Remote Reclosing Device with Insulation Control

MT51SD Series

Modbus_Communication Protocol

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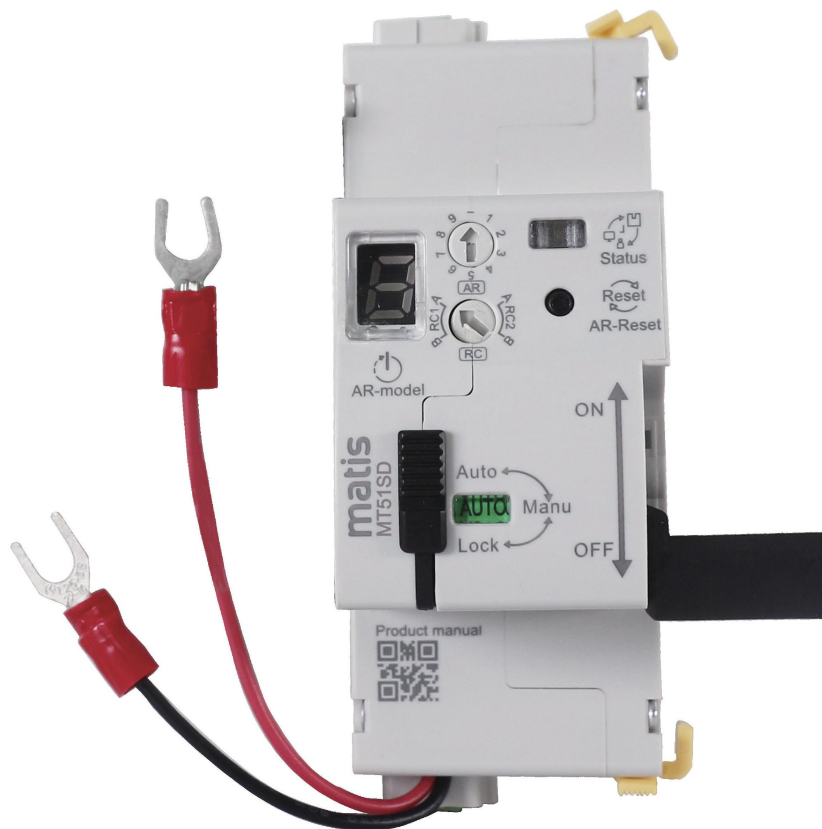
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1. Protocol Description

This is the Modbus communication protocol for smart recloser, which is convenient for users to read and write device parameters using Modbus commands. In this protocol, the values sent and returned in communication are all in hexadecimal unless otherwise specified.

2. Introduction to Frame Formats

Tabe 1   Modbus Frame Format

Address Code	Function Code	Data Field	Check Code

1、Address Code

➢ Occupies 1 byte;

➢ One device terminal (slave) corresponds to one address code, the address range is 1~247 (0x01 to 0xF7)

➢ A host can send to any address:

0x00 is the broadcast address, which can be used to broadcast configuration but not to broadcast read data;

0xFF is a public address, which can be configured and read by the public, but requires only one slave to be connected;

1~247 are the addresses of the designated slaves, and other addresses will not respond;

2、Function Code

➢ Occupies 1 byte;

➢ According to the function code definition of the standard Modbus protocol, two commonly used basic function codes are selected as the read and write function codes of this protocol.

Table 2   Function Code Definition

Function Code	Function
0x03	Read holding register
0x06	Write to a single register

3、Data Field

➢ The format of the data field is determined by the function code.

➢ Read Register 0x03

➢ When reading a register, you need to know the starting address and length of the register to be read, so the data field consists of the starting address of the register and the number of registers; the data field of the returned response frame is the number of bytes and data in the corresponding range register.

➢ Table 3　0x03 Read Register Frame Format

Request Frame			Response Frame		
Frame Format	Value/Range	Bytes	Frame Format	Value/Range	Bytes
Address code	0～247	1	Address code	0～247	1
Function code	0x03	1	Function code	0x03	1
Register starting address	0～0xFFFF	2	Return data length	2*N	1
Number of consecutive registers N	1～125	2	Return data	2～250	2*N
CRC check		2	CRC check		2

Note: 1. For any frame data containing 2 bytes (except CRC), the high byte comes first and the low byte comes last.

2. In the request frame, if the read continuous registers include undefined registers, an error will be reported;

➢ Write single register 0x06

Write a single holding register, mainly used to configure parameters, occupying 8 bytes in total, the return frame is consistent with the request frame. The register value is the written value.

Table 4　0x06 Write Single Register Frame Format

Request Frame			Response Frame		
Frame Format	Value/Range	Bytes	Frame Format	Value/Range	Bytes
Address code	0～247,255	1	Address code	1～247	1
Function code	0x06	1	Function code	0x06	1
Register address	0～0xFFFF	2	Register address	0～0xFFFF	2
Register value	0～0xFFFF	2	Register value	0～0xFFFF	2

CRC Check		2	CRC Check		2

4、 Check Code

The check code is calculated using CRC-16 (generator polynomial A001), with **the low byte first and the high byte last**.

5、 MODBUS Exception Response Frame

When the device receives the request frame from the master and successfully processes the data of the request frame, the device returns a normal response frame to the master; when the device fails to receive the request frame from the master, it does not perform any operation and does not return. The master can set a timeout as a basis for judging device failure.

When the device receives the request frame from the master, but the function code or register of the request frame does not meet the data definition requirements, the device cannot perform data processing of the request frame, and the device must return an abnormal response frame to the master station. The abnormal response frame format is shown in Table 6 below:

Table 6   MODBUS Exception Response Frame

Exception Response Frame		
Frame Format	**Value/Range**	**Bytes**
Address code	1～247	1
Function code	0x80 + request function code	1
Exception code	01/02/03	1
CRC check		2

The function code is to set the high position of the function code of the received request frame to 1, indicating that the frame is an exception response frame;

The exception code is defined in the following table 7:

Table 7   MODBUS Exception Response Frame Format

Exception Code	**Name**	**Meaning**
01	Illegal function code	The function code of the request frame is undefined
02	Illegal register	The register address of the request frame is

	address	undefined
03	Illegal register value	The register value or register length of the request frame does not conform to the defined format

3. Register Definition

1、Register address classification

Data Type	Register Base Address Range
Configuration parameter data	Above 0x0000
Smart electric operator parameters	Above 0x1000

2、Register address

Parameter data: 03H function code read, 06H, 10H function code write					
DEC Address	HEX Address	Data Item	Bytes	WORD	Read / Write
0	0x0000	Read and write address Default address 1 (The allowed decimal value: 1~247)	2	1	R/W

4	0x0004	Read and write baud rate
		   0x0000 (baud rate 2400)
		   0x0001 (baud rate 4800)
		Default 0x0002 (baud rate 9600)
		   0x0003 (baud rate 19200)
			2	1	R/W

5	0x0005	Read and write data bit, check bit, stop bit
		Default 8n1 (0x0011)
		   8o1 (0x0021)
		   8e1 (0x0041)
		   8n2 (0x0012)
		   8o2 (0x0022)
		   8e2 (0x0042)
			2	1	R/W

DEC Address	HEX Address	Data Item	Bytes	WORD	Read / Write
4096	0x1000	The read value is fixed at (0x00 00)	2	1	R
		Write data: Control closing: (0x00 01) Control opening: (0x00 02)	2	1	RW
4097	0x1001	Read firmware version number Default: (0x00 01)	2	1	R
4098	0x1002	Read the opening and closing status Read data: The handle is in the middle: (0x00 00) The handle is in the closed position: (0x00 01) The handle is in the open position: (0x00 02)	2	1	R
4099	0x1003	xR position set by the upper knob; Data cannot be written; Data can only be read: Auto-reclosing disabled - 0 gear (0x00 00) Auto-reclosing mode 1~9 gears (corresponding to register values 0x0001 to 0x0009) Please refer to the data sheet for details;	2	1	R
4100	0x1004	The maximum allowed number of reclosings corresponding to the xR position set by the upper knob; Please refer to the data sheet for details;	2	1	R
4101	0x1005	Accumulated non-manual closing times Read data: Automatic closing once, the number of times increases by one; Controlled closing once, the	2	1	RW

		number of times increases by one;			
		Write data: Write any data, and clear the accumulated non-manual closing; Example: Clear (0x00 01)			
4102	0x1006	Read data: Current reclosing times	2	1	RW
		Write data: Write any data, and clear the number of automatic reclosings; Example: Clear (0x00 01)			
4103	0x1007	Automatic reset time (also called stabilization time) Unit: seconds Default 900; Allowed writing range: 1-65535	2	1	RW
4104	0x1008	Read system fault: 0 by default: no fault Bit4 set to 1: motor fault Other bits reserved;	2	1	R
4105	0x1009	The maximum number of reclosing times allowed in xR9 mode; If the MCB firmware allows writing: 1~3 times, 3 times by default If the RCCB firmware allows writing: 1~10 times, 10 times by default;	2	1	RW
4106	0x100A	The 1st stage reclosing time in xR9 mode, in seconds; The writable range is 10~600; The default is 120;	2	1	RW
4107	0x100B	The 2nd stage reclosing time in xR9 mode, in seconds; The writable range is 10~600; The default is 240;	2	1	RW
4108	0x100C	The 3rd stage reclosing time in xR9 mode, in seconds; The writable range is 10~600; The default is 480;	2	1	RW
4109	0x100D	The 4th stage reclosing time in xR9 mode, in seconds;	2	1	RW

		The writable range is 10~1200; The default is 90;			
4110	0x100E	The 5th stage reclosing time in xR9 mode, in seconds; The writable range is 10~1200; The default is 90;	2	1	RW
4111	0x100F	The 6th stage reclosing time in xR9 mode, in seconds; The writable range is 10~1200; The default is 90;	2	1	RW
4112	0x1010	The 7th stage reclosing time in xR9 mode, in seconds; The writable range is 10~1200; The default is 90;	2	1	RW
4113	0x1011	The 8th stage reclosing time in xR9 mode, in seconds; The writable range is 10~1200; The default is 90;	2	1	RW
4114	0x1012	The 9th stage reclosing time in xR9 mode, in seconds; The writable range is 10~1200; The default is 90;	2	1	RW
4115	0x1013	The 10th stage reclosing time in xR9 mode, in seconds; The writable range is 10~1200; The default is 90;	2	1	RW
4116	0x1014	Insulation detection enable; 1: Enable (default) 2: Shield	2	1	RW
4117	0x1015	Output DO mode setting The writable range is 1~4; Please refer to the data sheet for the specific meaning	2	1	RW
4118	0x1016	After the electrical lock is triggered 0 Disable (default 1) Enable C1/C2 control ON/OFF	2	1	RW
4119	0x1017	After the electrical lock is triggered 0 Disable (default 1) Enable RS485 control ON/OFF	2	1	RW
4120	0x1018	Whether the electrical lock is effective (it will also be triggered if the closing fails)	2	1	R

		0 Not effective			
		1 Effective			

Note 1: Since the RTU mode has been specified, the data bits are fixed to 8 data bits, there is no corresponding register for read and write operations, and it cannot be changed. Only the check bit and stop bit are considered to complete the communication;

Note 2: The write operation of the total number of reclosings (0x1005) and the current number of reclosing failures (0x1006) will clear the total number of reclosings and the current number of reclosing failures;

Note 4: The read/write address 0x00 is a broadcast address. Access to this address can access all units, but there will be no response.

Note 5: The read/write address 0xFF is a public address. Access to this address can access all units and respond normally.

Note 6: After the safety lock is pulled out, the RS485 function is temporarily disabled; after the safety lock is pushed back, the RS485 function is restored;

4. Complete Command Example

Communication fault code (return function code highest position 1)

		Send	Return
Invalid function code	0x01	01 26 10 00 00 01 CD 0D	01 A6 01 9A 60
Invalid register address	0x02	01 06 20 00 00 01 43 CA	01 86 02 C3 A1
Invalid value	0x03	01 06 10 00 00 03 CD 0B	01 86 03 02 61

Communication Command
Select Hex format for both sending and receiving
Read address 01 03 00 00 00 01 84 0A (default 1)
Write address 01 06 00 00 00 02 08 0B (address 1 changed to 2)
　　　　　　 02 06 00 00 00 01 48 39 (address 2 changed to 1)

The following takes address 1 as an example:
Read baud rate 01 03 00 01 00 01 D5CA (default 9600)
Write baud rate 01 06 00 01 00 00 D80A (2400)
　　　　　　 01 06 00 01 00 01 19CA (4800)
　　　　　　 01 06 00 01 00 02 59CB (9600)
　　　　　　 01 06 00 01 00 03 980B (19200)

Control closing   01 06 10 00 00 01 4C CA
Control opening   01 06 10 00 00 02 0C CB

Read firmware version number   01 03 10 01 00 01 D1 0A(current version number: 2)

Read the ON/OFF status   01 03 10 02 00 01 21 0A (0x0001 handle is in the ON position; 0x0002 handle is in the OFF position)

Read the total number of accumulated non-manual closing times
        01 03 10 05 00 01 90 CB (Total number of actual device non-manual closing times)
Write the total number of accumulated non-manual closing times to zero
        01 06 10 05 00 01 DD 0A (Write any number to clear the total number of non-manual closings)

Read the current reclosing times of the recloser
        01 03 10 06 00 01 60 CB(Current number of reclosings of the device)
Write the current reclosing times of the recloser to zero
        01 06 10 06 00 01 AC CB(Write any number to clear the current reclosing times)

Read system failure   01 03 10 08 00 01 01 08(Read system fault, now only judge motor fault)

Test
Read address
2022/12/1 20:28:09.39 [TX] - 01 03 00 00 00 01 84 0A
2022/12/1 20:28:09.42 [RX] - 01 03 02 00 01 79 84
Read baud rate
2022/12/1 20:30:31.34 [TX] - 01 03 00 04 00 01 C5 CB
2022/12/1 20:30:31.37 [RX] - 01 03 02 00 02 39 85
Control ON
2022/12/1 20:31:00.60 [TX] - 01 06 10 00 00 01 4C CA
2022/12/1 20:31:00.64 [RX] - 01 06 10 00 00 01 4C CA
Control OFF
2022/12/1 20:31:11.12 [TX] - 01 06 10 00 00 02 0C CB
2022/12/1 20:31:11.16 [RX] - 01 06 10 00 00 02 0C CB
Read version number
2022/7/1 20:31:30.09 [TX] - 01 03 10 01 00 01 D1 0A
2022/7/1 20:31:30.13 [RX] - 01 03 02 00 02 39 85
Read ON and OFF status
2022/12/1 20:31:40.32 [TX] - 01 03 10 02 00 01 21 0A
2022/12/1 20:31:40.35 [RX] - 01 03 02 00 00 B8 44
Read the total number of non-manual closing times

2022/12/1 20:32:01.00 [TX] - 01 03 10 05 00 01 90 CB

2022/12/1 20:32:01.04 [RX] - 01 03 02 00 03 F8 45 (3 times)

Write the total number of accumulated non-manual closing times to zero

2022/12/1 20:32:17.49 [TX] - 01 06 10 05 00 01 DD 0A (Write any number and it will be cleared to zero)

2022/12/1 20:32:17.53 [RX] - 01 06 10 05 00 01 DD 0A

Read the number of automatic reclosings

2022/12/1 20:32:37.84 [TX] - 01 03 10 06 00 01 60 CB

2022/12/1 20:32:37.87 [RX] - 01 03 02 00 01 79 84 (once)

Write the number of automatic reclosings to zero

2022/12/1 20:32:56.80 [TX] - 01 06 10 06 00 01 AC CB (Write any number and it will be cleared to zero)

2022/12/1 20:32:56.86 [RX] - 01 06 10 06 00 01 AC CB

Read system failure

2022/12/1 20:32:56.80 [TX] - 01 06 10 06 00 01 AC CB

2022/12/1 20:32:56.86 [RX] - 01 06 10 06 00 10 6C C7