SmartKits
V100R023C00SPC310

Modbus Interface Definitions

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Contents

1 About This Document

Purpose

This document describes the definitions of the STS Modbus interface.

Change History

Version	Date	Description
09	2024-04-16	1. This issue is the fourth official release. 2. Alarms related to the medium-voltage cable temperature are added.
08	2024-03-20	1.The issue is the third official release. 2.The PSU alarm and parameter display in the medium-voltage room are deleted. 3.Modify the current detection threshold for the current detection loop fault.
07	2024-02-08	1. A protection alarm is added for the medium-voltage relay protection. 2. Modify the logic of overfrequency and underfrequency alarms and overfrequency and underfrequency tripping to independent control. 3. Parameters related to the open STS solar-only box model adapting to the energy storage and power distribution. 4. Modify the remote/local switch-on/off logic.
06	2023-11-15	The issue is the second official release.
05	2023-10-12	Supporting Japanese box transformer
04	2023-08-11	Fixed the UPS signal display and alarm scheme, changed the transformer zero-sequence overvoltage action bit and transformer differential protection action bit, and updated the display scheme of different relay protection models.

Version	Date	Description
03	2023-06-06	1. Fixed zero drift and other issues. 2. Changed the software version number. 3. Solve the problem that the keeper cannot be started after being damaged.
02	2023-04-23	Fixed an issue where the alarm is incorrectly reported.
01	2023-01-31	The issue is the first official release.

2 Introduction

The Modbus protocol is a widely used industrial communications protocol. It is a common language for electrical communications terminals. Through this protocol, a transformer station can communicate with other devices. The protocol has become a universal industry standard. With the protocol, transformer stations can be connected to devices from different vendors to form an industrial network for centralized monitoring. The protocol describes how master and slave nodes are defined, the processes in which the master node accesses other devices using various requests, how a slave node responds to requests from other devices, and how both parties involved in a communications process detect and record errors. It also specifies the message field formats and detailed data content.

With the continuous expansion of Huawei inverter business, more and more devices use the Modbus protocol for communication. This document describes the Modbus protocol of a transformer station to standardize and restrict subsequent third-party integration development and customization.

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	Recorded in two bytes.

Name	Description
Epoch seconds	Number of seconds since 1970-01-01 00:00:00
U16	Unsigned integer (16 bits)
U32	Unsigned integer (32 bits)
I16	Signed integer (16 bits)
I32	Signed integer (32 bits)
STR	String
N/A	Not applicable
STS	Smart Transformer Station

2.2 System Requirements

Applicable models:

JUPITER-9000K-H0

JUPITER-3000K-H1(No low-voltage cabinet B)

JUPITER-6000K-H1

JUPITER-9000K-H1

JUPITER_3000K_H1_AC(No low-voltage cabinet B)

JUPITER_6000K_H1_AC

JUPITER_3000K_H1_GF(No low-voltage cabinet B)

JUPITER_4000K_H1

3 Register Definitions

3.1 Signal Definitions

3.1.1 Definition of Teleindication Registers

Table 3-1 Teleindication information (function code: 0x03)

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
1	Heavy transformer gas	RO	0	0	Teleindication 1	
2	Light transformer gas	RO	0	1	Teleindication 1	
3	Transformer pressure relief valve action	RO	0	2	Teleindication 1	
4	Transformer oil level low	RO	0	3	Teleindication 1	
5	Transformer oil level high	RO	0	4	Teleindication 1	
6	Transformer oil temperature high	RO	0	5	Teleindication 1	
7	Transformer oil temperature ultra high	RO	0	6	Teleindication 1	
8	Transformer winding temperature high	RO	0	7	Teleindication 1	
9	ACB switch-on in low-voltage cabinet A	RO	0	8	Teleindication 1	
10	ACB switch-off in low-voltage cabinet A	RO	0	9	Teleindication 1	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
11	Fault-induced ACB tripping in low-voltage cabinet A	RO	0	10	Teleindication 1	
12	Remote operation of ACB in low-voltage cabinet A	RO	0	11	Teleindication 1	
13	ACB switch-on in low-voltage cabinet B	RO	0	12	Teleindication 1	
14	ACB switch-off in low-voltage cabinet B	RO	0	13	Teleindication 1	
15	Fault-induced ACB tripping in low-voltage cabinet B	RO	0	14	Teleindication 1	
16	Remote operation of ACB in low-voltage cabinet B	RO	0	15	Teleindication 1	
17	Low-voltage room end door opening	RO	1	0	Teleindication 2	
18	Cooling system fault in low-voltage cabinet A	RO	1	1	Teleindication 2	
19	Cooling system fault in low-voltage cabinet B	RO	1	2	Teleindication 2	
20	N/A	RO	1	3	Teleindication 2	
21	Circuit breaker switch-on in transformer cabinet G2	RO	1	4	Teleindication 2	
22	Circuit breaker switch-off in transformer cabinet G2	RO	1	5	Teleindication 2	
23	Disconnector switch-on in transformer cabinet G2	RO	1	6	Teleindication 2	
24	Disconnector switch-off in transformer cabinet G2	RO	1	7	Teleindication 2	
25	Earthing switch switch-on in transformer cabinet G2	RO	1	8	Teleindication 2	
26	Earthing switch switch-off in transformer cabinet G2	RO	1	9	Teleindication 2	
27	Unloaded state of disconnector spring in transformer cabinet G2	RO	1	10	Teleindication 2	
28	Remote operation of disconnector in transformer cabinet G2	RO	1	11	Teleindication 2	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
29	Circuit breaker switch-off failure in transformer cabinet G2	RO	1	12	Teleindication 2	
30	Switch-on of load switch of ring main unit/incoming line cabinet G1	RO	1	13	Teleindication 2	
31	Switch-off of load switch of ring main unit/incoming line cabinet G1	RO	1	14	Teleindication 2	
32	Switch-on of earthing switch of ring main unit/ incoming line cabinet G1	RO	1	15	Teleindication 2	
33	Switch-off of earthing switch of ring main unit/ incoming line cabinet G1	RO	2	0	Teleindication 3	
34	Switch-on of load switch of ring main unit/outgoing line cabinet G3	RO	2	1	Teleindication 3	
35	Switch-off of load switch of ring main unit/outgoing line cabinet G3	RO	2	2	Teleindication 3	
36	Switch-on of earthing switch of ring main unit/ outgoing line cabinet G3	RO	2	3	Teleindication 3	
37	Switch-off of earthing switch of ring main unit/ outgoing line cabinet G3	RO	2	4	Teleindication 3	
38	Low insulation gas pressure of ring main unit	RO	2	5	Teleindication 3	
39	Medium-voltage room door opening	RO	2	6	Teleindication 3	
40	Cooling system fault in medium-voltage room	RO	2	7	Teleindication 3	
41	N/A	RO	2	8	Teleindication 3	
42	Transformer winding temperature ultra high	RO	2	9	Teleindication 3	
43	IMD warning in low-voltage cabinet A	RO	2	10	Teleindication 3	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
44	IMD alarm in low-voltage cabinet A	RO	2	11	Teleindication 3	
45	IMD warning in low-voltage cabinet B	RO	2	12	Teleindication 3	
46	IMD alarm in low-voltage cabinet B	RO	2	13	Teleindication 3	
47	N/A	RO	2	14	Teleindication 3	
48	N/A	RO	2	15	Teleindication 3	
49	Transformer safety shutdown	RO	3	0	Teleindication 4	
50	Transformer overcurrent protection action	RO	3	1	Teleindication 4	
51	Transformer zero-sequence overcurrent protection	RO	3	2	Teleindication 4	
52	Transformer non-electrical protection action	RO	3	3	Teleindication 4	
53	High temperature alarm in medium-voltage room	RO	3	4	Teleindication 4	
54	N/A	RO	3	5	Teleindication 4	
55	N/A	RO	3	6	Teleindication 4	
56	High temperature alarm in low-voltage cabinet A	RO	3	7	Teleindication 4	
57	High temperature alarm in low-voltage cabinet B	RO	3	8	Teleindication 4	
58	N/A	RO	3	9	Teleindication 4	
59	EPO button operation	RO	3	10	Teleindication 4	
60	Maintenance-free dehumidifier fault	RO	3	11	Teleindication 4	
61	Maintenance-free dehumidifier heating	RO	3	12	Teleindication 4	
62	Automatic mode of circuit breaker in transformer cabinet G2	RO	3	13	Teleindication 4	
63	N/A	RO	3	14	Teleindication 4	
64	N/A	RO	3	15	Teleindication 4	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
65	DC power distribution cabinet door opening	RO	4	0	Teleindication 5	
66	N/A	RO	4	1	Teleindication 5	
67	N/A	RO	4	2	Teleindication 5	
68	N/A	RO	4	3	Teleindication 5	
69	Heat exchanger fault in distribution transformer 1	RO	4	4	Teleindication 5	
70	MCCB switch-on of distribution transformer 1	RO	4	5	Teleindication 5	
71	Distribution transformer cabinet door opening	RO	4	6	Teleindication 5	
72	Heat exchanger fault in distribution transformer 2	RO	4	7	Teleindication 5	
73	MCCB switch-on of distribution transformer 2	RO	4	8	Teleindication 5	
74	N/A	RO	4	9	Teleindication 5	
75	Smoke alarm 1 in low-voltage room	RO	4	10	Teleindication 5	
76	Smoke alarm 2 in low-voltage room	RO	4	11	Teleindication 5	
77	SPD fault in low-voltage cabinet A	RO	4	12	Teleindication 5	
78	SPD fault in low-voltage cabinet B	RO	4	13	Teleindication 5	
79	Smoke alarm 1 in medium-voltage room	RO	4	14	Teleindication 5	
80	Smoke alarm 2 in medium-voltage room	RO	4	15	Teleindication 5	
81	Transformer overvoltage action	RO	5	0	Teleindication 6	
82	Transformer undervoltage action	RO	5	1	Teleindication 6	
83	Delayed automatic switch-on of transformer medium-voltage switch	RO	5	2	Teleindication 6	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
84	Transformer medium-voltage switch control loop disconnection	RO	5	3	Teleindication 6	
85	Protection action and switch-on blocking	RO	5	4	Teleindication 6	
86	Transformer zero-sequence overvoltage protection action	RO	5	5	Teleindication 6	
87	Medium-voltage side underfrequency protection	RO	5	6	Teleindication 6	
88	Medium-voltage side overfrequency protection	RO	5	7	Teleindication 6	
89	Transformer differential protection action	RO	5	8	Teleindication 6	
90	Circuit breaker fail-safe protection action	RO	5	9	Teleindication 6	
91	N/A	RO	5	10	Teleindication 6	
92	N/A	RO	5	11	Teleindication 6	
93	N/A	RO	5	12	Teleindication 6	
94	N/A	RO	5	13	Teleindication 6	
95	N/A	RO	5	14	Teleindication 6	
96	N/A	RO	5	15	Teleindication 6	
97	Auxiliary loop SPD fault	RO	6	0	Teleindication 7	
98	UPS AC power failure	RO	6	1	Teleindication 7	
99	UPS-associated alarm	RO	6	2	Teleindication 7	
100	Smoke sensor fault alarm signal in low-voltage room	RO	6	3	Teleindication 7	
101	relay protection power loss alarm	RO	6	4	Teleindication 7	
102	Heat exchanger fault in distribution transformer 3	RO	6	5	Teleindication 7	
103	MCCB switch-on of distribution transformer 3	RO	6	6	Teleindication 7	
104	Heat exchanger fault in distribution transformer 4	RO	6	7	Teleindication 7	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
105	MCCB switch-on of distribution transformer 4	RO	6	8	Teleindication 7	
106	User-defined singal 3	RO	6	9	Teleindication 7	
107	User-defined singal 4	RO	6	10	Teleindication 7	
108	User-defined singal 5	RO	6	11	Teleindication 7	
109	NA	RO	6	12	Teleindication 7	
110	NA	RO	6	13	Teleindication 7	
111	NA	RO	6	14	Teleindication 7	
112	NA	RO	6	15	Teleindication 7	
113	NA	RO	7	0	Teleindication 8	
114	NA	RO	7	1	Teleindication 8	
115	NA	RO	7	2	Teleindication 8	
116	NA	RO	7	3	Teleindication 8	
117	NA	RO	7	4	Teleindication 8	
118	Overtemperature-induced tripping in low-voltage cabinet A	RO	7	5	Teleindication 8	
119	Overtemperature-induced tripping in low-voltage cabinet B	RO	7	6	Teleindication 8	
120	Overtemperature-induced tripping in medium-voltage room	RO	7	7	Teleindication 8	
121	Dual smoke sensor tripping in low-voltage room	RO	7	8	Teleindication 8	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
122	Dual smoke sensor tripping in medium-voltage room	RO	7	9	Teleindication 8	
123	PSU shutdown in low-voltage cabinet A	RO	7	10	Teleindication 8	
124	PSU shutdown in low-voltage cabinet B	RO	7	11	Teleindication 8	
125	PSU shutdown in medium-voltage room	RO	7	12	Teleindication 8	
126	Low-voltage side zero-sequence overcurrent	RO	7	13	Teleindication 8	
127	N/A	RO	7	14	Teleindication 8	
128	N/A	RO	7	15	Teleindication 8	
129	Smoke sensor fault alarm signal in medium-voltage room	RO	8	0	Teleindication 9	
130	Cabinet G1 short-circuit fault indicator alarm signal	RO	8	1	Teleindication 9	
131	Cabinet G3 short-circuit fault indicator alarm signal	RO	8	2	Teleindication 9	
132	NA	RO	8	3	Teleindication 9	
133	NA	RO	8	4	Teleindication 9	
134	Low-voltage room side door opening	RO	8	5	Teleindication 9	
135	User-defined singal 1	RO	8	6	Teleindication 9	
136	User-defined singal 2	RO	8	7	Teleindication 9	
137	User-defined singal 15	RO	8	8	Teleindication 9	
138	User-defined singal 16	RO	8	9	Teleindication 9	
139	G1 cabinet cable temperature abnormal alarm signal	RO	8	10	Teleindication 9	

No.	Signal Name	Read/Write	Address	Bit	Teleindication Signal	Remarks
140	G3 cabinet cable temperature abnormal alarm signal	RO	8	11	Teleindication 9	
141	N/A	RO	8	12	Teleindication 9	
142	N/A	RO	8	13	Teleindication 9	
143	N/A	RO	8	14	Teleindication 9	
144	N/A	RO	8	15	Teleindication 9	
145	N/A	RO	9		Teleindication 10	
146	N/A	RO	10		Teleindication 11	
147	N/A	RO	11		Teleindication 12	
148	N/A	RO	12		Teleindication 13	
149	N/A	RO	13		Teleindication 14	
150	N/A	RO	14		Teleindication 15	
151	N/A	RO	15		Teleindication 16	

3.1.2 Definition of Telemetering Registers

Table 3-2 Telemetering information (function code: 0x03)

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
1	Voltage Uab in low-voltage cabinet A	RO	UINT16	10	V	10007	1	
2	Voltage Ubc in low-voltage cabinet A	RO	UINT16	10	V	10008	1	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
3	Voltage Uca in low-voltage cabinet A	RO	UINT16	10	V	10009	1	
4	Active power P in low-voltage cabinet A	RO	INT16	1	kW	10010	1	
5	Reactive power Q in low-voltage cabinet A	RO	INT16	1	kVar	10011	1	
6	Power factor cosϕ in low-voltage cabinet A	RO	INT16	1000	N/A	10012	1	
7	Positive active energy of low-voltage cabinet A	RO	UINT32	1	kWh	10013	2	
8	Negative active energy of low-voltage cabinet A	RO	UINT32	1	kWh	10015	2	
9	Positive reactive energy of low-voltage cabinet A	RO	UINT32	1	kVarh	10017	2	
10	Negative reactive energy of low-voltage cabinet A	RO	UINT32	1	kVarh	10019	2	
11	Voltage Uab in low-voltage cabinet B	RO	UINT16	10	V	10028	1	
12	Voltage Ubc in low-voltage cabinet B	RO	UINT16	10	V	10029	1	
13	Voltage Uca in low-voltage cabinet B	RO	UINT16	10	V	10030	1	
14	Active power P in low-voltage cabinet B	RO	INT16	1	kW	10031	1	
15	Reactive power Q in low-voltage cabinet B	RO	INT16	1	kVar	10032	1	
16	Power factor cosϕ in low-voltage cabinet B	RO	INT16	1000	N/A	10033	1	
17	Positive active energy of low-voltage cabinet B	RO	UINT32	1	kWh	10034	2	
18	Negative active energy of low-voltage cabinet B	RO	UINT32	1	kWh	10036	2	
19	Positive reactive energy of low-voltage cabinet B	RO	UINT32	1	kVarh	10038	2	
20	Negative reactive energy of low-voltage cabinet B	RO	UINT32	1	kVarh	10040	2	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
21	Frequency	RO	UINT16	100	Hz	10042	1	
22	Transformer oil surface temperature	RO	INT16	10	℃	10043	1	
23	Transformer winding temperature	RO	INT16	10	℃	10044	1	
24	Medium-voltage side current Ia of transformer	RO	INT16	10	A	10045	1	
25	Medium-voltage side current Ib of transformer	RO	INT16	10	A	10046	1	
26	Medium-voltage side current Ic of transformer	RO	INT16	10	A	10047	1	
27	Temperature in medium-voltage room	RO	INT16	10	℃	10048	1	
28	Humidity in medium-voltage room	RO	UINT16	10	%	10049	1	
29	Medium-voltage side active power P of transformer	RO	INT32	1	kW	10056	2	
30	Medium-voltage side reactive power Q of transformer	RO	INT32	1	kVar	10058	2	
31	Medium-voltage side power factor cosϕ of transformer	RO	INT32	1000	N/A	10060	2	
32	Humidity in maintenance-free dehumidifier	RO	UINT16	10	%	10064	1	
33	Temperature in low-voltage cabinet A	RO	INT16	10	℃	10067	1	
34	Humidity in low-voltage cabinet A	RO	UINT16	10	%	10068	1	
35	Temperature in low-voltage cabinet B	RO	INT16	10	℃	10069	1	
36	Humidity in low-voltage cabinet B	RO	UINT16	10	%	10070	1	
37	Medium-voltage side frequency of transformer	RO	UINT16	100	Hz	10074	1	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
38	Auxiliary transformer voltage Ua/Auxiliary transformer voltage U1	RO	UINT16	10	V	10079	1	
39	Auxiliary transformer voltage Ub/Auxiliary transformer voltage U2	RO	UINT16	10	V	10080	1	
40	Auxiliary transformer voltage Uc	RO	UINT16	10	V	10081	1	
41	Auxiliary transformer active power P	RO	INT16	1	kW	10082	1	
42	Auxiliary transformer reactive power Q	RO	INT16	1	kVar	10083	1	
43	Auxiliary transformer power factor cosϕ	RO	INT16	1000	N/A	10084	1	
44	Positive active energy of auxiliary transformer	RO	UINT32	1	kWh	10085	2	
45	Negative active energy of auxiliary transformer	RO	UINT32	1	kWh	10087	2	
46	Positive reactive energy of auxiliary transformer	RO	UINT32	1	kVarh	10089	2	
47	Negative reactive energy of auxiliary transformer	RO	UINT32	1	kVarh	10091	2	
48	Auxiliary transformer frequency	RO	UINT16	100	Hz	10093	1	
49	Total harmonic component of phase A voltage on medium-voltage side	RO	UINT32	100	%	10096	2	
50	Total harmonic component of phase B voltage on medium-voltage side	RO	UINT32	100	%	10098	2	
51	Total harmonic component of phase C voltage on medium-voltage side	RO	UINT32	100	%	10100	2	
52	Total harmonic component of phase A current on medium-voltage side	RO	UINT32	100	%	10102	2	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
53	Total harmonic component of phase B current on medium-voltage side	RO	UINT32	100	%	10104	2	
54	Total harmonic component of phase C current on medium-voltage side	RO	UINT32	100	%	10106	2	
55	Current Ia in low-voltage cabinet A	RO	INT32	10	A	10108	2	
56	Current Ib in low-voltage cabinet A	RO	INT32	10	A	10110	2	
57	Current Ic in low-voltage cabinet A	RO	INT32	10	A	10112	2	
58	Current Ia in low-voltage cabinet B	RO	INT32	10	A	10114	2	
59	Current Ib in low-voltage cabinet B	RO	INT32	10	A	10116	2	
60	Current Ic in low-voltage cabinet B	RO	INT32	10	A	10118	2	
61	Auxiliary transformer current Ia/Auxiliary transformer current l1	RO	INT32	10	A	10120	2	
62	Auxiliary transformer current Ib/Auxiliary transformer current l2	RO	INT32	10	A	10122	2	
63	Auxiliary transformer current Ic	RO	INT32	10	A	10124	2	
64	Medium-voltage side voltage Uab of transformer	RO	UINT16	1	kV	10126	1	
65	Medium-voltage side voltage Ubc of transformer	RO	UINT16	1	kV	10127	1	
66	Medium-voltage side voltage Uca of transformer	RO	UINT16	1	kV	10128	1	
67	PSU output voltage in low-voltage cabinet A	RO	UINT16	10	V	10129	1	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
68	PSU output current in low-voltage cabinet A	RO	UINT16	10	A	10130	1	
69	PSU output voltage in low-voltage cabinet B	RO	UINT16	10	V	10131	1	
70	PSU output current in low-voltage cabinet B	RO	UINT16	10	A	10132	1	
71	Front row phase A cable head temperature of cabinet G1	RO	INT16	10	℃	10135	1	
72	Front row phase B cable head temperature of cabinet G1	RO	INT16	10	℃	10136	1	
73	Front row phase C cable head temperature of cabinet G1	RO	INT16	10	℃	10137	1	
74	Rear cable head temperature of phase A of cabinet G1	RO	INT16	10	℃	10138	1	
75	Rear cable head temperature of phase B of cabinet G1	RO	INT16	10	℃	10139	1	
76	Rear cable head temperature of phase C of cabinet G1	RO	INT16	10	℃	10140	1	
77	Phase A cable head temperature of cabinet G2	RO	INT16	10	℃	10141	1	
78	Phase B cable head temperature of cabinet G2	RO	INT16	10	℃	10142	1	
79	Phase C cable head temperature of cabinet G2	RO	INT16	10	℃	10143	1	
80	Front row phase A cable head temperature of cabinet G3	RO	INT16	10	℃	10144	1	
81	Front row phase B cable head temperature of cabinet G3	RO	INT16	10	℃	10145	1	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
82	Front row phase C cable head temperature of cabinet G3	RO	INT16	10	℃	10146	1	
83	Rear cable head temperature of phase A of cabinet G3	RO	INT16	10	℃	10147	1	
84	Rear cable head temperature of phase B of cabinet G3	RO	INT16	10	℃	10148	1	
85	Rear cable head temperature of phase C of cabinet G3	RO	INT16	10	℃	10149	1	
86	Total harmonic distortion of voltage Uab in low-voltage cabinet A	RO	UINT16	1	%	10500	1	
87	Total harmonic distortion of voltage Ubc in low-voltage cabinet A	RO	UINT16	1	%	10501	1	
88	Total harmonic distortion of voltage Uca in low-voltage cabinet A	RO	UINT16	1	%	10502	1	
89	Average total harmonic voltage distortion in low-voltage cabinet A	RO	UINT16	1	%	10503	1	
90	Total harmonic distortion of current Ia in low-voltage cabinet A	RO	UINT16	1	%	10504	1	
91	Total harmonic distortion of current Ib in low-voltage cabinet A	RO	UINT16	1	%	10505	1	
92	Total harmonic distortion of current Ic in low-voltage cabinet A	RO	UINT16	1	%	10506	1	
93	Average total harmonic current distortion in low-voltage cabinet A	RO	UINT16	1	%	10507	1	
94	Total harmonic distortion of voltage Uab in low-voltage cabinet B	RO	UINT16	1	%	10688	1	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
95	Total harmonic distortion of voltage Ubc in low-voltage cabinet B	RO	UINT16	1	%	10689	1	
96	Total harmonic distortion of voltage Uca in low-voltage cabinet B	RO	UINT16	1	%	10690	1	
97	Average total harmonic voltage distortion in low-voltage cabinet B	RO	UINT16	1	%	10691	1	
98	Total harmonic distortion of current Ia in low-voltage cabinet B	RO	UINT16	1	%	10692	1	
99	Total harmonic distortion of current Ib in low-voltage cabinet B	RO	UINT16	1	%	10693	1	
100	Total harmonic distortion of current Ic in low-voltage cabinet B	RO	UINT16	1	%	10694	1	
101	Average total harmonic current distortion in low-voltage cabinet B	RO	UINT16	1	%	10695	1	
102	Fan 1 speed in low-voltage cabinet A	RO	UINT16	1	RPM	31000	1	
103	Fan 2 speed in low-voltage cabinet A	RO	UINT16	1	RPM	31001	1	
104	Fan 1 speed outside low-voltage cabinet A	RO	UINT16	1	RPM	31002	1	
105	Fan 2 speed outside low-voltage cabinet A	RO	UINT16	1	RPM	31003	1	
106	Mixed-flow fan 1 speed in low-voltage cabinet A	RO	UINT16	1	RPM	31004	1	
107	Mixed-flow fan 2 speed in low-voltage cabinet A	RO	UINT16	1	RPM	31005	1	Pre-assignment
108	Fan 1 speed in low-voltage cabinet B	RO	UINT16	1	RPM	31006	1	
109	Fan 2 speed in low-voltage cabinet B	RO	UINT16	1	RPM	31007	1	

No.	Signal Name	Read/ Write	Type	Gain	Unit	Address	Quantity	Remarks
110	Fan 1 speed outside low-voltage cabinet B	RO	UINT16	1	RPM	31008	1	
111	Fan 2 speed outside low-voltage cabinet B	RO	UINT16	1	RPM	31009	1	
112	Mixed-flow fan 1 speed in low-voltage cabinet B	RO	UINT16	1	RPM	31010	1	
113	Mixed-flow fan 2 speed in low-voltage cabinet B	RO	UINT16	1	RPM	31011	1	Pre-assignment
114	Fan speed in medium-voltage room	RO	UINT16	1	RPM	31012	1	
115	Fan speed outside medium-voltage room	RO	UINT16	1	RPM	31013	1	
116	Mixed-flow fan 1 speed in medium-voltage room	RO	UINT16	1	RPM	31014	1	Pre-assignment
117	Mixed-flow fan 2 speed outside medium-voltage room	RO	UINT16	1	RPM	31015	1	Pre-assignment
118	Fan self-check status	RO	ENUM16	N/A	N/A	31016	1	
119	Temperature of 3-phase copper bar in low-voltage cabinet A	RO	INT16	10	℃	31021	1	
120	Temperature of Secondary component compartment in low-voltage cabinet A	RO	INT16	10	℃	31022	1	
121	Temperature of 3-phase copper bar in low-voltage cabinet B	RO	INT16	10	℃	31023	1	
122	Temperature of Secondary component compartment in low-voltage cabinet B	RO	INT16	10	℃	31024	1	

3.1.3 Definition of Telecontrol Registers

Table 3-3 Telecontrol information (function code: 0x06)

No.	Signal Name	Read/ Write	Value Range	Address	Quantity	Remarks
1	Remote ACB switch-on in low-voltage cabinet A	WO	0xFF00: switch-on	20000	1	
2	Remote ACB switch-off in low-voltage cabinet A	WO	0xFF00: switch-off	20001	1	
3	Remote ACB switch-on in low-voltage cabinet B	WO	0xFF00: switch-on	20002	1	
4	Remote ACB switch-off in low-voltage cabinet B	WO	0xFF00: switch-off	20003	1	
5	Remote switch-on of medium-voltage circuit breaker	WO	0xFF00: switch-on	20004	1	
6	Remote switch-off of medium-voltage circuit breaker	WO	0xFF00: switch-off	20005	1	

3.1.4 Other Register Signals

Table 3-4 Version information (function code: 0x03)

No.	Signal Name	Read/ Write	Type	Gain	Unit	Value Range	Address	Quantity	Remarks
1	Software Version	RO	String	N/A	N/A	N/A	30073	15	Software SPC version.

Table 3-5 Device information (function code: 0x03)

No.	Signal Name	Read/ Write	Type	Gain	Unit	Value Range	Address	Quantity	Remarks
1	SN	RO	String	N/A	N/A	N/A	30015	10	Container serial number, which is written by the transformer station factory. When Huawei barcode is empty, the main control SN is displayed.
2	STS model	RW	ENUM16	N/A	N/A	0: JUPITER-9000K-H0	42000	1	Capacity: 9000 kVA
						1: JUPITER-3000K-H1			Capacity: 3300 kVA
						7：JUPITER-4000K-H1			Capacity: 4000 kVA
						2: JUPITER-6000K-H1			Capacity: 6600 kVA
						3: JUPITER-9000K-H1			Capacity: 9000 kVA
						4：JUPITER-3000K-H1-AC			Capacity: 3300 kVA
						5：JUPITER-6000K-H1-AC			Capacity: 6000 kVA
						6：JUPITER-3000K-H1-GF			Capacity: 3300 kVA
3	Ring main unit model	RW	ENUM16	N/A	N/A	0：CVC	42015	1	
						1：DVC			
						2：Dnv			
						3：CV			
4	Medium-voltage relay protection model	RW	ENUM16	N/A	N/A	0：1	42016	1	1：iRelay 50-P
						1：2			2：ekor.rpg
						2：3			3：7SJ58
						3：4			4：PA620-L1
						4：5			5：ekor.rpa-031

No.	Signal Name	Read/ Write	Type	Gain	Unit	Value Range	Address	Quantity	Remarks
						5：6			6：PA620-L1
						6：7			7：7SR45
						7：8			8：7SR1003
						8：9			9：7SR1004
						9：10			10：PA620-L1C
						10：11			11：ekor.rpa-220
						11：12			12：ST260E

4 Overview of the Communications Protocol

The Modbus communications protocol consists of the following layers:

Physical Layer

Data Link Layer

Application Layer

4.1 Physical Layer

- Source device: STS
- Source IP: STS WAN IP
- Source port: Dynamic allocation
- Destination device: SACU
- Destination IP: SACU LAN IP
- Destination port: 504
- The port cannot be changed

4.2 Data Link Layer

4.2.1 Addressing Mode

The protocol supports the unicast and broadcast modes. The following table describes the address allocation rule.

Table 4-1 IP address configuration rules

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

4.2.2 Frame Structure

Table 4-2 Frame structure

Address	Function Code	Data	CRC Code
1 byte	1 byte	2 x *N* bytes	2 bytes

NOTE

- A frame can contain a maximum of 256 bytes.
- In a CRC code, the bit on the leftmost is least significant.
- Frame structure definitions in this document include only the function code and data.

4.2.3 Data Encoding

Modbus uses a big-Endian representation for addresses and data elements. This means that when multiple bytes are sent, the most significant byte is sent first.

The following shows an example.

Table 4-3 Example of data coding format

Register Size	Value
16 bits	0x1234

The first byte sent is 0x12, followed by 0x34.

4.2.4 Interaction Process

A communication process is always initiated by the master node. Slave nodes do not initiate communication processes.

In unicast mode, a slave node returns one response for each request from the master node. If the master node does not receive any response from the slave node in five seconds, the communication process is regarded as timed out.

In broadcast mode, slave nodes receive but do not respond to the requests from the master node.

4.2.5 CRC

The CRC code consists of 16 bits and applies to all bytes in front of it. 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*

4.3 Application Layer

4.3.1 Function Code

Table 4-4 Function code list

Function Code	Description	Remarks
0x01	Reads teleindication information.	Supports continuous reading of a single register or multiple registers.
0x03	Reads telemetering information.	Supports continuous reading of a single register or multiple registers.
0x06	Writes a single register.	Supports writing into a single register.
0x10	Writes multiple registers.	Supports continuous writing into multiple registers.

4.3.2 Exception Code

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

Table 4-5 Exception codes returned by an NE (0x00–0x8F used for common exception codes)

Code	Name	Description
0x01	Invalid 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 cannot be implemented in the unit selected. It also indicates 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	Invalid 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 the start register address in a request is 96 and the number of registers is 4, the request can obtain the return values of registers 96, 97, 98, and 99. If the start register address of a request is 96 and the number of registers is 5, the request fails and the exception code 0x02 "Invalid data address" is returned because the request attempts to read registers 96, 97, 98, 99, and 100, among which 100 is not a defined address.
0x03	Invalid data value	The value contained in the query data field is not an allowable value for the server (or slave node). The value indicates a fault in the structure of the remainder of a complex request, such as an incorrectly implied length. It 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 occurs while the server attempts to perform the requested action.
0x05	Acknowledge	This command is used together with programming commands. The server has accepted the request and is processing it, but it takes a long time to do so. This response is returned to prevent timeout errors on the client. The client can next issue a Poll Program Complete message to determine whether the processing is complete.
0x06	Slave node busy	The server cannot accept a Modbus request PDU. The client application determines whether and when to retransmit the request.

4.3.3 Reading Registers (0x01)

4.3.3.1 Frame Format of a Master Node Request

Table 4-6 Frame format of a request from a master node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x01
Register start address	2 bytes	0x0000–0xFFFF
Number of registers	2 bytes	1–125
CRC	2 bytes	N/A

4.3.3.2 Frame Format of a Normal Response from a Slave Node

Table 4-7 Frame format of a normal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x01
Byte count	1 byte	2 x *N*
Register value	2 x *N* bytes	N/A
CRC	2 bytes	N/A

NOTE

N refers to the number of registers.

4.3.3.3 Frame Format of an Abnormal Response from a Slave Node

Table 4-8 Frame format of an abnormal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x81
Exception code	1 byte	See Exception Code.
CRC	2 bytes	N/A

4.3.3.4 Examples

The master node sends a request to a slave node (address: 01) to query the teleindication information (register address: 0/0x0000):

01 01 00 00 00 04 3D C9

Normal response from a slave node:

01 02 08 00 00 00 00 00 00 00 C4 12

Abnormal response from a slave node:

01 81 03 00 51

4.3.4 Reading Registers (0x03)

4.3.4.1 Frame Format of a Master Node Request

Table 4-9 Frame format of a request from a master node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x03
Register start address	2 bytes	0x0000–0xFFFF
Number of registers	2 bytes	1–125
CRC	2 bytes	N/A

4.3.4.2 Frame Format of a Normal Response from a Slave Node

Table 4-10 Frame format of a normal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x03
Byte count	1 byte	2 x *N*
Register value	2 x *N* bytes	N/A
CRC	2 bytes	N/A

NOTE

N refers to the number of registers.

4.3.4.3 Frame Format of an Abnormal Response from a Slave Node

Table 4-11 Frame format of an abnormal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x83
Exception code	1 byte	See Exception Code.
CRC	2 bytes	N/A

4.3.4.4 Examples

The master node sends a request to a slave node (address: 01) to query the telemetering information (register address: 10000/0x2710):

01 03 27 10 00 04 4F 4B

Normal response from a slave node:

01 03 08 00 0A 00 14 00 1E 00 28 6F CC

Abnormal response from a slave node:

01 83 0A C1 37

4.3.5 Writing a Single Register (0x06)

4.3.5.1 Frame Format of a Master Node Request

Table 4-12 Frame format of a request from a master node

Data Field	Length	Description
Slave node address	1 byte	0–247
Function code	1 byte	0x06
Register address	2 bytes	0x0000–0xFFFF
Register value	2 bytes	0x0000–0xFFFF
CRC	2 bytes	N/A

4.3.5.2 Frame Format of a Normal Response from a Slave Node

Table 4-13 Frame format of a normal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x06
Register address	2 bytes	0x0000–0xFFFF
Register value	2 bytes	0x0000–0xFFFF
CRC	2 bytes	N/A

4.3.5.3 Frame Format of an Abnormal Response from a Slave Node

Table 4-14 Frame format of an abnormal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x86
Exception code	1 byte	See Exception Code.
CRC	2 bytes	N/A

4.3.5.4 Examples

The master node sends a request to a slave node (address: 01) to set the telecontrol information (register address: 20000/0x4E20):

01 06 4E 20 FF 00 DE D8

Normal response from a slave node:

01 06 4E 20 FF 00 DE D8

Abnormal response from a slave node:

01 86 03 02 61

4.3.6 Writing Multiple Registers (0x10)

4.3.6.1 Frame Format of a Master Node Request

Table 4-15 Frame format of a request from a master node

Data Field	Length	Description
Slave node address	1 byte	0–247
Function code	1 byte	0x10
Register start address	2 bytes	0x0000–0xFFFF
Number of registers	2 bytes	0x0000–0x007B
Byte count	1 byte	2 x *N*
Register value	2 x *N* bytes	Value
CRC	2 bytes	N/A

NOTE

N refers to the number of registers.

4.3.6.2 Frame Format of a Normal Response from a Slave Node

Table 4-16 Frame format of a normal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x10
Register address	2 bytes	0x0000–0xFFFF
Number of registers	2 bytes	0x0000–0x007B
CRC	2 bytes	N/A

4.3.6.3 Frame Format of an Abnormal Response from a Slave Node

Table 4-17 Frame format of an abnormal response from a slave node

Data Field	Length	Description
Slave node address	1 byte	1–247
Function code	1 byte	0x90
Exception code	1 byte	See Exception Code.

Data Field	Length	Description
CRC	2 bytes	N/A

4.3.6.4 Examples

The master node sends a request to a slave node (address: 01) to set the time (register address: 40000/0x9C40; value: 2018.09.06 12:00:00):

01 10 9C 40 00 02 04 5B 91 16 C0 42 60

Normal response from a slave node:

01 10 9C 40 00 02 6E 4C

Abnormal response from a slave node:

01 90 03 0C 01

NOTE

The time setting can respond to broadcast instructions and unicast instructions. If a broadcast command is received, no reply is required after the response.

