SUN2000ME
V500R023C00

# Modbus Interface Definitions

| | |
|---|---|
| **Issue** | 03 |
| **Date** | 2025-03-29 |

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# Contents



# 1 Change History

| Issue | Date | Description |
| --- | --- | --- |
| 03 | 2025-3-29 | (1) Delete redundant registers;<br>(2) Add a "Reactive Fixed Value" register. |
| 02 | 2024-10-10 | Delete redundant registers. |
| 01 | 2023-4-21 | This issue is the first official release. |

# 2 Supported Models

## 2.1 Model Description

**Table 2-1** Supported models and firmware versions

| Model | Model ID | Earliest Firm Version |
| --- | --- | --- |
| SUN2000-100KTL-M0 | 141 | SUN2000ME V500R023C00 |
| SUN2000-100KTL-M1 | 142 | SUN2000ME V500R023C00 |
| SUN2000-100KTL-INM0 | 143 | SUN2000ME V500R023C00 |
| SUN2000-110KTL-M0 | 144 | SUN2000ME V500R023C00 |
| SUN2000-125KTL-M0 | 145 | SUN2000ME V500R023C00 |
| SUN2000-111KTL-NHM0 | 146 | SUN2000ME V500R023C00 |
| SUN2000-75KTL-M1 | 147 | SUN2000ME V500R023C00 |
| SUN2000-110KTL-M2 | 148 | SUN2000ME V500R023C00 |
| SUN2000-115KTL-M2 | 149 | SUN2000ME V500R023C00 |
| SUN2000-100KTL-M2 | 150 | SUN2000ME V500R023C00 |
| SUN2000-111KTL-NHM2 | 151 | SUN2000ME V500R023C00 |

**NOTE**

The maximum active power ($P_{max}$), maximum reactive power ($Q_{max}$), and rated power ($P_n$) corresponding to each model can be obtained from the register interface. The model ID is the unique code of the model.

# 3 Overview

The ModBus protocol is released as a general-purpose device-level communication protocol standard. This document describes and describes the ModBus protocol of Huawei inverters to standardize and restrict subsequent third-party integration development. Huawei inverters comply with the standard ModBus specifications. This document focuses on Huawei inverter-specific information. For details about other information, see the ModBus standard specifications document. For details about the standard protocols used by Huawei inverters and the interaction modes and examples of customized parts, see 7-Communication Protocol Overview.

## 3.1 Terms and Abbreviations

**Table 3-1** Terms and abbreviations

| Name | Description |
| --- | --- |
| Master node | During master-slave communication, the party that initiates a communication request is referred to as the master node. |
| Slave node | During master-slave communication, the party that responds to a communication request is referred to as the slave node. |
| Broadcast address | Fixed to 0. |
| Register address | A register address is recorded in two bytes. |
| U16 | Unsigned integer (16 bits) |
| U32 | Unsigned integer (32 bits) |
| I16 | Signed integer (16 bits) |
| I32 | Signed integer (32 bits) |
| STR | Character string |
| MLD | Multiple bytes |

| Name | Description |
| --- | --- |
| Bitfield16 | 16-bit data expressed by bit |
| Bitfield32 | 32-bit data expressed by bit |
| N/A | Not applicable |
| s | Second |
| Epoch seconds | The number of seconds that have elapsed since 1970-01-01 00:00:00 |
| RO | Data that is readable only |
| RW | Data that is readable and writable |
| WO | Data that is writable only |

# 4 Register Definitions

**Table 4-1** Register definitions

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 1 | Model | RO | STR | N/A | 1 | 30000 | 15 | For details, see **2.1 Model Description**. |
| 2 | SN | RO | STR | N/A | 1 | 30015 | 10 | N/A |
| 3 | PN | RO | STR | N/A | 1 | 30025 | 10 | N/A |
| 4 | Model ID | RO | U16 | N/A | 1 | 30070 | 1 | For details, see **2.1 Model Description**. |
| 5 | Number of PV strings | RO | U16 | N/A | 1 | 30071 | 1 | N/A |
| 6 | Number of MPP trackers | RO | U16 | N/A | 1 | 30072 | 1 | N/A |
| 7 | Rated power ($P_n$) | RO | U32 | kW | 1000 | 30073 | 2 | N/A |
| 8 | Maximum active power ($P_{max}$) | RO | U32 | kW | 1000 | 30075 | 2 | N/A |
| 9 | Maximum apparent power ($S_{max}$) | RO | U32 | kVA | 1000 | 30077 | 2 | N/A |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 10 | Maximum reactive power ($Q_{max}$, fed to the power grid) | RO | I32 | kVar | 1000 | 30079 | 2 | N/A |
| 11 | Maximum reactive power ($Q_{max}$, absorbed from the power grid) | RO | I32 | kVar | 1000 | 30081 | 2 | N/A |
| 12 | State 1 | RO | Bitfield16 | N/A | 1 | 32000 | 1 | Bit 0: standby<br>Bit 1: grid-connected<br>Bit 2: grid-connected normally<br>Bit 3: grid connection with derating due to power rationing<br>Bit 4: grid connection with derating due to internal causes of the solar inverter<br>Bit 5: normal stop<br>Bit 6: stop due to faults<br>Bit 7: stop due to power rationing<br>Bit 8: shutdown<br>Bit 9: spot check |
| 13 | State 2 | RO | Bitfield16 | N/A | 1 | 32002 | 1 | Bit 0: locking status (0: locked; 1: unlocked)<br>Bit 1: PV connection status (0: disconnected; 1: connected)<br>Bit 2: DSP data collection (0: no; 1: yes) |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 14 | State 3 | RO | Bitfield32 | N/A | 1 | 32003 | 2 | Bit 0: off-grid (0: on-grid; 1: off-grid)<br>Bit 1: off-grid switch (0: disable; 1: enable) |
| 15 | Alarm 1 | RO | Bitfield16 | N/A | 1 | 32008 | 1 | For details, see**6.1 Alarm Information** . |
| 16 | Alarm 2 | RO | Bitfield16 | N/A | 1 | 32009 | 1 | For details, see **6.1 Alarm Information**. |
| 17 | Alarm 3 | RO | Bitfield16 | N/A | 1 | 32010 | 1 | For details, see **6.1 Alarm Information**. |
| 18 | PV1 voltage | RO | I16 | V | 10 | 32016 | 1 | A maximum of 20 PV strings are supported. The number of PV strings read by the host is defined by the **Number of PV strings** signal. The voltage and current register addresses for each PV string are as follows:<br>PV*n* voltage: 32014 + 2*n*<br>PV*n* current: 32015 + 2*n*<br>*n* indicates the PV string number, which ranges from 1 to 20. |
| 19 | PV1 current | RO | I16 | A | 100 | 32017 | 1 | |
| 20 | PV2 voltage | RO | I16 | V | 10 | 32018 | 1 | |
| 21 | PV2 current | RO | I16 | A | 100 | 32019 | 1 | |
| 22 | PV3 voltage | RO | I16 | V | 10 | 32020 | 1 | |
| 23 | PV3 current | RO | I16 | A | 100 | 32021 | 1 | |
| 24 | PV4 voltage | RO | I16 | V | 10 | 32022 | 1 | |
| 25 | PV4 current | RO | I16 | A | 100 | 32023 | 1 | |
| 26 | PV5 voltage | RO | I16 | V | 10 | 32024 | 1 | |
| 27 | PV5 current | RO | I16 | A | 100 | 32025 | 1 | |
| 28 | PV6 voltage | RO | I16 | V | 10 | 32026 | 1 | |
| 29 | PV6 current | RO | I16 | A | 100 | 32027 | 1 | |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 30 | PV7 voltage | RO | I16 | V | 10 | 32028 | 1 | |
| 31 | PV7 current | RO | I16 | A | 100 | 32029 | 1 | |
| 32 | PV8 voltage | RO | I16 | V | 10 | 32030 | 1 | |
| 33 | PV8 current | RO | I16 | A | 100 | 32031 | 1 | |
| 34 | PV9 voltage | RO | I16 | V | 10 | 32032 | 1 | |
| 35 | PV9 current | RO | I16 | A | 100 | 32033 | 1 | |
| 36 | PV10 voltage | RO | I16 | V | 10 | 32034 | 1 | |
| 37 | PV10 current | RO | I16 | A | 100 | 32035 | 1 | |
| 38 | PV11 voltage | RO | I16 | V | 10 | 32036 | 1 | |
| 39 | PV11 current | RO | I16 | A | 100 | 32037 | 1 | |
| 40 | PV12 voltage | RO | I16 | V | 10 | 32038 | 1 | |
| 41 | PV12 current | RO | I16 | A | 100 | 32039 | 1 | |
| 42 | PV13 voltage | RO | I16 | V | 10 | 32040 | 1 | |
| 43 | PV13 current | RO | I16 | A | 100 | 32041 | 1 | |
| 44 | PV14 voltage | RO | I16 | V | 10 | 32042 | 1 | |
| 45 | PV14 current | RO | I16 | A | 100 | 32043 | 1 | |
| 46 | PV15 voltage | RO | I16 | V | 10 | 32044 | 1 | |
| 47 | PV15 current | RO | I16 | A | 100 | 32045 | 1 | |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 48 | PV16 voltage | RO | I16 | V | 10 | 32046 | 1 | |
| 49 | PV16 current | RO | I16 | A | 100 | 32047 | 1 | |
| 50 | PV17 voltage | RO | I16 | V | 10 | 32048 | 1 | |
| 51 | PV17 current | RO | I16 | A | 100 | 32049 | 1 | |
| 52 | PV18 voltage | RO | I16 | V | 10 | 32050 | 1 | |
| 53 | PV18 current | RO | I16 | A | 100 | 32051 | 1 | |
| 54 | PV19 voltage | RO | I16 | V | 10 | 32052 | 1 | |
| 55 | PV19 current | RO | I16 | A | 100 | 32053 | 1 | |
| 56 | PV20 voltage | RO | I16 | V | 10 | 32054 | 1 | |
| 57 | PV20 current | RO | I16 | A | 100 | 32055 | 1 | |
| 58 | DC power | RO | I32 | kW | 1000 | 32064 | 2 | |
| 59 | Power grid line A and B voltage | RO | U16 | V | 10 | 32066 | 1 | When the output mode is L/N, the signal name is Grid Voltage.<br>When Output Mode is set to L1/L2/N or L1/L2, the signal name is UW Grid Voltage. |
| 60 | Power grid B/C line voltage | RO | U16 | V | 10 | 32067 | 1 | This parameter is invalid when the output mode is L/N, L1/L2/N, or L1/L2. |
| 61 | Power grid CA line voltage | RO | U16 | V | 10 | 32068 | 1 | This parameter is invalid when the output mode is L/N, L1/L2/N, or L1/L2. |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 62 | Power grid phase A voltage | RO | U16 | V | 10 | 32069 | 1 | This parameter is invalid when the output mode is L/N.<br>When Output Mode is set to L1/L2/N or L1/L2, the signal name is UO Grid Voltage.<br>Not displayed in off-grid mode |
| 63 | Power grid phase B voltage | RO | U16 | V | 10 | 32070 | 1 | This parameter is invalid when the output mode is L/N.<br>When Output Mode is set to L1/L2/N or L1/L2, the signal name is WO Grid Voltage.<br>Not displayed in off-grid mode |
| 64 | Power grid phase C voltage | RO | U16 | V | 10 | 32071 | 1 | This parameter is invalid when the output mode is L/N, L1/L2/N, or L1/L2. |
| 65 | Power grid phase A current | RO | I32 | A | 1000 | 32072 | 2 | When the output mode is L/N, L1/L2/N, or L1/L2, the signal name is Grid Current. |
| 66 | Power grid phase B current | RO | I32 | A | 1000 | 32074 | 2 | This parameter is invalid when the output mode is L/N, L1/L2/N, or L1/L2. |
| 67 | Power grid phase C current | RO | I32 | A | 1000 | 32076 | 2 | This parameter is invalid when the output mode is L/N, L1/L2/N, or L1/L2. |
| 68 | Peak active power of the current day | RO | I32 | kW | 1000 | 32078 | 2 | |
| 69 | Active power | RO | I32 | kW | 1000 | 32080 | 2 | |
| 70 | reactive power | RO | I32 | kVar | 1000 | 32082 | 2 | |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 71 | Power factor | RO | I16 | N/A | 1000 | 32084 | 1 | N/A |
| 72 | Grid frequency | RO | U16 | Hz | 100 | 32085 | 1 | N/A |
| 73 | Efficiency | RO | U16 | % | 100 | 32086 | 1 | N/A |
| 74 | Internal temperature | RO | I16 | °C | 10 | 32087 | 1 | N/A |
| 75 | Insulation resistance | RO | U16 | MΩ | 1000 | 32088 | 1 | N/A |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 76 | Device status | RO | U16 | N/A | 1 | 32089 | 1 | 0x0000 Standby: initializing<br>0x0001 Standby: detecting insulation resistance<br>0x0002 Standby: detecting irradiation<br>0x0003 Standby: drid detecting<br>0x0100 Starting<br>0x0200 On-grid<br>(Off-grid mode: running)<br>0x0201 Grid connection: power limited<br>(Off-grid mode: running: power limited)<br>0x0202 Grid connection: self-derating<br>(Off-grid mode: running: self-derating)<br>0x0300 Shutdown: fault<br>0x0301 Shutdown: command<br>0x0302 Shutdown: OVGR<br>0x0303 Shutdown: communication disconnected<br>0x0304 Shutdown: power limited<br>0x0305 Shutdown: manual startup required<br>0x0306 Shutdown: DC switches disconnected<br>0x0307 Shutdown: rapid cutoff |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 0x0308 Shutdown: input underpower<br>0x0401 Grid scheduling: cosϕ-P curve<br>0x0402 Grid scheduling: Q-U curve<br>0x0403 Grid scheduling: PF-U curve<br>0x0404 Grid scheduling: dry contact<br>0x0405 Grid scheduling: Q-P curve<br>0x0500 Spot-check ready<br>0x0501 Spot-checking<br>0x0600 Inspecting<br>0X0700 AFCI self check<br>0X0800 I-V scanning<br>0X0900 DC input detection<br>0X0A00 Running: off-grid charging<br>0xA000 Standby: no irradiation |
| 77 | Fault code | RO | U16 | N/A | 1 | 32090 | 1 | N/A |
| 78 | Startup time | RO | U32 | N/A | 1 | 32091 | 2 | Epoch seconds, local time |
| 79 | Shutdown time | RO | U32 | N/A | 1 | 32093 | 2 | Epoch seconds, local time |
| 80 | Accumulated energy yield | RO | U32 | kWh | 100 | 32106 | 2 | N/A |
| 81 | Daily energy yield | RO | U32 | kWh | 100 | 32114 | 2 | N/A |
| 82 | Monthly energy yield | RO | U32 | kWh | 100 | 32116 | 2 | N/A |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 83 | yearly energy yield | RO | U32 | kWh | 100 | 32118 | 2 | N/A |
| 84 | [Active] Adjustment mode | RO | U16 | N/A | 1 | 35300 | 1 | 0: percentage<br>1: fixed value<br>**NOTE**<br>Addresses 35300 to 35303 need to be read at a time. |
| 85 | [Active] Adjustment value | RO | U32 | N/A | * | 35302 | 2 | Percentage: 0.1%<br>Fixed value: 0.001 kW<br>Note: For details about the adjustment value precision, see the corresponding adjustment command precision. |
| 86 | [Active] Adjustment command | RO | U16 | N/A | 1 | 35303 | 1 | 40125: active power derating by percentage (0.1%)<br>40120: active power derating by fixed value<br>40126: active power derating by fixed value (W)<br>42178: maximum active power<br>**NOTE**<br>40126 supports only residential inverters. |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 87 | [Reactive] Adjustment mode | RO | U16 | N/A | 1 | 35304 | 1 | 0: power factor<br>1: absolute value<br>2: Q/S<br>3: Q-U characteristic curve (command ID: 0)<br>4: cosϕ-P/$P_n$ characteristic curve (command ID: 0)<br>5: PF-U characteristic curve (command ID: 0)<br>6: Q-P characteristic curve (command ID: 0)<br>**NOTE**<br>Addresses 35304 to 35306 need to be read at a time. |
| 88 | [Reactive] Adjustment value | RO | U32 | N/A | * | 35305 | 2 | Power factor: 0.001<br>Absolute value: 0.001 kVar<br>Q/S: 0.001<br>Q-U characteristic curve: 0<br>cosϕ-P/$P_n$ characteristic curve: 0<br>PF-U characteristic curve: 0<br>Q-P characteristic curve: 0 |
| 89 | [Reactive] Adjustment command | RO | U16 | N/A | 1 | 35307 | 1 | 40122: power factor<br>40123: Q/S adjustment<br>40129: reactive power compensation at night (kVar)<br>42809: reactive power at night Q/S |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 90 | [Power meter collection] Active power* | RO | I32 | W | 1 | 37113 | 2 | > 0: feeding power to the power grid<br>< 0: obtaining power from the power grid |
| 91 | [Optimizer] Total number of optimizers* | RO | U16 | N/A | 1 | 37200 | 1 | N/A |
| 92 | [Optimizer] Number of online optimizers* | RO | U16 | N/A | 1 | 37201 | 1 | N/A |
| 93 | [Optimizer] Feature data* | RO | U16 | N/A | 1 | 37202 | 1 | N/A |
| 94 | System time | RW | U32 | N/A | 1 | 40000 | 2 | [946684800, 3155759999]<br>Epoch seconds, local time |
| 95 | [Power grid scheduling] Q-U characteristic curve mode* | RW | U16 | N/A | 1 | 40037 | 1 | 0: non-hysteresis<br>1: hysteresis |
| 96 | [Power grid scheduling] Q-U dispatch trigger power (%)* | RW | U16 | % | 1 | 40038 | 1 | [0, 100] |
| 97 | [Power grid scheduling] Fixed active power derated | RW | U16 | kW | 10 | 40120 | 1 | Scope: [0, $P_{max}$] |
| 98 | [Power grid scheduling] Reactive power compensation (PF) | RW | I16 | N/A | 1000 | 40122 | 1 | (–1, –0.8]U[0.8, 1] |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 99 | [Power grid scheduling] Reactive power compensation (Q/S) | RW | I16 | N/A | 1000 | 40123 | 1 | [–1, 1]<br>The device converts the value to a fixed value of Q for reactive power control. S indicates $S_{max}$. |
| 100 | [Power grid scheduling] Active power percentage derating (0.1%) | RW | U16 | % | 10 | 40125 | 1 | Scope: [0, 100]<br>Interface for fine adjustment of active power |
| 101 | [Power grid scheduling] Reactive power compensation at night (kVar) | RW | I32 | kVar | 1000 | 40129 | 2 | [$-Q_{max}$, $Q_{max}$] |
| 102 | [Power grid scheduling] cosϕ-P/$P_n$ characteristic curve | RW | MLD | N/A | 1 | 40133 | 21 | For details, see**6.2 Power Grid Scheduling** . |
| 103 | [Power grid scheduling] Q-U characteristic curve | RW | MLD | N/A | 1 | 40154 | 21 | For details, see .**6.2 Power Grid Scheduling** |
| 104 | [Power grid scheduling] PF-U characteristic curve | RW | MLD | N/A | 1 | 40175 | 21 | For details, see**6.2 Power Grid Scheduling** . |
| 105 | [Power grid scheduling] Reactive power adjustment time | RW | U16 | s | 1 | 40196 | 1 | [1, 120]. The default value is 10. |

| No. | Signal Name | Read/Write | Type | Unit | Gain | Address | Quantity | Scope |
|---|---|---|---|---|---|---|---|---|
| 106 | [Power grid scheduling] Q-U power percentage to exit scheduling* | RW | U16 | % | 1 | 40198 | 1 | [0, 100] |
| 107 | Startup | WO | U16 | N/A | 1 | 40200 | 1 | N/A |
| 108 | Shutdown | WO | U16 | N/A | 1 | 40201 | 1 | N/A |
| 109 | Grid code | RW | U16 | NA | 1 | 42000 | 1 | For details, see**6.3 Grid Codes** . |
| 110 | [Power grid scheduling] Reactive power change gradient | RW | U32 | %/s | 1000 | 42015 | 2 | [0.1, 1000] |
| 111 | [Power grid scheduling] Active power change gradient | RW | U32 | %/s | 1000 | 42017 | 2 | [0.1, 1000] |
| 112 | [Power grid scheduling] Schedule instruction valid duration | RW | U32 | s | 1 | 42019 | 2 | [0, 86400]<br>The value 0 indicates that the command is valid permanently. |
| 113 | Time zone | RW | I16 | min | 1 | 43006 | 1 | [–720, 840] |
| 114 | Reactive power fixed value | RW | I32 | kVar | 1000 | 47426 | 2 | [-2000.0, 2000.0] |

**NOTICE**

Signals marked with * are supported only by certain models or standard codes.

# 5 Customized Interfaces

## 5.1 Obtaining the System Information of Optimizers

Data synchronization mechanism: The host is driven to refresh the system information of optimizers by the change of the serial number (SN).

Synchronization process: For details, see**7.3.7.1 Uploading Files** .

Data storage of the solar inverters: After the device search and positioning are complete, the record is updated. The record format is as follows:

File type: 0x45

**Table 5-1** File format(V102)

| Data | Length (Bytes) | Remarks |
| --- | --- | --- |
| File version | 4 | V102 |
| Feature data sequence number | 2 | |
| Length | 2 | The file version number and feature data sequence number are not included. |
| Reserved | 1 | The reserved byte 0 is defined as the status.<br>bit0: inverter disconnection status (1=disconnected) |
| | 3 | |
| Number of optimizers | 2 | Total number, including the offline optimizers. |

| Data | Length (Bytes) | Remarks |
| --- | --- | --- |
| Feature data of optimizer 1 | 108 | For details about the data domain definition, see the Optimizer Feature Data Domain Definition. |
| Feature data of optimizer 2 | 108 | |
| Feature data of optimizer… | 108 | |
| Feature data of optimizer N | 108 | |

**Table 5-2** Feature data unit format(V102)

| Data | Length (Bytes) | Remarks |
| --- | --- | --- |
| Optimizer address | 2 | RS485 address |
| Online status | 2 | 0: offline<br>1: online<br>2: disconnected |
| String number | 2 | |
| Position in current string | 2 | relative positive connection starting point |
| SN | 20 | |
| Software version | 30 | |
| Alias | 20 | |
| Model | 30 | |

# 5.2 Obtaining Real-time Data of Optimizers

Data synchronization mechanism: fifteen-minute interval

Synchronization process: uploads the files and synchronizes data according to the time period; uploads the most recent data if there is no filter condition. For details, see .**7.3.7.1 Uploading Files**

Data storage: stores real-time data at five-minute intervals.

File type: 0x44

**Table 5-3** Record format

| Data | Length (Byte) | Remarks |
| --- | --- | --- |
| File version | 4 | V101 |
| Reserved | 8 | - |
| Optimizer data unit 1 | N | 12 + 26 x Number of optimizers , For details about the definition of this unit, see the data unit format. |
| Optimizer data unit 2 | N | - |
| ... | - | - |
| Optimizer data unit *n* | N | *n* indicates the number of data records that meet the filter condition. Each piece of data contains all optimizer data for a time node. |

**Table 5-4** Data unit format (V101)

| Data | Length (Byte) | Remarks |
| --- | --- | --- |
| Time | 4 | Epoch seconds, local time |
| Reserved | 4 | - |
| Length | 2 | - |
| Number of optimizers | 2 | - |
| Real-time data of optimizer 1 | 26 | For details about the definition of this unit, see the real-time data format. |
| Real-time data of optimizer 2 | 26 | - |
| ... | - | - |
| Real-time data of optimizer *n* | 26 | *n* is the number of optimizers. |

**Table 5-5** Real-time data format

| Data | Length (Byte) | Remarks |
| --- | --- | --- |
| Optimizer address | 2 | RS485 address |

| Data | Length (Byte) | Remarks |
| --- | --- | --- |
| Output power | 2 | Gain: 10<br>Unit: W |
| Voltage to ground | 2 | Gain: 10<br>Unit: V |
| Alarm | 4 | Bit00: input overvoltage<br>Bit01: input undervoltage<br>Bit02: output overvoltage<br>Bit04: overtemperature<br>Bit06: output short circuit<br>Bit07: EEPROM fault<br>Bit08: internal hardware fault<br>Bit09: abnormal voltage to ground<br>Bit 10: power-off due to heartbeat timeout<br>Bit 11: fast shutdown<br>Bit 12: request escape alarm<br>Bit 13: version mismatch alarm<br>Bit 16: input overvoltage<br>Bit 17: overtemperature<br>Bit 18: output short circuit<br>Bit 19: internal hardware fault<br>Bit 20: version mismatch alarm<br>Bit 21: backfeed alarm<br>Bit 22: abnormal output voltage<br>Bit 23: upgrade failure<br>Bit 31: alarm display selection, 1=Display bit 16 to bit 30 alarms, 0: Bits 0 to 15 are displayed. |
| Output voltage | 2 | Gain: 10<br>Unit: V |
| Output current | 2 | Gain: 100<br>Unit: A |
| Input voltage | 2 | Gain: 10<br>Unit: V |
| Input current | 2 | Gain: 100<br>Unit: A |

| Data | Length (Byte) | Remarks |
| --- | --- | --- |
| Temperature | 2 | Gain: 10<br>Unit: ℃ |
| Running status | 2 | 0: offline<br>1: standby<br>3: faulty<br>4: running<br>12: power-off |
| Accumulated energy yield | 4 | Gain: 1000<br>Unit: kWh |

# 6 Interface Instructions

## 6.1 Alarm Information

**Table 6-1** Alarm information

| No. | Alarm | Bit | Alarm Name | Alarm ID | Level |
|---|---|---|---|---|---|
| 1 | Alarm 1 | 0 | High String Input Voltage | 2001 | Major |
| 2 | Alarm 1 | 1 | DC Arc Fault[1] | 2002 | Major |
| 3 | Alarm 1 | 2 | String Reverse Connection | 2011 | Major |
| 4 | Alarm 1 | 3 | String Current Backfeed | 2012 | Warning |
| 5 | Alarm 1 | 4 | Abnormal String Power | 2013 | Warning |
| 6 | Alarm 1 | 5 | AFCI Self-Check Fail.[1] | 2021 | Major |
| 7 | Alarm 1 | 6 | Phase Wire Short-Circuited to PE | 2031 | Major |
| 8 | Alarm 1 | 7 | Grid Loss | 2032 | Major |
| 9 | Alarm 1 | 8 | Grid Undervoltage | 2033 | Major |
| 10 | Alarm 1 | 9 | Grid Overvoltage | 2034 | Major |

| No. | Alarm | Bit | Alarm Name | Alarm ID | Level |
|---|---|---|---|---|---|
| 11 | Alarm 1 | 10 | Grid Volt. Imbalance | 2035 | Major |
| 12 | Alarm 1 | 11 | Grid Overfrequency | 2036 | Major |
| 13 | Alarm 1 | 12 | Grid Underfrequency | 2037 | Major |
| 14 | Alarm 1 | 13 | Unstable Grid Frequency | 2038 | Major |
| 15 | Alarm 1 | 14 | Output Overcurrent | 2039 | Major |
| 16 | Alarm 1 | 15 | Output DC Component Overhigh | 2040 | Major |
| 17 | Alarm 2 | 0 | Abnormal Residual Current | 2051 | Major |
| 18 | Alarm 2 | 1 | Abnormal Grounding | 2061 | Major |
| 19 | Alarm 2 | 2 | Low Insulation Resistance | 2062 | Major |
| 20 | Alarm 2 | 3 | Overtemperature | 2063 | Minor |
| 21 | Alarm 2 | 4 | Device Fault | 2064 | Major |
| 22 | Alarm 2 | 5 | Upgrade Failed or Version Mismatch | 2065 | Minor |
| 23 | Alarm 2 | 6 | License Expired | 2066 | Warning |
| 24 | Alarm 2 | 7 | Faulty Monitoring Unit | 61440 | Minor |
| 25 | Alarm 2 | 8 | Faulty Power Collector[2] | 2067 | Major |
| 26 | Alarm 2 | 9 | Battery abnormal | 2068 | Minor |
| 27 | Alarm 2 | 10 | Active Islanding | 2070 | Major |
| 28 | Alarm 2 | 11 | Passive Islanding | 2071 | Major |

| No. | Alarm | Bit | Alarm Name | Alarm ID | Level |
|---|---|---|---|---|---|
| 29 | Alarm 2 | 12 | Transient AC Overvoltage | 2072 | Major |
| 30 | Alarm 2 | 13 | Peripheral port short circuit[3] | 2075 | Warning |
| 31 | Alarm 2 | 14 | Churn output overload[4] | 2077 | Major |
| 32 | Alarm 2 | 15 | Abnormal PV module configuration | 2080 | Major |
| 33 | Alarm 3 | 0 | Optimizer fault[5] | 2081 | Warning |
| 34 | Alarm 3 | 1 | Built-in PID operation abnormal[6] | 2085 | Minor |
| 35 | Alarm 3 | 2 | High input string voltage to ground. | 2014 | Major |
| 36 | Alarm 3 | 3 | External Fan Abnormal | 2086 | Major |
| 37 | Alarm 3 | 4 | Battery Reverse Connection[7] | 2069 | Major |
| 38 | Alarm 3 | 5 | On-grid/Off-grid controller abnormal[4] | 2082 | Major |
| 39 | Alarm 3 | 6 | PV String Loss | 2015 | Warning |
| 40 | Alarm 3 | 7 | Internal Fan Abnormal | 2087 | Major |
| 41 | Alarm 3 | 8 | DC Protection Unit Abnormal[8] | 2088 | Major |
| 42 | Alarm 4 | 10 | Management system certificate not effective | 2095 | Major |
| 43 | Alarm 4 | 11 | Management system certificate not effective | 2096 | Major |
| 44 | Alarm 4 | 12 | Management system certificate has expired | 2097 | Major |
| 45 | Alarm 5 | 3 | CT disconnection | 2067 | Major |
| 46 | Alarm 5 | 4 | PT disconnection | 2067 | Major |

| No. | Alarm | Bit | Alarm Name | Alarm ID | Level |
|---|---|---|---|---|---|
| Note a: AFCI functional unit.<br>Note b: Power collector or meter directly connected to the inverter.<br>Note c: Detection of external 12V power supply provided by inverter models with external ports.<br>Note d: Detectable when equipped with built-in or external grid-tie functional unit.<br>Note e: Detectable when equipped with an optimizer on the DC side.<br>Note f: Detectable when equipped with inverter PID functional unit.<br>Note g: Detectable when equipped with energy storage unit.<br>Note h: Some models have DC protection unit. | | | | | |

**NOTICE**

The preceding table lists the alarm information about Huawei solar inverters. Some alarms can be detected only after corresponding functional modules are configured.

# 6.2 Power Grid Scheduling

This section describes the curve configuration format and precautions for power grid scheduling by curve.

## 6.2.1 cosϕ-P/Pn Characteristic Curve

**Table 6-2** cosϕ-P/$P_n$ characteristic curve definition

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| Number of points | U16 | 1 | N/A | [2, 10] |
| P/$P_n$ value at point 1 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 1 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| P/$P_n$ value at point 2 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 2 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| P/$P_n$ value at point 3 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 3 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| P/$P_n$ value at point 4 | U16 | 10 | % | [0, 100] |

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| cosϕ value at point 4 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $P/P_n$ value at point 5 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 5 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $P/P_n$ value at point 6 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 6 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $P/P_n$ value at point 7 | U16 | 10 | % | [0,100] |
| cosϕ value at point 7 | I16 | 1000 | N/A | (–1,–0.8]U[0.8,1] |
| $P/P_n$ value at point 8 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 8 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $P/P_n$ value at point 9 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 9 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $P/P_n$ value at point 10 | U16 | 10 | % | [0, 100] |
| cosϕ value at point 10 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |

## 6.2.2 Q-U Characteristic Curve

**Table2** Q-U Characteristic Curve definition

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| Number of points | U16 | 1 | N/A | [2, 10] |
| $U/U_n$ value at point 1 | U16 | 10 | % | [80, 136] |
| Q/S value at point 1 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 2 | U16 | 10 | % | [80, 136] |
| Q/S value at point 2 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 3 | U16 | 10 | % | [80, 136] |
| Q/S value at point 3 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 4 | U16 | 10 | % | [80, 136] |
| Q/S value at point 4 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 5 | U16 | 10 | % | [80, 136] |

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| Q/S value at point 5 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 6 | U16 | 10 | % | [80, 136] |
| Q/S value at point 6 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 7 | U16 | 10 | % | [80, 136] |
| Q/S value at point 7 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 8 | U16 | 10 | % | [80, 136] |
| Q/S value at point 8 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 9 | U16 | 10 | % | [80, 136] |
| Q/S value at point 9 | I16 | 1000 | N/A | [–0.6, 0.6] |
| $U/U_n$ value at point 10 | U16 | 10 | % | [80, 136] |
| Q/S value at point 10 | I16 | 1000 | N/A | [–0.6, 0.6] |

**NOTICE**

In Italian standards, this curve may be used together with the **Q-U characteristic curve mode**, **Q-U dispatch trigger power (%)**, and **Q-U power percentage to exit scheduling** parameters.

## 6.2.3 PF-U Characteristic Curve

**Table3** PF-U Characteristic Curve definition

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| Number of points | U16 | 1 | N/A | [2, 10] |
| $U/U_n$ value at point 1 | U16 | 10 | % | [80, 136] |
| PF value at point 1 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 2 | U16 | 10 | % | [80, 136] |
| PF value at point 2 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 3 | U16 | 10 | % | [80, 136] |
| PF value at point 3 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 4 | U16 | 10 | % | [80, 136] |

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| PF value at point 4 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 5 | U16 | 10 | % | [80, 136] |
| PF value at point 5 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 6 | U16 | 10 | % | [80, 136] |
| PF value at point 6 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 7 | U16 | 10 | % | [80, 136] |
| PF value at point 7 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 8 | U16 | 10 | % | [80, 136] |
| PF value at point 8 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 9 | U16 | 10 | % | [80, 136] |
| PF value at point 9 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |
| $U/U_n$ value at point 10 | U16 | 10 | % | [80, 136] |
| PF value at point 10 | I16 | 1000 | N/A | (–1, –0.8]U[0.8, 1] |

# 6.3 Grid Codes

**Table 6-3** List of grid codes

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 0 | VDE-AR-N-4105 | Germany |
| 1 | NB/T 32004 | China |
| 2 | UTE C 15-712-1(A) | France |
| 3 | UTE C 15-712-1(B) | France |
| 4 | UTE C 15-712-1(C) | France |
| 5 | VDE 0126-1-1-BU | Bulgaria |
| 6 | VDE 0126-1-1-GR(A) | Greece |
| 7 | VDE 0126-1-1-GR(B) | Greece |
| 8 | BDEW-MV | Germany |
| 9 | G59-England | UK |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 10 | G59-Scotland | UK |
| 11 | G83-England | UK |
| 12 | G83-Scotland | UK |
| 13 | CEI0-21 | Italy |
| 14 | EN50438-CZ | Czech Republic |
| 15 | RD1699/661 | Spain |
| 16 | RD1699/661-MV480 | Spain |
| 17 | EN50438-NL | Netherlands |
| 18 | C10/11 | Belgium |
| 19 | AS4777 | Australia |
| 20 | IEC61727 | General |
| 21 | Custom (50 Hz) | Custom |
| 22 | Custom (60 Hz) | Custom |
| 23 | CEI0-16 | Italy |
| 24 | CHINA-MV480 | China |
| 25 | CHINA-MV | China |
| 26 | TAI-PEA | Thailand |
| 27 | TAI-MEA | Thailand |
| 28 | BDEW-MV480 | Germany |
| 29 | Custom MV480 (50 Hz) | Custom |
| 30 | Custom MV480 (60 Hz) | Custom |
| 31 | G59-England-MV480 | UK |
| 32 | IEC61727-MV480 | General |
| 33 | UTE C 15-712-1-MV480 | France |
| 34 | TAI-PEA-MV480 | Thailand |
| 35 | TAI-MEA-MV480 | Thailand |
| 36 | EN50438-DK-MV480 | Denmark |
| 37 | Japan standard (50 Hz) | Japan |
| 38 | Japan standard (60 Hz) | Japan |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 39 | EN50438-TR-MV480 | Turkey |
| 40 | EN50438-TR | Turkey |
| 41 | C11/C10-MV480 | Belgium |
| 42 | Philippines | Philippines |
| 43 | Philippines-MV480 | Philippines |
| 44 | AS4777-MV480 | Australia |
| 45 | NRS-097-2-1 | South Africa |
| 46 | NRS-097-2-1-MV480 | South Africa |
| 47 | KOREA | South Korea |
| 48 | IEEE 1547-MV480 | USA |
| 49 | IEC61727-60Hz | General |
| 50 | IEC61727-60Hz-MV480 | General |
| 51 | CHINA_MV500 | China |
| 52 | ANRE | Romania |
| 53 | ANRE-MV480 | Romania |
| 54 | ELECTRIC RULE NO.21-MV480 | California, USA |
| 55 | HECO-MV480 | Hawaii, USA |
| 56 | PRC_024_Eastern-MV480 | Eastern USA |
| 57 | PRC_024_Western-MV480 | Western USA |
| 58 | PRC_024_Quebec-MV480 | Quebec, Canada |
| 59 | PRC_024_ERCOT-MV480 | Texas, USA |
| 60 | PO12.3-MV480 | Spain |
| 61 | EN50438_IE-MV480 | Ireland |
| 62 | EN50438_IE | Ireland |
| 63 | IEEE 1547a-MV480 | USA |
| 64 | Japan standard (MV420-50 Hz) | Japan |
| 65 | Japan standard (MV420-60 Hz) | Japan |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 66 | Japan standard (MV440-50 Hz) | Japan |
| 67 | Japan standard (MV440-60 Hz) | Japan |
| 68 | IEC61727-50Hz-MV500 | General |
| 70 | CEI0-16-MV480 | Italy |
| 71 | PO12.3 | Spain |
| 72 | Japan standard (MV400-50 Hz) | Japan |
| 73 | Japan standard (MV400-60 Hz) | Japan |
| 74 | CEI0-21-MV480 | Italy |
| 75 | KOREA-MV480 | South Korea |
| 76 | Egypt ETEC | Egypt |
| 77 | Egypt ETEC-MV480 | Egypt |
| 78 | CHINA_MV800 | China |
| 79 | IEEE 1547-MV600 | USA |
| 80 | ELECTRIC RULE NO.21-MV600 | California, USA |
| 81 | HECO-MV600 | Hawaii, USA |
| 82 | PRC_024_Eastern-MV600 | Eastern USA |
| 83 | PRC_024_Western-MV600 | Western USA |
| 84 | PRC_024_Quebec-MV600 | Quebec, Canada |
| 85 | PRC_024_ERCOT-MV600 | Texas, USA |
| 86 | IEEE 1547a-MV600 | USA |
| 87 | EN50549-LV | Ireland |
| 88 | EN50549-MV480 | Ireland |
| 89 | Jordan-Transmission | Jordan |
| 90 | Jordan-Transmission-MV480 | Jordan |
| 91 | NAMIBIA | Namibia |

| No. | Standard | Applicable Country or Region |
| --- | --- | --- |
| 92 | ABNT NBR 16149 | Brazil |
| 93 | ABNT NBR 16149-MV480 | Brazil |
| 94 | SA_RPPs | South Africa |
| 95 | SA_RPPs-MV480 | South Africa |
| 96 | INDIA | India |
| 97 | INDIA-MV500 | India |
| 98 | ZAMBIA | Zambia |
| 99 | ZAMBIA-MV480 | Zambia |
| 100 | Chile | Chile |
| 101 | Chile-MV480 | Chile |
| 102 | CHINA-MV500-STD | China |
| 103 | CHINA-MV480-STD | China |
| 104 | Mexico-MV480 | Mexico |
| 105 | Malaysian | Malaysia |
| 106 | Malaysian-MV480 | Malaysia |
| 107 | KENYA_ETHIOPIA | East Africa |
| 108 | KENYA_ETHIOPIA-MV480 | East Africa |
| 109 | G59-England-MV800 | UK |
| 110 | NIGERIA | Nigeria |
| 111 | NIGERIA-MV480 | Nigeria |
| 112 | DUBAI | Dubai |
| 113 | DUBAI-MV480 | Dubai |
| 114 | Northern Ireland | Northern Ireland |
| 115 | Northern Ireland-MV480 | Northern Ireland |
| 116 | Cameroon | Cameroon |
| 117 | Cameroon-MV480 | Cameroon |
| 118 | Jordan-Distribution | Jordan |
| 119 | Jordan-Distribution-MV480 | Jordan |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 120 | Custom MV600-50 Hz | Custom |
| 121 | AS4777-MV800 | Australia |
| 122 | INDIA-MV800 | India |
| 123 | IEC61727-MV800 | General |
| 124 | BDEW-MV800 | Germany |
| 125 | ABNT NBR 16149-MV800 | Brazil |
| 126 | UTE C 15-712-1-MV800 | France |
| 127 | Chile-MV800 | Chile |
| 128 | Mexico-MV800 | Mexico |
| 129 | EN50438-TR-MV800 | Turkey |
| 130 | TAI-PEA-MV800 | Thailand |
| 131 | Philippines-MV800 | Philippines |
| 132 | Malaysian-MV800 | Malaysia |
| 133 | NRS-097-2-1-MV800 | South Africa |
| 134 | SA_RPPs-MV800 | South Africa |
| 135 | Jordan-Transmission-MV800 | Jordan |
| 136 | Jordan-Distribution-MV800 | Jordan |
| 137 | Egypt ETEC-MV800 | Egypt |
| 138 | DUBAI-MV800 | Dubai |
| 139 | SAUDI-MV800 | Saudi Arabia |
| 140 | EN50438_IE-MV800 | Ireland |
| 141 | EN50549-MV800 | Ireland |
| 142 | Northern Ireland-MV800 | Northern Ireland |
| 143 | CEI0-21-MV800 | Italy |
| 144 | IEC 61727-MV800-60Hz | General |
| 145 | NAMIBIA_MV480 | Namibia |
| 146 | Japan (LV202-50 Hz) | Japan |
| 147 | Japan (LV202-60 Hz) | Japan |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 148 | Pakistan-MV800 | Pakistan |
| 149 | BRASIL-ANEEL-MV800 | Brazil |
| 150 | Israel-MV800 | Israel |
| 151 | CEI0-16-MV800 | Italy |
| 152 | ZAMBIA-MV800 | Zambia |
| 153 | KENYA_ETHIOPIA-MV800 | East Africa |
| 154 | NAMIBIA_MV800 | Namibia |
| 155 | Cameroon-MV800 | Cameroon |
| 156 | NIGERIA-MV800 | Nigeria |
| 157 | ABUDHABI-MV800 | Abu Dhabi |
| 158 | LEBANON | Lebanon |
| 159 | LEBANON-MV480 | Lebanon |
| 160 | LEBANON-MV800 | Lebanon |
| 161 | ARGENTINA-MV800 | Argentina |
| 162 | ARGENTINA-MV500 | Argentina |
| 163 | Jordan-Transmission-HV | Jordan |
| 164 | Jordan-Transmission-HV480 | Jordan |
| 165 | Jordan-Transmission-HV800 | Jordan |
| 166 | TUNISIA | Tunisia |
| 167 | TUNISIA-MV480 | Tunisia |
| 168 | TUNISIA-MV800 | Tunisia |
| 169 | JAMAICA-MV800 | Jamaica |
| 170 | AUSTRALIA-NER | Australia |
| 171 | AUSTRALIA-NER-MV480 | Australia |
| 172 | AUSTRALIA-NER-MV800 | Australia |
| 173 | SAUDI | Saudi Arabia |
| 174 | SAUDI-MV480 | Saudi Arabia |
| 175 | Ghana-MV480 | Ghana |

| No. | Standard | Applicable Country or Region |
| --- | --- | --- |
| 176 | Israel | Israel |
| 177 | Israel-MV480 | Israel |
| 178 | Chile-PMGD | Chile |
| 179 | Chile-PMGD-MV480 | Chile |
| 180 | VDE-AR-N4120-HV | Germany |
| 181 | VDE-AR-N4120-HV480 | Germany |
| 182 | VDE-AR-N4120-HV800 | Germany |
| 183 | IEEE 1547-MV800 | USA |
| 184 | Nicaragua-MV800 | Nicaragua |
| 185 | IEEE 1547a-MV800 | USA |
| 186 | ELECTRIC RULE NO.21-MV800 | California, USA |
| 187 | HECO-MV800 | Hawaii, USA |
| 188 | PRC_024_Eastern-MV800 | Eastern USA |
| 189 | PRC_024_Western-MV800 | Western USA |
| 190 | PRC_024_Quebec-MV800 | Quebec, Canada |
| 191 | PRC_024_ERCOT-MV800 | Texas, USA |
| 192 | Custom-MV800-50Hz | Custom |
| 193 | RD1699/661-MV800 | Spain |
| 194 | PO12.3-MV800 | Spain |
| 195 | Mexico-MV600 | Mexico |
| 196 | Vietnam-MV800 | Vietnam |
| 197 | CHINA-LV220/380 | China |
| 198 | SVG-LV | Dedicated |
| 199 | Vietnam | Vietnam |
| 200 | Vietnam-MV480 | Vietnam |
| 201 | Chile-PMGD-MV800 | Chile |
| 202 | Ghana-MV800 | Ghana |
| 203 | TAIPOWER | Taiwan |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 204 | TAIPOWER-MV480 | Taiwan |
| 205 | TAIPOWER-MV800 | Taiwan |
| 206 | IEEE 1547-LV208 | USA |
| 207 | IEEE 1547-LV240 | USA |
| 208 | IEEE 1547a-LV208 | USA |
| 209 | IEEE 1547a-LV240 | USA |
| 210 | ELECTRIC RULE NO.21-LV208 | USA |
| 211 | ELECTRIC RULE NO.21-LV240 | USA |
| 212 | HECO-O+M+H-LV208 | USA |
| 213 | HECO-O+M+H-LV240 | USA |
| 214 | PRC_024_Eastern-LV208 | USA |
| 215 | PRC_024_Eastern-LV240 | USA |
| 216 | PRC_024_Western-LV208 | USA |
| 217 | PRC_024_Western-LV240 | USA |
| 218 | PRC_024_ERCOT-LV208 | USA |
| 219 | PRC_024_ERCOT-LV240 | USA |
| 220 | PRC_024_Quebec-LV208 | USA |
| 221 | PRC_024_Quebec-LV240 | USA |
| 222 | ARGENTINA-MV480 | Argentina |
| 223 | Oman | Oman |
| 224 | Oman-MV480 | Oman |
| 225 | Oman-MV800 | Oman |
| 226 | Kuwait | Kuwait |
| 227 | Kuwait-MV480 | Kuwait |
| 228 | Kuwait-MV800 | Kuwait |
| 229 | Bangladesh | Bangladesh |
| 230 | Bangladesh-MV480 | Bangladesh |
| 231 | Bangladesh-MV800 | Bangladesh |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 232 | Chile-Net_Billing | Chile |
| 233 | EN50438-NL-MV480 | Netherlands |
| 234 | Bahrain | Bahrain |
| 235 | Bahrain-MV480 | Bahrain |
| 236 | Bahrain-MV800 | Bahrain |
| 238 | Japan-MV550-50Hz | Japan |
| 239 | Japan-MV550-60Hz | Japan |
| 241 | ARGENTINA | Argentina |
| 242 | KAZAKHSTAN-MV800 | Kazakhstan |
| 243 | Mauritius | Mauritius |
| 244 | Mauritius-MV480 | Mauritius |
| 245 | Mauritius-MV800 | Mauritius |
| 246 | Oman-PDO-MV800 | Oman |
| 247 | EN50438-SE | Sweden |
| 248 | TAI-MEA-MV800 | Thailand |
| 249 | Pakistan | Pakistan |
| 250 | Pakistan-MV480 | Pakistan |
| 251 | PORTUGAL-MV800 | Portugal |
| 252 | HECO-L+M-LV208 | USA |
| 253 | HECO-L+M-LV240 | USA |
| 254 | C10/11-MV800 | Belgium |
| 255 | Austria | Austria |
| 256 | Austria-MV480 | Austria |
| 257 | G98 | UK |
| 258 | G99-TYPEA-LV | UK |
| 259 | G99-TYPEB-LV | UK |
| 260 | G99-TYPEB-HV | UK |
| 261 | G99-TYPEB-HV-MV480 | UK |
| 262 | G99-TYPEB-HV-MV800 | UK |

| No. | Standard | Applicable Country or Region |
|---|---|---|
| 263 | G99-TYPEC-HV-MV800 | UK |
| 264 | G99-TYPED-MV800 | UK |
| 265 | G99-TYPEA-HV | UK |
| 266 | CEA-MV800 | India |
| 267 | EN50549-MV400 | Europe |
| 268 | VDE-AR-N4110 | Germany |
| 269 | VDE-AR-N4110-MV480 | Germany |
| 270 | VDE-AR-N4110-MV800 | Germany |
| 271 | Panama-MV800 | Panama |
| 272 | North Macedonia-MV800 | Nprth Macedonia |
| 273 | NTS | Spain |
| 274 | NTS-MV480 | Spain |
| 275 | NTS-MV800 | Spain |

**NOTICE**

Set the grid code based on local laws and regulations.

# 6.4 Energy Storage Specifications

**Table 6-4** Format description of parameters for time-of-use electricity price periods

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| Number of periods | U16 | 1 | N/A | [0, 10] |
| Start time of period 1 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |

| Description | Data Type | Gain | Unit | Value Range |
| --- | --- | --- | --- | --- |
| End time of period 1 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| Electricity price in period 1 | U32 | 1000 | N/A | N/A |
| Start time of period 2 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| End time of period 2 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| Electricity price in period 2 | U32 | 1000 | N/A | N/A |
| ... | ... | ... | ... | ... |
| Start time of period 10 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| End time of period 10 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| Electricity price in period 10 | U32 | 1000 | N/A | N/A |

**Table 6-5** Format description of parameters for fixed charging and discharging periods

| Description | Data Type | Gain | Unit | Value Range |
|---|---|---|---|---|
| Number of periods | U16 | 1 | N/A | [0, 10] |
| Start time of period 1 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| End time of period 1 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| Charging and discharging power in period 1 | I32 | 1 | W | [Discharging power limit, Charging power limit]. For details, see the description of the supported model. |
| Start time of period 2 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| End time of period 2 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| Charging and discharging power in period 2 | I32 | 1 | W | [Discharging power limit, Charging power limit]. For details, see the description of the supported model. |
| ... | ... | ... | ... | ... |
| Start time of period 10 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |

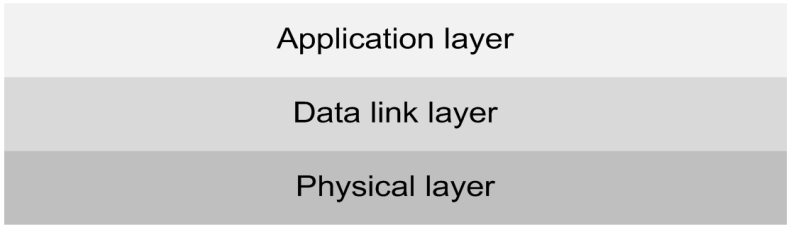
| Description | Data Type | Gain | Unit | Value Range |
| --- | --- | --- | --- | --- |
| End time of period 10 | U16 | 1 | min | [0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time. |
| Charging and discharging power in period 10 | I32 | 1 | W | [Discharging power limit, Charging power limit]. For details, see the description of the supported model. |

# 7 Overview of the Communications Protocol

The Modbus communication protocol is divided into the following layers:

Figure 1 Modbus protocol hierarchy



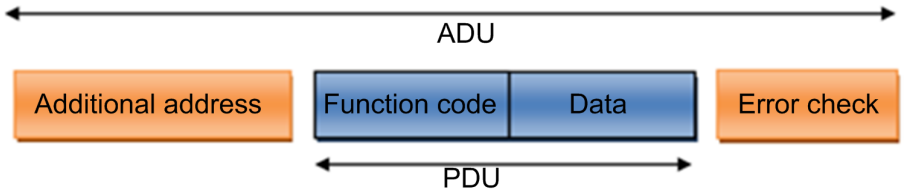

## 7.1 Physical Layer

Huawei solar inverters provide Modbus communication based on physical media such as MBUS, RS485, WLAN, FE, and 4G. MBUS and RS485 comply with the Modbus-RTU format. The communication through the WLAN, FE, and 4G media is based on the TCP link and complies with the Modbus-TCP format.

## 7.2 Data Link Layer

The following figure shows the generic frame structure of the Modbus protocol.

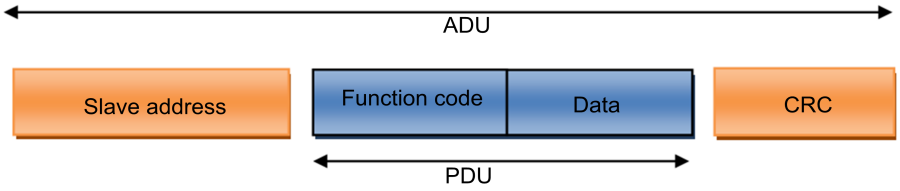
**Figure 7-1** Modbus generic frame format



## 7.2.1 Modbus-RTU

**Figure 7-2** Modbus-RTU frame format




### 7.2.1.1 ADU Length

The application data unit (ADU) consists of 256 bytes based on the serial bus.

1. Slave address: 1 byte
2. Cyclic redundancy check (CRC): 2 bytes
3. PDU: 253 bytes

### 7.2.1.2 Communications Address

As shown in7.2.1 Modbus-RTU , Modbus-RTU is usually used for serial communication. Slave address represents the address of a slave solar inverter. The address range is allocated as follows:

**Table 7-1** Serial link address allocation

| Broadcast Address | Slave Node Address | Reserved Address |
| --- | --- | --- |
| 0 | 1–247 | 248–255 |

Reserved addresses are used for access control of the communication extension modules. Huawei reserves the right to allocate the reserved addresses.

### 7.2.1.3 CRC

CRC applies to all bytes in front of the CRC code, which consists of 16 bits. The reference code is as follows:

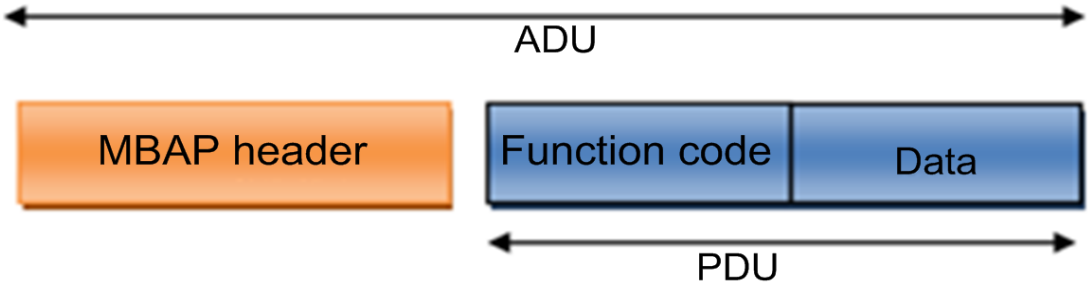
```
static unsigned char auchCRCHi[] = {
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01,
```

```
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40
} ;
/*CRC values for the low-order byte*/
static char auchCRCLo[] = {
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7, 0x05, 0xC5, 0xC4,
0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09,
0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD,
0x1D, 0x1C, 0xDC, 0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32, 0x36, 0xF6, 0xF7,
0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A,
0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38, 0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE,
0x2E, 0x2F, 0xEF, 0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1, 0x63, 0xA3, 0xA2,
0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4, 0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F,
0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB, 0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB,
0x7B, 0x7A, 0xBA, 0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0, 0x50, 0x90, 0x91,
0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97, 0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C,
0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88,
0x48, 0x49, 0x89, 0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83, 0x41, 0x81, 0x80, 0x40
};
unsigned short CRC16 ( puchMsg, usDataLen ) /* The function returns the CRC as a unsigned short type */
unsigned char *puchMsg ; /* message to calculate CRC upon */
unsigned short usDataLen ; /* quantity of bytes in message */
{
unsigned char uchCRCHi = 0xFF ; /* high byte of CRC initialized */
unsigned char uchCRCLo = 0xFF ; /* low byte of CRC initialized */
unsigned uIndex ; /* will index into CRC lookup table */
while (usDataLen--) /* pass through message buffer */
{
uIndex = uchCRCLo ^ *puchMsg++ ; /* calculate the CRC */
uchCRCLo = uchCRCHi ^ auchCRCHi[uIndex] ;
uchCRCHi = auchCRCLo[uIndex] ;
}
return (uchCRCHi << 8 | uchCRCLo) ;
}
```

Code source: *MODBUS over Serial Line Specification and Implementation Guide V1.02*

## 7.2.2 Modbus-TCP

**Figure 7-3** Modbus-TCP frame format




### 7.2.2.1 ADU Length

The recommended frame length is 260 bytes based on the standard. When some extended functions are applied, the data service provider may extend the ADU to a proper length based on the resources it possesses, to improve network

transmission efficiency. The ADU length is indicated by the length field in the MBAP packet header.

### 7.2.2.2 MBAP Packet Header

If Modbus is applied to TCP/IP, a dedicated MBAP packet header (Modbus application protocol packet header) is used to identify the Modbus ADU. The Modbus packet header consists of four fields and seven bytes, which are defined as follows.

**Table 7-2** MBAP definition

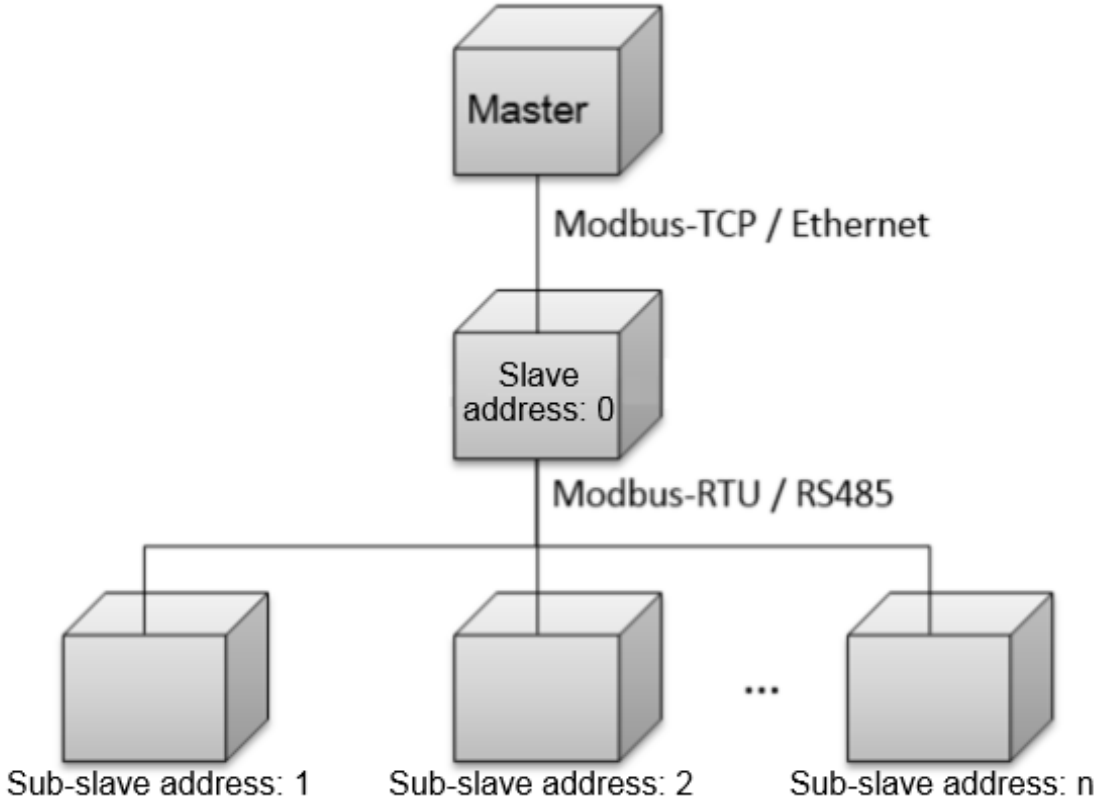
| Data Field | Length (Byte) | Description | Client | Server |
|---|---|---|---|---|
| Transmission identifier | 2 | Matching identifier between a request frame and a response frame | Assigned by the client; better be unique for each data frame | The identifier of the response frame from the server must be consistent with that of the request frame. |
| Protocol type | 2 | 0 = Modbus protocol | Assigned by the client; 0 by default | The identifier of the response frame from the server must be consistent with that of the request frame. |
| Data length | 2 | Follow-up data length | Assigned by the client based on the actual data frame | Assigned by the server based on the actual frame length |
| Logical device ID | 1 | 0 | Assigned by the client based on the actual data frame request | The identifier of the response frame from the server must be consistent with that of the request frame. |

### 7.2.2.3 Communications Address

Based on the TCP communications host, unit 0 is used by default to access the directly connected slave node, and other addresses are used to access the downstream devices of the slave node. The default address of the slave node is 0. The address is adjustable.

**Figure 7-4** Communications address of the three-layer object structure




### 7.2.2.4 TCP Port

In a local area network or VPN environment, the master node may actively initiate TCP socket link establishment to the slave node. The master node can use the 502 port to request data services from the slave node.

In a non-VPN environment across the public network, the device deployed on the internal network needs to initiate TCP socket link establishment to the master node exposed on the public network. In this case, you need to preset the fixed access port number of the master node on the slave node. To ensure security and reduce traffic, the master node must provide at least one encrypted port and one non-encrypted port.

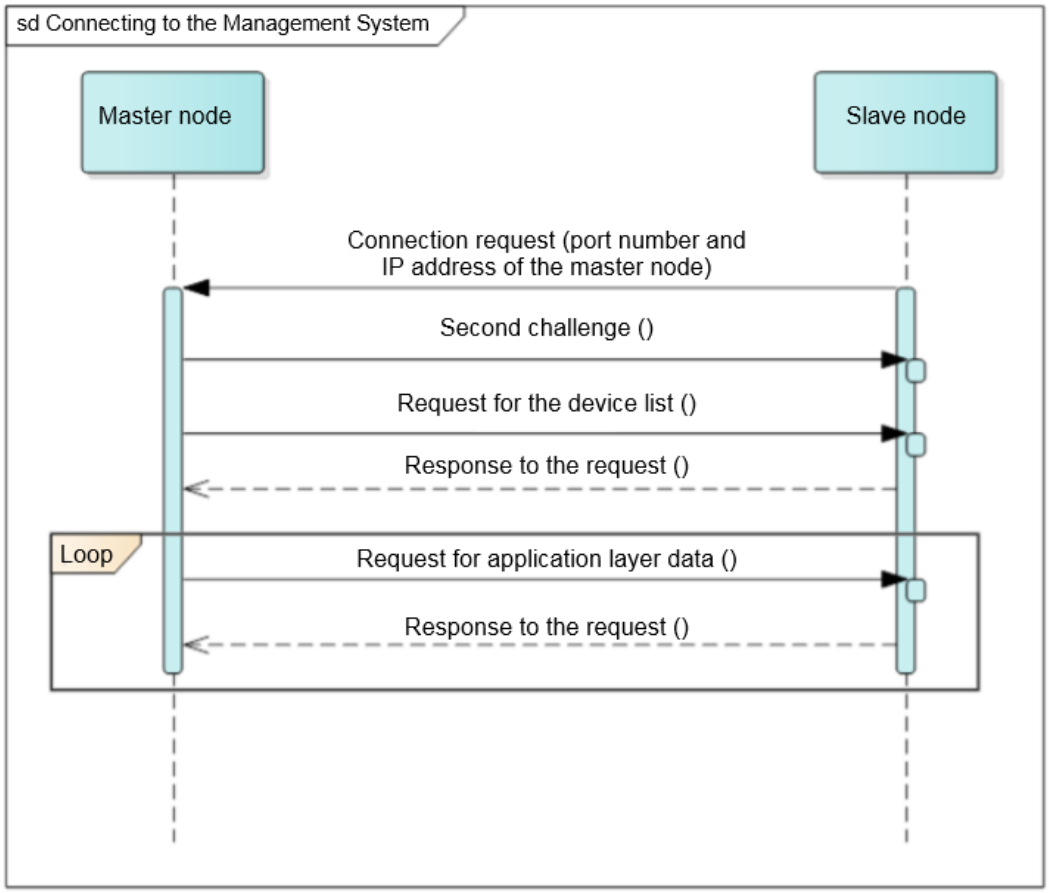
### 7.2.2.5 TCP Link Establishment Process

This section focuses on the cross-public network application.

The following figure shows the process of connecting a slave node.

**Figure 7-5** Process of establishing a secure TCP connection




# 7.3 Application Layer

## 7.3.1 Function Code List

**Table 7-3** Function code list

| Function Code | Meaning | Remarks |
| --- | --- | --- |
| 0x03 | Read registers. | Continuously reads a single register or multiple registers. |
| 0x06 | Write a single register. | Writes into a single register. |
| 0x10 | Write multiple registers. | Continuously writes into multiple registers. |

## 7.3.2 Exception Code List

The exception codes must be unique for each network element (NE) type. The names and descriptions should be provided in both the Chinese and English NE

interface document. Different versions of the same NE type must be backward compatible. Exception codes in use cannot be assigned to other exceptions.

**Table 7-4** Exception codes returned by an NE (0x00–0x8F are for common exception codes)

| Code | Name | Description |
| --- | --- | --- |
| 0x01 | Illegal function | The function code received in the query is not an allowable action for the server (or slave node). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave node) is in the wrong state to process a request of this type, for example because it is not configured and is being asked to return register values. |
| 0x02 | Illegal data address | The data address received in the query is not an allowable address for the server. More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 "Illegal Data Address" since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100. |
| 0x03 | Illegal data value | The value contained in the query data field is not an allowable value for the server (or slave). The value indicates a fault in the structure of the remainder of a complex request, such as an incorrectly implied length. It specifically does not mean that a data item submitted for storage in a register has a value outside the expectation of the application program since the Modbus protocol is unaware of the significance of any particular value of any particular register. |
| 0x04 | Slave node failure | An error occurred while the server was attempting to perform the requested action. |
| 0x06 | Slave device busy | The server cannot accept a Modbus request PDU. A client application determines whether and when to resend the request. |

| Code | Name | Description |
| --- | --- | --- |
| 0x80 | No permission | An operation is not allowed because of a permission authentication failure or permission expiration. |

## 7.3.3 Reading Registers (0x03)

### 7.3.3.1 Frame Format of a Request from a Master Node

| Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x03 |
| Register start address | 2 | 0x0000–0xFFFF |
| Number of registers | 2 | 1–125 |

### 7.3.3.2 Frame Format of a Normal Response from a Slave Node

| Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x03 |
| Number of bytes | 1 | 2 x N |
| Register value | 2 x N | N/A |

NOTE

N is the number of registers.N is the number of registers.

### 7.3.3.3 Frame Format of an Abnormal Response from a Slave Node

| Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x83 |
| Exception code | 1 | See**7.3.2 Exception Code List** . |

### 7.3.3.4 Examples

This section takes the Modbus-TCP communications frames as an example. The differences between Modbus-RTU and Modbus-TCP lie in the additional address

field and the CRC. Pay attention to the differences when using the Modbus-RTU frames. This also works for the follow-up examples.

The master node sends a query request (register address: 32306/0X7E32) to the slave node (logical device ID: 00).

| Description | | Frame Data |
| --- | --- | --- |
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |
| | | 06 |
| | Logical device ID | 00 |
| Function code | | 03 |
| Data | Register address | 7E |
| | | 32 |
| | Number of registers | 00 |
| | | 02 |

Normal response from the slave node

| Description | | Frame Data |
| --- | --- | --- |
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |
| | | 07 |
| | Logical device ID | 00 |
| Function code | | 03 |
| Data | Number of bytes | 04 |
| | Register data | 00 |
| | | 00 |

| Description | | Frame Data |
| --- | --- | --- |
| | | 00 |
| | | 01 |

Abnormal response from the slave node

| Description | | Frame data |
| --- | --- | --- |
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |
| | | 03 |
| | Logical device ID | 00 |
| Function code | | 83 |
| Data | Error code | 03 |

## 7.3.4 Writing a Single Register (0x06)

### 7.3.4.1 Frame Format of a Request from a Master Node

| Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x06 |
| Register address | 2 | 0x0000–0xFFFF |
| Register value | 2 | 0x0000–0xFFFF |

### 7.3.4.2 Frame Format of a Normal Response from a Slave Node

| Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x06 |
| Register address | 2 | 0x0000–0xFFFF |
| Register value | 2 | 0x0000–0xFFFF |

### 7.3.4.3 Frame Format of an Abnormal Response from a Slave Node

| Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x86 |
| Exception code | 1 | See7.3.2 Exception Code List . |

### 7.3.4.4 Examples

A master node sends a command (register address: 40200/0X9D08) to a slave node (address: 00).

| Description | | Frame data |
| --- | --- | --- |
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |
| | | 06 |
| | Logical device ID | 00 |
| Function code | | 06 |
| Data | Register address | 9D |
| | | 08 |
| | Register data | 00 |
| | | 00 |

Normal response from the slave node

| Description | | Frame Data |
| --- | --- | --- |
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |

| Description | | Frame Data |
|---|---|---|
| | | 06 |
| | Logical device ID | 00 |
| Function code | | 06 |
| Data | Register address | 9D |
| | | 08 |
| | Register data | 00 |
| | | 00 |

Abnormal response from the slave node

| Description | | Frame Data |
|---|---|---|
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |
| | | 03 |
| | Logical device ID | 00 |
| Function code | | 86 |
| Data | Error code | 04 |

## 7.3.5 Writing Multiple Registers (0x10)

### 7.3.5.1 Frame Format of a Request from a Master Node

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x10 |
| Register start address | 2 | 0x0000–0xFFFF |
| Number of registers | 2 | 0x0000–0x007b |
| Number of bytes | 1 | 2 x N |
| Register value | 2 x N | Value |

NOTE

N is the number of registers.N is the number of registers.

### 7.3.5.2 Frame Format of a Normal Response from a Slave Node

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x10 |
| Register address | 2 | 0x0000–0xFFFF |
| Number of registers | 2 | 0x0000–0x007b |

### 7.3.5.3 Frame Format of an Abnormal Response from a Slave Node

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x90 |
| Exception code | 1 | See 7.3.2 Exception Code List. |

### 7.3.5.4 Examples

The master node sets the register address 40118/0X9CB6 to 2 and the register address 40119/0X9CB7 to 50 for the slave node (address: 00). The request frame format is as follows.

| Description | | Frame Data |
|---|---|---|
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |
| | | 0B |
| | Logical device ID | 00 |
| Function code | | 10 |
| Data | Register address | 9C |
| | | B6 |

| Description | | Frame Data |
| --- | --- | --- |
| | Number of registers | 00 |
| | | 02 |
| | Number of bytes | 04 |
| | Register data | 00 |
| | | 02 |
| | | 00 |
| | | 32 |

Normal response from the slave node

| Description | | Frame Data |
| --- | --- | --- |
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |
| | Data length | 00 |
| | | 06 |
| | Logical device ID | 00 |
| Function code | | 10 |
| Data | Register address | 9C |
| | | B6 |
| | Number of registers | 00 |
| | | 02 |

Abnormal response from the slave node

| Description | | Frame Data |
| --- | --- | --- |
| MBAP header | Protocol identifier | 00 |
| | | 01 |
| | Protocol type | 00 |
| | | 00 |

| Description | | Frame Data |
|---|---|---|
| | Data length | 00 |
| | | 03 |
| | Logical device ID | 00 |
| Function code | | 90 |
| Data | Error code | 04 |

## 7.3.6 Reading Device Identifiers (0x2B)

This command code allows reading identifiers and added packets that are relevant to the physical and function description of the remote devices.

Simulate the interface of the read device identifier as an address space. This address space consists of a set of addressable data elements. The data elements are objects to be read, and the object IDs determine these data elements.

A data element consists of three objects:

1. Basic device identifier: All objects of this type are mandatory, such as the vendor name, product code, and revision version.
2. Normal device identifier: Except basic data objects, the device provides additional and optional identifiers and data object description. Define all types of objects according to definitions in the standard, but the execution of this type of objects is optional.
3. Extended device identifier: In addition to the normal data objects, the device provides additional and optional identifiers and special data object description. All the data is related to the device.

**Table 7-5** Reading device identifiers

| Object ID | Object Name or Description | Type | Mandatory or Optional (M/O) | Type |
|---|---|---|---|---|
| 0x00 | Manufacturer name | ASCII character string | M | Basic |
| 0x01 | Product code | ASCII character string | M | |
| 0x02 | Main revision version | ASCII character string | M | |
| 0x03–0x7F | - | - | - | Normal |

| Object ID | Object Name or Description | Type | Mandatory or Optional (M/O) | Type |
|---|---|---|---|---|
| 0x80–0xFF | - | - | - | Expansion |

### 7.3.6.1 Command for Querying Device Identifiers

**Table 7-6** Request frame format

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x2B |
| MEI type | 1 | 0x0E |
| ReadDevId code | 1 | 01 |
| Object ID | 1 | 0x00 |

**Table 7-7** Frame format for a normal response

| Data Field | | | Length (Byte) | Description |
|---|---|---|---|---|
| Function code | | | 1 | 0x2B |
| MEI type | | | 1 | 0x0E |
| ReadDevId code | | | 1 | 01 |
| Consistency level | | | 1 | 01 |
| More | | | 1 | - |
| Next object ID | | | 1 | - |
| Number of objects | | | 1 | - |
| Object list | First object | Object ID | 1 | 0x00 |
| | | Object length | 1 | N |
| | | Object value | N | - |
| | ... | ... | ... | ... |

**Table 7-8** Object list

| Object ID | Object Name or Description | Description | Type |
|---|---|---|---|
| 0x00 | Manufacturer name | HUAWEI | Basic |
| 0x01 | Product code | SUN2000 | |
| 0x02 | Main revision version | ASCII character string, software version | |

**Table 7-9** Frame format for an abnormal response

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0xAB |
| Exception code | 1 | See **7.3.2 Exception Code List**. |

### 7.3.6.2 Command for Querying a Device List

**Table 7-10** Request frame format

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x2B |
| MEI type | 1 | 0x0E |
| ReadDevId code | 1 | 03 |
| Object ID | 1 byte | 0x87 |

**Table 7-11** Frame format for a normal response

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x2B |
| MEI type | 1 | 0x0E |
| ReadDevId code | 1 | 03 |
| Consistency level | 1 | 03 |
| More | 1 | - |

| Data Field | | | Length (Byte) | Description |
|---|---|---|---|---|
| Next object ID | | | 1 | - |
| Number of objects | | | 1 | - |
| Object list | First object | Object ID | 1 | 0x87 |
| | | Object length | 1 | N |
| | | Object value | N | - |
| | ... | ... | ... | ... |

**Table 7-12** Object list

| Object ID | Object Name | Type | Description |
|---|---|---|---|
| 0x80–0x86 | Reserved | -- | Returns a null object with a length of 0. |
| 0x87 | Number of devices | int | Returns the number of devices connected to the RS485 address. |
| 0x88 | Description about the first device | ASCII character string<br>See the device description definitions. | Returns only description about the first device if a NE allows only one device to be connected to each RS485 address. |
| 0x8A | Description about the second device | - | - |
| - | - | - | - |
| 0xFF | Description about the 120th device | - | - |

### 7.3.6.3 Device Description Definition

Each device description consists of all "attribute=value" character strings.

"Attribute ID=%s;attribute ID=%s;... attribute ID=%s"

For example: "1=SUN2000MA-XXKTL;2=V100R001C00SPC100;3=P1.0-D5.0;4=123232323;5=1;6=1.1"

**Table 7-13** Attribute definition

| Attribute ID | Name | Type | Description |
|---|---|---|---|
| 1 | Device model | ASCII character string | SUN2000 |
| 2 | Device software version | ASCII character string | - |
| 3 | Port protocol version | ASCII character string | See the interface protocol version definitions. |
| 4 | ESN | ASCII character string | - |
| 5 | Device ID | int | 0, 1, 2, 3...(assigned by NEs; 0 indicates the master device into which the Modbus card is inserted) |
| 6 | Feature version | ASCII character string | - |

**Table 7-14** Frame format for an abnormal response

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0xAB |
| Exception code | 1 | See **7.3.2 Exception Code List**. |

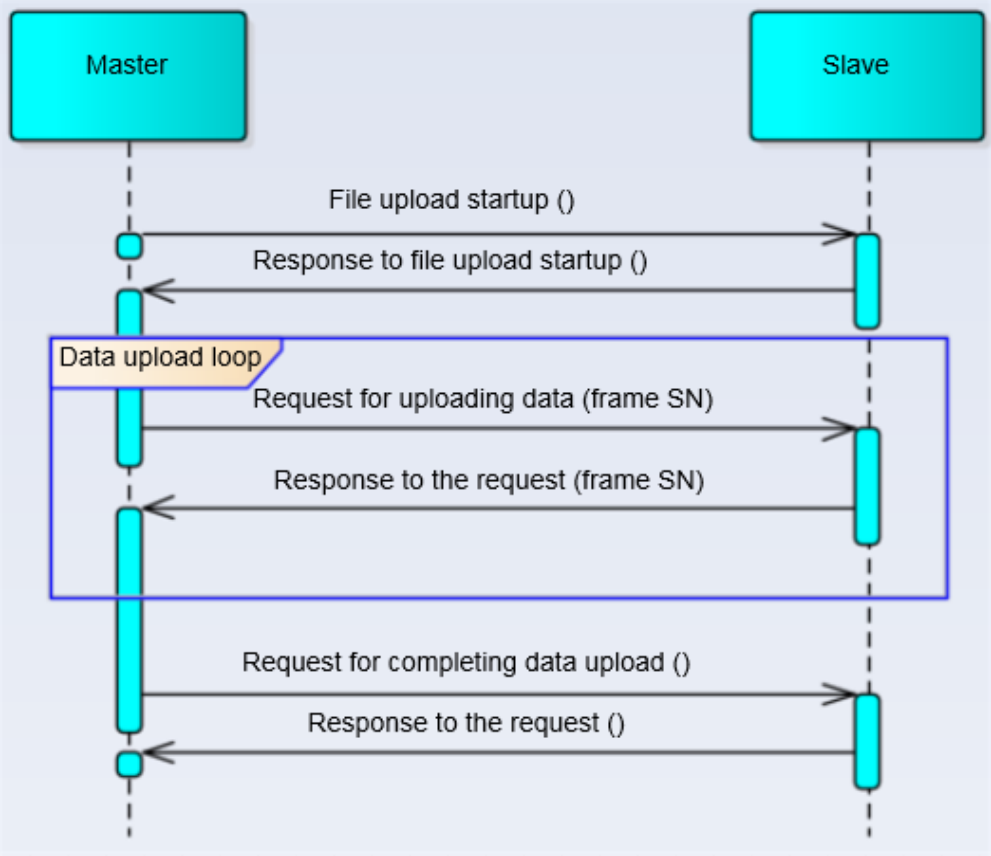
# 7.3.7 Huawei-defined Functions (0x41)

## 7.3.7.1 Uploading Files

Uploading files means uploading them by stream data from a slave node to a master node. The following figure shows the file uploading process.

**Figure 7-6** File uploading process




#### 7.3.7.1.1 Starting the Upload

Frame format of a request from a master node

**Table 7-15** PDU data field of the request frame for starting upload (0x05)

| PDU Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x41 |
| Sub-function code | 1 | 0x05 |
| Data length | 1 | 1 + N |
| File type | 1 | Unique ID of a file |
| Customized data | N | - |

**Table 7-16** PDU data field of the response frame for starting upload (0x05)

| Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x41 |
| Sub-function code | 1 | 0x05 |
| Data length | 1 | 6 + N |
| File type | 1 | Unique ID of a file |
| File length | 4 | - |
| Data frame length | 1 | - |
| Customized data | N | - |

**Table 7-17** PDU data field in the abnormal response frame of the slave node

| PDU Data Field | Length (Byte) | Description |
|---|---|---|
| Error code | 1 | 0xC1 |
| Exception code | 1 | See **7.3.2 Exception Code List**. |

NOTE

If the exception code is 0x06, resend the request after 10 seconds. A request can be resent for no more than six times.

### 7.3.7.1.2 Uploading Data

**Table 7-18** Request frame for uploading data (0x06)

| PDU Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x41 |
| Sub-function code | 1 | 0x06 |
| Data length | 1 | 3 |

| PDU Data Field | Length (Byte) | Description |
| --- | --- | --- |
| File type | 1 | Unique ID of a file |
| Frame No. | 2 | 0x0000–0xFFFF |

**Table 7-19** Response frame for uploading data (0x06)

| PDU Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x41 |
| Sub-function code | 1 | 0x06 |
| Data length | 1 | 3 + N |
| File type | 1 | - |
| Frame No. | 2 | 0x0000–0xFFFF |
| Frame data | N | - |

**Table 7-20** Abnormal response frame for uploading data

| PDU Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Error code | 1 | 0xC1 |
| Exception code | 1 | See .**7.3.2 Exception Code List** |

### 7.3.7.1.3 Completing the Data Upload

**Table 7-21** Request frame for completing the data upload

| PDU Data Field | Length (Byte) | Description |
| --- | --- | --- |
| Function code | 1 | 0x41 |
| Sub-function code | 1 | 0x0c |
| Data length | 1 | 1 |
| File type | 1 | - |

**Table 7-22** Response frame for completing the data upload

| PDU Data Field | Length (Byte) | Description |
|---|---|---|
| Function code | 1 | 0x41 |
| Sub-function code | 1 | 0x0c |
| Data length | 1 | 3 |
| File type | 1 | - |
| File CRC | 2 | - |

**Table 7-23** Abnormal response frame for completing the data upload

| Data Field | Length (Byte) | Description |
|---|---|---|
| Error code | 1 | 0xC1 |
| Exception code | 1 | See **7.3.2 Exception Code List**. |

### 7.3.7.1.4 Timeout Processing

**Table 7-24** Processing specifications of sub-process timeout

| Name | Restraints |
|---|---|
| Response timeout period for starting an upload | 10s |
| Response timeout period for uploading data | 10s |
| Number of times of resending a data upload command | 6 |
| Response timeout period for completing a data upload | 10s |