***Revision:***

**-** *10/07/2025: version 1.0*

1. ***BLE communication***
2. **Packet**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Command Packet frame[30B] | | | | | |
| Header | Timestamp | Address | Command payload | | Sequence |
| 1B | 4B | 1B | 22B DATA | 1B CRC | 1B |

- Header: to specify type of packet. It is included command and report packet with encryption or non-encryption

|  |  |
| --- | --- |
| Header | Type of packet |
| 0x55 | Command Non-Encrypted |
| 0x56 | Command Encrypted |
| 0x57 | Report Non-Encrypted |
| 0x58 | Report Encrypted |
| 0x59 | OTA packet Non-Encrypted |
| 0x5A | OTA packet Encrypted |

- Timestamp: is 4 bytes Unix timestamp

- Address: device ID that sent this message

- Payload: include 20 bytes DATA and 1 byte CRC with encryption or non-encryption

+ DATA payload format follow the type of packet and type of device

+ CRC = DATA[0] + DATA[1] + … + DATA[19]

- Sequence: to specify the message is relay message from another or original message

1. **Command packet**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Command Packet frame[30B] | | | | | |
| Header | Timestamp | Address | Command payload | | Sequence |
| 1B | 4B | 1B | 22B DATA | 1B CRC | 1B |

|  |  |  |
| --- | --- | --- |
| Command DATA payload[22B] | | |
| CMD | Length | Data |
| 1B | 1B | 20B |

|  |  |  |
| --- | --- | --- |
| List of CMD | Description | Encryption |
| 0x00 | Pairing open | No |
| 0x01 | Pairing request | Yes |
| 0x02 | Pairing ACK | Yes |
| 0x03 | Ping | Yes |
| 0x04 | Ping ACK | Yes |
| 0x05 | Report request | Yes |
| 0x06 | Report ACK | Yes |

1. Pairing open

Gateway broadcast this CMD to all devices to ask for the pairing

|  |  |  |
| --- | --- | --- |
| Byte | Description | Value |
| 0..15 | Key encryption for network  (The actual key using to encrypt payload is derived from this key and default key) | any |
| 16..19 | Reverse |  |

1. Pairing request

Device send this CMD to gateway for asking to join network

|  |  |  |
| --- | --- | --- |
| Byte | Description | Value |
| 0 | Type of device | 0x00: power meter 1 phase 1 channel  0x01: power meter 1 phase 3 channel  0x02: power meter 3 phase 1 channel  0x03: product counter |
| 1..6 | MAC address  (address of device that want to pair) | any |
| 1..19 | Reverse |  |

1. Pairing ACK

ACK between gateway and device

|  |  |  |
| --- | --- | --- |
| Byte | Description | Value |
| 0 | Type of ACK | 0x00: pairing accepted  0x01: pairing cancle  0x02: pairing ack |
| 1..6 | MAC address  (address of device that gateway send to) | any |
| 7 | Device ID  (Gateway assigns to device in pairing accepted ) | 0 -> 255 |
| 8..19 | Reverse |  |

1. Ping

Gateway send to device to identification(blinking LED)

|  |  |  |
| --- | --- | --- |
| Byte | Description | Value |
| 0..5 | MAC address | any |
| 6..19 | Reverse |  |
|  |  |  |

1. Ping ACK

Device response to gateway

|  |  |  |
| --- | --- | --- |
| Byte | Description | Value |
| 0..5 | MAC address | any |
| 6..19 | Reverse |  |

1. Report request

Gateway broadcast this CMD to all devices to ask for data report

|  |  |  |
| --- | --- | --- |
| Byte | Description | Value |
| 0..3 | Timestamp( that want to get data) | any |
| 4 | Number of devices in group(max 10 devices) | 0 -> 10 |
| 5 | ID of Device 1 | 0 -> 200 |
| … | … |  |
| 14 | ID of Device 10 | 0 -> 200 |
| 15..19 | Reverse |  |

1. Report ACK

Gateway broadcast this CMD to all devices to show which device’s report is received successful

|  |  |  |
| --- | --- | --- |
| Byte | Description | Value |
| 0..3 | Timestamp( that want to get data) | any |
| 4 | Number of devices in group(max 10 devices) | 0 -> 10 |
| 5 | ID of Device 1 | 0 -> 200 |
| … | … |  |
| 14 | ID of Device 10 | 0 -> 200 |
| 15 | Bit 0: device 1 ACK  ...  Bit 7: device 8 ACK | 0b: not receive data from device  1b: received data from device OK |
| 16 | Bit 0: device 9 ACK  Bit 1: device 10 ACK  Bit 2..7: reverse | 0b: not receive data from device  1b: received data from device OK |
| 17..19 | Reverse |  |

1. **Report packet**

Device send this packet for report data every time received CMD report request from gateway

1. Common format

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Report Packet frame[30B] | | | | | |
| Header | Timestamp | Address | Report payload[22B] | | Sequence |
| 1B | 4B | 1B | 22B DATA | 1B CRC | 1B |

1. Data for power meter

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 22B DATA payload for 1 phase 3 channel | | | | | | | | | | | |
| Frequency | Voltage | Current 1 | Current 2 | Current 3 | Power 1 | Power 2 | Power 3 | Energy 1 | Energy 2 | Energy 3 | Reverse |
| 7 bits | 9 bits | 10 bits | 10 bits | 10 bits | 14 bits | 14 bits | 14 bits | 24 bits | 24 bits | 24 bits | 16 bits |
| 11 Bytes | | | | | | | | 3 Bytes | 3 Bytes | 3 Bytes | 2 Bytes |

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Length(bits) | Range | Description |
| Frequency | 7 | 0 -> 128 Hz |  |
| Voltage | 9 | 0 -> 512 V |  |
| Current 1 | 10 | 0 -> 102.4 A | Current = value/10  Range: 0 -> 102.4 A |
| Current 2 | 10 | 0 -> 102.4 A | Current = value/10  Range: 0 -> 102.4 A |
| Current 3 | 10 | 0 -> 102.4 A | Current = value/10  Range: 0 -> 102.4 A |
| Power 1 | 14 | 0 -> 16,384 W |  |
| Power 2 | 14 | 0 -> 16,384 W |  |
| Power 3 | 14 | 0 -> 16,384 W |  |
| Energy 1 | 24 | 0 -> 16,777,216 KWh | Energy = value/10  Range: 0 -> 1,677,721.6 KWh |
| Energy 2 | 24 | 0 -> 16,777,216 KWh | Energy = value/10  Range: 0 -> 1,677,721.6 KWh |
| Energy 3 | 24 | 0 -> 16,777,216 KWh | Energy = value/10  Range: 0 -> 1,677,721.6 KWh |
| Total length | 160(20 Bytes) |  |  |

1. Data for product counter

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 22B DATA payload for product counter | | | | | |
| Call button | End call button | Reset button | Pass product | Error product | Reverse |
| 1B | 1B | 1B | 4B | 4B | 11B |

1. **OTA packet**
2. Memory Map on ex-flash

|  |  |  |
| --- | --- | --- |
| **Address** | **Region** | **Length** |
| 0x00000000 | Original FW | 512 KB |
| 0x00080000 | OTA FW | 512 KB |
| 0x00100000 | NVM | 512 KB |
| 0x00180000 | Device weekly storage | 512 KB |
| 0x00200000 | Device weekly unspecified storage | 512 KB |
| 0x00280000 | Broadcast FW | 512 KB |
| 0x00300000 | Reverse | 1 MB |

- Original FW: contain the FW from factory

- OTA FW: contain the FW got from OTA services

- NVM: non-volatile memory for saving data

- Device weekly storage: region for storing weekly data

- Device weekly unspecified storage: region for storing weekly data when losing timestamp

1. Common format

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Report Packet frame[30B] | | | | | |
| Header | Timestamp | Address | Report payload[22B] | | Sequence |
| 1B | 4B | 1B | 22B DATA | 1B CRC | 1B |

1. OTA packet

|  |  |  |  |
| --- | --- | --- | --- |
| 22B DATA payload for 1 phase 3 channel | | | |
| Device type | Version | Memory address | Data |
| 1 Byte | 1 Byte | 3 Bytes | 16 Bytes |

1. ***UART communication***
2. **Format frame**

|  |  |  |  |
| --- | --- | --- | --- |
| UART communication frame | | | |
| LEN | CMD | CRC | DATA |
| 1 Byte | 1 Byte | 1 Byte | LEN Bytes |

LEN: length of DATA

CMD: command

CRC: checksum of DATA

If LEN = 0 -> CRC = 0

If LEN > 0 -> CRC = DATA[0] + …+ DATA[LEN - 1]

DATA: data of command

1. **List of command**

|  |  |  |  |
| --- | --- | --- | --- |
| List of CMD | Description | Direction | Data |
| 0x00 | Ping | BLE <-> WIFI | MAC address |
| 0x01 | Report request | WIFI -> BLE | MAC + timestamp begin + timestamp end |
| 0x02 | Report response | BLE -> WIFI | MAC + timestamp + DATA |
| 0x03 | Get list request | WIFI -> BLE | NONE |
| 0x04 | Get list response | BLE -> WIFI | Number of devices + MAC + device type |

1. **Ping(0x00)**

To identify device

|  |  |  |  |
| --- | --- | --- | --- |
| UART communication frame | | | |
| LEN | CMD | CRC | DATA |
| 1 Byte | 1 Byte | 1 Byte | 6 Bytes MAC address |

DATA: 6 bytes MAC address

Ex: send ping to device has MAC address = 01:02:03:04:05:06

Send: 0x06 0x00 0x15 0x01 0x02 0x03 0x04 0x05 0x06

1. **Report request(0x01)**

To request data from device

|  |  |  |  |
| --- | --- | --- | --- |
| UART communication frame | | | |
| LEN | CMD | CRC | DATA |
| 1 Byte | 1 Byte | 1 Byte | 6B MAC + 4B timestamp begin + 4B timestamp end |

DATA:

- 6 bytes MAC: address of device

- 4 bytes timestamp begin: beginning time that you want to get data

- 4 bytes timestamp end: ending time that you want to get data

Ex: Get report from device has MAC address = 01:02:03:04:05:06 from 06:00 - 1/1/2026 to 06:00 - 2/1/2026

“timestamp begin” at 06:00 - 1/1/2026 = 1767222000 = 0x6955AAF0

“timestamp end” at 06:00 - 2/1/2026 = 1767308400 = 0x6956FC70

Send: 0x0E 0x01 0x00 0x01 0x02 0x03 0x04 0x05 0x06 0xF0 0xAA 0x55 0x69 0x70 0xFC 0x56 0x69

1. **Report response(0x02)**

Device response data

|  |  |  |  |
| --- | --- | --- | --- |
| UART communication frame | | | |
| LEN | CMD | CRC | DATA |
| 1 Byte | 1 Byte | 1 Byte | 6B MAC + 4B timestamp + 1B device type + device data |

Device type:

- 0x00: Product counter

- 0x01: Power meter 1 phase 3 channel

1. ***Device data for product counter***

DATA = 6 bytes [MAC] + 4 bytes [timestamp] + 1 bytes [device type] + 11 bytes [device data]

[MAC] : device MAC address

[timestamp] : time of this device data

[device type] : type of device = 0x00

[device data] : call button + end call button + reset button + pass product + error product

- Call button: 1 byte

- End call button: 1 byte

- Reset button: 1 byte

- Pass product: 4 bytes

- Error product: 4 bytes

1. ***Device data for power meter 1 phase 3 channel***

DATA = 6 bytes [MAC] + 4 bytes [timestamp] + 1 bytes [device type] + 23 bytes [device data]

[MAC] : device MAC address

[timestamp] : time of this device data

[device type] : type of device = 0x01

[device data] : Frequency + Voltage + current channel 1,2,3 + power channel 1,2,3 + energy channel 1,2,3

- Frequency : 1 byte

- Voltage : 2 bytes

- Current channel 1: 2 bytes

- Current channel 2: 2 bytes

- Current channel 3: 2 bytes

- Power channel 1: 2 bytes

- Power channel 2: 2 bytes

- Power channel 3: 2 bytes

- Energy channel 1: 4 bytes

- Energy channel 2: 4 bytes

- Energy channel 3: 4 bytes