



Solar Inverter

Modbus Interface Definitions (V3.0)

Issue 02

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1 Supported Models

This chapter describes the solar inverter models that use the Modbus protocol and the earliest firmware version. When a host needs to connect to these solar inverters, ensure that the firmware version is correct.

[1.1 Model Description](#)

1.1 Model Description

Table 1-1 Supported models and firmware versions

Model	Model ID	Earliest Firm Version
SUN2000L-2KTL	305	SUN2000L V100R001C00
SUN2000-2KTL-L0	338	SUN2000L V100R001C00
SUN2000L-3KTL	304	SUN2000L V100R001C00
SUN2000L-3KTL-CN	310	SUN2000L V100R001C00
SUN2000L-3KTL-CN-4G	311	SUN2000L V100R001C00
SUN2000-3KTL-CNLO	334	SUN2000L V100R001C20
SUN2000-3KTL-L0	339	SUN2000L V100R001C00
SUN2000-3KTL-M0	410	SUN2000MA V100R001C00
SUN2000-3KTL-M1	424	SUN2000MA V100R001C00
SUN2000L-3.68KTL	303	SUN2000L V100R001C00
SUN2000-3.8KTL-USL0	318	SUN2000L V100R001C10
SUN2000-3.8KTL-USL0	319	SUN2000L V100R001C10
SUN2000L-4KTL	302	SUN2000L V100R001C00
SUN2000L-4KTL-CN	308	SUN2000L V100R001C00

Model	Model ID	Earliest Firm Version
SUN2000L-4KTL-CN-4G	309	SUN2000L V100R001C00
SUN2000-4KTL-CNLO	335	SUN2000L V100R001C20
SUN2000-4KTL-L0	340	SUN2000L V100R001C00
SUN2000-4KTL-M0	411	SUN2000MA V100R001C00
SUN2000-4KTL-M1	425	SUN2000MA V100R001C00
SUN2000L-4.125KTL-JP	331	SUN2000L V100R001C12
SUN2000L-4.6KTL	301	SUN2000L V100R001C00
SUN2000L-4.95KTL-JP	330	SUN2000L V100R001C12
SUN2000-4.95KTL-JPL0	342	SUN2000L V100R001C20
SUN2000L-5KTL	300	SUN2000L V100R001C00
SUN2000L-5KTL-CN	306	SUN2000L V100R001C00
SUN2000L-5KTL-CN-4G	307	SUN2000L V100R001C00
SUN2000-5KTL-USL0	315	SUN2000L V100R001C10
SUN2000-5KTL-USL0	316	SUN2000L V100R001C10
SUN2000-5KTL-CNLO	336	SUN2000L V100R001C20
SUN2000-5KTL-L0	341	SUN2000L V100R001C00
SUN2000-5KTL-M0	400	SUN2000MA V100R001C00
SUN2000-5KTL-M0	401	SUN2000MA V100R001C00
SUN2000-5KTL-M1	426	SUN2000MA V100R001C00
SUN2000-6KTL-CNLO	337	SUN2000L V100R001C20
SUN2000-6KTL-M0	402	SUN2000MA V100R001C00
SUN2000-6KTL-M0	403	SUN2000MA V100R001C00
SUN2000-6KTL-M1	427	SUN2000MA V100R001C00
SUN2000-7.6KTL-USL0	312	SUN2000L V100R001C10
SUN2000-7.6KTL-USL0	313	SUN2000L V100R001C10
SUN2000-8KTL-M0	404	SUN2000MA V100R001C00
SUN2000-8KTL-M0	405	SUN2000MA V100R001C00
SUN2000-8KTL	415	SUN2000MA V100R001C10
SUN2000-8KTL-M0	418	SUN2000MA V100R001C10
SUN2000-8KTL-M1	428	SUN2000MA V100R001C00

Model	Model ID	Earliest Firm Version
SUN2000-8KTL-M2	430	SUN2000MA V100R001C10
SUN2000-9KTL-USL0	324	SUN2000L V100R001C10
SUN2000-9KTL-USL0	325	SUN2000L V100R001C10
SUN2000-10KTL-USL0	332	SUN2000L V100R001C10
SUN2000-10KTL-USL0	333	SUN2000L V100R001C10
SUN2000-10KTL-M0	406	SUN2000MA V100R001C00
SUN2000-10KTL-M0	407	SUN2000MA V100R001C00
SUN2000-10KTL	416	SUN2000MA V100R001C10
SUN2000-10KTL-M0	419	SUN2000MA V100R001C10
SUN2000-10KTL-M1	429	SUN2000MA V100R001C00
SUN2000-10KTL-M2	431	SUN2000MA V100R001C10
SUN2000-11.4KTL-USL0	321	SUN2000L V100R001C10
SUN2000-11.4KTL-USL0	322	SUN2000L V100R001C10
SUN2000-12KTL-M0	408	SUN2000MA V100R001C00
SUN2000-12KTL	417	SUN2000MA V100R001C10
SUN2000-12KTL-M0	420	SUN2000MA V100R001C10
SUN2000-12KTL-M2	432	SUN2000MA V100R001C10
SUN2000-15KTL-M0	412	SUN2000MA V100R001C10
SUN2000-15KTL-M0	421	SUN2000MA V100R001C10
SUN2000-15KTL-M2	433	SUN2000MA V100R001C10
SUN2000-17KTL-M0	413	SUN2000MA V100R001C10
SUN2000-17KTL-M0	422	SUN2000MA V100R001C10
SUN2000-17KTL-M2	434	SUN2000MA V100R001C10
SUN2000-20KTL-M0	414	SUN2000MA V100R001C10
SUN2000-20KTL-M0	423	SUN2000MA V100R001C10
SUN2000-20KTL-M2	435	SUN2000MA V100R001C10
SUN2000-50KTL-JPM1	59	SUN2000 V300R001C00
SUN2000-50KTL-M0	50	SUN2000 V300R001C00
SUN2000-50KTL-JPM0	53	SUN2000 V300R001C00
SUN2000-60KTL-M0	55	SUN2000 V300R001C00

Model	Model ID	Earliest Firm Version
SUN2000-63KTL-JPM0	51	SUN2000 V300R001C00
SUN2000-63KTL-JPH0	76	SUN2000HA V200R001C00
SUN2000-65KTL-M0	46	SUN2000 V300R001C00
SUN2000-70KTL-INM0	48	SUN2000 V300R001C00
SUN2000-70KTL-C1	45	SUN2000 V300R001C00
SUN2000-75KTL-C1	56	SUN2000 V300R001C00
SUN2000-90KTL-H1	73	SUN2000HA V200R001C00
SUN2000-95KTL-INH0	74	SUN2000HA V200R001C00
SUN2000-90KTL-H0	75	SUN2000HA V200R001C00
SUN2000-90KTL-H2	81	SUN2000HA V200R001C00
SUN2000-95KTL-INH1	82	SUN2000HA V200R001C00
SUN2000-100KTL-USH0	70	SUN2000HA V200R001C00
SUN2000-100KTL-H1	71	SUN2000HA V200R001C00
SUN2000-100KTL-H0	72	SUN2000HA V200R001C00
SUN2000-100KTL-H2	78	SUN2000HA V200R001C00
SUN2000-100KTL-M0	141	SUN2000 V500R001C00
SUN2000-100KTL-M1	142	SUN2000 V500R001C00
SUN2000-100KTL-INM0	143	SUN2000 V500R001C00
SUN2000-105KTL-H1	79	SUN2000HA V200R001C00
SUN2000-110KTL-M0	144	SUN2000 V500R001C00
SUN2000-125KTL-M0	145	SUN2000 V500R001C00
SUN2000-168KTL-H1	103	SUN2000HA V300R001C00
SUN2000-185KTL-INH0	102	SUN2000HA V300R001C00
SUN2000-175KTL-H0	101	SUN2000HA V300R001C00
SUN2000-185KTL-H1	104	SUN2000HA V300R001C00
SUN2000-193KTL-H0	105	SUN2000HA V300R001C00

 **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.

2 Overview

Modbus is a widely used protocol for device communications. This document describes the Modbus protocol used by Huawei solar inverters, and can be used to regulate follow-up third-party integrated development. Huawei solar inverters comply with the standard Modbus protocol, and this document focuses on the information specific to Huawei solar inverters. For other information about Modbus, see the standard documents about the Modbus protocol. For details about the standard protocols used by Huawei solar inverters and customized interaction modes and examples, see chapter [6 Overview of the Communications Protocol](#).

[2.1 Terms and Abbreviations](#)

2.1 Terms and Abbreviations

Table 2-1 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

Name	Description
MLD	Multiple bytes
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

3 Register Definitions

Table 3-1 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 1.1 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 1.1 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	Bitfield 16	N/A	1	32000	1	Bit 0: standby Bit 1: grid-connected Bit 2: grid-connected normally Bit 3: grid connection with derating due to power rationing Bit 4: grid connection with derating due to internal causes of the solar inverter Bit 5: normal stop Bit 6: stop due to faults Bit 7: stop due to power rationing Bit 8: shutdown Bit 9: spot check
13	State 2	RO	Bitfield 16	N/A	1	32002	1	Bit 0: locking status (0: locked; 1: unlocked) Bit 1: PV connection status (0: disconnected; 1: connected) Bit 2: DSP data collection (0: no; 1: yes)

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
14	State 3	RO	Bitfield 32	N/A	1	32003	2	Bit 0: off-grid (0: on-grid; 1: off-grid) Bit 1: off-grid switch (0: disable; 1: enable)
15	Alarm 1	RO	Bitfield 16	N/A	1	32008	1	For details, see 5.1 Alarm Information .
16	Alarm 2	RO	Bitfield 16	N/A	1	32009	1	For details, see 5.1 Alarm Information .
17	Alarm 3	RO	Bitfield 16	N/A	1	32010	1	For details, see 5.1 Alarm Information .
18	PV1 voltage	RO	I16	V	10	32016	1	A maximum of 24 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: PV n voltage: 32014 + 2 n PV n current: 32015 + 2 n n indicates the PV string number, which ranges from 1 to 24.
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	Input power	RO	I32	kW	1000	32064	2	N/A
27	Power grid voltage/Line voltage between phases A and B	RO	U16	V	10	32066	1	When the output mode is L/N, L1/L2/N, or L1/L2, Power grid voltage is used.

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
28	Line voltage between phases B and C	RO	U16	V	10	32067	1	When the output mode is L/N, L1/L2/N, or L1/L2, the information is invalid.
29	Line voltage between phases C and A	RO	U16	V	10	32068	1	When the output mode is L/N, L1/L2/N, or L1/L2, the information is invalid.
30	Phase A voltage	RO	U16	V	10	32069	1	When the output mode is L/N, L1/L2/N, or L1/L2, the information is invalid.
31	Phase B voltage	RO	U16	V	10	32070	1	When the output mode is L/N, L1/L2/N, or L1/L2, the information is invalid.
32	Phase C voltage	RO	U16	V	10	32071	1	When the output mode is L/N, L1/L2/N, or L1/L2, the information is invalid.
33	Power grid current/ Phase A current	RO	I32	A	1000	32072	2	When the output mode is L/N, L1/L2/N, or L1/L2, Power grid current is used.
34	Phase B current	RO	I32	A	1000	32074	2	When the output mode is L/N, L1/L2/N, or L1/L2, the information is invalid.
35	Phase C current	RO	I32	A	1000	32076	2	When the output mode is L/N, L1/L2/N, or L1/L2, the information is invalid.
36	Peak active power of current day	RO	I32	kW	1000	32078	2	N/A
37	Active power	RO	I32	kW	1000	32080	2	N/A
38	Reactive power	RO	I32	kVar	1000	32082	2	N/A

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
39	Power factor	RO	I16	N/A	1000	32084	1	N/A
40	Grid frequency	RO	U16	Hz	100	32085	1	N/A
41	Efficiency	RO	U16	%	100	32086	1	N/A
42	Internal temperature	RO	I16	°C	10	32087	1	N/A
43	Insulation resistance	RO	U16	MΩ	1000	32088	1	N/A

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

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
								0x0308 Shutdown: input underpower 0x0401 Grid scheduling: $\cos\phi$ -P curve 0x0402 Grid scheduling: Q-U curve 0x0403 Grid scheduling: PF-U curve 0x0404 Grid scheduling: dry contact 0x0405 Grid scheduling: Q-P curve 0x0500 Spot-check ready 0x0501 Spot-checking 0x0600 Inspecting 0x0700 AFCI self check 0x0800 I-V scanning 0x0900 DC input detection 0x0A00 Running: off-grid charging 0xA000 Standby: no irradiation
45	Fault code	RO	U16	N/A	1	32090	1	N/A
46	Startup time	RO	U32	N/A	1	32091	2	Epoch seconds, local time
47	Shutdown time	RO	U32	N/A	1	32093	2	Epoch seconds, local time
48	Accumulated energy yield	RO	U32	kWh	100	32106	2	N/A
49	Daily energy yield	RO	U32	kWh	100	32114	2	N/A

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
50	[Active] Adjustment mode	RO	U16	N/A	1	35300	1	0: percentage 1: fixed value NOTE Addresses 35300 to 35303 need to be read at a time.
51	[Active] Adjustment value	RO	U32	N/A	*	35302	2	Percentage: 0.1% Fixed value: 0.001 kW Note: For details about the adjustment value precision, see the corresponding adjustment command precision.
52	[Active] Adjustment command	RO	U16	N/A	1	35303	1	40125: active power derating by percentage (0.1%) 40120: active power derating by fixed value 40126: active power derating by fixed value (W) 42178: maximum active power

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

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
56	[Energy storage unit 1] Running status*	RO	U16	N/A	1	37000	1	0: offline 1: standby 2: running 3: fault 4: sleep mode
57	[Energy storage unit 1] Charge and discharge power*	RO	I32	W	1	37001	2	> 0: charging < 0: discharging
58	[Energy storage unit 1] Current-day charge capacity*	RO	U32	kWh	100	37015	2	N/A
59	[Energy storage unit 1] Current-day discharge capacity*	RO	U32	kWh	100	37017	2	N/A
60	[Power meter collection] Active power*	RO	I32	W	1	37113	2	> 0: feeding power to the power grid < 0: obtaining power from the power grid
61	[Optimizer] Total number of optimizers*	RO	U16	N/A	1	37200	1	N/A
62	[Optimizer] Number of online optimizers*	RO	U16	N/A	1	37201	1	N/A
63	[Optimizer] Feature data*	RO	U16	N/A	1	37202	1	N/A

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
64	System time	RW	U32	N/A	1	40000	2	[946684800, 3155759999] Epoch seconds, local time
65	[Power grid scheduling] Q-U characteristic curve mode*	RW	U16	N/A	1	40037	1	0: non-hysteresis 1: hysteresis
66	[Power grid scheduling] Q-U dispatch trigger power (%)*	RW	U16	%	1	40038	1	[0, 100]
67	[Power grid scheduling] Fixed active power derated	RW	U16	kW	10	40120	1	Scope: [0, P _{max}]
68	[Power grid scheduling] Reactive power compensation (PF)	RW	I16	N/A	1000	40122	1	(-1, -0.8]U[0.8, 1]
69	[Power grid scheduling] Reactive power compensation (Q/S)	RW	I16	N/A	1000	40123	1	[-1, 1] The device converts the value to a fixed value of Q for reactive power control. S indicates S _{max} .
70	[Power grid scheduling] Active power percentage derating (0.1%)	RW	U16	%	10	40125	1	Scope: [0, 100] Interface for fine adjustment of active power
71	[Power grid scheduling] Fixed active power derated (W)	RW	U32	W	1	40126	2	Scope: [0, P _{max}]

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
72	[Power grid scheduling] Reactive power compensation at night (kVar)	RW	I32	kVar	1000	40129	2	$[-Q_{\max}, Q_{\max}]$
73	[Power grid scheduling] $\cos\phi$ -P/P _n characteristic curve	RW	MLD	N/A	1	40133	21	For details, see 5.2 Power Grid Scheduling .
74	[Power grid scheduling] Q-U characteristic curve	RW	MLD	N/A	1	40154	21	For details, see 5.2 Power Grid Scheduling .
75	[Power grid scheduling] PF-U characteristic curve	RW	MLD	N/A	1	40175	21	For details, see 5.2 Power Grid Scheduling .
76	[Power grid scheduling] Reactive power adjustment time	RW	U16	s	1	40196	1	[1, 120]. The default value is 10.
77	[Power grid scheduling] Q-U power percentage to exit scheduling*	RW	U16	%	1	40198	1	[0, 100]
78	Startup	WO	U16	N/A	1	40200	1	N/A
79	Shutdown	WO	U16	N/A	1	40201	1	N/A
80	Grid code	RW	U16	NA	1	42000	1	For details, see 5.3 Grid Codes .

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
81	[Power grid scheduling] Reactive power change gradient	RW	U32	%/s	1000	42015	2	[0.1, 1000]
82	[Power grid scheduling] Active power change gradient	RW	U32	%/s	1000	42017	2	[0.1, 1000]
83	[Power grid scheduling] Schedule instruction valid duration	RW	U32	s	1	42019	2	[0, 86400] The value 0 indicates that the command is valid permanently.
84	Time zone	RW	I16	min	1	43006	1	[-720, 840]
85	[Energy storage unit] Working mode*	RW	U16	N/A	1	47004	1	0: unlimited 1: grid connection with zero power 2: grid connection with limited power
86	[Energy storage unit] Time-of-use electricity price*	RW	U16	N/A	1	47027	1	0: disable 1: enable
87	[Energy storage unit] Time-of-use electricity price periods*	RW	MLD	N/A	1	47028	41	For details, see 5.4 Energy Storage Specifications .
88	[Energy storage unit] LCOE*	RW	U32	N/A	1000	47069	2	N/A

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
89	[Energy storage unit] Maximum charging power*	RW	U32	W	1	47075	2	[0, Upper threshold] Default value: 3500
90	[Energy storage unit] Maximum discharging power*	RW	U32	W	1	47077	2	[0, Upper threshold] Default value: 3500
91	[Energy storage unit] Power limit of the grid-tied point*	RW	I32	W	1	47079	2	[0, P _{max}] Default value: P _{max}
92	[Energy storage unit] Charging cutoff capacity*	RW	U16	%	10	47081	1	[90, 100] Default value: 100
93	[Energy storage unit] Discharge cutoff capacity*	RW	U16	%	10	47082	1	[12, 20] Default value: 15
94	[Energy storage unit] Forced charging and discharging period*	RW	U16	min	1	47083	1	[0, 1440] The value is not stored.
95	[Energy storage unit] Forced charging and discharging power*	RW	I32	W	1	47084	2	[-Max discharging power, Max charging power] Forced charging and discharging power ≤ Maximum charging and discharging power ≤ Rated charging and discharging power The value is not stored.

No.	Signal Name	Read/Write	Type	Unit	Gain	Address	Quantity	Scope
96	[Energy storage unit] Fixed charging and discharging periods*	RW	MLD	N/A	1	47200	41	For details, see 5.4 Energy Storage Specifications .

NOTICE

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

4 Customized Interfaces

4.1 Obtaining the System Information of Optimizers

4.2 Obtaining Real-time Data of Optimizers

4.1 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 [6.3.7.1 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 4-1 Record format

Data	Length (Byte)	Remarks
Format version	4	V101
SN	2	-
Length	2	-
Reserved	4	-
Number of optimizers	2	n , including the offline optimizers
Feature data of optimizer 1	78	-
Feature data of optimizer 2	78	-
...	...	-

Data	Length (Byte)	Remarks
Feature data of optimizer <i>n</i>	78	-

Table 4-2 Feature data format (V101)

Data	Length (Byte)	Remarks
Optimizer address	2	Logical communication address
Status	2	0: offline 1: online
String number	2	-
Relative position of the PV string	2	1: near DC wiring terminals of the solar inverters
SN	20	-
Software version	30	-
Alias	20	-

4.2 Obtaining Real-time Data of Optimizers

Data synchronization mechanism: five-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 [6.3.7.1 Uploading Files](#).

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

File type: 0x44

Table 4-3 Record format

Data	Length (Byte)	Remarks
File version	4	V101
Reserved	8	-
Optimizer data unit 1	N	12 + 26 x Number of optimizers
Optimizer data unit 2	N	-

Data	Length (Byte)	Remarks
...	-	-
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 4-4 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	-
Real-time data of optimizer 2	26	-
...	-	-
Real-time data of optimizer n	26	n is the number of optimizers.

Table 4-5 Real-time data format

Data	Length (Byte)	Remarks
Optimizer address	2	Logical communication address
Output power	2	Gain: 10 Unit: W
Voltage to ground	2	Gain: 10 Unit: V

Data	Length (Byte)	Remarks
Alarm	4	Bit 00: abnormal PV module: input overvoltage Bit 01: abnormal PV module: input undervoltage Bit 02: abnormal PV module: output overvoltage Bit 04: overtemperature alarm: overtemperature Bit 06: short circuit alarm: output short circuit Bit 07: abnormal device: EEPROM fault Bit 08: abnormal device: internal hardware fault Bit 09: abnormal device: abnormal voltage to ground Bit 10: abnormal communication: shutdown due to heartbeat timeout
Output voltage	2	Gain: 10 Unit: V
Output current	2	Gain: 100 Unit: A
Input voltage	2	Gain: 10 Unit: V
Input current	2	Gain: 100 Unit: A
Temperature	2	Gain: 10 Unit: °C
Running status	2	0: offline 1: standby 2: locking 3: faulty 4: running 5: pass-through 6: inspecting 7: escaping 8: current limiting 9: secure

Data	Length (Byte)	Remarks
Accumulated energy yield	4	Gain: 1000 Unit: kWh

5 Interface Instructions

- [5.1 Alarm Information](#)
- [5.2 Power Grid Scheduling](#)
- [5.3 Grid Codes](#)
- [5.4 Energy Storage Specifications](#)

5.1 Alarm Information

Table 5-1 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

No.	Alarm	Bit	Alarm Name	Alarm ID	Level
9	Alarm 1	8	Grid Undervoltage	2033	Major
10	Alarm 1	9	Grid Overvoltage	2034	Major
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

No.	Alarm	Bit	Alarm Name	Alarm ID	Level
27	Alarm 2	10	Active Islanding	2070	Major
28	Alarm 2	11	Passive Islanding	2071	Major
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

NOTICE

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

[1] AFCI functional unit

[2] Power collector or power meter connected to the solar inverters

[3] Detection of the external ports of the solar inverters that provide the 12 V power supply

[4] This item can be detected when a built-in or external on-grid/off-grid functional unit is configured.

[5] This item can be detected when optimizers are configured on the DC side.

[6] This item can be detected when the solar inverters are configured with PID functional units.

[7] This item can be detected when energy storage units (ESUs) are configured.

[8] Some models have DC protection units.

5.2 Power Grid Scheduling

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

5.2.1 $\cos\phi$ -P/P_n Characteristic Curve

Table 5-2 $\cos\phi$ -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]
$\cos\phi$ 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]
$\cos\phi$ 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]
$\cos\phi$ 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]
$\cos\phi$ 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]
$\cos\phi$ value at point 5	I16	1000	N/A	(-1, -0.8]U[0.8, 1]

Description	Data Type	Gain	Unit	Value Range
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]

5.2.2 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]
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]

Description	Data Type	Gain	Unit	Value Range
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.

5.2.3 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]
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]

Description	Data Type	Gain	Unit	Value Range
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]

5.3 Grid Codes

Table 5-3 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
10	G59-Scotland	UK
11	G83-England	UK
12	G83-Scotland	UK

No.	Standard	Applicable Country or Region
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
39	EN50438-TR-MV480	Turkey
40	EN50438-TR	Turkey
41	C11/C10-MV480	Belgium

No.	Standard	Applicable Country or Region
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
66	Japan standard (MV440-50 Hz)	Japan
67	Japan standard (MV440-60 Hz)	Japan

No.	Standard	Applicable Country or Region
68	IEC61727-50Hz-MV500	General
70	CEIO-16-MV480	Italy
71	PO12.3	Spain
72	Japan standard (MV400-50 Hz)	Japan
73	Japan standard (MV400-60 Hz)	Japan
74	CEIO-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
92	ABNT NBR 16149	Brazil
93	ABNT NBR 16149-MV480	Brazil
94	SA_RPPs	South Africa

No.	Standard	Applicable Country or Region
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
120	Custom MV600-50 Hz	Custom
121	AS4777-MV800	Australia
122	INDIA-MV800	India

No.	Standard	Applicable Country or Region
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	CEIO-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
148	Pakistan-MV800	Pakistan
149	BRASIL-ANEEL-MV800	Brazil
150	Israel-MV800	Israel

No.	Standard	Applicable Country or Region
151	CEIO-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
176	Israel	Israel
177	Israel-MV480	Israel
178	Chile-PMGD	Chile

No.	Standard	Applicable Country or Region
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
204	TAIPOWER-MV480	Taiwan
205	TAIPOWER-MV800	Taiwan
206	IEEE 1547-LV208	USA

No.	Standard	Applicable Country or Region
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
232	Chile-Net_Billing	Chile
233	EN50438-NL-MV480	Netherlands
234	Bahrain	Bahrain

No.	Standard	Applicable Country or Region
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
263	G99-TYPEC-HV-MV800	UK
264	G99-TYPED-MV800	UK
265	G99-TYPEA-HV	UK

No.	Standard	Applicable Country or Region
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	North Macedonia
273	NTS	Spain
274	NTS-MV480	Spain
275	NTS-MV800	Spain

NOTICE

Set the grid code based on local laws and regulations.

5.4 Energy Storage Specifications

Table 5-4 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.
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.

Description	Data Type	Gain	Unit	Value Range
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 5-5 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]

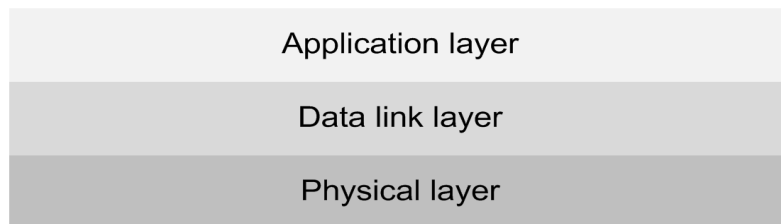
Description	Data Type	Gain	Unit	Value Range
Start time of period 1	U16	1	min	[0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should be earlier than the end time.
End time of period 1	U16	1	min	[0, 1440]. The value is the elapsed minutes since 00:00 a.m. The start time should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

6 Overview of the Communications Protocol

The Modbus communications protocol consists of the following layers.

Figure 6-1 Modbus protocol layers



[6.1 Physical Layer](#)

[6.2 Data Link Layer](#)

[6.3 Application Layer](#)

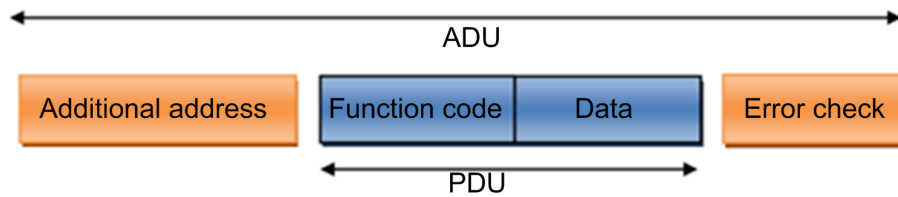
6.1 Physical Layer

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.

6.2 Data Link Layer

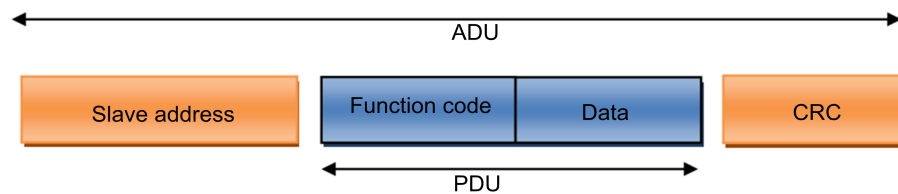
The following figure shows the generic frame structure of the Modbus protocol.

Figure 6-2 Modbus generic frame format



6.2.1 Modbus-RTU

Figure 6-3 Modbus-RTU frame format



6.2.1.1 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

6.2.1.2 Communications Address

As shown in the figure below, 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:

Figure 6-4 Modbus generic frame format

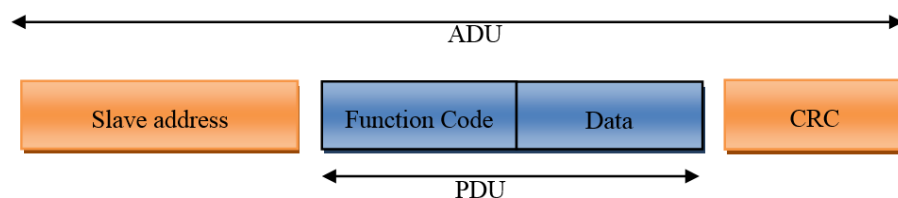
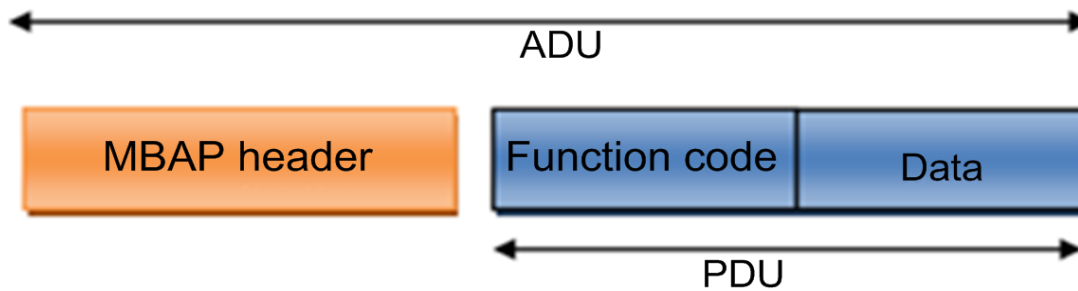


Table 6-1 Serial link address allocation

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

6.2.2 Modbus-TCP

Figure 6-5 Modbus-TCP frame format



6.2.2.1 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.

6.2.2.2 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 6-2 MBAP definition

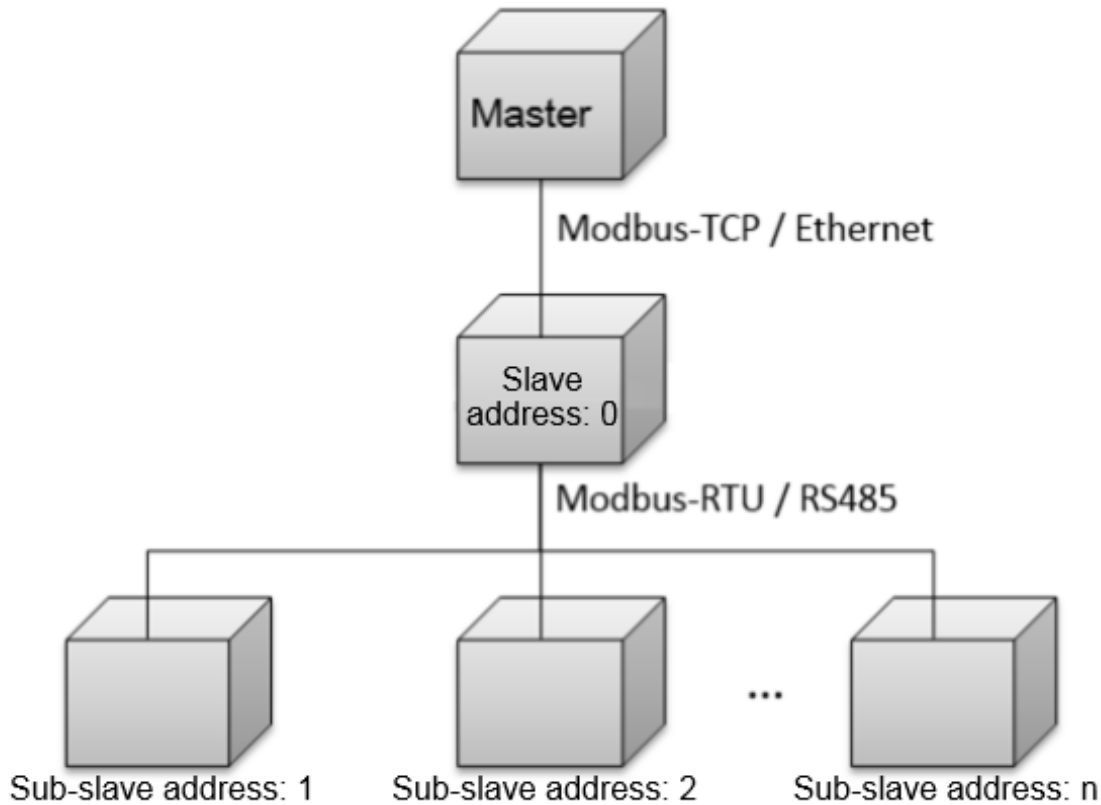
Data Field	Length (Byte)	Description	Client	Server
Transmission identifier	2	Matching identifier between a request frame and a response frame	Assigned by the client; better be unique for each data frame	The identifier of the response frame from the server must be consistent with that of the request frame.

Data Field	Length (Byte)	Description	Client	Server
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.

6.2.2.3 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 6-6 Communications address of the three-layer object structure



6.2.2.4 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.

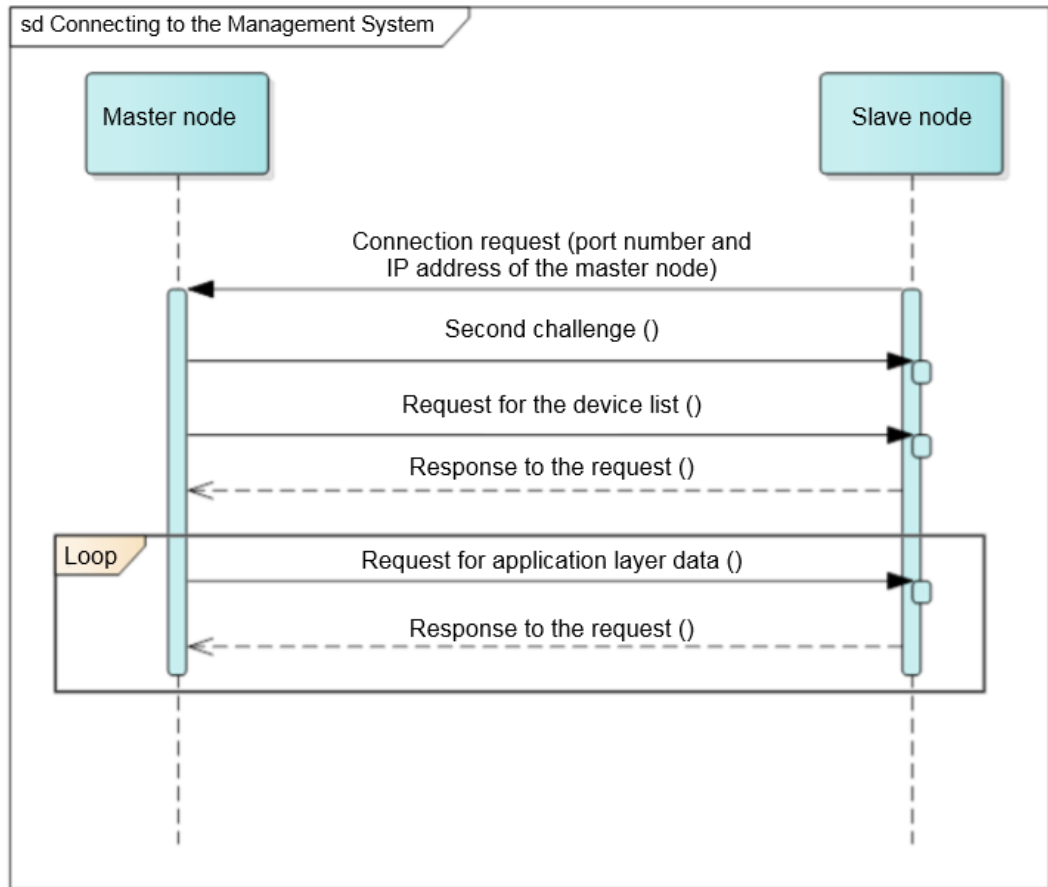
In a non-VPN environment across the public network, the device deployed on the internal network needs to initiate TCP socket link establishment to the master node exposed on the public network. In this case, you need to preset the fixed access port number of the master node on the slave node. To ensure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

6.2.2.5 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 6-7 Process of establishing a secure TCP connection



6.3 Application Layer

6.3.1 Function Code List

Table 6-3 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.

6.3.2 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 6-4 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.

Code	Name	Description
0x06	Slave device busy	The server cannot accept a Modbus request PDU. A client application determines whether and when to resend the request.
0x80	No permission	An operation is not allowed because of a permission authentication failure or permission expiration.

6.3.3 Reading Registers (0x03)

6.3.3.1 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

6.3.3.2 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 refers to the number of registers.

6.3.3.3 Frame Format of an Abnormal Response from a Slave Node

Data Field	Length (Byte)	Description
Function code	1	0x83
Exception code	1	See 6.3.2 Exception Code List .

6.3.3.4 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

Description		Frame Data
	Register data	00
		00
		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	
Data	Error code	03

6.3.4 Writing a Single Register (0x06)

6.3.4.1 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

6.3.4.2 Frame Format of a Normal Response from a Slave Node

Data Field	Length (Byte)	Description
Function code	1	0x06

Data Field	Length (Byte)	Description
Register address	2	0x0000–0xFFFF
Register value	2	0x0000–0xFFFF

6.3.4.3 Frame Format of an Abnormal Response from a Slave Node

Data Field	Length (Byte)	Description
Function code	1	0x86
Exception code	1	See 6.3.2 Exception Code List .

6.3.4.4 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

Description		Frame Data
		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

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

6.3.5 Writing Multiple Registers (0x10)

6.3.5.1 Frame Format of a Request from a Master Node

Data Field	Length (Byte)	Description
Function code	1	0x10

Data Field	Length (Byte)	Description
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 refers to the number of registers.

6.3.5.2 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

6.3.5.3 Frame Format of an Abnormal Response from a Slave Node

Data Field	Length (Byte)	Description
Function code	1	0x90
Exception code	1	See 6.3.2 Exception Code List .

6.3.5.4 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	

Description		Frame Data
		0B
	Logical device ID	00
Function code		10
Data	Register address	9C
		B6
	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
	Data length	00
		03
Logical device ID	00	
Function code		90
Data	Error code	04

6.3.6 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 6-5 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	

Object ID	Object Name or Description	Type	Mandatory or Optional (M/O)	Type
0x02	Main revision version	ASCII character string	M	
0x03–0x7F	-	-	-	Normal
0x80–0xFF	-	-	-	Expansion

6.3.6.1 Command for Querying Device Identifiers

Table 6-6 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 6-7 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 6-8 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 6-9 Frame format for an abnormal response

Data Field	Length (Byte)	Description
Function code	1	0xAB
Exception code	1	See 6.3.2 Exception Code List .

6.3.6.2 Command for Querying a Device List

Table 6-10 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 6-11 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 6-12 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 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	-	-

6.3.6.3 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 6-13 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 6-14 Frame format for an abnormal response

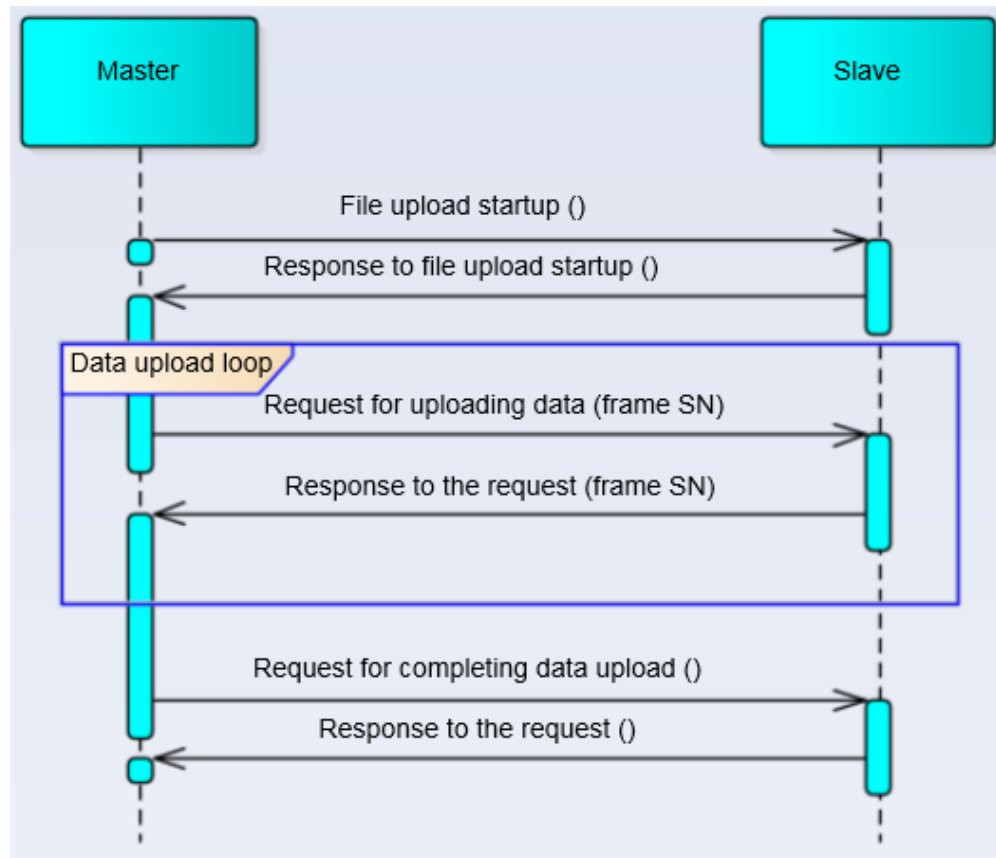
Data Field	Length (Byte)	Description
Function code	1	0xAB
Exception code	1	See 6.3.2 Exception Code List .

6.3.7 Huawei-defined Functions (0x41)

6.3.7.1 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 6-8 File uploading process



6.3.7.1.1 Starting the Upload

Frame format of a request from a master node

Table 6-15 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 6-16 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 6-17 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 6.3.2 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.

6.3.7.1.2 Uploading Data

Table 6-18 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 6-19 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 6-20 Abnormal response frame for uploading data

PDU Data Field	Length (Byte)	Description
Error code	1	0xC1
Exception code	1	See 6.3.2 Exception Code List .

6.3.7.1.3 Completing the Data Upload

Table 6-21 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 6-22 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 6-23 Abnormal response frame for completing the data upload

Data Field	Length (Byte)	Description
Error code	1	0xC1
Exception code	1	See 6.3.2 Exception Code List .

6.3.7.1.4 Timeout Processing

Table 6-24 Processing specifications of sub-process timeout

Name	Restrains
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