WJ121 series Analog Signal to RS485/232 Converter

(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

>> Signal input/output: 1000VDC Isolation

>> 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

>> Size: 105.5x24x59mm

>> AD conversion rate can be programmed

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

Figure 1   WJ121

Product Overview:

WJ121 series products realize the signal acquisition between sensor and host, to measure analog signals. WJ121 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 WJ121 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.
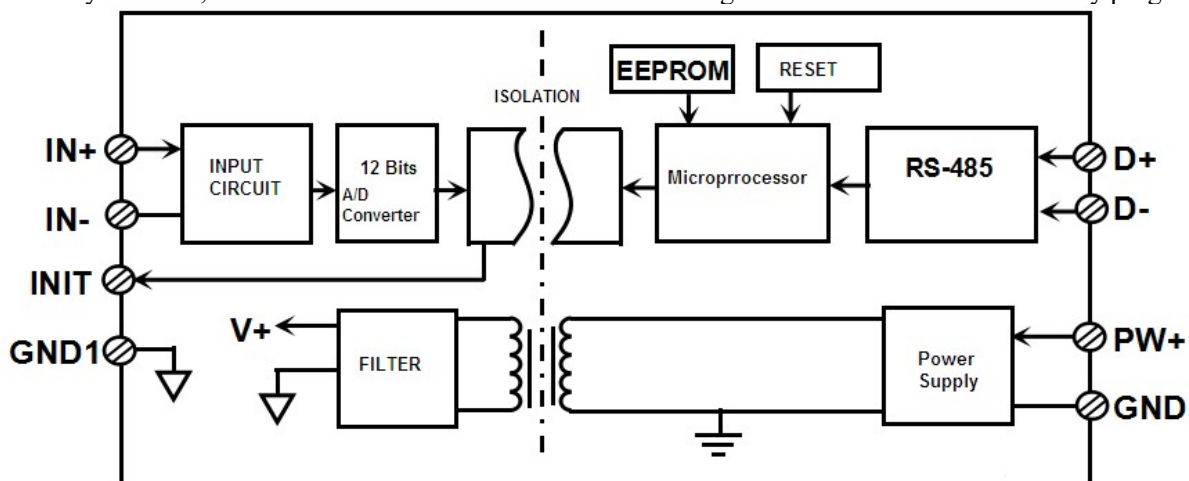

Figure 2   WJ121 Block Diagram

WJ121 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.

WJ121 products are according to industry standard design, isolation between signal input / output, can withstand voltage 1000VDC, high anti-interference ability and reliability. Operating temperature range is - 45～+85 ℃.

Function Description:

WJ121 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:

$$\text{WJ121} \quad \text{U(A)} \quad \square \quad - \quad \square$$

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.:**WJ121-A4-485**   4-20mA input signal，output is RS485 interface

Sample 2: part No.:**WJ121-U1-232**   0-5V input signal，output is RS232 interface

Sample 3: part No.:**WJ121-U8(U8:0-12V)-485**   0-12V input signal，output is RS485 interface

General parameters:

(typical @ +25 ℃, Vs to 24VDC)

Input type: Input current / voltage input

Accuracy: 0.1%

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

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

300Ω (0-10mA/0- ± 10mA current input)

1.5KΩ (0-1mA/0- ± 1mA current input)

>200K (5V/10V voltage input)

>1MΩ (<2.5V voltage input)

Bandwidth: -3 dB 10 Hz

Conversion rate: 10 Sps (factory default, the user can send commands to modify the conversion rate)

You can set the AD conversion rate 2.5 SPS, 5 SPS, 10 SPS, 20 SPS.

(Channel conversion rate = AD conversion rate / Open numbers of channel)

NOTE: after Modify the conversion rate, need re-calibration module, otherwise the measurement data will be biased. You can also specify the conversion rate when ordering, we press the conversion rate you require recalibration in the factory.

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: 1KVDC, 1 minute, leakage current:1mA

Which output signal and power supply are common ground.

Shock Voltage: 1KVAC, 1.2/50us (peak)

Dimensions: 79 mm x 69.5 mm x 25mm

Footprint Function:

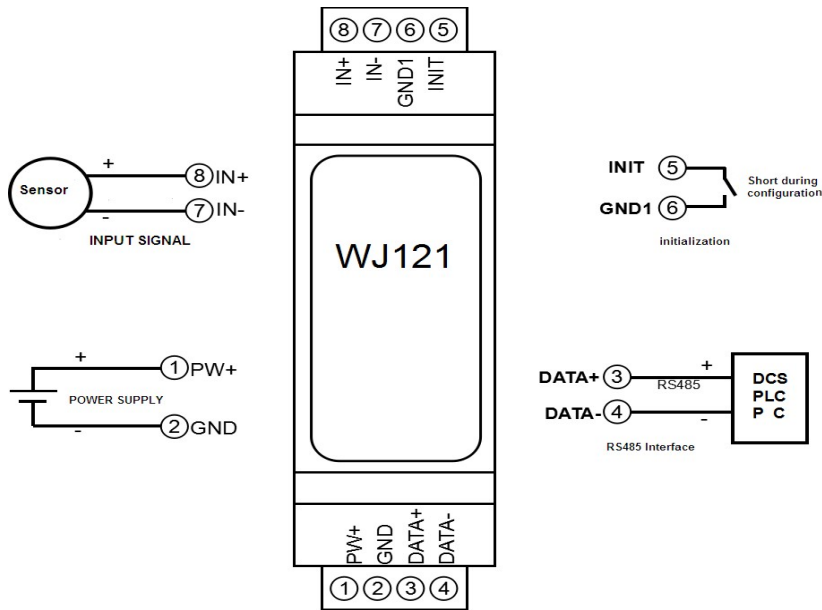| PIN	Name	Function	PIN	Name	Function
1	PW+	Power+	5	INIT	Initial state setting
2	GND	Power-	6	GND1	Digital signal output ground
3	DATA+	RS-485 signal+	7	IN-	Input-
4	DATA-	RS-485 signal-	8	IN+	Input+

Figure 3   WJ121 Wiring Diagram

Initialization WJ121 modules:

All WJ121 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 WJ21 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 WJ121 module address. WJ121 module can be connected the power cord and RS485 communication lines, through configuration commands to modify the WJ121 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:

WJ121 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 WJ121 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.

WJ121 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 WJ21 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 Analog input module Data Command

    Description: Returns the analog input measurement data from the module

    Command Format：**#01**

    Parameters: # delimiter character.

         01 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)   **>+18.000 (cr)**

          (Hexadecimal format)   **3E2B31382E3030300D**

    Description: In the address 01H module, input is (Data format is engineering units): +18.000 mA

2、 Set WJ121 Module Command

    Description: Set address, input ranges, baud rate, data formats, checksum and 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.WJ121 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
09	57600 baud
0A	115200 baud

Table 2   Baud rate code

FF   Hexadecimal 8-bit represents the data format, checksum. Note from bits0 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 and 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**   **%0111000600(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

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00   indicates data format is Engineering Units，checksum is disabled

3、Read Set Status Command

Description: Read configuration for a specified WJ121 module.

Command Format：   **$012(cr)**

Parameter： **$**   delimiter character

01   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 $012(cr)

response   !300F0600(cr)

!   delimiter character

301   indicates WJ121 module address is 01H

00   indicates input type code

06   represents that baud rate is 9600 baud

00   represents that data format is Engineering Units, disable checksum

4、Span Module Calibration Command

Description: Calibrates an analog input module offset errors

Command Format：   **$AA0D (span)**

Parameter： **$**   delimiter character

AA   module address, (range 00-FF) represents the 2-character hexadecimal. The factory address is 01, which is converted into hexadecimal ASCII code for each character. For example, the address 01 is replaced by hexadecimal as 30H and 31H.

0   Set range command

D   Set the data format, the data has several decimals, and the value range is 0～4. For example, 3 means 00.000, with 3 decimals.

(span)   Indicates the full scale of the channel, a symbol plus 5 numbers, no decimal point. For example, 100 can be set to +00100

Response: ! AA (cr)   command is valid

?AA(cr)   command is invalid or Illegal operation

Example 1:   Set the module to display output according as the actual 0-5000.0

command $0101+05000

response   !01 (cr)

$ delimiter character

01   module address

0   Set range command

1   means there is 1 decimal

+05000   the range is 5000

The format of the data display after the setting is completed: +1234.5

5、Read Module Range Command

Description: Read Module Range.

Command Format: **$AA1**

Response: **! AA1D (span) (cr)**   command is valid

　　　　　　?AA(cr)　　　　　command is invalid or illegal operation

Example:　command　**$011**

　　　　　Response　　**!0113+00100 (cr)**

　　　!　　delimiter character

　　01　　module address

　　1　　read range command

　　3　　means there is 1 decimal

　+00100　Indicates that the full scale is 100

6、Set module AD conversion rate

Description: Set the module AD conversion. Channel conversion rate = AD conversion rate / Open numbers of channel The slower sampling rate, the more accurate data collection. The user can send commands to modify the conversion rate, the factory default is 10 SPS.

　　　NOTE: after Modify the conversion rate, need re-calibration module, otherwise the measurement data will be biased. You can also specify the conversion rate when ordering, we press the conversion rate you require recalibration in the factory.

Command Format:　**$AA3R**

Parameter:　**$**　　delimiter character

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

　　　　　3　　represents setting conversion rate command

　　　　　R　　conversion rate code (0~3)

Code R	0	1	2	3
conversion rate	2.5 SPS	5 SPS	10 SPS	20 SPS

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.

Example 1:　　command　　**$0032(cr)**

　　　　　　　response　　**!00 (cr)**

　　set module AD conversion rate for 10SPS

Example 2:　　command　　**$0033(cr)**

　　　　　　　response　　**!00 (cr)**

　　set module AD conversion rate for 20SPS

7、Read module AD conversion rate

Description: Read the module AD conversion. Channel conversion rate = AD iconversion rate / Open numbers of channel. The slower sampling rate, the more accurate data collection.

Command Format: **$AA4(cr)**

Parameter: **$** delimiter character

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

4 represents setting conversion rate command

Response: !AAR(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

R conversion rate code (0~3)

Code R	0	1	2	3
conversion rate	2.5 SPS	5 SPS	10 SPS	20 SPS

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

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

Example 1: **command** **$004(cr)**

response **!002 (cr)**

Current module AD conversion rate for 10SPS

Example 2: **command** **$004(cr)**

response **!003 (cr)**

Current module AD conversion rate for 20SPS

8、Set all the parameters set by the above character command to restore the factory settings.

Description: The parameters set by the above character command in the setting module are restored to the factory settings.

Command Format**: $AA900** Set parameters to restore factory settings.

Parameter: **AA** module address, the value range is 00～FF (hexadecimal). The factory address is 01, which is converted into hexadecimal ASCII code for each character. For example, the address 01 is replaced by hexadecimal as 30H and 31H.

Response: ! AA(cr) means the setting is successful, and the module will automatically restart.

Example: **command(character format)** **$01900**

Response(character format) **! 01(cr)**

The parameters are restored to factory settings

Modbus RTU communication protocol:

The initial factory settings of the module are as follows:

Modbus address is 01

Baud rate 9600 bps

How to make the module enter the default state:

　　The WJ121 module has a special pin labeled INIT. Short-circuit the INIT pin to the GND1 pin, and then turn on the power supply, and the module enters the default state. In this state, the module temporarily restores to the default state: the address is 01 and the baud rate is 9600. When unsure of the specific configuration of a certain module, the user can query the address and baud rate registers 40201-40202 to get the actual address and baud rate of the module, and can also modify the address and baud rate as needed.

Support MODBUS RTU communication protocol **function code 03** (read holding register) and **function code 06** (write single register), the command format is in accordance with the standard Modbus RTU communication protocol.

MODBUS software test example:
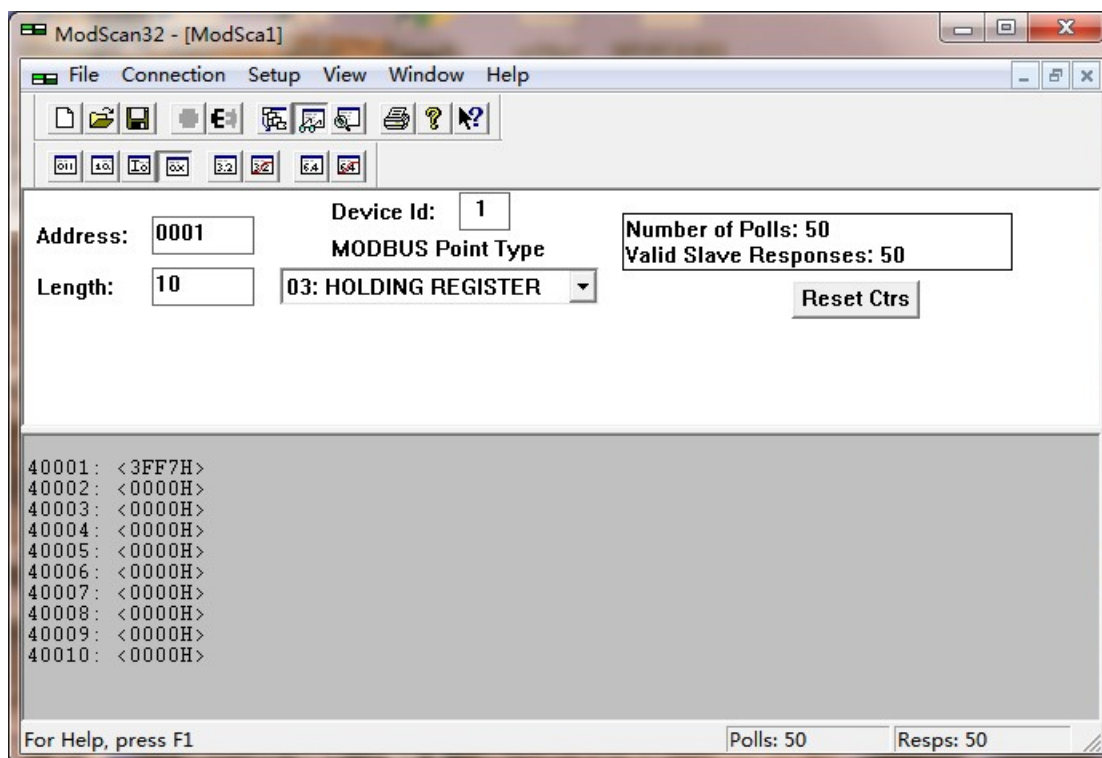
The registers supporting function codes 03 and 06 are as follows:

Address 4X（PLC）	Address（PC，DCS）	Data	Property	Data Explanation

40001	0000	Input Analog Signal	Read Only	Signed integer, data is 2's complement 0x0000-0x7FFF represents a positive number 0x8000-0xFFFF represents a negative number For example, the range is 0-10V, 0 is 0x0000, and 10V is 0x7FFF If no negative numbers are used, the data read greater than 0x7FFF can be converted to 0.
40021	0020	4-20mA special	Read Only	Unsigned integer, read when 4-20mA signal is input. 4mA=0x0000，20mA=0x7FFF
40061	0060	Data after user range conversion	Read Only	Signed integer, The range is defined by the 40161 register Can be used for conversion of analog quantity and actual data
40081	0080	Data after 4-20mA user range conversion	Read Only	Unsigned integer, The range is defined by the 40181 register. When the data is less than 4mA, it is displayed as 0, and when the data is 20mA, it is displayed as the set value. The middle is displayed proportionally. Can be used for conversion of analog quantity and actual data
40161	0160	Channel 0 range	read/ write	integer，0x0001-0x7FFF，after the modification, the data of the 40061 register is converted according to this range
40181	0180	User-defined 4-20mA range	read/ write	integer，0x0001-0x7FFF，After the modification, the data of the 40081 register is converted according to this range
40200	0199	Parameter reset to factory setting	read/ write	Set to FF00, the parameters of all registers of the module will be restored to the factory settings, and the module will automatically restart after completion
40201	0200	Module address	read/ write	Integer, take effect after restart, range: 0x0000-0x00FF
40202	0201	Baud rate	read/ write	Integer, take effect after restart, range: 0x0004-0x000A 0x0004 = 2400 bps，0x0005 = 4800 bps 0x0006 = 9600 bps，0x0007 = 19200 bps 0x0008 = 38400 bps，0x0009 = 57600 bps

				0x000A = 115200bps
40204	0203	Conversion rate	read/ write	Integer, range: 0x0000-0x0003, The factory default is 2, please recalibrate the module after modification。 0x0000 = 2.5 SPS，0x0001 = 5 SPS，0x0002 = 10 SPS， 0x0003 = 20 SPS

Example 2: Rang is A4:4-20mA, you can also read the data 4-20mA special register data, register address 40021, 4mA correspond 0x0000, 20mA correspond 0x7FFF.As followings:

If the module address is 01, hexadecimal sent: **010300140001C40E,** to get the register 40021 data**.**

01	03	00	14	00	01	C4	0E
Module address	Read holding register	Register address High	Register address low	Register quantity high	Register quantity low	CRC check low	CRC check high

If module reply: **010302199973BE** **read data:** 0x1999, if the range is 4-20mA, conversion 0x1999*16mA/0x7FFF= 3.2mA,then adds ZERO 4mA,That indicates the input current is 7.2mA.

01	03	02	19	99	73	BE
Module address	Read holding register	Data Bytes	Data High	Data Lower	CRC check low	CRC check high

Correspondence between MODBUS protocol range and high 16 bits of data

Input range	positive full scale	zero	negative full scale
A1：0-1mA			
A2：0-10mA			
A3：0-20mA			
A4：4-20mA			
A5：0-±1mA			
A6：0-±10mA	0x7FFF	0x0000	0x8000
A7：0-±20mA			
A8：user-defined			
U1：0-5V			
U2：0-10V			
U3：0-75mV			

U4: 0-2.5V U5: 0-±5V U6: 0-±10V U7: 0-100mV U8: user-defined			
A4: 4-20mA Register 40021~40028 Correspondence of the range of 4-20mA special register	0x7FFF (20mA)	0x0000 (4mA)	0x0000

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 WJ121 module zero calibration is at input 0, full scale calibration is at the input full-scale 100% . For example, input signal is **4-20mA**, when calibrate zero, input **0mA**, when full-scale calibration, input **20mA**.

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

2. To WJ121 module input zero signal, usually is **0mA** or **0V**.
3. Until the signal stabilized, send the offset calibration **$ 01C0** command to WJ121 module.
4. To WJ121 module input 100% of full scale current or voltage signal.
5. Until the signal is stable, send the gain calibration **$ 01C0** command to WJ121 module.
6. Finished

Size(unit:mm)　　　　**DIN35 Rail Mounted**
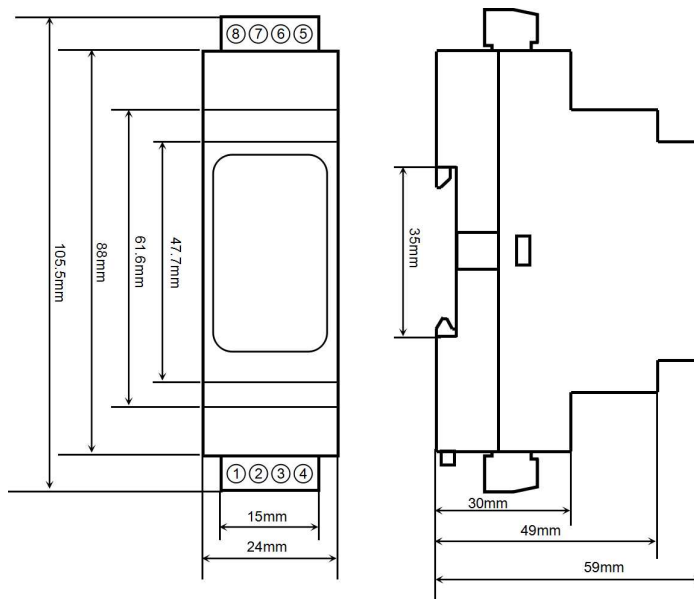
Warranty

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

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