ATO

Temperature Module
Communication Protocol

ATO

Protocol Description (limited to RS485 signal output; the default address is 01, and all data is in hexadecimal format).

Transmitter Basic Specifications

This protocol follows the Modbus communication protocol and adopts the RTU subset of the Modbus standard. The RS485 interface operates in half-duplex mode.

a) Output Signal: RS485 (transmission distance up to 1000 meters, supports up to 32 nodes)
b) Standard: Modbus-RTU protocol (Function Code 03: Read Data; Function Code 06: Write Configuration Data)
c) Data Format: 9600, N, 8, 1 (9600 bps, no parity, 8 data bits, 1 stop bit)
d) Response Frequency: ≤ 5 Hz
e) Response Time: ≥ 10 ms
f) Resolution: 0.1 ℃

Modbus-RTU Command 03 – Read Data Format

	Device Address	Function Code	Data Address	Number of Registers to Read	CRC16 (Low Byte First)
Master Command	Address	03	00 00	CN	CRC0 CRC1
	Device Address	Function Code	Byte Count	Sensor Data	CRC16 (Low Byte First)
Slave Response	Address	03	02 × CN	S_HN , S_LN	CRC0 CRC1

Communication Example

For a 0 – 100° C sensor with the device address set to 01 (i.e., [Address] = 01, valid address range: 01 – 254). In this case, CRC0 = 84 and CRC1 = 0A.
Master Send: 01 03 00 00 00 01 84 0A
Slave Response: 01 03 02 02 AC B9 59
Here, 02AC is in hexadecimal, which converts to 684 in decimal.
Thus, the current temperature is calculated as:
T = 684 / 10 – 50 = 18.4 ° C

Formula:
When the lower limit of the measurement range ≥ -50° C:
Current Temperature = (Data / 10) – 50
When the lower limit of the measurement range < -50° C:
Current Temperature = (Data / 10) – 200

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Query Example

Reading the current device address can only be completed individually by a single sensor offline.

Master Send: FF 03 00 0F 00 01 A1 D7
Slave Response: FF 03 02 00 01 50 50
Therefore, the device address is 01 (hexadecimal).

Modbus-RTU Write Command 06 – Detailed Description

	Device Address	Function Code	Data Address	New Address	CRC16 (Low before high)
Master Command	Address	06	00 0F	H L	CRC0 CRC1
	Device Address	Function Code	Data Address	New Address	CRC16 (Low before high)
Slave Response	Address	06	00 0F	H L	CRC0 CRC1

Modification Example

For example, changing device address 01 to 09:

Master Send: 01 06 00 0F 00 09 79 CF
Slave Response: 01 06 00 0F 00 09 79 CF

This indicates that the original address 01 has been successfully changed to 09. The address modification can be performed either offline or online, and after completion, there is no need to power cycle the device — it can continue to work directly with the new address.

Precautions for Use

a) The RS485 bus must adopt a daisy-chain bus structure. Do not use star or branched connections. Device addresses should be assigned sequentially from near to far: the management computer connects to controller No.1, controller No.2 connects to No.1, controller No.3 connects to No.2, and so on.

Warning!
b) The AC power supply and chassis of the device must be properly grounded with a reliable earth connection. Be cautious: many outlets with a ground pin are not truly grounded. Proper grounding ensures that in the event of lightning surges, electrostatic discharge, or accumulated static energy, the system’s surge protection can safely release the energy, protecting RS485 bus devices and related chips. If grounding is poor or absent, do not use the RS485 bus, to avoid equipment damage or even personal injury.

c) Use multi-stranded shielded twisted-pair cable with a conductor cross-sectional area of at least 0.3 mm^2 . Multi-stranded wires provide redundancy. Run the cables inside a dedicated PVC conduit, and avoid routing them together with high-voltage power cables to reduce interference.

d) RS485(A) and RS485(B) must be a twisted pair, since RS485 communication is based on differential signaling. Twisted pairs provide strong anti-interference capability. Using non-twisted wires is incorrect and should be avoided.

e) Connect the reference ground (GND) of the RS485 converter and all access controllers in series. Use one or all spare wires in the multi-stranded twisted-pair cable for GND connection. If the reference ground is not properly connected, communication may become unstable due to high-frequency common-mode interference from distributed capacitance and inductance.

f) The shielding layer of the network communication cable must be connected to earth ground. Note: it must be connected to ground, otherwise the bus may pose unknown potential risks.

g) If communication is unstable with multiple slave devices or long wiring distances, install 120 Ω termination resistors between RS485(A) and RS485(B) at both the first and last slave devices on the bus. (Shielded twisted-pair cable must be used.)

h) Properly arrange transmission rate, number of nodes, and transmission distance. Follow the principle: long distance → low baud rate with fewer nodes; short distance → higher baud rate with more nodes.

i) Data communication must include error checking to ensure transmission accuracy. Modbus-RTU generally uses the CRC-16 check mode, achieving an error rate of less than 1 in 1 billion.

j) If necessary, choose the company’ s isolated RS485 modules, though the price is generally higher.