MS1UE Switch Module and Related Products

---- Modbus Protocol

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CONTENTS

1. INTRODUCTION

1.1 Overview

This manual describes the Modbus communication protocol used by Shanghai Matis Electric Co., Ltd.'s switch modules and related products, which is applied to the communication between switch modules and related products and superior monitoring device.

1.2 Scope of Application

The protocol applies to switch modules and related products developed by Shanghai Matis Electric Co., Ltd., and is the basis for the development, testing and use of Matis switch modules and related products

1.3 References

Modicon Modbus Protocol Reference Guide PI-MBUS-300 Rev.J

2. DEVICE INSTALLATION

2.1 Hardware Interface

RS485, baud rate 9600, character format adopts asynchronous serial communication format with none parity, 8 data bits, 1 stop bit, data response time <500ms (data response time refers to the time between the host computer sending the last byte of the query data packet and receiving the first valid byte of the switch module's response).

3. STRUCTURE

B9	03	30	00	...	3D	5E
Address	Function code		Data		CRC check code	

Using the RTU (Remote Terminal Unit) method of Modbus protocol, each byte is 2 hexadecimal numbers, and the valid data range is 0~9, A~F.

3.1 Address

It refers to the address of the switch module, range: 1~247; broadcast address: 0x00 (the product does not response to messages).

Using USS protocol. Communication between the master and the slave is carried out in a polling manner. Each communication is initiated by the host, which sends a task message to the slave. After receiving the task command from the host, the slave returns a response message and performs corresponding actions. In addition to sending response messages, the slave can only be in the receiving status.

3.2 Function code

The device only supports function codes 0x03 (read data), 0x10 (set user parameters), and 0x16 (read key data packets in batches, see Appendix E for details). If the function code is wrong, the device will not respond.

3.3 Data

The data reported or set is sent according to the register (data ID). Each register consists of two or more bytes (the number of bytes is an even number). For the definition of register number, please refer to Appendix A.

3.4 CRC check code

CRC16 (Cyclical Redundancy Check) checks the address, function code and data, and it consists of two bytes. The CRC is generated by the transmission device and appended to the data frame. If the checksum calculated from the received data does not match the checksum appended to the data, an error occurs. See Appendix F for details on the CRC calculation method.

4. COMMANDS

4.1 Query data, function code 03

The host computer sends a data query command information frame. After the switch module (or device) receives the correct query command, it responds to the command and sends data back to the host computer. The format is as follows:

4.1.1 Query command frame format

Field Value	Field Description
B9	Address 0-247, 0x00 is the broadcast address
03	Function code 03
18	Starting register address high byte
04	Starting register address low byte
00	Register number high byte
02	Low byte of register number, read 2 registers
CRCLo	CRC low byte
CRCHi	CRC high byte

4.1.2 Normal response frame format

Field Value	Field Description	
B9	Address 0-247	
03	Function code 03	
08	Number of response data bytes	
D1HHi	High-high byte of register 1	Register 1 - 4 bytes
D1HLo	High-low byte of register 1	
D1LHi	Low-high byte of register 1	
D1LLo	Low-low byte of register 1	
D2HHi	High-high byte of register 2	Register 2 - 4 bytes
D2HLo	High-low byte of register 2	
D2LHi	Low-high byte of register 2	
D2LLo	Low-low byte of register 2	

CRCLo	CRC low byte	
CRCHi	CRC high byte	

4.1.3 Error response frame format

Field Value	Field Description
B9	Address 0-247
83	Function code 03
02	Number of response data bytes
ERRHi	Error message high byte
ERRLo	Error message low byte
CRCLo	CRC low byte
CRCHi	CRC high byte

Note: The high position of the function code 1 indicates an error

4.2 Setting data, function code 10

The host computer sends a setting data command. After receiving the correct setting command, the switch module sets the corresponding data in the specified register and returns the data as it is to respond. If the setting is unsuccessful, it responds with an error information frame. The format is as follows:

4.2.1 Set command frame format

Field Value	Field Description
B9	Address 0-247
10	Function code 10
30	Starting register address high byte
04	Starting register address low byte
00	Register number high byte
03	Register number low byte, write 3 registers
06	Number of data bytes
00	Register 1, high byte
AA	Register 1, low byte
1B	Register 2, high byte
12	Register 2, low byte
00	Register 3, high byte

64	Register 3, low byte
CRCLo	CRC low byte
CRCHi	CRC high byte

Note: In order to ensure communication reliability, when setting continuous registers in one frame, the maximum setting is 9 bytes.

4.2.2 Normal response frame format

Field Value	Field Description
B9	Address 0-247
10	Function code 10
18	Starting register address high byte
00	Starting register address low byte
06	The number of bytes actually operated (when there are read-only registers in the continuous operation register, the number of bytes actually operated is the sum of the bytes of all writable registers)
03	Number of registers operated (corresponding to the setting command frame)
CRCLo	CRC low byte
CRCHi	CRC high byte

4.2.3 Error response frame format

Field Value	Field Description
B9	Address 0-247
83	Function code 03
02	Number of response data bytes
ERRHi	Error message high byte
ERRLo	Error message low byte
CRCLo	CRC low byte
CRCHi	CRC high byte

Note: The high position of the function code 1 indicates an error

5. APPENDIX

5.1 Appendix A: Register List

Communication Parameters					
1800H	High byte	Device address	2	R	
	Low byte	Baud rate: 1:9600 2:4800 3:2400 4:1200		R	Modifying the baud rate is not currently supported.
1801H	High byte	0: No parity; 2: Even parity; 4: Odd parity	2	R	
	Low byte	0: 1 stop bit; 1: 2 stop bits			
1802H	Communication time interval (referring to the minimum time required between two instructions, the default is 10ms)		2	R/W	Unit: ms
1803H	Communication sending and receiving time interval (referring to the delay time for the circuit breaker to respond after receiving the command, the default is 20ms)		2	R/W	Unit: ms
Operating Status					
1804H	Voltage		4	R	2 decimal places, unit: V
1806H	Current (the highest bit 1 represents the negative direction, the lower 31 bits are the absolute value of the variable)		4	R	2 decimal places, unit: A
1808H	Power (the highest position 1 represents negative direction, the lower 31 bits are the absolute value of the variable)		4	R	2 decimal places, unit: kW
180AH	The output energy of this period (that is, the current cumulative output energy, if the host computer does not issue a clear command, it will continue to accumulate)		4	R/W	2 decimal places, unit: kWh
180CH	Last period output energy (assigned or		4	R/	2 decimal places,

	cleared by the customer)		W	unit: kWh
180EH	Cumulative output energy	4	R	2 decimal places, unit: kWh
1827H	The input energy of this period (that is, if the host computer does not issue a clear command, the current accumulated input energy will continue to accumulate)	4	R/W	2 decimal places, unit: kWh
1829H	Input power in the last period (assigned or cleared by the customer)	4	R/W	2 decimal places, unit: kWh
182BH	Accumulated input energy	4	R	2 decimal places, unit: kWh
1810H	Cumulative operating time	4	R	Unit: min
1812H	Electricity settlement time: day, hour, minute (00 DD hh:mm)	4	R/W	
1814H	Date, week, time (YYYY.MM.DD WW hh:mm:ss)	8	R/W	
1818H	Temperature of detection point A (when the register value is greater than 32767, it is a negative temperature, negative temperature value = register value - 65536)	2	R	Integer, unit: ℃
1819H	Detection point B temperature (when the register value is greater than 32767, it is a negative temperature, negative temperature value = register value - 65536)	2	R	Integer, unit: ℃
181AH	Reserved	20		
1824H	Operating status word	2	R	See Appendix C
1825H	Device alarm status word 1	2	R/W	See Appendix C Writing only supports clearing
1826H	Device alarm status word 2	2	R/W	See Appendix C Writing only supports clearing
182DH	Number of fault openings	2	R/W	Writing only supports clearing

182EH-1830H	Reserved				
1831H	Total number of openings		4	R/W	Writing only supports clearing
1832H-18FFH	Reserved				
Device Information					
1900H	Manufacturer SN (manufacturer code 1 byte + production year 2 bytes + production month 1 byte + serial number 4 bytes)		8	R	
1904H	Software version number		4	R	ASCII code
1906H	Hardware version number		4	R	ASCII code
1908H	Production date (YYYY.MM.DD)		4	R	
190AH	Product name		4	R	ASCII code
190CH	High byte	Factory rated current	2	R	Integer, unit: A
	Low byte	Switch width (0.5P: 0x05, 1P: 0x0A)			0x01 corresponds to 0.1P
190DH	High byte	Rated voltage	2	R/W	Integer, unit: V
	Low byte	Rated current			Integer, unit: A
190EH-1FFFH	Reserved				
2000H	User configuration information 1 (only for reading and writing, saving when power off)		2	R/W	
2001H-2FFFH	Reserved				
ON/OFF Control					
3000H	High byte	Default: 0x00; closing priority: 0x01	2	R/W	Closing priority: Automatic closing after 30 seconds of offline operation

	Low byte	ON/OFF control (0x77 or 0xAA: fully closed; 0x33: standby; 0x55: fully closed)			For 125A products, 0x33 and 0x55 are equivalent to opening; for 63A products, restarting does not change the opening and closing status, and 0x77 or 0xAA is equivalent to the power-on full closing of the earlier version.
3001H	No communication alarm delay		2	R/W	Unit: s
3002H	Overcurrent alarm threshold		2	R/W	2 decimal places, unit: A
3003H	High byte	Overcurrent protection self-recovery times	2	R/W	
	Low byte	Overcurrent protection self-recovery interval time			Unit: min
3004H	Overcurrent protection enable (0x00AA: enable; 0x0055: disable)		2	R/W	
3005H	Overcurrent protection threshold (recovery hysteresis 1A)		2	R/W	2 decimal places, unit: A
3006H	Overcurrent protection delay time		2	R/W	Unit: 0.1s
3007H	Undervoltage protection enable (0x00AA: enable; 0x0055: disable)		2	R/W	
3008H	Undervoltage protection threshold (default recovery value 42V)		2	R/W	2 decimal places, unit: V
3009H	Undervoltage protection delay time		2	R/W	Unit: 0.1s
300AH-3021H	Reserved				

3022H	High byte	Rent authorization (0x01: Authorization; 0x00: Cancel authorization)	2	R/W	
	Low byte	One-key function (0x01: enter; 0x00: exit)			
3023H	Overcurrent self-recovery interval setting 2-Note 1		2	R/W	Unit: s
3024H	Undervoltage self-recovery voltage absolute value setting-Note 2		2	R/W	2 decimal places, unit: V
30FFH	Power light pulse output enable configuration (0xA55A: enabled, other values: disabled) - Note 3		2	R/W	

Note 1: The function of "over-current self-recovery interval setting 2" is the same as the 3003H low byte (over-current protection self-recovery interval). When "overcurrent self-recovery interval setting 2" is configured, the 3003H value is automatically divided by 60 and rounded. When the rounded part is 0, it is automatically set to 1. The device uses 3023H "overcurrent self-recovery interval setting 2" as the actual self-recovery interval time. For customers using 3023H, after adjusting 3003H, it may be necessary to reset the 3023H register to ensure that the device operates correctly.

Note 2: "Undervoltage self-recovery voltage absolute value setting", the setting of this value needs to match the 3008H data, that is, the value needs to be greater than or equal to the setting value of 3008H.

Note 3: "Energy light pulse output enable configuration", after the configuration is enabled, the product shields the normal operation indicator light, the red indicator outputs energy pulses, and other indicator lights go out; the initial value of this value is disabled after power-on, and will not be saved after power-off. .

5.2 Appendix B: Message Sample

- Read the communication address

  18 03 18 00 00 01 BF DC

- Set the the device with address 0x18 to standby status

  18 10 30 00 00 01 02 00 33 C8 69

5.3 Appendix C: Status word format

5.3.1 Communication error message (optional)

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Data ID error				Communication rate change error	Wrong password or unauthorized	No data requested	Other errors

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8
							Illegal data

Note: 0 means no corresponding error occurs, 1 means the corresponding error occurs. Except for the defined errors, other situations are classified as ”other errors”.

5.3.2 Communication error message (optional)

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Full ON	Standby	Full OFF	Emergency ON/OFF	Remote ON/OFF command			

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8
	Battery discharge	Reserved	Switch self-test passed	Offline operating status	Rental authorization status	Failsafe state	Alarm status

5.3.3 Device alarm status word 1 (optional)

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Level 1 overcurrent fault trip	Level 2 overcurrent fault trip	Level 1 overvoltage fault trip	Undervoltage fault trip	Short circuit fault lock	Reserved	Hardware short circuit fault	Trip coil failure

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8
Reserved	Circuit breaker reverse connection fault tripping	Reserved	Reserved	Detection point B over-temperature fault trip	Detection point A over-temperature fault trip	Level 3 overcurrent fault trip	Level 2 overcurrent fault trip

5.3.4 Device alarm status word 2 (optional)

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Mechanical ON/OFF adhesion fault alarm	Reserved	Reserved	Detection point B over temperature alarm	Detection point A over temperature alarm	Overcurrent alarm	Reserved	Reserved

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8
Communication loss alarm	ON/OFF failure alarm	Switch address error alarm	Memory error alarm	Reserved	Overcurrent lock	Lightning overvoltage alarm	Reserved

5.4 Appendix E: Batch reading of key data packets

Users can use function code 0x16 to read key data packets in batches. The starting register address field in the read command frame is fixed at 0x1804, and the register number field is fixed at 0x0010. The command frame and response frame formats are as follows:

5.4.1 Read command frame format

Field Value	Field Description
B9	Address 0-247, 0x00 is the broadcast address
16	Function code 16
18	Starting register address high byte
04	Starting register address low byte
00	Register number high byte
10	Low byte of register number, read 16 registers
CRCLo	CRC low byte
CRCHi	CRC high byte

5.4.2 Response frame format

Field NO.	Number of bytes	Field Description
0	1	Address 0-247, 0x00 is the broadcast address
1	1	Function code, fixed at 16
2	1	Number of data bytes, fixed at 2A
3~6	4	Voltage, unit: V, keep two decimal places
7~10	4	Current, unit: A, keep two decimal places
11~14	4	Power, unit: kW, keep two decimal places
15~18	4	The output energy of this period, unit: kWh, keep two decimal places.
19~22	4	The output energy of the last period, unit: kWh, keep two decimal places.
23~26	4	Cumulative energy power, unit: kWh, keep two decimal places
27~30	4	Accumulated input energy, unit: kWh, keep two

		decimal places
31~32	2	Semiconductor switching temperature, unit: °C, integer
33~34	2	Temperature near the negative pole of the incoming line, unit: °C, integer
35~36	2	Operating status word
37~38	2	Device alarm status word 1
39~40	2	Device alarm status word 2
41~42	2	High byte: factory rated current; low byte: switch width
43~44	2	High byte: rated voltage; low byte: rated current
45~46	2	CRC

5.5 Appendix F: Batch reading of key data packets 2

Users can use function code 0x19 to read key data packets in batches. The starting register address field in the read command frame is fixed at 0x1804, and the register number field is fixed at 0x0010. The command frame and response frame formats are as follows:

5.5.1 Read command frame format

Field Value	Field Description
B9	Address 0-247, 0x00 is the broadcast address
19	Function code 19
18	Fixed at 0x1804
04	
00	Fixed at 0x0010
10	
CRCLo	CRC low byte
CRCHi	CRC high byte

5.5.2 Response frame format

Field No.	Number of bytes	Field Description
0	1	Address 0-247, 0x00 is the broadcast address
1	1	Function code, fixed at 0x19
2	1	Number of data bytes, fixed at 0x38
3~6	4	Voltage, unit: V, keep two decimal places
7~10	4	Current, unit: A, keep two decimal places
11~14	4	Power, unit: kW, keep two decimal places
15~18	4	The output energy of this period, unit: kWh, keep two decimal places.
19~22	4	The output energy of the last period, unit: kWh, keep two decimal places.
23~26	4	Accumulative output energy, unit: kWh, keep two decimal places
27~30	4	Output energy of this period, unit: kWh, keep two decimal places.
31~34	4	Input energy of last period, unit: kWh, keep two decimal places.
35~38	4	Accumulated input energy, unit: kWh, keep two decimal places
39~42	4	Total number of openings
43~44	2	Semiconductor switching temperature, unit: °C, integer
45~46	2	Temperature near the negative pole of the incoming line, unit: °C, integer
47~48	2	Operating status word
49~50	2	Device alarm status word 1
51~52	2	Device alarm status word 2
53~54	2	High byte: factory rated current; low byte: switch width
55~56	2	High byte: rated voltage; low byte: rated current
57~58	2	User configuration information 1
59~60	2	CRC

5.6 Appendix G: CRC Calculation Code

```
uint16_t CrcCal(uint8_t *data, uint16_t num)
{
uint8_t i,j,con1,con2;
uint16_t CrcR=0xFFFF, con3=0x00;
for(i=0; i<num; i++)
{
con1=CrcR&0xff;
con3=CrcR&0xff00;
CrcR=con3+data[i]^con1;
for(j=0; j<8; j++)
{
con2=CrcR&0x0001;
CrcR=CrcR>>1;
if(con2==1)
CrcR=CrcR^0xA001;
}
}
con1=CrcR>>8;
con2=CrcR&0xff;
CrcR=con2;
CrcR=(CrcR<<8)+con1;
return CrcR;
}
```

7. TECHNICAL SREVICE

Anyone who purchases this MS1UE enjoys a 24-month warranty period from the date of purchase. During the warranty period, if the quality of the device itself affects the normal use, you can enjoy free repair and replacement, and the condition of paid service as follows: the improper use, drop, installation and wiring errors that cause irreversible damage. Besides, if you disassemble and modify the device yourself, you will not enjoy the warranty service.

If you have any questions about the operation or malfunction of the device, please contact Matis technical support service.

Statement:

- The information provided in this manual can be changed without prior notice.
- **Shanghai Matis Electric Co., Ltd. reserves the right to interpret the foregoing information.**

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