

MATSN Series

Dual-Source ATS Communication Protocol



Powering Business Worldwide

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The MATSN series dual-source automatic transfer switch (ATS) communication protocol provides a serial asynchronous half-duplex RS485 interface utilizing the MODBUS-RTU protocol.

MODBUS-RTU Communication Protocol: The MODBUS protocol employs a master-slave response-based communication scheme over a single transmission line. In this configuration, the master initiates communication by addressing a specific terminal device (slave) using its unique address. The addressed slave then transmits its response back to the master in the reverse direction. In other words, signals transmit all communication data flows in opposite directions over a single communication line (in half-duplex operation mode)

The Modbus communication adopts a master-slave query-response mechanism. Only when the master initiates a query can the slave provide a response – the slaves cannot transmit data autonomously. The master may either address queries to individual slaves or broadcast messages to all slaves. Slaves only respond to specifically addressed queries and ignore broadcast messages.

Master Query

A query message frame consists of the device address code, function code, data code, and checksum code. The address code identifies the target slave, while the function code tells the selected slave which operation to perform – for example, function code 03 requests the slave to read registers and return their contents. The data field contains additional information required for the slave to execute the function. For example, in a read command, the additional information in the data field includes both the starting register address and the number of registers to read. The checksum code is used to verify the accuracy of a message frame, providing the slave with a method to confirm the message’s correctness. It adopts the CRC16 validation rules.

Slave Response

When a slave generates a normal response, the response message includes the slave address code, function code, data code, and CRC16 checksum code. The data code contains the information collected by the slave, such as register values or status information. In case of errors, it is agreed that the slave will not respond at all.

The following defines the transmission mode compatible with the MODBUS protocol - RTU mode.

Each data byte consists of 1 start bit, 8 data bits, 1 stop bit (no parity bit).

The structure of a Modbus-RTU data frame is as follows:

Address field	Function code	Data code	Checksum code
1 Byte	1 Byte	N Bytes	2 Bytes

Address Code

Consists of one byte (8-bit binary code) with slave device addresses ranging from 1 to 247 (in decimal). All other addresses are reserved.

Function Code

Tells the addressed slave which operation to perform. The following table lists the supported function codes, along with their descriptions and functionalities.

Code	Description	Action
03	Read Data Registers	Retrieve current binary values from one or more registers (dual-source ATS operational status).

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Code	Description	Action
06	Write Single Data Register	Set binary values into register 0x100 for remote fire alarm linkage of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x101 for remote fire alarm reset of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x102 to modify the undervoltage action value of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x103 to modify the undervoltage recovery value of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x104 to modify the overvoltage action value of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x105 to modify the overvoltage recovery value of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x106 to modify the function mode of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x107 to modify the transfer delay time of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x108 to modify the pole configuration of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x10a to modify the auto/electric (manual?) mode of the dual-source ATS.
	Write Single Data Register	Set binary values into register 0x10b to force the dual-source ATS transfer operation.

For split-type dual-source ATS only

Data Code

Contains either the data required for the slave to execute specific functions or the data collected by the slave when responding to queries. The data may consist of numerical values, reference addresses, or setting values. For instance, when the function field code tells the slave to read a register, the data field must specify both the starting register address and the number of registers to read, while the response data field from the slave will include the data length and the corresponding data.

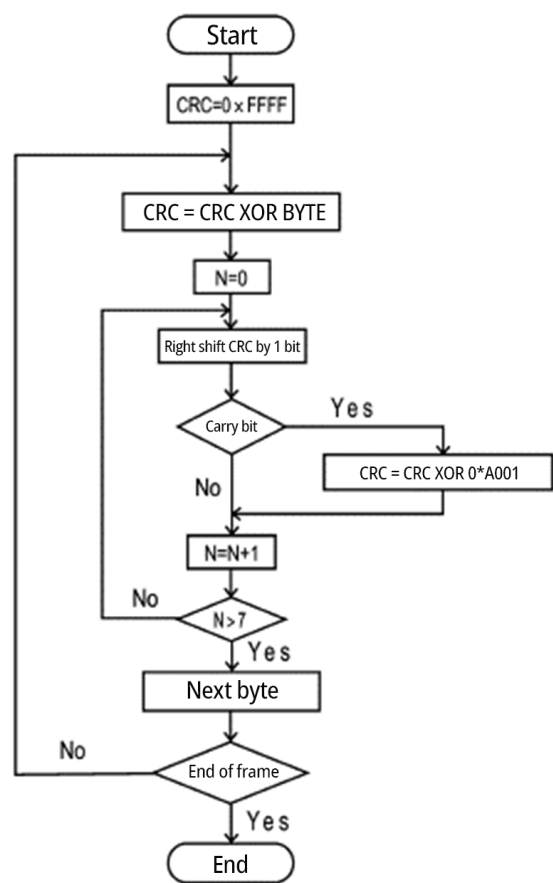
Checksum Code

The checksum field (CRC) code occupies two bytes and contains a 16-bit binary value. The CRC value is calculated by the transmitting device and then appended to the data frame. Upon receiving the data, the receiving device recalculates the CRC value and compares it with the value contained in the received CRC frame. If these two values do not match, an error has occurred.

The CRC generation process proceeds as follows:

- (1) Preset a 16-bit register with the value OFFFHH (hexadecimal, all bits set to 1), referred to as the CRC register.
- (2) Perform an XOR operation between the first 8-bit byte of the data frame and the low byte of the CRC register, then store the result back into the CRC register.
- (3) Right-shift the CRC register by one bit, filling the Most Significant Bit (MSB) with 0 while shifting out and examining the Least Significant Bit (LSB).
- (4) If the shifted-out bit is 0: Repeat step 3 (perform another shift). If the shifted-out bit is 1: Perform an XOR operation between the CRC register and a predefined polynomial value (0A001H).
- (5) Repeat steps 3 and 4 until 8 shifts have been completed, thereby processing one full 8-bit byte.
- (6) Repeat steps 2 through 5 for each subsequent byte until all bytes in the frame have been processed.
- (7) The final value contained in the CRC register represents the computed CRC value.

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MODBUS-RTU Function Code Descriptions

1. Read Data (Function Code: 03)

This function allows the user to obtain various operational statuses of the dual-source ATS. The master can request to read 1 data unit per query.

Example: Read the operational status of the dual-source ATS from a slave with address 01 (01H).

Query Data Frame (Master → Slave):

Address	Command	Start register address (High)	Start register address (Low)	No. of registers (High)	No. of registers (Low)	CRC16 Low	CRC16 High
01H	03H	00H	80H	00H	01H	85H	E2H

Response Data Frame (Slave → Master)

Indicates the dual-source ATS is operating on Source I, with no faults on I/II and no fire alarm linkage.

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Address	Command	Data length	Data 1 ~ 2	CRC16 Low	CRC16 High
01H	03H	02H	00H 01H	79H	84H

2. Remote Fire Alarm Linkage (Function Code: 06)

Enables remote activation of the dual-source ATS fire alarm linkage, executing a dual-disconnection action on the dual-source ATS.

Preset Data Frame (Master → Slave)

Address	Command	Register address (High)	Register address (Low)	Modify data (High)	Modify data (Low)	CRC16 Low	CRC16 High
01H	06H	01H	00H	00H	01H	49H	F6H

Response Data Frame (Slave → Master)

If the data is successfully written to the preset register, the slave echoes the received command frame verbatim.

Address	Command	Register address (High)	Register address (Low)	Modify data (High)	Modify data (Low)	CRC16 Low	CRC16 High
01H	06H	01H	00H	00H	01H	49H	F6H

3. Remote Setting of the Undervoltage Trip Value (Function Code: 06)

Allows remote modification of the dual-source ATS undervoltage action values.

Preset Data Frame (Master → Slave)

Address	Command	Register address (High)	Register address (Low)	Modify data (High)	Modify data (Low)	CRC16 Low	CRC16 High
01H	06H	01H	02H	00H	A0H	29H	8EH

Response Data Frame (Slave → Master)

If the data is successfully written to the preset register, the slave echoes the received command frame verbatim

Address	Command	Register address (High)	Register address (Low)	Modify data (High)	Modify data (Low)	CRC16 Low	CRC16 High
01H	06H	01H	02H	00H	A0H	29H	8EH

If the slave returns a frame in the following format, it indicates invalid data from the master:

Address	Command	Error code	CRC16 Low	CRC16 High
01H	86H	03H	02H	61H

Error Code Definitions:

- 01 Illegal Function Code
- 02 Illegal Data Address
- 03 Illegal Data Value
- 08 CRC Checksum Error

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MODBUS Address Mapping Table

Function Code 03 - Read Register Description

Register address	Item	Description	Response bytes	Remark
0x80	SRS	Dual-source ATS operational status	3, 4	See Response Data Frame Description
0x81	I -Ua	Source I phase A incoming voltage	5, 6	The received power supply incoming voltage values have been pre-scaled by a factor of 10.
0x82	I -Ub	Source I phase B incoming voltage	7, 8	
0x83	I -Uc	Source I phase C incoming voltage	9, 10	
0x84	II -Ua	Source II phase A incoming voltage	11, 12	
0x85	II -Ub	Source II phase B incoming voltage	13, 14	
0x86	II -Uc	Source II phase C incoming voltage	15, 16	
0x87	Uqy	Dual-source ATS undervoltage action value	17, 18	See Response Data Frame Description
0x88	Uqyf	Dual-source ATS undervoltage recovery value	19, 20	
0x89	Ugy	Dual-source ATS overvoltage action value	21, 22	
0x8a	Ugyf	Dual-source ATS overvoltage recovery value	23, 24	See Response Data Frame Description
0x8b	Fun/Time	Dual-source ATS function mode and transfer time	25, 26	
0x8c	Phase/Addr	Dual-source ATS poles detection & communication address	27, 28	Default: 1, not editable
0x8d	PTU	Dual-source ATS incoming power voltage ratio	29, 30	
0x8e	F-time	Generator start signal delay time	31, 32	
0x8f	G-code	Dual-source ATS fault code	33, 34	Normal status: 0

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Function Code 06 - Preset Register Description

Register address	Description	Valid range	
0x100	Remote fire alarm linkage function for dual-source ATS – triggers dual-disconnection action	0x01: Execute dual-disconnection action	
0x101	Remote fire alarm reset function for dual-source ATS	0x01: Execute fire alarm reset action	
0x102	Modify dual-source ATS undervoltage action value	145 -- 200V	
0x103	Modify dual-source ATS undervoltage recovery value	160 -- 220V	
0x104	Modify dual-source ATS overvoltage action value	240 -- 300V	The difference between undervoltage action and recovery values and the difference between overvoltage action and recovery values must be greater than 15V.
0x105	Modify dual-source ATS overvoltage recovery value	220 -- 285V	
0x106	Modify dual-source ATS function mode selection	See Response Data Frame Description	For split-type dual-source ATS only.
0x107	Modify dual-source ATS transfer delay time	0 -- 255s	
0x108	Modify dual-source ATS pole configuration	2 -- 4P	
0x10a	Modify dual-source ATS auto/motorized manual mode	0xa5: Motorized manual mode 0xb5: Auto mode	
0x10b	Dual-source ATS forced transfer operation	0xa1: Normal source 0xa2: Standby source 0xa3: Dual-disconnection Requires motorized manual mode	

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Appendix

Response Data Frame Description

Register address	Information	Response bytes	Description																
0x80	Dual-source ATS operational status	3, 4	Byte 3 Bit Assignment <table><tr><td>Bit7</td><td>Bit6</td><td>Bit5</td><td>Bit4</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr><tr><td>↘</td><td>↘</td><td>↘</td><td>↘</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table> Bit0=1: Source I overvoltage; Bit0=0: Source I no overvoltage Bit1=1: Source II overvoltage; Bit1=0: Source II no overvoltage Bit2=1: Source I undervoltage; Bit2=0: Source I no undervoltage Bit3=1: Source II undervoltage; Bit3=0: Source II no undervoltage	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	↘	↘	↘	↘	0	0	0	0
			Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0									
			↘	↘	↘	↘	0	0	0	0									
Byte 4 Bit Assignment <table><tr><td>Bit7</td><td>Bit6</td><td>Bit5</td><td>Bit4</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr><tr><td>↘</td><td>↘</td><td>↘</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr></table> Bit0 and Bit1: Dual-source ATS action command 01: Source I close action 10: Source II close action 11: Dual-disconnection Bit2: Action abnormal status flag Bit2=1: Action incomplete Bit2=0: Action complete Bit3: Source I/II as normal source selection flag Bit3=0: Source I as normal source Bit3=1: Source II as normal source Bit4: Auto/Motorized manual mode selection Bit4=0: In auto mode Bit4=1: In motorized manual mode For example, when Bytes 3-4 in the response data frame are 01H (00000001) and 02H (00000010) respectively, this indicates the operational status of the dual-source ATS shows an overvoltage condition on Source I while Source II has properly closed and is fully engaged.	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	↘	↘	↘	0	0	0	1	0			
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0												
↘	↘	↘	0	0	0	1	0												
0x8B	Dual-source ATS function mode	25	1 =Auto transfer and auto recovery; 2 =Auto transfer and no auto recovery; 3 =Utility-Generator; 4 =Mutual backup; System default: 1																
	Dual-source ATS transfer time	26	0 -- 99s System default: 0s																
0x8c	Dual-source ATS poles detection	27	2-4P System default: 4P																
	Dual-source ATS communication address	28	1-247 System default: 1																

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Register address	Information	Response bytes	Description																
			Byte 33 is reserved as a null byte (for future use). Byte 34 contains the dual-source ATS fault code, defined as follows:																
			<table><tr><td>Bit7</td><td>Bit6</td><td>Bit5</td><td>Bit4</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr></table>	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	0	0	0	0	0	0	1	0
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0												
0	0	0	0	0	0	1	0												
0x8f	Dual-source ATS fault code	33, 34	Bit0 = 1 -----> Test function failure Bit1 = 1 -----> Dual-disconnection signal not detected Bit2 = 1 -----> Source I close signal not detected Bit3 = 1 -----> Source II close signal not detected Bit4 = 1 -----> Dual-source ATS communication failure with split-type controller Bit5 = 1 -----> Mismatch detected between the feedback signal and actual position (Source I closed) Bit6 = 1 -----> Mismatch detected between the feedback signal and actual position (Source II closed) Bit7 = 1 -----> Mismatch detected between the feedback signal and actual position (zero dual-disconnection)																

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Publication No. MN140002EN
January 2026

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