Appendix:

SMA series-RS485 communication protocol

● Introduction to communication protocol

SMA series AC drives are equipped with RS485 communication interface as standard, and adopt the international standard ModBus communication protocol for master-slave communication. Users can realize centralized control through PC/PLC, upper computer, master AC drive, etc. (setting AC drive control commands, operating frequency, modification of related function code parameters, monitoring of AC drive working status and fault information, etc.) to adapt Specific application requirements.

● Application method

1. SMA series AC drives have a "single-master and multiple-slave" control network connected to RS485 bus. When the master uses the broadcast command (the slave address is 0), the slave does not respond.

2. SMA only provides RS485 interface, asynchronous half-duplex. If the communication port of the external device is RS232, an RS232/RS485 converter is required.

3. The ModBus protocol defines the information content and format of asynchronous transmission in serial communication, which can be divided into RUT mode and ASCII mode. SMA is RTU (Remote Terminal Unit) mode.

● Communication frame structure

The communication data format is as follows:

Byte composition: including start bit, 8 data bits, parity bit and stop bit.

Start bit	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Parity Bit	Stop bit

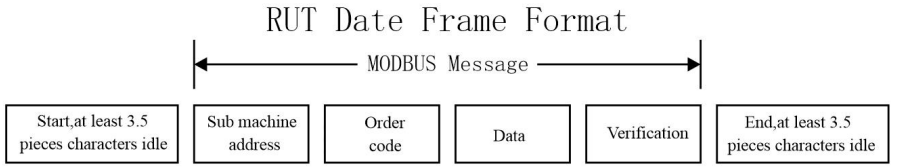
The information of a frame must be transmitted in a continuous data stream. If the interval time exceeds 1.5 bytes before the end of the entire frame transmission, the receiving device will clear the incomplete information and mistakenly believe that the next byte is a new one. The address field part of the frame. Similarly, if the interval between the start of a new frame and the previous frame is less than 3.5 bytes, the receiving device will consider it to be the continuation of the previous frame. Due to the frame disorder, the final CRC check value is incorrect, resulting in communication error.

Standard structure of RTU frame:

Frame header	3.5 bytes transmission time
slave address	mail address: 0-247 (decimal) (0 is broadcast address)
Command code	03h: read slave parameters 06h: write slave parameters 08h: loop self test

Data area	**Parameter address, number of parameters, parameter value, etc**
CRC CHK low	**Test value: 16 bit CRC test value**
CRC CHK high	
Frame tail	**3.5 bytes transmission time**

In RTU mode, a new frame starts with a transmission time pause interval of at least 3.5 bytes. The data fields transmitted next are: slave address, operation command code, data and CRC check word. The transmitted bytes in each field are hexadecimal 0...9, A...F. The network device continuously detects the network bus, including the pause interval. When receiving the first field (address information), each network device decodes the byte to determine whether it is sent to itself. After the transmission of the last byte is completed, a transmission time interval of at least 3.5 bytes is used to indicate the end of the frame. After this, a new message can begin.



● Command code and communication data description

Command code: 03H, read N words (Word), up to 5 words can be read continuously.

For example: the AC drive whose slave address is 01H, the memory start address is 2100H ([C-00]), read 3 consecutive words, then the structure of the frame is described as follows:

RTU host command information

START	3.5 bytes transmit time
Sub machine address	01H
Start address high position	21H
Start address low position	00H
Data quantity high position	00H
Data quantity low position	03H
CRC CHK low position	0FH
CRC CHK high position	F7H
END	3.5 bytes transmit time

RTU sub machine responding information(when normal)

START	3.5 bytes transmit time
Sub machine address	01H
Order code	03H
Bytes quantity low position	06H
Data address 2100H high position	13H
Data address 2100H low position	88H
Data address 2101H high position	00H
Data address 2101H low position	00H
Data address 2102H high position	00H
Data address 2102H low position	00H
CRC CHK low position	EDH
CRC CHK high position	5DH
END	3.5 bytes transmit time

RTU sub machine responding information(when abnormal)

START	3.5 bytes transmit time
Sub machine address	01H
Order code	88H
Error code	03H
CRC CHK low position	06H
CRC CHK high position	01H
END	3.5 bytes transmit time

Order code:06H, write one word

Function:write one word data into appointed data address, can use into modify the frequency transformer parameter value.

Example:write the 5000(1388H) in the 3000H address of sub machine address 1 frequency transformer. Then the structure description of this frame as below:

RTU main machine order information

START	3.5 bytes transmit time
Sub machine address	01H
Order code	06H
Write data address high position	30H
Write data address low position	00H
Data content high position	13H
Data content low position	88H

CRC CHK low position	8BH
CRC CHK high position	9CH
END	3.5 bytes transmit time

RTU sub machine responding information(when normal)

START	3.5 bytes transmit time
Sub machine address	01H
Order code	06H
Write data address high position	30H
Write data address low position	00H
Data content high position	13H
Data content low position	88H
CRC CHK low position	8BH
CRC CHK high position	9CH
END	3.5 bytes transmit time

RTU sub machine responding information(when abnormal)

START	3.5 bytes transmit time
Sub machine address	01H
Order code	86H
Error code	01H
CRC CHK low position	83H
CRC CHK high position	A0H
END	3.5 bytes transmit time

Command code: 08H, loop self-test

Function: Send back the response information of the slave which is the same as the command information of the master, which is used to detect whether the signal transmission between the master and the slave is normal.

The detection code and data can be set arbitrarily.

RTU host command information

Communication frame error checking method:

The standard Modbus serial network uses two error detection methods. The parity check is used to check each character, and the CRC check is used to check a frame of data.

1. Parity check

The user can configure the controller to have odd or even parity, or no parity. This will determine how the parity bit in each character is set.

If odd or even parity is specified, the number of "1" bits will be counted into the number of bits per character (7 data bits in ASCII mode, 8 data bits in RTU). For example, the RTU character frame contains the following 8 data bits: 1 1 0 0 0 1 0 1 The number of the

entire "1" is 4. If even parity is used, the parity bit of the frame will be 0, and the entire The number of "1" is still 4. If odd parity is used, the parity bit of the frame will be 1, and the total number of "1"s will be 5. If the parity bit is not specified, there will be no check bit during transmission and no check check will be performed. Instead of an additional stop bit, it is filled into the character frame to be transmitted.

2. CRC-16 (cyclic redundancy check)

Using the RTU frame format, the frame includes a frame error detection field calculated based on the CRC method. The CRC field detects the content of the entire frame. The CRC field is two bytes and contains a 16-bit binary value.

This CRC calculation method uses the international standard CRC verification rule. When editing the CRC algorithm, the user can refer to the CRC algorithm of the relevant standard and write a CRC calculation program that truly meets the requirements.

● Definition of communication data address

This part is the address definition of communication data, which is used to control the operation of the AC drive, obtain the status information of the AC drive and set the relevant function parameters of the AC drive.

(1) SMA series function parameter address expression rules

Take the AC drive function parameter serial number as the register address, which is divided into high byte and low byte. The high byte indicates the group serial number of the function parameter, and the low byte indicates the group serial number of the function parameter, which needs to be converted into hexadecimal. For the address of specific parameters, please see the communication address column in the parameter column table of the chapter

Note: Due to the possibility of frequent rewriting of parameter values in communication, if the EEPROM is frequently stored, the service life will be reduced. For users, some function code parameters do not need to be stored in the communication mode, and only need to change the value in the on-chip RAM to meet the requirements. The SMA communication protocol stipulates that when the write command (06H) is used, it will only be written into the RAM of the AC drive and will not be stored after power failure. If the write command (41H) is used, it will be written into the EEPROM, which means it will be stored after power failure.

Control order function instruction	Address definition	Data meanings instruction		R/W characteristics
Communication running control order	2000H	**BIT0**	0-STOP RUN 1-RUN	**W**

		BIT1	0-FORWARD RUN 1-REVERSE RUN	
		BIT2	0-NO ORDER 1-JOG RUNNING	
		BIT3	0-NO ORDER 1-RESET OPERATION	
		BIT4-7	DO1-DO4	
		BIT8	COMMUNICATION FAULT INPUT	
		BIT9-15	RESERVE	
Communication frequency setting value	2001H	Setting range:0-Maximum frequency		**W**
Communication frequency setting value	2002H	Reserve		
Communication frequency setting value	2003H	Reserve		
Communication frequency setting value	2004H	Reserve		
Communication AO1 output value	2005H	Setting range:0-100.0%		**W**

Monitor command function instruction	Address definition	Data meanings instruction		R/W characteristics
AC drive operation status	2100H	**BIT0**	Run	**R**
		BIT1	Reverse Run	
		BIT2	Ready	
		BIT3	Fault	
		BIT4	Jog Running	
		BIT5	Pre-alarm	
		BIT6-15	NC	
AC drive fault type	2101	0 - No fault 1 SC IGBT unit failure 2 OC1 Acceleration overcurrent 3 OC2 Constant speed overcurrent 4 OC3 Deceleration overcurrent 5 OU1 Acceleration overvoltage 6 OU2 Constant speed overvoltage		**R**

		7 OU3 Deceleration overvoltage 8 LU Undervoltage 9 OL1 AC drive overload 10 OL2 Motor overload 11 OH2 Radiator overheated 12 EFF External input failure 13 EPF0 Power unit power setting data lost 14 EPF1 Power unit user setting data lost 15 EPF2 Power unit user data memory is damaged 16 EPFA1 Control unit user data data is lost 17 EPFA2 Control unit user data memory is damaged	