4-20mA or 0-10V to network Modbus TCP and MQTT data acquisition module

WJ181

Product features:

●Convert 4-20mA signal to standard Modbus TCP protocol
● Supports communication protocols such as TCP Server, UDP, MQTT, etc
● Built in web page function, data can be queried through web pages
●Wide power supply range: 8~32VDC
●High reliability, easy programming, and easy application
●Standard DIN35 rail installation, convenient for centralized wiring
●Users can set module IP addresses and other parameters on the webpage
●Low cost, small size, modular design
● Dimensions: 106 mm x 59mm x 37mm

WJ181

Typical applications:

● Signal measurement, monitoring, and MQTT reporting
●Modbus TCP network, data acquisition
●Intelligent building control, security engineering and other application systems
● Industrial automation control system
●Industrial site signal isolation and long-distance transmission
●Equipment operation monitoring, MES system
●Measurement of sensor signals
● Acquisition and recording of industrial field data
●Development of medical and industrial control products
● 4-20mA or 0-5V signal acquisition

Product Overview:

The WJ181 product is an IoT and industrial Ethernet acquisition module that enables transparent data exchange between sensors and networks. The analog data from sensors can be forwarded to the network.

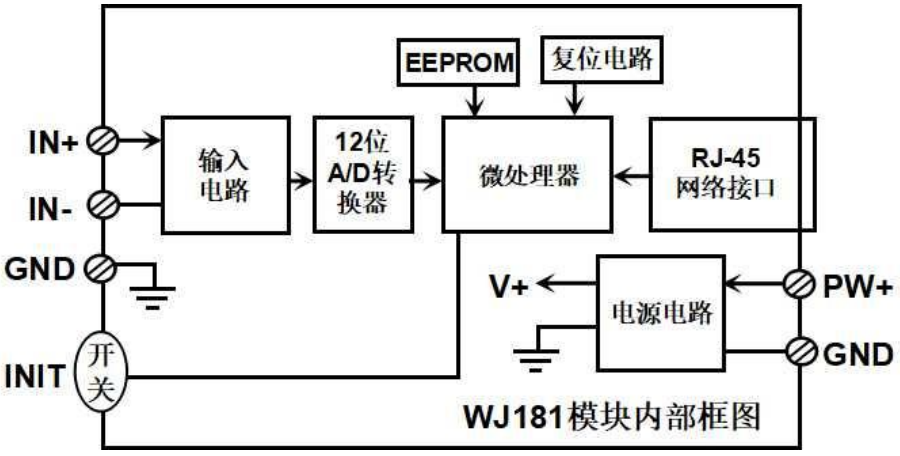


Figure 2 Internal Block Diagram of WJ181 Module

The WJ181 series products include power conditioning, analog acquisition, and RJ-45 network interface communication. The communication method adopts MODBUS TCP protocol. TCP is a transport layer based protocol that is widely used and a reliable connection oriented protocol. Users can directly set module IP addresses, subnet masks, etc. on the webpage. Can be used for monitoring and controlling the operation of sensor devices.

The WJ181 series products are intelligent monitoring and control systems based on microcontrollers, where user set

module IP addresses, subnet masks, and other configuration information are stored in non-volatile memory EEPROM.

The WJ181 series products are designed and manufactured according to industrial standards, with strong anti-interference ability and high reliability. The working temperature range is -45 ℃ to+80 ℃.

Function Introduction:

The WJ181 remote I/O module can be used to measure one analog signal.

1. Analog signal input

12 bit acquisition accuracy, one analog signal input. All signal input ranges have been calibrated before the product leaves the factory. During use, users can also easily program and calibrate themselves. Please refer to the product selection for specific current or voltage input range.

2. Communication Protocol

Communication interface: RJ-45 network interface. The two indicator lights at the network port position, the Link light (green light) stays on and the Data light (yellow light) stays on after the network cable is plugged in.

Communication protocol: MODBUS TCP protocol is adopted to achieve industrial Ethernet data exchange. It can also communicate with modules through TCP sockets.

Network cache: 2K bytes (for both sending and receiving)

Communication response time: less than 10mS.

3. Anti interference

There is a transient suppression diode inside the module, which can effectively suppress various surge pulses and protect the module.

Product model:

WJ181 - U(A)□ - RJ45

Communication interface

RJ45: Output as RJ-45 network interface

Input voltage or current ~~signal va~~lue

U1：0-5V	**A1**：0-1mA
U2：0-10V	**A2**：0-10mA
U3：0-75mV	**A3**：0-20mA
U4：0-2.5V	**A4**：4-20mA
U5：0-±5V	**A5**：0-±1mA
U6：0-±10V	**A6**：0-±10mA
U7：0-±100mV	**A7**：0-±20mA

U8: User defined **A8:** User defined

Selection Example 1: Model: **WJ181-A4-RJ45** represents one 4-20mA signal input and an RJ-45 network interface output

Selection Example 2: Model: **WJ181-U1-RJ45** represents one 0-5V signal input, and the output is an RJ-45 network interface

WJ181 General Parameters:

(Typical @+25 ℃, Vs is 24VDC)

Input type: current input/voltage input

Accuracy: 0.1%

Temperature drift: ± 50 ppm/℃ (± 100 ppm/℃, maximum)

Input resistance: 150 Ω (4-20mA/0-20mA/0- ± 20mA current input)

300 Ω (0-10mA/0- ± 10mA current input)

1.5K Ω (0-1mA/0- ± 1mA current input)
Greater than 200K (5V/10V voltage input)
Greater than 1M Ω (input voltage below 2.5V)
Bandwidth: -3 dB 10 Hz
Conversion rate: 16FPS (factory default value, users can modify the conversion rate on the webpage.)
You can set the AD conversion rate to 2SPS, 4SPS, 8SPS, 16SPS, 32SPS, 50SPS, 80SPS, 100SPS by sending commands
Common mode rejection (CMR): 120 dB (1k Ω Source Imbalance @ 50/60 Hz)
Normal mode suppression (NMR): 60 dB (1k Ω Source Imbalance @ 50/60 Hz)
Input protection: overvoltage protection, overcurrent protection
Communication: MODBUS TCP communication protocol or TCP socket character protocol or MQTT protocol
Web page: Supports web access module and web page setting module parameters.
Interface: RJ-45 network interface.
Communication response time: 10 ms maximum
Working power supply:+8~32VDC wide power supply range, with internal anti reverse and overvoltage protection circuits
Power consumption: less than 3W
Working temperature: -45~+80 ℃
Working humidity: 10~90% (no condensation)
Storage temperature: -45~+80 ℃
Storage humidity: 10~95% (no condensation)
Dimensions: 106 mm x 59mm x 37mm

Pin definition and wiring:

Pin	name	Description	Pin	name	Description
one (Switch)	INIT	Long press for 3 seconds to restore factory settings	**three**	GND	Negative terminal of power supply, signal common ground
			four	PW+	Positive end of power supply
two (Internet port)	RJ-45	RJ-45 network interface	**five**	GND	Signal public area
			six	IN-	Analog signal input negative terminal
			seven	IN+	Analog signal input positive terminal

Note: The pins with the same name are internally connected

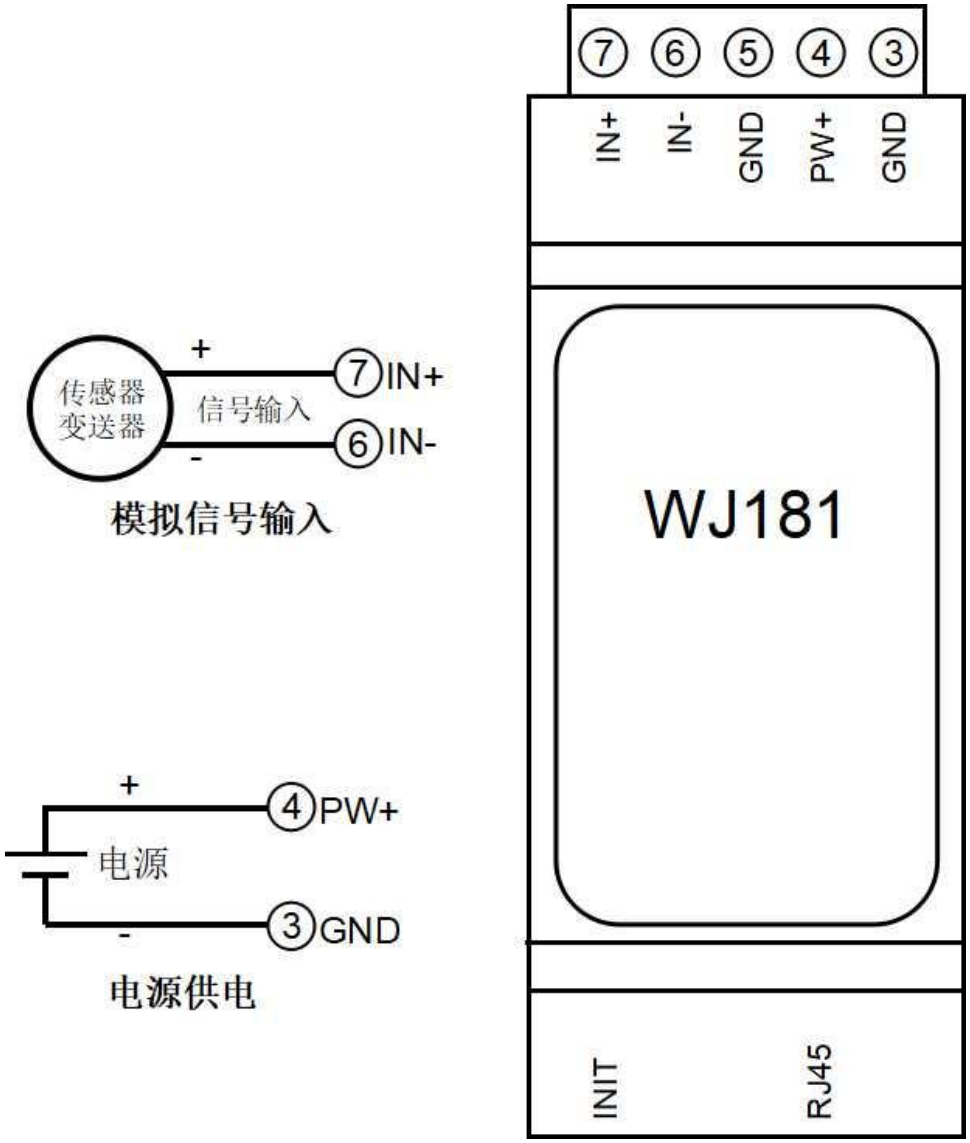
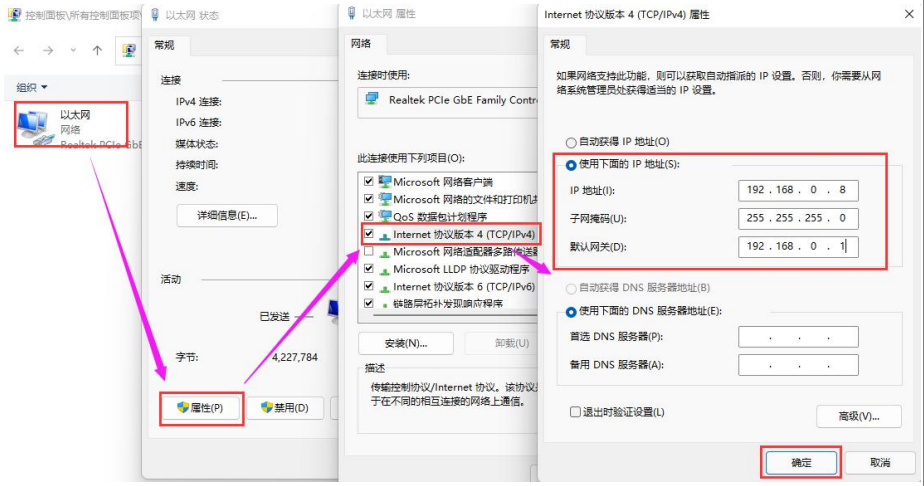


Figure 3 Wiring diagram of WJ181 module

Configure WJ181 module through computer

1、 Connect the module directly to the computer via Ethernet cable and provide power to the module.



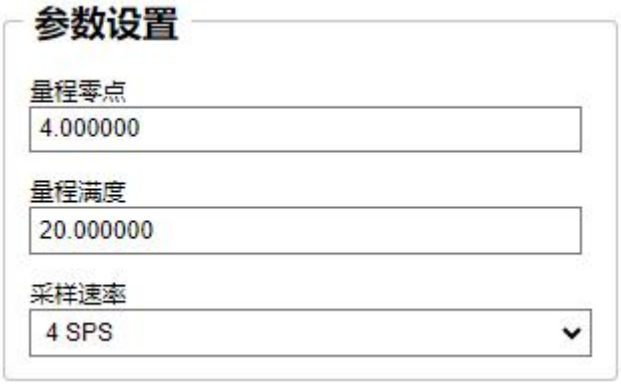
2、 Open the computer "Ethernet" - "Properties" - "Internet Protocol Version 4 (TCP/IPv4)" - Set the computer IP and other information as follows:

“

IP address: 192 168 . 0 eight
Subnet mask: 255 255 . 255 . 0
Default gateway: 192 168 . 0 one

”

3. Open a browser to access: "192.168.0.7"



Click on 'Configure Module Parameters' to set module parameters, as shown in the figure

Click on 'View Data Online' to view module data, as shown in the figure

Character Communication Protocol:

MQTT protocol: After a successful connection, a command is sent to the MQTT subscription topic of the module, and the replied data is displayed on the MQTT publication topic of the module.

Under working modes such as **TCP Server, TCP Client, UDP Mode, Web Socket**, **etc.:** After a successful connection, commands can be sent and data can be received.

（1） Read data command

Send: # 01 (If timed automatic reporting is set, there is no need to send commands, the module will report data at regular intervals)

Reply: {"devName": "98CDAC3FA407", "time": 43545, "ADC": [0], "overrange": [0], actual data ": [0]}

Format Description:

The module name 'devName' can be modified on the webpage as needed

The internal time of the 'time' module, measured in mS.

The AD conversion data collected by the ADC module ranges from 0 to 32767. 0=zero point; 32767=full degree.

For example, 4-20mA input: 0=4mA; 32767=20mA; Users can also directly use the converted engineering values.

OverRanger "0 indicates normal, 1 indicates input signal below zero, and 2 indicates input signal above full scale.

The 'practicalData' data is a value obtained by converting the zero point and fullness set by the user on the webpage. Generally, this value can be directly used for general applications.

No need to process the data in the ADC.

You can also read a single set of data:

#01>ADC **reply:** {"ADC": [32767]}

#01>actual data **reply:** {"actual data": [20000]}

#01>OverRanger **reply:** {"overRanger": [0]}

（2） Set range

Send: $01 {"range": [0,20]}

Reply:! 01 (cr) indicates successful setting? 01 (cr) indicates a command error

3. Read configuration commands

The configuration parameters of the reading module can also be viewed directly on the webpage.

Send:% 01ReadConfig

Reply: {"version": "V1.0", "rangeStart": 4.000000, "rangeEnd": 20.000000, "dataRate": 1, "setIP": 1, "mac": "EE: 86: B0:52:7F:12", "ipAddress": "192.168.0.7", "gateway": "192.168.0.1", "netmask": "255.255.255.0", "work mode": 0, "localPort": 23, "remoteServerIP": "192.168.0.160", "remotePort": 23, "setQuickUp": 0, "sendTime": 0, "devName": EE86B0527F12 "," setMQTT ": 0," mqttHostURL ":" broker. emqx. io "," contentId ":" EE86B0527F12 "," username ":" "," passwd ":" "," topic ":"/wayjun/sub "," port ": 1883," pubTime ": 1000," subtopic ":"/wayjun/sub "}

4. Set configuration commands

The configuration parameters of the module can also be set directly on the webpage. You can set all or some parameters, and the module will automatically restart after setting.

send out:

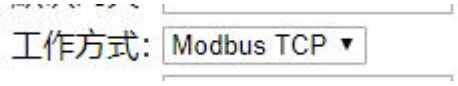
%01WriteConfig{"version":"V1.0","rangeStart":4.000000,"rangeEnd":20.000000,"dataRate":1,"setIP":1,"mac":"EE:86:B0:52:7F:12","ipAddress":"192.168.0.7","gateway":"192.168.0.1","netmask":"255.255.255.0","workmode":0,"localPort":23,"remoteServerIp":"192.168.0.160","remotePort":23,"setQuickUp":0,"sendTime":0,"devName":"EE86B0527F12","setMQTT":0,"mqttHostUrl":"broker.emqx.io","clientId":"EE86B0527F12","username":"","passwd":"","topic":"/wayjun/pub","port":1883,"pubTime":1000,"subtopic":"/wayjun/sub"}

You can also set only a single parameter, such as modifying IP:% 01WriteConfig {"ipAddress": "192.168.0.7"}

Reply:! 01 (cr) indicates successful setting? 01 (cr) indicates a command error

Modbus TCP protocol

The module defaults to one Modbus TCP Server at the factory, no need to set it up, just communicate according to the Modbus TCP protocol. If more Modbus TCP servers are needed, please change the module's working mode to Modbus TCP in the configuration parameters. Supports up to 6 Modbus TCP servers.



(1) Modbus TCP data frames:

Transmission over TCP/IP Ethernet, supporting Ethernet II and 802.3 frame formats. As shown in Figure 3, the Modbus TCP data frame consists of three parts: packet header, function code, and data.

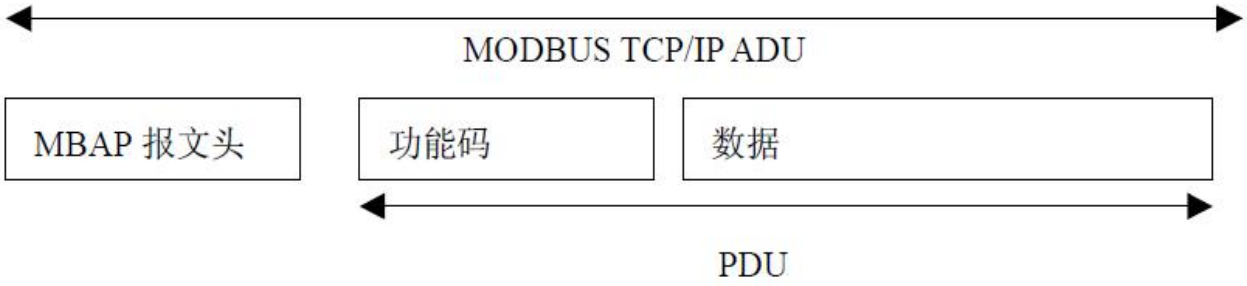


Figure 6: Request/Response of MODBUS on TCP/IP

(2) MBAP message header description:

The MBAP header (MBAP, Modbus Application Protocol, Modbus Application Protocol) is divided into 4 fields, totaling 7 bytes, as shown in Table 1.

Table 1: MBAP Message Header

Domain	Length (B)	Description
Transmission identification	2 bytes	Indicate the transmission of a MODBUS query/response
Protocol Logo	2 bytes	0=MODBUS protocol
Length	2 bytes	Subsequent byte count
Unit identifier	1 byte	Identification code of remote slave station connected on serial link or other bus

(3) Modbus function code:

Modbus function codes are divided into three types, namely:

(1) Public Function Code: Defined function codes that ensure their uniqueness and are recognized by Modbus.org;

(2) There are two sets of user-defined function codes, namely 65-72 and 100-110, which do not require approval but do not guarantee the uniqueness of code usage. If it becomes public code, it needs to be approved by RFC;

(3) The reserved functional code, which is used by certain companies on certain traditional devices, cannot be used for public purposes.

Among the commonly used public function codes, WJ89 supports some function codes, as shown below:

Function code		name	explain
03	Read Holding Register	Read and hold register	1 represents high level, 0 represents low level.

(4) Description of supported function codes

03 (0x03) Read hold register

In a remote device, use this function code to read the contents of consecutive blocks in the hold register. The request PDU specifies the starting register address and the number of registers. Address registers from scratch. Therefore, addressing registers 1-16 are 0-15. In the response message, each register has two bytes, with the first byte being the data high bit and the second byte being the data low bit.

Example of function code 03, read input analog quantity, register address 40001:

request			**response**		
Field Name		**hexadecimal**	**Field Name**		**hexadecimal**
MBAP message header	Transmission identification	01	MBAP message header	Transmission identification	01
		00			00
	Protocol Logo	00		Protocol Logo	00
		00			00
	length	00		length	00
		06			05
	Unit identifier	01		Unit identifier	01
Function code		03	Function code		03
Starting address Hi		00	Byte count		02
Starting address Lo		00	Register value Hi (0x00)		00
Register number Hi		00	Register value Lo (DI7-DI0)		00
Register number Lo		01			

Register **address description for WJ181** (note: addresses are all decimal numbers)

Supports registers with function code 03.

Address 4X (PLC)	**Address (PC, DCS)**	**Data content**	**attribute**	**Data Explanation**
forty thousand and one	0	Input analog quantity	read-only	Signed integer, AD converted value. 0x0000=zero point; 0x7FFF=Full Degree For example, 4-20mA: 0x0000=4mA; 0x7FFF=20mA;
forty thousand and two	one	Is it out of range	read-only	Signed integer, 0 represents normal, 1 represents input signal below zero, and 2 represents input signal above full scale.
40003~40004	2~3	Actual engineering value	read-only	The data is a 32-bit floating-point number stored in CDAB order. It is a value obtained by converting the zero point and fullness set by the user on the

				webpage. For example, if the input signal is 4-20mA, representing a temperature of -20~100 degrees, the zero point can be set to -20 and the full degree can be set to 100. After the setting is completed, the actual engineering value read out is the actual temperature value. Generally, this value can be directly used for general applications. No need to process the data in the 40001 register. Note that some PLCs require swapping of high 16 and low 16 bit SWAPs to read data.
forty thousand two hundred and eleven	two hundred and ten	Module Name	read-only	High bit: 0x01 Low bit: 0x81

Calibration module:

The product has been calibrated before leaving the factory, and users can use it directly without calibration.

During use, you can also use the product's calibration function to recalibrate the module. When in school, the module needs to input appropriate signals, and different input ranges require different input signals.

To improve calibration accuracy, it is recommended to use the following equipment for calibration:

1. A DC voltage/current signal source with stable output and low noise
2. A voltage/current measuring instrument with a precision of 5 and a half bits or higher is used to monitor the accuracy of input signals

Calibration process

1， 1. Connect the corresponding input signal to the channel that needs to be calibrated according to the input range of the module.

2， The zero point of the WJ181 module is calibrated when the zero point signal is input, and the full degree is calibrated when the full degree signal is input. For example, when inputting 4-20mA, input 4mA for zero calibration and 20mA for full calibration. When inputting 0-5V, input 0V for zero calibration and 5V for full calibration.

3， 2. Input zero signal to WJ181 module, usually 4mA or 0V.

4， After the signal stabilizes, send $01 {"calibrationCH0": 0}, and the module will perform zero point calibration.

5， 4. Input a full current or voltage signal to the WJ181 module.

6， After the signal stabilizes, send $01 {"calibrationCH0": 1}, and the module will perform full-scale calibration.

7， 6. Calibration completed

Common problems with WJ181

1. Cross network segment issues

If the IP of the device and the communicating PC are not in the same network segment and are directly connected via Ethernet or under the same sub router, then the two cannot communicate at all.

give an example:

Device IP: 192.168.0.7

Subnet mask: 255.255.255.0

PC's IP: 192.168.1.100

Subnet mask: 255.255.255.0

Due to the device's IP being 192.168.0.7, it is unable to log in to the device's webpage or ping it on the PC.

If you want the two to communicate, you need to set the subnet mask of the device and PC, as well as the subnet mask on the router, to 255.255.0.0, so that you can log in to the module webpage.

2. The device can ping, but the webpage cannot be opened

There may be several reasons for this:

1) The device has set a static IP address that conflicts with the IP addresses of existing devices in the network

2) The HTTP server port has been modified (default should be 80)

3) Other reasons

Solution: Reset the device to an unused IP address; Restore factory settings or enter the correct port when opening the browser.

3. Every once in a while, there is a disconnection and reconnection

Every once in a while, there will be a phenomenon of disconnection and reconnection

Reason: There is an issue of IP address conflict between the serial server and other devices

4. Communication is **abnormal, network connection cannot** be established**, or search cannot** be **found**

The firewall of the current computer needs to be turned off (in the Windows firewall settings)

Three local ports must not conflict, meaning they must be set to different values. Default values are 23, 26, and 29

Having illegal MAC addresses, such as full FF MAC addresses, may result in inability to connect to the target IP address or duplicate MAC addresses.

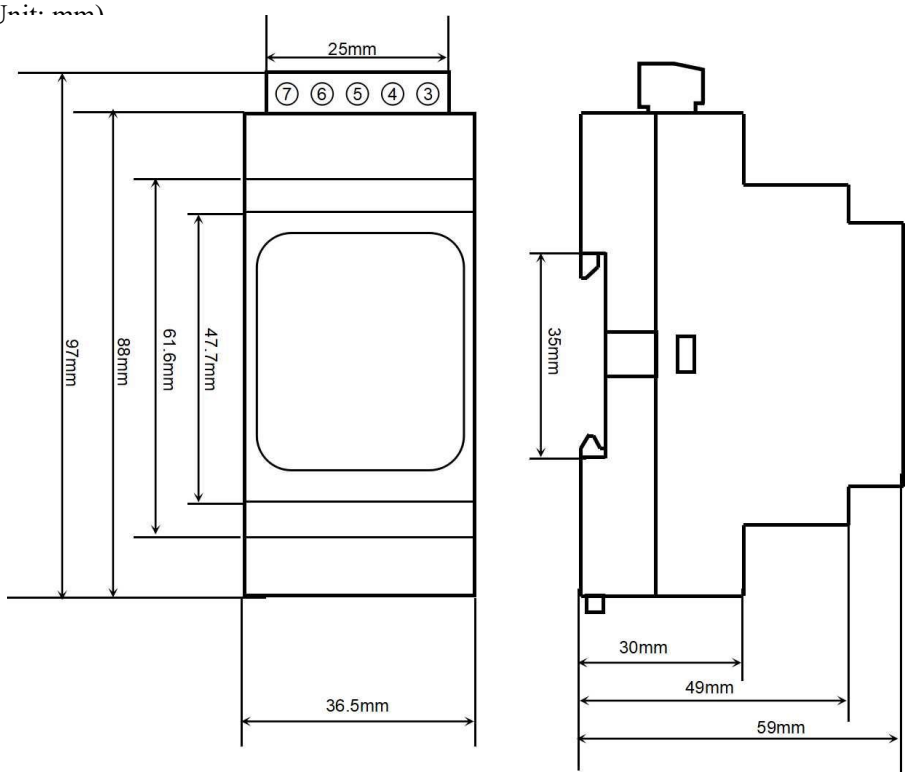
Illegal IP addresses, such as network segments that are not in the same network segment as the router, may not be able to access the external network.

5. Hardware problem search

Poor power supply from the power adapter or poor contact of the plug

If the power light and network port light are not on, it means there is no power supply or the hardware is broken

Dimensions: (Unit: mm)



Can be installed on standard DIN35 rails

guarantee:

Within two years from the date of sale, if the user complies with the storage, transportation, and usage requirements and the product quality is lower than the technical specifications, it can be returned to the factory for free repair. If damage is caused due to violation of operating regulations and requirements, device fees and maintenance fees shall be paid.

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