8-Channel Thermocouple Temperature Acquisition Module (Modbus RTU) User Manual

I. Product Overview

This module is part of the PowerIO series of remote temperature acquisition modules, designed specifically for the precise acquisition of temperature signals from 8 thermocouple sensors. It is suitable for applications such as high-temperature environmental monitoring, industrial furnace temperature measurement, and equipment heat flux monitoring, and is widely used in high-temperature industrial sectors including metallurgy, chemical processing, heat treatment, and power equipment. The module utilizes an RS-485 communication bus and the standard Modbus-RTU protocol, enabling seamless integration into third-party application systems and direct compatibility with PLCs and various domestic configuration software. The power supply, RS485 communication, and temperature acquisition channels all feature a 3750 Vrms optically isolated design. With built-in high-precision cold-junction compensation circuits and anti-interference filtering circuits, the module effectively suppresses serial-mode and common-mode interference in industrial environments, ensuring stable and reliable operation under complex high-temperature conditions.

II. Technical Specifications

(1) Operating Conditions

Category	Specific Parameters	Description
Power Input	9-30V DC	Wide voltage compatibility to meet power supply requirements in industrial settings
Power Consumption	＜ 1W	Low-power design for energy efficiency
Ambient Temperature	-40℃~55℃	Wide operating temperature range to withstand harsh environments
Ambient Humidity	10%–90% RH, No condensation	Moisture-resistant design to prevent condensation from affecting performance

(2) EMC Specifications

Protection Type	Specific Parameters
Electrostatic Protection	Contact Discharge: ±6 KV; Air Discharge: ±8 KV
EFT Protection	±2 KV

(3) Physical Dimensions and Structure

• Length × Width × Height: 125 × 73 × 44 mm (standard rail mounting dimensions, suitable for typical industrial installation scenarios)

(4) Communication Parameters

Category	Specific Parameters	Description
Interface Type	RS485, pluggable terminals	Stable connection; easy to install, remove, and maintain
Data Format	N.8.1	Standard data format with strong compatibility
Data Baud Rate	1200–256,000 bps, default 9,600 bps	Adjustable baud rate to accommodate different communication needs
Address Range	1–247 (Cannot be set to 0; 0 is the broadcast address)	Supports networking of multiple modules to prevent address conflicts
Optical Isolation Voltage	3750 Vrms	Strong isolation protection with outstanding interference resistance

(5) Temperature Measurement Parameters

Category	Specific Parameters	Description
Input Channels	8 thermocouple inputs (CH01–CH08)	Independent channel design ensures no mutual interference
Supported Sensor Types	K, E, J, T, B, R, S, and N thermocouples	Supports common industrial thermocouple types; software-configurable
Wiring Configuration	Two-wire differential input	Compatible with standard thermocouple wiring to minimize signal attenuation
Measurement Range	Depends on thermocouple type: Type K: –200°C to 1372°C Type J: –200°C to 1200°C Type S: 0°C to 1768°C Type T: -200°C to 400°C Type E: -200°C to 1000°C Type R: 0°C to 1768°C Type B: 600°C to 1820°C Type N: -200°C to 1300°C	Covers all temperature measurement scenarios, from high to low temperatures
Resolution	16-bit	Temperature resolution of 0.1°C with high data accuracy
Measurement Accuracy	±0.3% (full scale) ±1°C	Includes cold-junction compensation error, ensuring accurate and reliable temperature measurement
Sampling Rate	5 Hz per channel	Suitable for high-temperature, slow-changing applications, balancing accuracy and efficiency
Cold-Junction Compensation	Built-in high-precision hardware cold-junction compensation	Compensation accuracy of ±0.5°C; no additional compensation circuitry required
Input Impedance	≥1 MΩ	High input impedance reduces the impact of thermocouple load
Filtering Function	Built-in digital filtering algorithm	Suppresses high-frequency interference to ensure measurement stability

III. Hardware Installation

(I) Installation Precautions

1• Do not perform hardware installation, wiring, or other operations while the power is on to avoid short circuits or equipment damage;

2• It is recommended to use compensation leads of the corresponding type for thermocouple leads, with the shield grounded at one end, to reduce electromagnetic interference and the effects of ambient temperature;

3• Install the module away from sources of strong electromagnetic interference (such as variable frequency drives and contactors) and areas of high-temperature radiation to ensure cold-junction compensation accuracy;

4• When installing the thermocouple probe, ensure full contact with the object being measured to avoid temperature measurement errors caused by air gaps.

(II) Installation Steps

1. Select an unused section of standard DIN rail. Ensure the rail's mounting surface is flat, secure, and located away from high-temperature areas;

2. Align the rail latches on the back of the module and gently slide the device into the rail until the latches engage securely, completing the installation.

(III) Wiring Instructions

1. Terminal Definitions

No.	Corresponding Location	Interface Name	Signal Description	Remarks
1	P01	TC5+	CH-5 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".
2	P02	TC5-	CH-5 Thermocouple Negative Terminal	
3	P03	TC6+	CH-6 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".
4	P04	TC6-	CH-6 Thermocouple Negative Terminal	
5	P05	TC7+	CH-7 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".
6	P06	TC7-	CH-7 Thermocouple Negative Terminal	
7	P07	TC8+	CH-8 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".
8	P08	TC8-	CH-8 Thermocouple Negative Terminal	
9	P09	Empty	NO Signal	Reserved Interface
10	P010	Empty	NO Signal	Reserved Interface
11	P011	Empty	NO Signal	Reserved Interface
12	P012	VIN-	Power Supply Negative Terminal	
13	P013	VIN+	Power Supply Positive Terminal (9–30 VDC)	
14	P014	TC1+	CH-1 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".
15	P015	TC1-	CH-1 Thermocouple Negative Terminal	
16	P016	TC2+	CH-2 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".
17	P017	TC2-	CH-2 Thermocouple Negative Terminal	
18	P018	TC3+	CH-3 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".
19	P019	TC3-	CH-3 Thermocouple Negative Terminal	
20	P020	TC4+	CH-4 Thermocouple Positive Terminal	Connect the red wire to "+" the negative terminal to "-".

No.	Corresponding Location	Interface Name	Signal Description	Remarks
21	P21	TC4-	CH-4 Thermocouple Negative Terminal	
22	P22	DGND	485-GND	Signal Ground
23	P23	D+	485-A Communication Signal	
24	P24	D-	485-B Communication Signal	
25	P25	GND	Signal Ground	With VIN - Common Ground
26	P26	Empty	NO Signal	Reserved Interface

2. Typical Wiring Scheme (Two-Wire Thermocouple)

1. Identify the thermocouple type (e.g., Type K), select the corresponding compensation leads, and distinguish between the positive and negative terminals (typically red for positive and other colors for negative);

2. Connect the positive terminal (red) of the thermocouple to the “TCx+” terminal of the corresponding channel on the module (e.g., Channel 1 to TC1+);

3. Connect the negative terminal of the thermocouple to the “TCx-” terminal of the corresponding channel on the module (e.g., connect Channel 1 to TC1-);

4. Connect the compensation leads to the thermocouple in a region with normal temperature (recommended <50°C) to avoid high temperatures affecting compensation accuracy;

5. After completing the wiring for all channels, ensure that the leads are securely tightened to prevent loose connections that could cause abnormal temperature readings;

6. When wiring multiple channels, route the wires for each channel independently to avoid crossing or tangling, thereby reducing interference.

3. Precautions for Connecting Multiple Modules

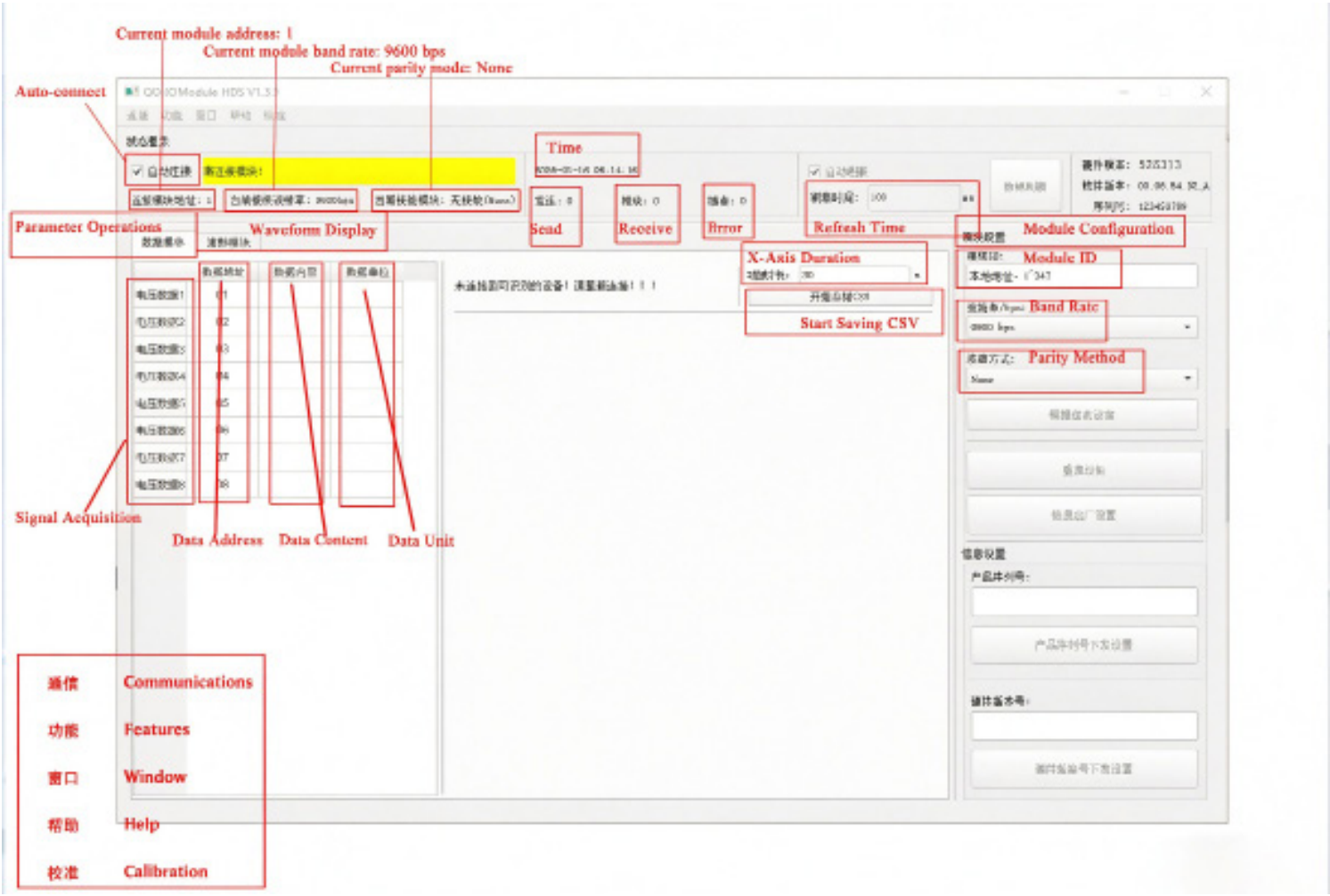
When multiple data acquisition modules are connected to the same RS485 bus, the addresses of each module must not be duplicated; 120Ω terminating resistors may be installed at both ends of the bus (optional) to optimize communication stability over long distances (exceeding 100 meters); the VIN- and GND pins of all modules should share a common ground to reduce interference caused by ground potential differences.

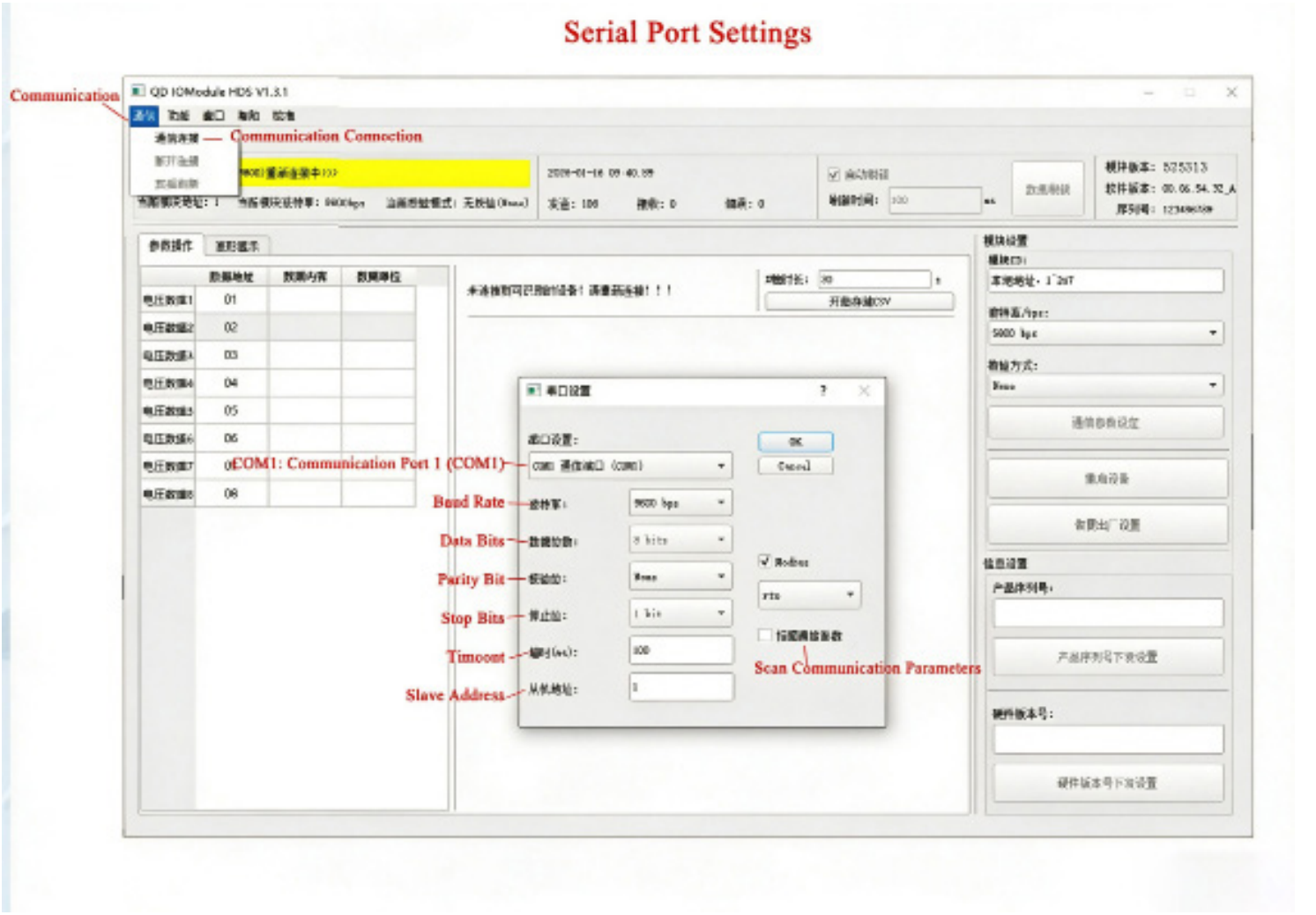
IV. Indicator Light Descriptions

The indicator lights are located on the front of the module and provide visual feedback on the device’s operating status. Their specific meanings are as follows:

No.	Light Name	Status	Description	Remarks
1	POWER (PWR)	Constant On	3.3V power supply is normal	Power Indicator
1	RUN	Flashing	Module is operating normally	Flashing frequency: 1 Hz
1	TX	Flashing	Communication port is sending data	Transmit Indicator
1	RX	Flashing	Communication port is receiving data	Receive Indicator

V. Software Debugging Procedures





(I) Software Preparation
Install the host computer debugging software “QD_IOModule_HDS_xxxx.exe.”

(II) Debugging Steps
1. Double-click the software icon to run the program and open the main interface;
2. Click the “Communication” menu > “Communication Connection,” and select the computer’s serial port number connected to the module;
3. Configure the communication parameters: The default baud rate is 9600 bps, the parity setting is “None,” and the data format is N,8,1;
4. Click the “Connect” button. If the connection is successful, the main interface will display device information such as the module’s hardware version, software version, and current address. If the connection fails, check the selected serial port and the 485 wiring (whether the A and B terminals are reversed);
5. Thermocouple Type Configuration: In the “Sensor Type” section, select the corresponding thermocouple type (K/J/S/T/E/R/B/N) for each channel. Independent channel configuration is supported; click the channel type setting button. Changes take effect immediately without requiring a restart;
6. Temperature Acquisition Test: After a successful connection, select “Automatic Acquisition” to enable continuous data collection. View real-time temperature values for channels CH01–CH08 (in °C, with an accuracy of 0.1°C) in the data display area. During continuous acquisition, you can set the refresh interval (default: 100 ms);
7. Troubleshooting: If a channel displays abnormal temperature readings (e.g., out of range or a fixed value), check whether the sensor wiring and type configuration are correct, and verify that the sensor is intact;
8. Module Configuration: In the “Module Configuration” section, you can modify parameters such as the module address (1–247) and baud rate. Changes take effect only after restarting the device; Supports restoring factory settings to revert to default parameters (address 1, baud rate 9600 bps, all channels set to Type K thermocouple by default);
9. Data Storage: On the waveform display screen, you can view real-time temperature change curves for each channel. Click “Start CSV Storage” to export data for subsequent analysis.

(III) Device Discovery Function
If you are unsure of the module’s baud rate and address, and only one data acquisition module is connected to the computer’s serial port during debugging, you can use the “Scan Communication Parameters” function:
1. Check the “Scan Communication Parameters” button in the software. A confirmation dialog box will pop up; follow the on-screen prompts and select “OK” (supports point-to-point connection only);
2. The software will automatically scan for compatible baud rates and addresses. Upon successful scanning, a pop-up window will appear stating, “Device found with address X and baud rate XXX bps.” Click “OK” to complete device identification.

VI. Communication Protocol (Modbus RTU)
(I) Core Protocol Description
The module uses the Modbus RTU protocol. It supports function codes 03H/04H for reading 8 channels of temperature data, sensor type configuration, and fault status, and function codes 06H/16H for modifying sensor type configuration. Data is transmitted as 16-bit signed integers, with temperature values amplified by a factor of 10 before transmission (e.g., actual temperature 850.5°C, transmitted data is 8505) to facilitate accurate parsing by the host computer.

(2) Register Address Definition

Function Code	Attribute	Register Address	Number of Bytes	Data Type	Name	Remarks
03H/04H	Read-only	0x0000	2	16-bit signed integer	CH-1 temperature	Amplified by 10
03H/04H	Read-only	0x0001	2	16-bit signed integer	CH-2 temperature	Amplified by 10
03H/04H	Read-only	0x0002	2	16-bit signed integer	CH-3 temperature	Amplified by 10
03H/04H	Read-only	0x0003	2	16-bit signed integer	CH-4 temperature	Amplified by 10
03H/04H	Read-only	0x0004	2	16-bit signed integer	CH-5 temperature	Amplified by 10
03H/04H	Read-only	0x0005	2	16-bit signed integer	CH-6 temperature	Amplified by 10
03H/04H	Read-only	0x0006	2	16-bit signed integer	CH-7 temperature	Amplified by 10
03H/04H	Read-only	0x0007	2	16-bit signed integer	CH-8 temperature	Amplified by 10

VII. Precautions

1. Module installation and wiring must be performed with the power turned off. After wiring is complete, carefully inspect the connections to ensure there are no short circuits or reversed polarity before turning on the power;

2. Do not reverse the positive and negative terminals of the thermocouple, as this will result in incorrect temperature readings.