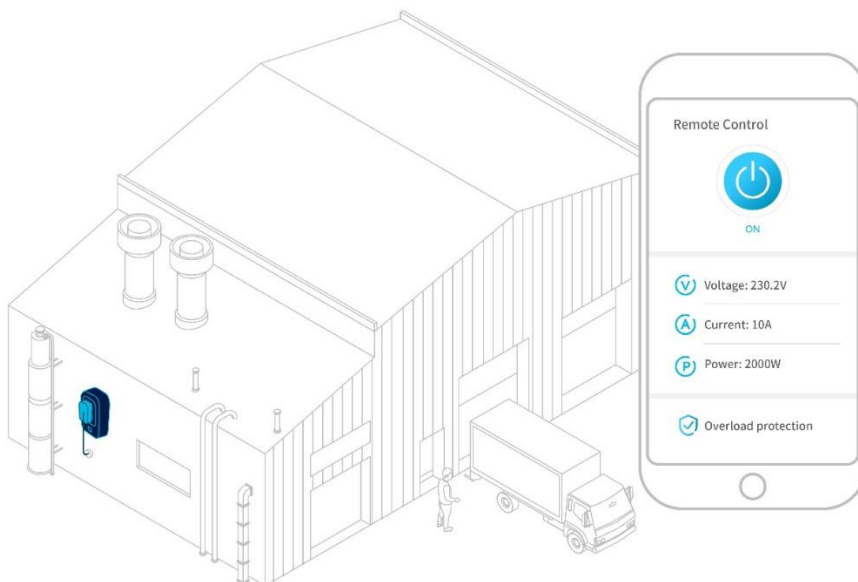
Scenario 2: Smart home appliance control
Connect the household appliances with the LW005-MP, you can remotely control the switch status

through the APP/server, and view the power consumption data at any time. When you leave home and forget to turn off an electrical appliance, you can use the APP to remotely turn it off, which can help you minimize the electricity risk and save electricity bills.
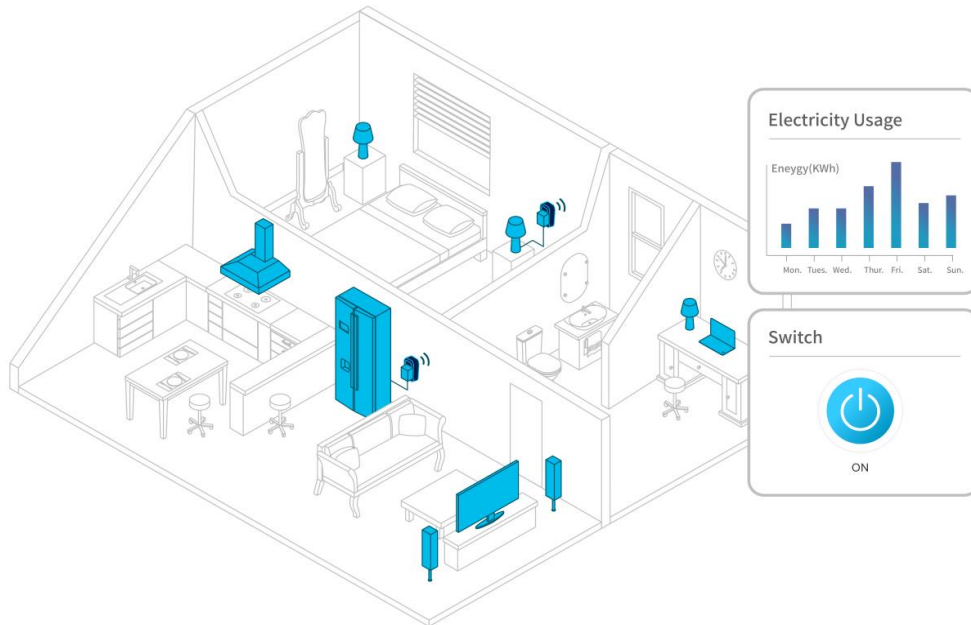
Scenario 3: Smart office energy solution

Monitor the power consumption of some frequently used office equipment or electrical appliances. The plug can automatically power on the electrical devices on working hours and turn off on the working-off hours. It also uploads the power consumption data of the load to the server in real time, the server can generate data analysis to find out the equipment with abnormal power consumption quickly, and limit the use when the power consumption exceeds the normal range. Which provides an effective way to manage the electrical devices and save the electricity bills.
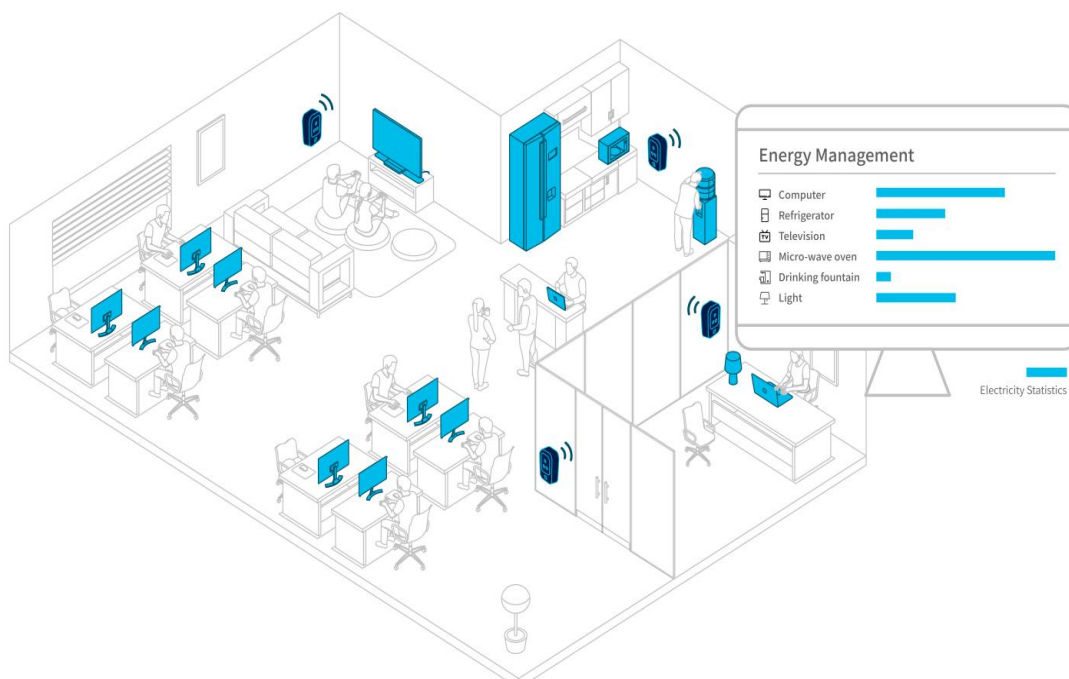
4 Product Appearance

4.1 Appearance

AV plug(EU/US/UK/FR type)

Network indicator
Antenna area(inside)

Switch/Reset button
Switch indicator
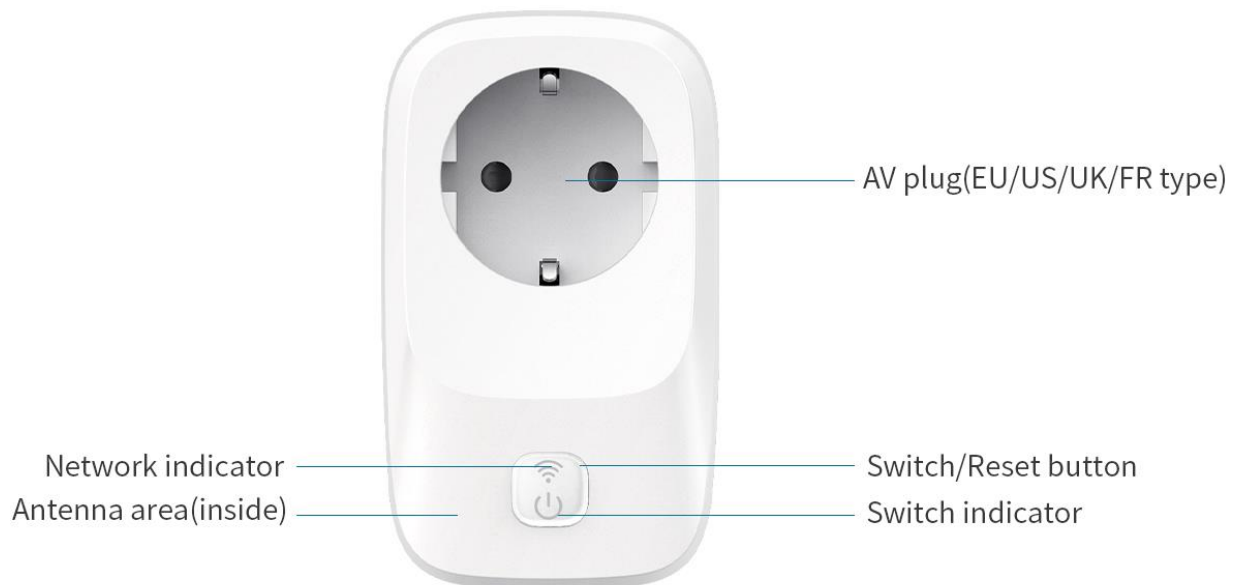
Note: *the environment and orientation of the device can influence the radio performance. For optimum results keep the zone around the antenna area clear from any conducting material or magnetic fields.*

4.2 Dimensions
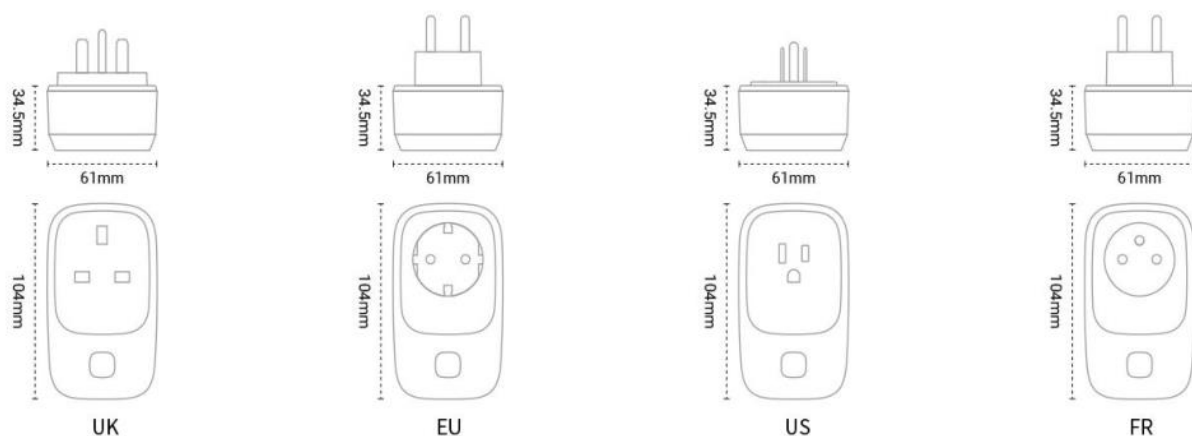
4.3 LED Patterns

Indicator	Action	LED Patterns
Network Indicator	Connect to network server successfully	Solid White

((wifi icon))	The device is connecting to network server	Flash blue once per second
	Start network check each time	Flash green one second each time
Switch Indicator ((power icon))	Switch ON	The color depends on the active power consumed by the load
	Switch OFF	LED OFF
	Restore to factory setting	Flash blue and yellow once
	Reset energy data	Triple flash white light
	Overload/voltage/current protection	Flash red once per second
	OTA process	Flash blue
	OTA succeed	Solid blue
	OTA Failed	Solid red

5 Product Specifications

Categories	Parameter	Value
Electronic Specification	Plug Type	US/UK/EU/FR
	Power Supply	100-240VAC, 50/60Hz
	Output Capacity	US type: 15A UK type: 13A EU/FR type: 16A
	Switch/reset button	Short click button once to turn the switch ON/OFF; Long press the button for 10 seconds to restore to factory setting
	LED indicator	2*RGB indicators
LoRa Wireless Specification	LoRa Protocol	LoRaWAN V1.0.3
	Lora Frequency	EU868/AU915/US915/AS923/IN865/KR920/EU433/CN470/CN779/RU864
	Tx Power	Max 21dBm
	Sensitivity	-137dBm@SF12 300bps
	LoRa Communication Distance	Up to 7 km (in urban open space)
BLE Wireless Specification	Bluetooth® (BLE)	V4.0
	TX Power	Max 4 dBm

	BLE Communication Distance	Up to 50m in free space
Physical Specification	Dimension	104mm*61mm*34.5mm
	Shell Material	ASA+PC
	Color	White
Application Specification	Operating Temperature	-20 ~ + 40℃
	Operating Humidity	10%-95%（No condensation）
	Certification	CE FCC certification in process

6 Main Functions

6.1 LoRaWAN Capabilities

The uplink payloads of LW005-MP will be transmitted via LoRa and LW005-MP is based on the standard LoRaWAN protocol V1.0.3.

LW005-MP is compatible with mainstream gateways and mainstream servers (TTN, SENET, LORA IOT, etc.) in the market.

DeviceTimeReq MAC Command: LW005-MP supports the DeviceTime feature, which enables users to periodically time their devices to avoid time offset. The *Time Sync Interval* of the MKLoRa APP is the Device Time MAC Command interval. (Please refer to *LW005-MP APP Guide*)

6.1.1 LoRa Uplink Transmission Strategy
Considering the load balance of the gateway, the battery power consumption and the reliability of the messages, the LW005-MP is equipped with a LoRa uplink mechanism for users to choose, so that users can select a suitable sending strategy according to different application scenarios.

6.1.2 Confirmed Message Retransmission Mechanism
Because the application scenario of this product requires high success in data transmission, the uplink payload is transmitted by default via confirmed message. When the device transmits data via confirmation message, if the data is not successfully reported, it can be retransmitted through the protocol layer, and the number of retransmissions can be set.

6.1.3 LoRaWAN Network Check
The user can set the network detection interval via MKLoRa or LoRaWAN downlink command.

The LW005-MP will check its network status periodically at this interval. If network check fails, network check process will be initiated again every 10s, if the network detection fails three times in a row, the device will rejoin the LoRaWAN network.

6.2 Connect to LoRaWAN network server

To join LW005-MP into LoRa network to communicate with LoRa gateway. The network operation is as following:

(1) If LW005-MP had never joined any network:

First, turn on the device.

Second, use MKLoRa APP to connect the device then get required ID and Keys.
Default join ID and Keys as following:
DevEUI: BLE MAC+ FFFF, example:MAC:112233445566 DevEUI:112233FFFF445566
AppEUI: 70b3d57ed0026b87
AppKey: 2b7e151628aed2a6abf7158809cf4f3c
DevAddr: The last four bytes of BLE MAC address
AppSKey: 2b7e151628aed2a6abf7158809cf4f3c
NwkSkey: 2b7e151628aed2a6abf7158809cf4f3c

Third, register the device on LoRa network server.

Forth, click save button on MKLoRa APP to send a join request to LoRa server, it will search an available LoRa network to join.

Note: About MKLoRa APP details, please check the instructions in LW005-MP APP guide.

6.3 ON/OFF Monitoring & Control

There are three ways to control the AC output of the plug:
- Through the physical button, click the button once to switch the ON/OFF state.
- Through the MKLoRa APP.
- Through LoRaWAN downlink command.

The device will regularly report Switch Payload for ON/OFF monitoring after connect to LoRaWAN network server successfully. In addition, whenever the ON/OFF state is switched, the device will also report Switch Payload.

6.4 Timer Control

After LW005-MP is successfully connected to the LoRaWAN network server, user can set a timer to LW005-MP through the MKLoRa APP/LoRaWAN downlink command.

When the timer is complete, the plug will automatically change the switch state. During the timer process, the device will regularly report Countdown Payload, which contains the remaining time of the timer process.

6.5 Electrical Monitoring

The plug can measure the instant voltage, current and frequency of the connected load, and the measuring accuracy can reach ±0.5%.

LW005-MP will report Electrical Payload periodically, which contains voltage, current, frequency, active power and power factor.

6.6 Energy Monitoring

The plug can record daily /historical total energy data locally, and the measuring accuracy can reach ±0.5%.

LW005-MP will report Energy Payload periodically, which contains historical total energy and energy data of the previous hour.

6.7 Power Consumption Indicator

The power indicator can be changed to different colors according to the active power of the connected loads. The different colors of the indicator represent different power levels, which is convenient for users to intuitively and quickly capture the changes in load power.

6.8 Over-voltage/Sag-voltage/Over-current/Over-load Protection

The plug has multiple protection mechanisms. When it detects that the voltage/current/power of the connected load is out of the safe range, the plug will automatically turn off, and the indicator will flash red, and report Over-voltage Payload/Sag-voltage Payload /Over-current Payload /Over-load Payload to LoRaWAN server.

- Over-voltage protection: When the plug detects that the measured voltage exceeds the over-voltage threshold for a period of time, it will automatically turn off.
- Sag-voltage protection: When the plug detects that the measured voltage lows the sag-voltage threshold for a period of time, it will automatically turn off.
- Over-current protection: When the plug detects that the measured current exceeds the current threshold for a period of time, it will automatically turn off.
- Over-load protection: When the plug detects that the measured power exceeds the power threshold for a period of time, it will automatically turn off.

6.9 Load Work State Detection

When the plug detects that the load starts/stops working, it will immediately report a notification to the server. The user can receive the notification from LoRaWAN server, and know the working status of the load at any time.

6.10 Restore to Factory Setting

There are two ways to restore to factory setting:

1.Through the physical button, press and hold the button for 10 seconds, the plug will restore to factory setting.

2.User can send LoRaWAN downlink commands to make the plug restore to factory setting via LoRaWAN server.
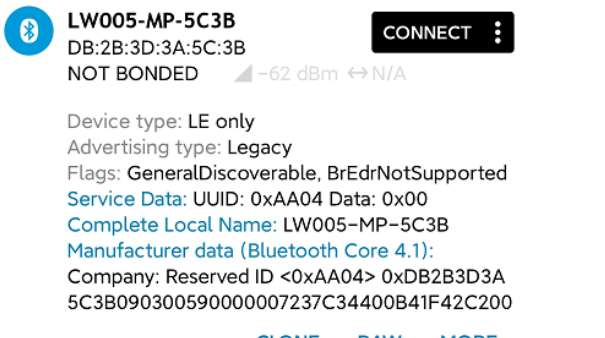
6.11 Default Power Status

When the LW005-MP is re-powered, users can configure the AC output of plug after power-up according to different scenario applications:

➢ OFF: Configure the AC output to off, after LW005-MP is re-powered.

➢ ON: Configure the AC output to on, after LW005-MP is re-powered.

➢ Restore last mode: Configure the AC output to return to last state it was, after LW005-MP is re-powered.

6.12 Bluetooth Configuration Tool

The device can use MKLoRa app developed by MOKO for quick OTA upgrades and parameter configuration via Bluetooth connection. About the detail of MKLoRa, pls refer to LW005-MP APP Guide.

The Bluetooth broadcast contents of LW005-MP are divided into advertising packet and response packet. The following is an example of the broadcast content:

6.12.1 Advertising packet

LEN	TYPE	VALUE
2	0x01	0x 06
4	0x16	0x 04 AA 00
14	0x09	0x 4C 57 30 30 35 2D 4D 50 2D 35 43 33 42

● Service UUID: LW005-MP (0x 04 AA)

● Device ADV Name: LW005-MP-5C3B (0x 4C 57 30 30 35 2D 4D 50 2D 35 43 33 42)
  (5C 3B is the last 4 bits of device MAC addresses)

6.12.2 Response packet

LEN	TYPE	VALUE
26	0xFF	0x04 AA DB 2B 3D 3A 5C 3B 09 03 00 59 00 00 00 72 37 C3 44 00 B4 1F 42 C2 00

● Device MAC Address: DB 2B 3D 3A 5C 3B

● Voltage: 230.7V (0x 09 03)

● Current: 89mA (0x 00 59)

● Active power: 11.4W (0x 00 00 00 72)

- Power factor: 55% (0x 37)
- Frequency: 49.988HZ (0x C3 44)
- Total energy: 3688.9 KW·H (0x 00 B4 1F 42)
- Device status:0x C2
  - Bit7 (1 means that the AC output is ON; 0 means that the AC output is OFF)
  - Bit6 (1 means there is a load on the plug; 0 means no load on the plug)
  - Bit5 (1 means that it is in Over-voltage; 0 means that it isn't in Over-voltage)
  - Bit4 (1 means that it is in Sag-voltage; 0 means that it isn't in Sag-voltage)
  - Bit3 (1 means that it is in Over-current; 0 means that it isn't in Over-current)
  - Bit2 (1 means that it is in Over-load; 0 means that it isn't in Over-load)
  - Bit1 (1 means password verification is required for login; 0 means password verification isn't required for login)
- BLE Tx Power: 0 dBm (0x 00)

7 Uplink Payload

7.1 Switch Payload

Switch payload will be sent in Port 5.

Byte 0~3	Byte 4	Byte 5	Byte 6
Timestamp	Time zone	AC output state	Plug load status

- **Timestamp:** Standard UTC time.
- **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone.
- **AC output state:** 00 means that AC output of plug is OFF; 01 means that AC output of plug is ON.
- **Plug load status:** 01 means there is a load on the plug; 00 means no load on the plug.

7.2 Electrical Payload

This payload will be sent in two parts.

The 1st part will be sent in Port 6:

Byte 0~3	Byte 4	Byte 5~6	Byte 7~8	Byte 9~10
Timestamp	Time zone	Instantaneous voltage	Instantaneous current	Instantaneous frequency

- **Timestamp:** Standard UTC time.
- **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone.
- **Instantaneous voltage:** Convert to decimal, then then divide by 10, the unit is V.
- **Instantaneous current:** Convert to decimal, then then divide by 1000, the unit is mA.

- ➢ **Instantaneous frequency:** Convert to decimal, then then divide by 1000, the unit is HZ.

The 2nd part will be sent in Port 7:

Byte 0~3	Byte 4	Byte 5~8	Byte 9
Timestamp	Time zone	Instantaneous active power	Power factor

- ➢ **Timestamp:** Standard UTC time.
- ➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
- ➢ **Instantaneous active power:** Convert to decimal, then then divide by 10, the unit is W.
- ➢ **Instantaneous power factor:** Convert to decimal, the unit is %.

7.3 Energy Payload

Energy payload will be sent in Port 8.

Byte 0~3	Byte 4	Byte 5~8	Byte 9~10
Timestamp	Time zone	Total energy	Last hour's energy data

- ➢ **Timestamp:** Standard UTC time.
- ➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
- ➢ **Total energy:** Convert to decimal, then divide by 3200, the unit is KW·H.
- ➢ **Last hour's energy data:** Convert to decimal, then divide by 3200, the unit is KW·H. This is the energy data of the last hour: for example, if the reported time is 14:23, the total ebergy data of the hour from 13:00 to 14:00 will be reported.

7.4 Over-voltage Payload

Over-voltage payload will be sent in Port 9.

Byte 0~3	Byte 4	Byte 5	Byte 6~7	Byte 8~9
Timestamp	Time zone	Over-voltage state	Currents instantaneous voltage	Over-voltage threshold

- ➢ **Timestamp:** Standard UTC time.
- ➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
- ➢ **Over-voltage state:** 01 means over-voltage state.
- ➢ **Currents instantaneous voltage:** Convert to decimal, then divide by 10, the unit is V.
- ➢ **Over-voltage threshold:** Convert to decimal, then divide by 10, the unit is V.

7.5 Sag-voltage Payload

Sag-voltage payload will be sent in Port 10.

Byte 0~3	Byte 4	Byte 5	Byte 6~7	Byte 8~9
Timestamp	Time zone	Sag-voltage state	Currents instantaneous voltage	Sag-voltage threshold

➢ **Timestamp:** Standard UTC time.
➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
➢ **Sag-voltage state:** 01 means sag-voltage state.
➢ **Currents instantaneous voltage:** Convert to decimal, then divide by 10, the unit is V.
➢ **Sag-voltage threshold:** Convert to decimal, then divide by 10, the unit is V.

7.6 Over-current Payload

Over-current payload will be sent in Port 11.

Byte 0~3	Byte 4	Byte 5	Byte 6~7	Byte 8~9
Timestamp	Time zone	Over-current state	Currents instantaneous current	Over-current threshold

➢ **Timestamp:** Standard UTC time.
➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
➢ **Over-current state:** 01 means over-current state.
➢ **Currents instantaneous current:** Convert to decimal, then divide by 1000, the unit is mA.
➢ **Over-current threshold:** Convert to decimal, then divide by 1000, the unit is mA.

7.7 Over-load Payload

Over-load payload will be sent in Port 12.

Byte 0~3	Byte 4	Byte 5	Byte 6~8	Byte 9~10
Timestamp	Time zone	Over-load state	Currents instantaneous power	Over-power threshold

➢ **Timestamp:** Standard UTC time.
➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
➢ **Over-load state:** 01 means over-load state.
➢ **Currents instantaneous power:** Convert to decimal, then divide by 10, the unit is W.
➢ **Over-load threshold:** Convert to decimal, then divide by 10, the unit is W.

7.8 Load State Payload

Load state payload will be sent in Port 13.

Byte 0~3	Byte 4	Byte 5
Timestamp	Time zone	Change of load state

- ➢ **Timestamp:** Standard UTC time.
- ➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
- ➢ **Change of load state:** 00 means load starts stop; 01 means load starts working

7.9 Countdown Payload

Countdown payload will be sent in Port 14.

Byte 0~3	Byte 4	Byte 5	Byte 6-9
Timestamp	Time zone	ON/OFF state after countdown process ends	Time remaining of the countdown process

- ➢ **Timestamp:** Standard UTC time.
- ➢ **Time zone:** It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone;
- ➢ **ON/OFF state after countdown process ends:** 00 means OFF; 01 means ON.
- ➢ **Time remaining of the countdown process:** Convert to decimal, the unit is S(second).

8 Maintenance instruction

- Do not use or store the device in dusty or dirty areas.
- Do not use or store the device in extremely hot temperatures. High temperatures may damage the device or battery.
- Do not use or store the device in extremely cold temperatures .when the device warms to its normal temperature, moisture can form inside the device and damage the device or battery.
- Do not drop ,knock, or shake the device. Rough handing would break it.
- Do not use strong chemicals or washing to clean the device.
- Do not paint the device ,paint would cause improper operation
- Do not disassemble the device casually or use the tools for maintenance without permission

Handle your device, battery and accessories with care. The suggestions above help you keep your device operational.

9 Revision History

Version	Description	Editor	Date
1.0	Initial version	Allen	2021-12-10

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