Analog Signal to RS485/232 Converter

(WJ21 series A/D Converter)

Features:

>> Analog signal acquisition, isolated RS-485/232 output

>> 12-bit AD converter, testing accuracy>0.1%

>> Can Program and calibrate modules accuracy via RS-485/232 interface

>> Three-port isolation (input/output/assistant power supply): 3000VDC

>> Wide power supply: 8~32VDC

>> High reliability, easy programming, easy installation.

>> Can program setting module address, baud rate

>> 0-5V voltage signal or 4-20mA current signal input

>> Supports Modbus RTU protocol

>> DIN35 Rail-mounted

Typical Application:

>> Signal measurement/monitoring/control

>> RS-485 remote I / O, data acquisition

>> RS-232/485 bus industrial automation control system

>> Industrial field signal data acquisition and recording

>> Industrial field signal isolation and long-term transmission

>> Medical, industrial product development

>> 4-20mA or 0-5V signal acquisition

Product Overview:

Figure 1   WJ21

   WJ21 series products realize the signal acquisition between sensor and host, to measure analog signals. WJ21 products can be applied to RS-232/485 bus industrial automation control system,4-20mA / 0-5V signal measurement, monitoring and control,0-75mV ,0-100mV and other small-signal measurement and signal isolation and long-term industrial transmission and so on.

   Products include power supply isolation, signal isolation, linearization, A/D conversion and RS-485 serial communication. Each serial interface can connect up to 255 pieces WJ21 Series modules, communication using ASCII code or MODBUS RTU communication protocol, and its instruction set compatible with the ADAM modules, baud rate can been set by the code, with other manufacturers control module hang in the same RS-485 bus for easy programming.
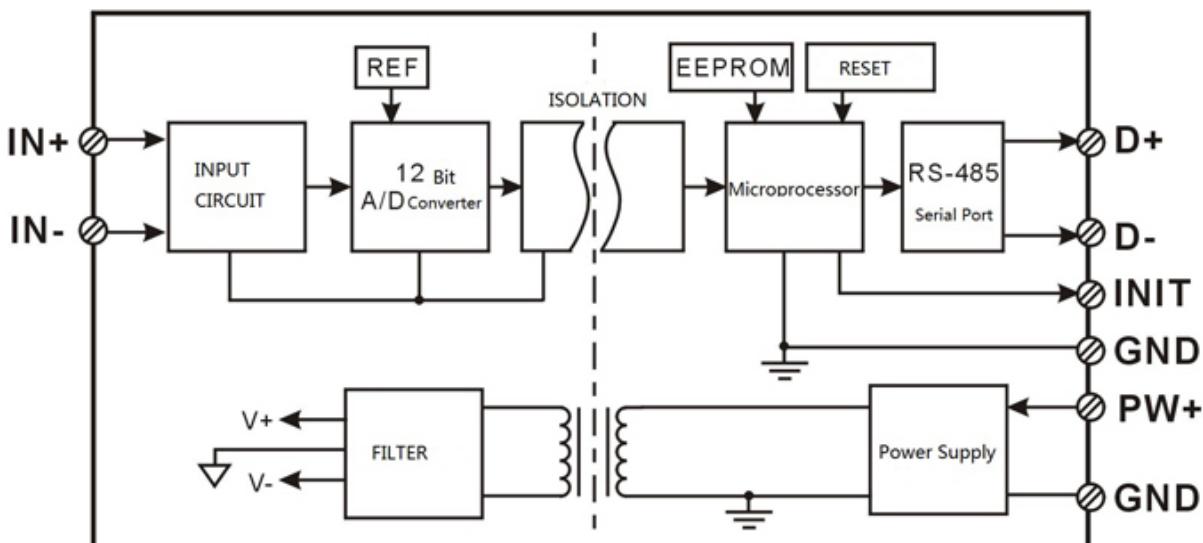

Figure 2   WJ21 Block Diagram

WJ21 series products are based on SCM's intelligent monitoring and control system, users set the calibration value, address, baud rate, data format, checksum status, and configuration information are all stored in nonvolatile memory EEPROM.

WJ21 products are according to industry standard design, isolation between signal input / output, can withstand voltage 3000VDC, high anti-interference ability and reliability. Operating temperature range is - 45 ~ +85 ℃.

Function Description:

WJ21 signal isolation acquisition module can be used to measure one channel voltage or current signal,

1. Analog signal input

12-Bit acquisition accuracy, all products signal input range have been calibrated. In use, users also can program calibration easily.

About the specific current or voltage input range, please see product selection.

2. Communication protocol

Communication Interface: one channel standard RS-485 communication interface, or one standard RS-232 communication interface, specify when ordering.

Communication Protocols: supports two protocols, characters protocol of the command set defined and MODBUS RTU communication protocol. Can be programmed using the kind of communication protocol, can be achieved with PLC, RTU of many Brands or computer monitoring system for network communication.

Data Format: 10 Bits. 1 start bit,8 data bits,1 stop bit.

Address: (0 to 255) and baud rate (2400,4800,9600,19200,38400 bps) can be set, the most long-distance about communication networks is up to 1200 meters, through the twisted-pair shielded cable.

Communication interface of high anti-jamming design, ± 15KV ESD protection, communication response time is less than 100mS.

3. Anti-jamming

According to need to set the checksum. Module internal has transient suppression diodes, can inhibit a variety of surge pulse, protection module, and internal digital filter can also be well suppressed from the grid frequency interference.

Product Selection:

$$\text{WJ21} \quad \text{U(A)} \quad \square \;-\; \square$$
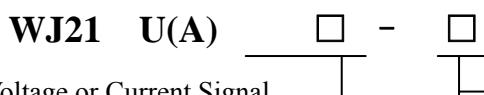
Input Voltage or Current Signal ⎯⎯⎯⎯⎯⎯⎯⎯⎯ ⎯⎯⎯⎯ Interface

U1：0-5V	**A1**：0-1mA	**485**： output is RS-485 interface
U2：0-10V	**A2**：0-10mA	**232**： output is RS-232 interface
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	

Sample 1:   part No.:**WJ21 A4-485**   4-20mA input signal，output is RS485 interface

Sample 1:   part No.:**WJ21 U1-232**   0-5V input signal，output is RS232 interface

General parameters:

(typical @ +25 ℃, Vs to 24VDC)

Input type: Input current / voltage input

Accuracy: 0.1%

Temperature drift:± 30 ppm / ℃ （± 50 ppm / ℃, maximum)

Input Resistance: 50Ω (4-20mA/0-20mA/0- ± 20mA current input)

　　　　　　　100Ω (0-10mA/0- ± 10mA current input)

1KΩ (0-1mA/0- ± 1mA current input)

>1MΩ(voltage input)

Bandwidth: -3 dB 10 Hz

Conversion rate: 10 Sps

Common Mode Rejection (CMR): 120 dB (1kΩ Source Imbalance @ 50/60 Hz)

Normal Mode Rejection (NMR): 60 dB (1kΩ Source Imbalance @ 50/60 Hz)

Input Protection: over-voltage protection, over-current protection

Communication: RS-485 protocol or RS-232 standard characters protocols and MODBUS RTU communication protocol

Baud Rate (2400,4800,9600,19200,38400 bps) can be selected via software

Address (0 to 255) can be selected via software

Communication Response Time: 100 ms maximum

Power Supply: +8 ~ 32VDC wide range power supply, internal anti-reverse and over-voltage protection circuit

Power Loss: less than 1W

Operating Temperature: - 45 ~ +80 ℃

Humidity: 10 ~ 90% (no condensation)

Storage Temperature: - 45 ~ +80 ℃

Storage Humidity: 10 ~ 95% (no condensation)

Isolation Voltage: input / output: 3KVDC, 1 minute, leakage current:1mA

Which output signal and power supply are common ground.

Shock Voltage: 3KVAC, 1.2/50us (peak)

Dimensions: 106.7 mm x 79 mm x 25mm

Footprint Function:

| PIN	Name	Function	PIN	Name	Function
1	PW+	Power+	7	IN+	Input+
2	GND	Power-	8	IN-	Input-
3	INIT	Initialization state set	9	NC	NO PIN
4	D+	RS-485 signal+	10	NC	NO PIN
5	D-	RS-485 signal-	11	NC	NO PIN
6	GND	Power-,Output port ground	12	NC	NO PIN
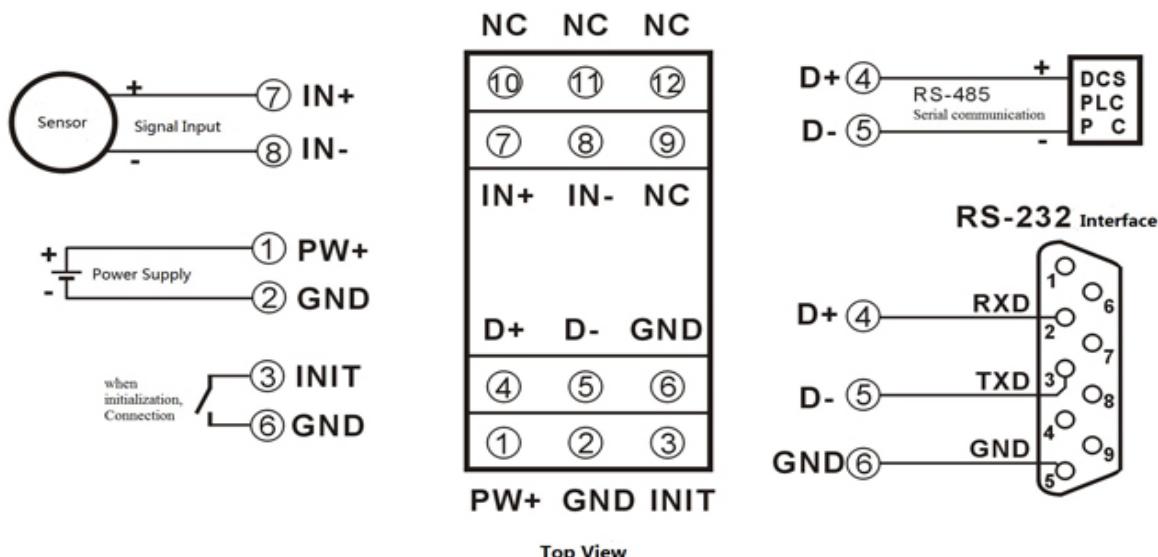
Figure 3   WJ21 Wiring Diagram

Initialization WJ21 modules:

All WJ21 modules, if you use RS-485 network, must be assigned a unique address code, address code value of hexadecimal numbers between 00 and FF. However, all new WJ62 module uses a factory initial settings, as follows:

Address code: 01

Baud rate: 9600 bps

Checksum is disable

As the new module address codes are the same, their address will be contradictory to other modules, so when you set up the system, you must reconfigure each WJ21 module address. WJ21 module can be connected the power cord and RS485 communication lines, through configuration commands to modify the WJ21 module address. Baud rate, parity and status, communication protocols also need to be adjusted according to user requirements. In the modified baud rate, parity and status, communication protocol, you must first enter the module to the default state, or can not be modified.

Let the module into the default state:

WJ21 module has a special INIT pin. Connecting the INIT PIN to ground (GND PIN), then open power, the module into the default state. In this state, the module is configured as follows:

Address code 00

9600 bps baud rate

Checksum is disable

At this time, via configuration commands you can modify the WJ21 module baud rate, parity, checksum state and other parameters, by setting the module communication protocol command to select the communication protocol. When are not sure a module specific configuration, can also be configured by installing the jumper, so that the module into the default state, then reconfigure the module. If clients need set the module to MODBUS RTU communication protocol, see the MODBUS protocol section for instructions.

WJ21 character protocol command set:

Order is by a series of characters, such as first code, address ID, variables, an optional checksum byte and a terminator **(cr)** which can show command. In addition to wildcard address "**"synchronization command, the host only commands a WJ31 module once.

Command format: **(Leading Code) (Addr) (Command) [data] [checksum] (cr)**

(Leading code) prefix is the first letter of the command. All commands require a command prefix, such as %,$,#,@,... etc. **1 - Character**

(Addr) module address code, if not specified below, range is from 00 ~ FF (hexadecimal). **2 - Character**

(Command) shows the command code or variable values. **Variable length**

[Data] some output command needs data **Variable length**

[Checksum] brackets Checksum (checksum) shows an optional parameter, only the checksum is enabled, need this option. **2 - Character**

(Cr) a control code character as identify , **(cr)** as a carriage return character, its value is 0x0D. **1 - Character**

When enabled checksum (checksum), users need [Checksum]. It accounted for 2 - character. Commands and responses must be attached checksum feature. Checksum used to check all input commands to help you find the host to the module command module to the host response to errors and mistakes. Checksum characters placed in command or in response to the character after the carriage return before.

Calculated as follows: two characters, the hexadecimal number for all issued prior to the ASCII values of and, then with hexadecimal digits 0xFF phase proceeds.

Examples: Disable checksum (checksum)

command: **$002(cr)**

response: **!00020600 (cr)**

Enable checksum

command: **$002B6 (cr)**

response: **!00020600 A9 (cr)**

'$' = 0x24   '0' = 0x30   '2' = 0x32

B6=(0x24+0x30+0x30+0x32) AND 0xFF

'!' = 0x21   '0' = 0x30   '2' = 0x32   '6' = 0x36

A9=(0x21+0x30+0x30+0x30+0x32+0x30+0x36+0x30+0x30) AND 0xFF

Command response:

Response message depends on a variety of commands. Response also is consists of several characters, includes leading code, variables and end tags. The first code of response signal has two:'**!**' Or '**>**' indicates that a valid command and '**?**' means invalid. By checking the response information, you can monitor whether the command is valid

Note:

1. In some cases, many commands use the same command format. To ensure that you use a command in the address is correct, if you use the wrong address and this address represents another module, then the command will take effect in another module, resulting in an error.

2. the command must be entered in uppercase letters.

1、Read Measurement Data Command

Description: Returns the analog input measurement data from the module in the currently configured data format

Command Format：**#AA(cr)**

Parameters: # delimiter character. Hexadecimal 23H

         AA module address, range is 00-FF(hexadecimal). Factory address is 01, converted to hexadecimal ASCII code for each character. Such as address 01 into hexadecimal are 30H and 31H.

    (cr)   is the terminating character, carriage return (0Dh)

Response：   **>(data)(cr)**   command is valid.

            ?AA(cr)   invalid command or illegal operation.

Parameter Description: >   delimiter character

         (data)   Returns data. The data format is in Engineering Units，Percent of FSR, Two's complement hexadecimal, Hexadecimal is each character ASCII code .Refer to Chapter 2 Command Set.

         (cr)   terminating character, carriage return (0Dh)

There is no response if the module is format error or communication error or address does not exist, the module does not respond. If you are using serial communication software, but can not enter the return key characters, please switch to hexadecimal format for communicate

  Example: Commands (character format)   **#01(cr)**

            (Hexadecimal format)   **2330310D**

      Module response (character format)   **>+16.000 (cr)**

            (Hexadecimal format)   **3E2B31362E3030300D**

 Description: In the address 01H module, input is (Data format is engineering units): +16.000 mA

2、Set WJ21 Module Command

Description: Set address, input ranges, baud rate, data formats, checksum state for a analog input module, counter data are stored in a EEPROM.

Command Format: **%AANNTTCCFF(cr)**

Parameter :   **%**   delimiter character

        AA   module address, (range 00-FF) represents the 2-character hexadecimal

        NN   indicates new module hexadecimal address, value NN range is 00~FF

        TT   hexadecimal indicates type code.WJ21 must been set 00

CC   Baud Rate code (hexadecimal)

Baud rate code	Baud rate
04	2400 baud
05	4800 baud
06	9600 baud
07	19200 baud
08	38400 baud

Table 2   Baud rate code

FF   Hexadecimal 8-bit represents the data format, checksum. Note from bits2 to bits5 not be set to zero.

Bit7	Bit 6	Bit 5	Bit 4	Bit 3	Bit2	Bit 1	Bit 0

Table 3   Data format, checksum code

Bit7：Reserved bits (must set to 0)

Bit6：checksum states, if 0:Disabled, if 1: Enabled

Bit5-bit2：Not used(must set to 0)

Bit1-bit0：Data Format Bit

　　00：Engineering Units

　　01：% of FSR

　　10：Twos complement hexadecimal

(cr)   terminating character, carriage return (0Dh)

Response: !AA(cr)   command is valid

?AA(cr) command is invalid or illegal operation, or do not set up line before changing baud rate or checksum

Parameter Description:

!   delimiter character which indicates a valid command.

?   delimiter character which indicates a invalid command.

AA   represents input module address

(cr)   terminating character, carriage return (0Dh)

If you configure module for the first time, AA=00 and NN equal to new address. If reconfigure module changing address, input range, data formats, AA equals to present configured address, NN equals to the current or new address. If reconfigure module changing baud rate or checksum state, must install command string, make them in listening mode, module address is 00H, also AA=00H, NN=present or new address.

There is no response if the format error or communication error or address does not exist.

Example: command   %0011000600(cr)

response   !11(cr)

Description: %   delimiter character

00   indicates you want to configure the WJ21 module original address set to 00H.

11   indicates new module hexadecimal address is 11H

00   indicates type code, WJ21 must been set to 00

06   indicates baud rate: 9600 baud

00   indicates data format is Engineering Units，checksum is disabled

3、Read Set Status Command

Description: Read configuration for a specified WJ21 module.

Command Format**:** $AA2(cr)

Parameter: **$** delimiter character

      AA module address, (range 00-FF) represents the 2-character hexadecimal

      2 indicates read set state command

      (cr) terminating character, carriage return (0Dh)

Response: !AATTCCFF(cr) command is valid

      ?AA(cr) command is invalid or illegal operation

      ! delimiter character

      AA represents input module address

      TT Type Code

      CC Baud rate code, Table 2

      FF Table 3

      (cr) terminating character, carriage return (0Dh)

    There is no response if the format error or communication error or address does not exist.

Example: **command** **$302(cr)**

        response **!300F0600(cr)**

      ! delimiter character

      30 indicates WJ21 module address is 30H

      00 indicates input type code

      06 represents that baud rate is 9600 baud

      00 represents that data format is Engineering Units, disable checksum

4、Offset Calibration Command

Description: Calibrates an analog input module offset errors

Command Format**:** $AA1(cr)

Parameter: **$** delimiter character

      AA module address, (range 00-FF) represents the 2-character hexadecimal

      1 represents offset calibration command

      (cr) terminating character, carriage return (0Dh)

Response: ! AA (cr) command is valid

      ?AA(cr) command is invalid or Illegal operation

      ! delimiter character which indicates a valid command.

      ? delimiter character which indicates a invalid command.

      AA represents input module address

      (cr) terminating character, carriage return (0Dh)

    Products have been calibrated, user can use them directly. After calibrating offset command, then calibrate gain errors. During calibration, WJ21 modules need to be connected to the input of the appropriate input signal. Different input range requires a different input voltage or current. (See following Calibration information)

    There is no response if the format error or communication error or address does not exist.

Example: **command** **$231(cr)**

        response **!23 (cr)**

Calibrate offset at address 23H module.

5、Span Calibration Command

Description: Calibrates an analog input module gain errors

Command Format**:** $AA0(cr)

Parameter: **$** delimiter character

AA module address, (range 00-FF) represents the 2-character hexadecimal

0 represents gain calibration command

(cr) terminating character, carriage return (0Dh)

Response: **!AA(cr)** command is valid

?AA(cr) command is invalid or illegal operation

! delimiter character which indicates a valid command.

? delimiter character which indicates a invalid command.

AA represents input module address

(cr) terminating character, carriage return (0Dh)

Products have been calibrated, user can use them directly. After calibrating offset command, then calibrate gain errors. During calibration, WJ21 module needs to be connected to the input of the appropriate input signal. Different input range requires a different input voltage or current. (See following Calibration information)

There is no response if the format error or communication error or address does not exist.

Example: **command** **$230(cr)**

Response **!23 (cr)**

Calibrate gain errors at address 23H module.

6、Read Module Name Command

Description: Return the module name from the specified analog input module

Command Format**: $AAM(cr)**

Parameter: **$** delimiter character

AA module address, (range 00-FF) represents the 2-character hexadecimal

M represents Read module name command

(cr) terminating character, carriage return (0Dh)

Response:!AA(Module Name)(cr) command is valid

?AA(cr) command is invalid or illegal operation

! delimiter character which indicates a valid command.

? delimiter character which indicates a invalid command.

AA represents input module address

(Module Name) module name WJ21

(cr) terminating character, carriage return (0Dh)

There is no response if the format error or communication error or address does not exist.

Example: **command** **$08M(cr)**

response **!08WJ21 (cr)**

Module is WJ21 at address 08H

7、Set Communication Protocol Command.

Description: Set the module communication protocol to characters protocol or Modbus RTU protocol.

Command Format**: $AAPV(cr)**

Parameter: **$** delimiter character

AA module address, (range 00-FF) represents the 2-character hexadecimal

P set communication protocol command

V protocol code, 0 or 1

0： characters protocol

1： Modbus RTU protocol

(cr) terminating character, carriage return (0Dh)

Response: **!AA(cr)** command is valid

?AA(cr)   command is invalid or illegal operation

!   delimiter character which indicates a valid command.

?   delimiter character which indicates a invalid command.

AA   represents input module address

(cr)   terminating character, carriage return (0Dh)

There is no response if the format error or communication error or address does not exist.

Set command protocol must be effective by default.

Example: **command**   **$00P1(cr)**

            response   **!00 (cr)**

Set protocol command to characters protocol

Input Ranges& Data Formats

WJ21 uses three data formats: 00：Engineering Units

                                01：% of FSR

                                10：Twos complement hexadecimal

Input Range	Data Format	+F.S.	ZERO	-F.S	Displayed Resolution
A1：0-1mA A5：0-±1mA	Engineering Units	+1.0000	±0.0000	-1.0000	0.1uA
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
A2：0-10mA A6：0-±10mA	Engineering Units	+10.000	±00.000	-10.000	1uA
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
A3：0-20mA A4：4-20mA A7：0-±20mA	Engineering Units	+20.000	±00.000	-20.000	1uA
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
U1：0-5V U5：0-±5V	Engineering Units	+5.0000	±0.0000	-5.0000	100uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
U2：0-10V U6：0-±10V	Engineering Units	+10.000	±00.000	-10.000	1mV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
U3：0-75mV	Engineering Units	+75.000	±00.000	-75.000	1uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
U4：0-2.5V	Engineering Units	+2.5000	±0.0000	-2.5000	100uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
U7：0-100mV	Engineering Units	+100.00	±000.00	-100.00	10uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB
A8：user-defined U8：user-defined	Engineering Units	+100.00	±000.00	-100.00	0.01%
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Twos complement hexadecimal	7FFFFF	000000	800000	1LSB

Table 4   Input Range and Data Format

Example:

1. Input Range is A4:4-20mA, Input is 4mA:

	Command	**#01(cr)**
Engineering Units	Response	**>+04.000(cr)**
Percent of FSR	Response	**>+020.00(cr)**
Twos complement	Response	**>199999(cr)**

2. Input Range is U1:0-5V, Input is 3V

	Command	**#01(cr)**
Engineering Units	Response	**>+3.0000(cr)**
Percent of FSR	Response	**>+060.00(cr)**
Twos complement	Response	**>4CCCCC(cr)**

Module Calibration:

We have calibrated the module, the user can use directly.

You can also use the product calibration function to re-calibrate the module. During calibration, the module need to been entered the appropriate signal, different input range needs different input signals.

In order to improve calibration accuracy, it is recommended to calibrate using the following equipment:

1. A stable output, low noise DC voltage / current signal source
2. A five and a half or more high-precision voltage / current measuring instruments to monitor the accuracy of the input signal

Calibration:

1. According to the module input range, connects to the corresponding input signal.

Which WJ21 module zero calibration is at input 0,full scale calibration is at the input full-scale 120% . For example, input signal is **4-20mA**, when calibrate zero, input **0mA**, when full-scale calibration, input **24mA**.

input signal is **0-5V**, when calibrate zero, input **0V**, when the full-scale calibration, input **6V**.

2. To WJ21 module input zero signal, usually is **0mA** or **0V**.
3. Until the signal stabilized, send the offset calibration **$ AA1** command to WJ21 module.
4. To WJ21 module input 120% of full scale current or voltage signal.
5. Until the signal is stable, send the gain calibration **$ AA0** command to WJ21 module.
6. Finished

Modbus RTU communication protocol:

Module default protocol is character communications protocol. If you need to set the module to Modbus RTU protocol, please follow these settings:

1. Short connect INIT pin (pin 8) and GND pin (pin 7).
2. Connect the power cord and the communication interface cable.
3. Turn on the power, the module enters the default state automatically, address 00, baud rate 9600.
4. Wait 1 minute, module is initialization.
5. Send the command **$00P1(cr)**, check the response, if is **!00 (cr),** set successfully.
6. Turn off the power, disconnect the INIT and GND connections.
7. The module has been set to the Modbus RTU protocol mode successfully.

Register Description:

Address 4X（PLC）	Address（PC，DCS）	Data	Property	Data Explanation
40001	0001	Input Analog Signal	Read Only	Measured data
40211	0211	Module Name	Read Only	High:0x00　Low:0x21

Table 5 Modbus RTU register description

Size(unit:mm)
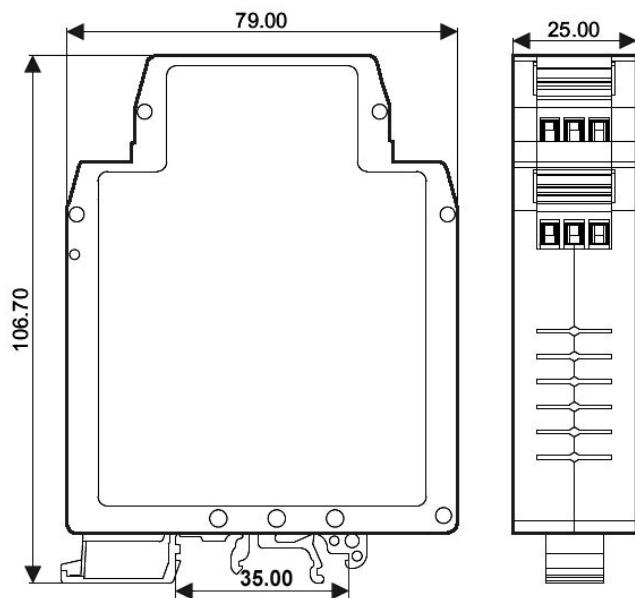
Standard DIN35 Rail

Warranty

Two years (but violate operating rules and requirements to create damage, clients need pay maintenance costs)

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