Analog Signal Isolated Data Acquisition
A-D Isolation Converter
ISO4021 Series

Features

- Measurement accuracy is better than 0.05%.
- Automatically select RS-485 or 232 output, programmable calibration of modules accuracy is available.
- Isolation voltage between I/O: 3000VDC.
- Wide power supply range :8 ~ 50VDC.
- High reliability, convenient to programme, install and wire.
- User can set object module's address and baud rate and other parameters by programming.
- Support Modbus RTU communication protocol.
- Analog signal acquisition, isolated conversion, RS-485/232 output.

Applications

- PLC, DCS Signal testing, monitoring and control.
- Intelligent building control, security system,etc.
- RS-232/485 industrial automation control system.
- Industrial fields signal isolation and long-distance transmission.
- Debugging and controlling of equipment operation.
- Sensors signal measurement and acquisition.
- Acquisition and record of industrial field data.
- Development of medical, electric and industrial products,etc.
- 4-20mA/0-10V signal acquisition and transmission.

Introduction

ISO 4021 series analog to digital converter realizes the signal acquisition between sensor and the host to test analog signal or control remote device. The configuration software can be used for a variety of sensors including analog input, analog output, and digital signal input / output (I / O), ISO 4021 series products can be used in industrial automation RS-232/485 bus system, 4-20mA / 0-5V signal measurement, monitoring and control, small-signal measurement, and industrial-site signal isolation and long-term transmission and so on. Through software configuration, it can be connected various sensors including current output type, voltage output type and thermocouple etc.

The converters has the following features: power supply isolation, signal isolation, linearization, A/D conversion and RS-485 serial communication. Each serial port can connect maximum is 256 pieces ISO 4021 modules. The method of communication used is character communication protocol ASCII or MODBUS RTU communication protocol, its command set is compatible with the ADAM modules, the baud rate is set by the user, it is able to operate in the same RS-485 bus with controlling module from other manufacturers to facilitate computer programming.

ISODA series converters are designed based on single chip of intelligent monitoring and control systems, all the calibration value, address, baud rate, data format, checksum status and other configuration information set by users are stored in nonvolatile memory EEPROM.

ISODA series converters are in accordance with industry standards in design, manufacturing, isolation voltage between signal I/O is 3000VDC, it possesses excellent anti-interference ability and high reliability. Operating temperature range:- 25℃～+70℃.

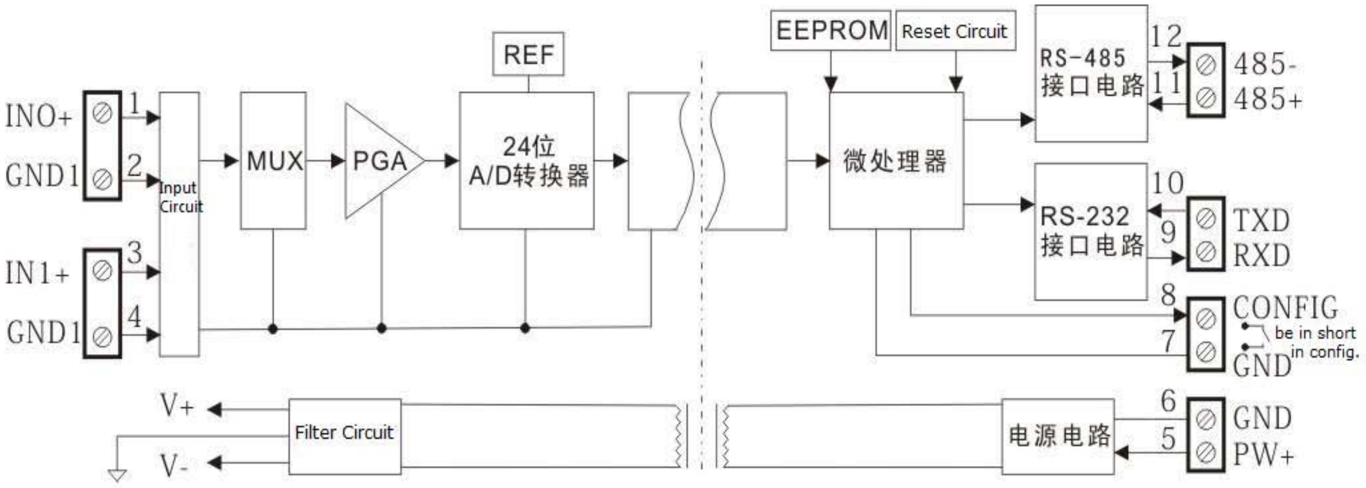


Fig. 1 ISO 4021 Schematic Diagram

Functions

ISO 4021 signal isolation acquisition module could be used to test one channel voltage/current signal, it could also be used to test 2-channel current/voltage signal which are common grounded but without interference from each other.

1. Analog signal input

Data acquisition accuracy grade:24-bit. The input range of the product has been calibrated before ex-factory. It is also convenient to be programmed and calibrated by the user in usage. For the specified current or voltage input range, user should refer to the **model selection.** The two outputs selection should be the same when it is used to measure two-channel signals.

2. Communication protocol

Communication Interface: 1-channel standard RS-485 interface or 1-channel standard RS-232 interface. Please notify us when ordering.

Communication protocol：support two types of protocol, one is standard Modbus RTU communication protocol and the other is ASCII character communication protocol. User could decide which protocol to be used by programming. It could have network communication with supervisory computer control system or various types of PLC, RTU.

Data format: 10-bit. one start bit, eight data bits, one stop bit.

Communication address:（0-255）and baud rate（300, 600, 1200, 2400, 4800, 9600, 19200, 38400bps）could be set. The network communication distance is up to 1200 meters, connecting by double ground shield cable. High anti-jamming in designing the communication interface, ±15KV ESD protection, and the response time is less than 100mS.

Anti-jamming: Set checksum based on requirements. TVS inside the module can actively restrain all kinds of surge impulse and protect the module. Digital filter inside could also restrain the power frequency jamming from power grid.

Model selection

ISO 4021 U(A)□ - □

Input Voltage or Current Signal

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：Customized	**A8**：Customized

Communication Interface

232: Output is RS-232 interface

485: Output is RS485 interface

322/485: Output is one channel RS232 or RS485 interface (automatically select one channel)

Examples:.

E.g.1: ISO 4021 A4-485 Means 4-20ma signal input, output is RS485 interface.

E.g.2: ISO 4021 A7-232 Means 0-±20mA signal input, output is RS232 interface.

E.g.3: ISO 4021 U1-232/485 Means 0-5V signal input, output is RS485 or RS232 (automatic selection).

ISO 4021 General Parameters

(typical @ +25℃，Vs is 24VDC)

Input： Voltage / Current Input

Accuracy： 0.05%

Input offset： ±0.1 uA/℃

Temperature Drift： ±15 ppm/℃ (±30 ppm/℃, max.)

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)

Band width： -3 dB 10 Hz

Switching rate：10 Sps

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

Normal mode restraint(NMR)： 60 dB （1kΩ Source Imbalance @ 50/60 Hz）

Input Port protection：over-voltage/over current protection

Communications： protocol RS-485 or RS-232 ASCII protocol and MODBUS RTU communication protocol

Baud rate（300， 600， 1200，2400， 4800， 9600，19200，38400bps）software configuration
address（0~255）software configuration

Communication Response Time：100 ms max.

Operation Power Supply： +8 ~ 50 VDC wide power supply range, internal anti-reverse & over-voltage protection

Watt Consumption： < 1W

Operation Temperature： - 25 ~ +70℃

Operation Humidity： 10 ~ 90% (non-condensing)

Storage Temperature： - 45 ~ +80℃

Storage Humidity： 10 ~ 95% (non-condensing)

Isolation withstand voltage：between I/O: 3KVDC，1 minute, leakage current 1mA
Output and power supply are common-ground.

Endure Impact Voltage： 3KVDC, 1.2/50us(peak value)

Dimensions： 83 mm x 37 mm x 51mm

Weight： about 72g

Pin Description

Pin	Name	Description
1	IN0+	Input Channel 0 +
2	GND1	Input Channel 0 -
3	IN1+	Input Channel 1 +
4	GND1	Input Channel 1 -
5	PW+	Power supply +
6	GND	Power supply -
7	GND	Power supply -
8	CONFIG	Config. interface
9	RXD	RS-232 signal
10	TXD	RS-232 signal
11	DATA+	RS485 signal +
12	DATA-	RS485 signal -

Form 1 Pin Definition

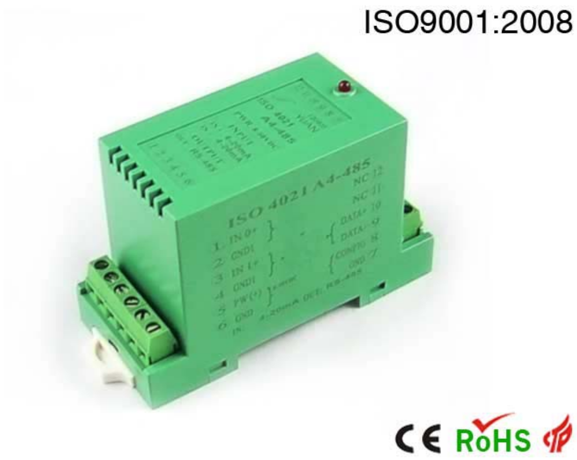


Fig.. 2 ISO 4021 External View

Application Wiring Diagram

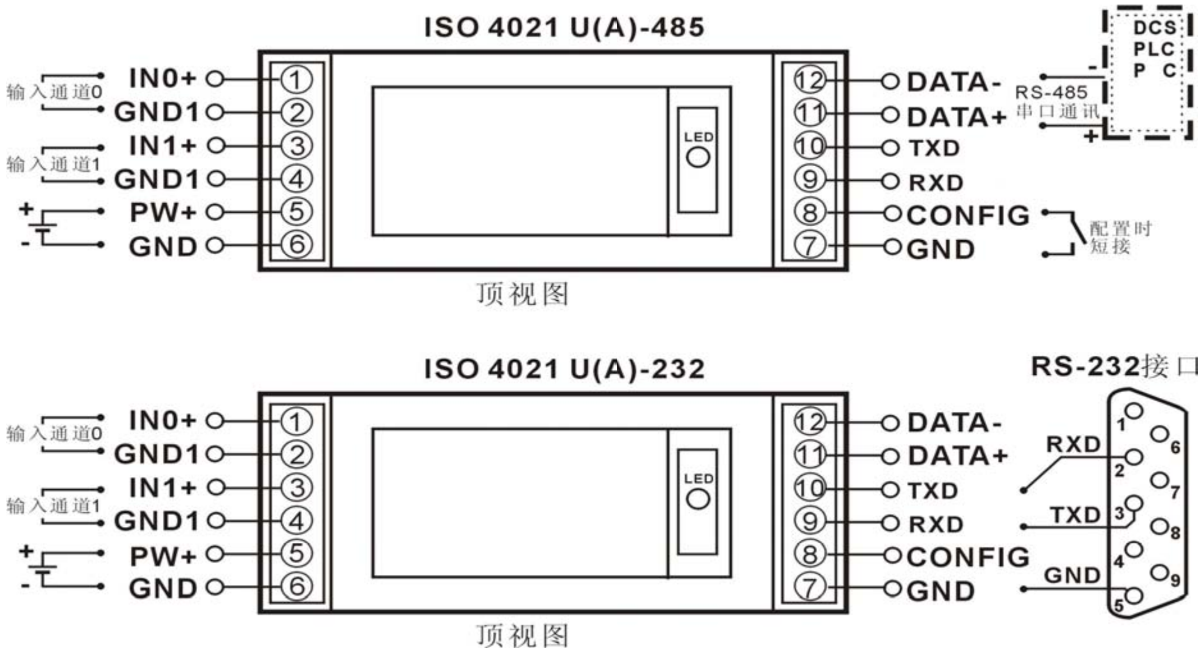


Fig.3 ISO 4021 Module Wiring Scheme

Initialization of ISO 4021 Module

For ISO4021 modules, if operating in RS-485 network, it must be assigned a unique address code (the address code is hexadecimal digit between 00 ~ FF). However, all the new ISODA modules have the same factory initial setting as following:
Address code is 01.
baud rate is 9600 bps.
Checksum prohibited.

As the new module address codes are the same, their address will be contradictory with other modules, so in setting up the system, user must re-configure each analog output module address. Users can modify ISO 4021 module's address through configuration commands after connecting ISODA module power cable and RS485 communication lines. Baud rate, checksum status, and communication protocols can also be adjusted according to user’s requirements. Before doing adjustment, user must set the module to the configuration status firstly, otherwise it can not be modified.

Let the modules be in configuration status

ISO 4021 module has a Pin marked CONFIG. Connect CONFIG Pin to the ground (GND) , and then connect power supply. In this way, the module is in configuration status.

Under configuration status, the module setting is as following：
Address code: 0
Baud rate: 9600 bps
Checksum: prohibited

At this time, users can modify the parameters of ISO 4021 module: baud rate, checksum state and other parameters by configuration command and select the communication protocol by setting the module's communication protocol command. If the configuration of a module is uncertain, the module could be in configuration state by installing the jumper and then reconfigure the module. If user requires the module to be set to use MODBUS RTU communication protocol, please refer to the introduction of MODBUS communication protocol section.

ISO 4021 Command Set

The command consists of a series of characters, such as the leading code, address ID, variables, and optional checksum byte and a stop command (cr). Except for the the command address with wildcard “**”, the host only controls one ISO4021 module each time.

Command format：(Leading Code)(Addr)(Command)[data][checksum](cr)
(Leading code): first letter of a command. Every command requires a leading code, such as %,$,#,@, etc. **1- C**
(Addr)： address code of a module. Its range is from 00 to FF (hexadecimal) if there is no allocation. **2- C**
(Command)： display command code or variable value. **Variable-length**
(Data): date required for output command **Variable-length**
[checksum]: Checksum is optional parameters. It is required only when checksum is used. **2- C**
(cr): control code used in identification. **(cr)** as ENTER character. Its value is 0x0D. **1- C**

Checksum is used to check whether the module communicate with host is right or not. when enabling checksum, command and response should attach **[checksum]** parameter which occupies 2 characters. Checksum character follows command or response character and in front of the ENTER.
Calculation method: Get the sum of ASCII code value of all prior issued bytes. The sum and hexadecimal digits 0xFF is two characters (the hexadecimal digits).

E.g.: Prohibit checksum
User command **$022(cr)**
Module response **!00020600 (cr)**
Enable checksum
User command **$002B6 (cr)**
Module response **!00020600 A9 (cr)**
‘$’ = 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

Analog Input Module Command Set

1. Read data of analog input module
2. Read the analog output value of channel N
3. Module allocation
4. Read configuration state
5. Offset calibration
6. Full scale calibration
7. Read module name
8. Enable or prohibit channel command
9. Read channel status command
10. Set communication protocol

Response of commands

Response message depends on a variety of commands. Response message also consists of several characters, including leading code, variables and end tags. There are two leading codes of response signal: **'!'** or **'>'** indicates a valid command, **'?'** means invalid. By checking the response information, user can monitor whether the command is valid or not.

Note: 1. User needs to ensure the address one used is correct in a command. If one uses the wrong address ,the object module will not response.

2. The command must be entered in capital letters.

1. Read Data of Analog Input Module

Command function: Based on current data format, read analog input data of all the channels from analog input modules.

Command Syntax ：**#AA(cr)**

Parameter Description ：**#** delimiter character
AA module address, value range 00～FF(hexadecimal)
(cr) end character, carriage return (0DH)

Response：**>(data)(cr)** command is valid.
?AA(cr) invalid command or illegal operation

Parameter Description : **>** delimiter character
(data) Represent the data of all channels which been read by the command. The data format is in Engineering Units, PERCENT OF FSR, complement of hexadecimal or ohms. Refer to the Article 3 (Module allocation) of the command set.
(cr) end character, carriage return of the host (0DH).

Note：If there is a syntax error or communication error or address does not exist, the module does not respond.
If a channel has been shut down, then the data read out as space character.

E.g.: User command **#23(cr)**
Module response **>+04.765+04.756 (cr)**

Description: On module with address 23H, the input is (data format is engineering unit)：
Channel 0: +04.765mA channel 1: +04.756mA

2. Read the Data of Analog Input Module in Channel N

Command function: Based on the current data format, read analog input data of channel N from analog input modules.

Command Syntax: **#AAN(cr)**

Parameter Description ：**#** delimiter character
AA module address, value range 00～FF (hexadecimal)
N channel code 0 or 1
(cr) end character, carriage return of the host (0DH).

Response： **>(data)(cr)** command is valid.
?AA(cr) invalid command or illegal operation or channel is closed.

Parameter Description: **>** delimiter character
(data) data read in channel N. The data format is in Engineering Units, PERCENT OF FSR, complement of hexadecimal. Or ohms. Refer to he Article 3 (Module allocation) of the command set.
(cr) end character, carriage return of the host (0DH).

Note: If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g.: User command **#230(cr)**
Module response **>+04.632 (cr)**

Description: The input current of channel 0 on module with address 23H is +04.632mA (data format is engineering unit).

3. Module Allocation

Command function: Set address, input range, baud rate, data format, checksum status for an analog input module. Configuration information is stored in nonvolatile memory EEPROM.

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

Parameter Description: **%** delimiter character

AA module address, value range 00～FF (hexadecimal)

NN hexadecimal address of a module, the value range of NN is from 00 to FF

TT hexadecimal represents type code. ISO4021series product should be set as 00

CC hexadecimal represents baud rate code. **Refer to table 2**

Baud rate code	Baud rate
01	300bps
02	600bps
03	1200bps
04	2400bps
05	4800bps
06	9600bps
07	19200bps
08	38400bps

Table 2 Baud rate code

FF The 8-bit of hexadecimal is used to represent data format and checksum. Note: From bits2 to bits 5 is unnecessary to be set to 0.

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

Table 3 Data format, checksum code

Bit7：Reserved bits , should be set to 0

Bit6：checksum status, **0:** represents prohibit, **1:** represents permission

Bit5-bit2：it is unnecessary and must be set to 0

Bit1-bit0：data format bit

00： Engineering Units

01： % of FSR

10：complement of hexadecimal (Twos complement)

11： ohms(only the thermal resistance products could be set)

(cr) end character, carriage return of the host (0DH).

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

?AA(cr) invalid command or illegal operation, no jumper allocation before setting baud rate checksum status.

Parameter Description: **!** delimiter code indicates valid command.

? delimiter code indicates invalid command.

AA indicates input module address

(cr) end character, carriage return of the host (0DH).

Note: If user configurate the module for the first time, AA=00, NN= new address. If user requires to reallocate module to change address, input range, data format, AA=the currently allocated address, NN=current or new address. If user requires to reallocate module to change baud rate and checksum status, user should install jumper to let the module be in default status. Now Module address is 00H, that is to say AA=00H, NN = new address or the current address. If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g.: User command **%0011000600(cr)**

Module response **!11(cr)**

Description: **%** Delimiter character

00 Indicate original address of the analog module which user wants to allocate is 00H.

11 Indicate the hexadecimal address of the new address is 11H.

00 type code，ISO4021 series products should be set to 00.

06 Indicate baud rate 9600bps

00 Indicate data format is engineering unit and the checksum is prohibited.

4. Read Configuration State

Command function: Read the configurate of the specified module

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

Parameter Description: **$** delimiter character
AA module address, value range 00～FF (hexadecimal)
2 read the configuration status command
(cr) end character, carriage return of the host (0DH).

Response：**!AATTCCFF(cr)** command is valid.
?AA(cr) invalid command or illegal operation

Parameter Description: **!** delimiter character
AA input module address
TT type code
CC baud rate code, Table 3 for reference
FF Table 4 for reference
(cr) end character, carriage return of the host (0DH)

Note: If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g.: User command **$302(cr)**
Module response **!300F0600(cr)**

Description: **!** delimiter character
30 object module address is 30H
00 input type code
06 baud rate 9600 bps
00 data format is engineering unit and the checksum is prohibited.

5. Offset calibration

Command function: Calibrate the offset of channel N in a module.

Command Syntax: **$AA1N(cr)**

Parameter Description: **$** delimiter character
AA module address, value range 00～FF (hexadecimal)
1 offset calibration command
N channel code 0～1
(cr) end character, carriage return of the host (0DH)

Response：**! AA (cr)** command is valid.
?AA(cr) invalid command or illegal operation

Parameter Description: **!** delimiter code which means valid command
? delimiter code means invalid command
AA indicates input module address
(cr) end character, carriage return of the host (0DH).

Note: The product has been calibrated before delivery, and the user can directly use it without calibration.
When calibrating an analog input, offset calibration should be done firstly, and then calibrate the gain.
During the calibration, analog input module needs to be connected with the appropriate input signal on the channel which is to be calibrated. Different input range requires different input voltage or current. See the calibration module section. If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g.: User command **$2310(cr)**
Module response **!23(cr)**

Description: offset calibration on channel 0 of a module with address 23H

6. Gain Calibration

Command function: calibrate the gain of channel N of a module.

Command Syntax: **$AA0N(cr)**

Parameter Description: **$** delimiter character
AA module address, value range 00～FF (hexadecimal)
0 gain calibration command
N channel code 0～1
(cr) end character, carriage return of the host (0DH).

Response：**!AA(cr)** command is valid.
?AA(cr) invalid command or illegal operation

Parameter Description: **!** delimiter code means valid command
? delimiter code means invalid command

AA input module address

(cr) end character, carriage return of the host (0DH).

Note: The product has been calibrated before delivery, and the user can directly use it without calibration.

When calibrating an analog input, offset calibration should be done firstly, and then calibrate the gain. During the calibration, analog input module needs to be connected with the appropriate input signal on the channel which as to be calibrated. Different input range requires different input voltage or current. See the calibration module section. If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g.: User command **$2303(cr)**

Module response **!23(cr)**

Description: Do gain calibration on channel 0 of a module with address 23H.

7. Read Module Name

Command function: Read module name of the specified analog input module.

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

Parameter Description: **$** delimiter character

AA module address, value range 00～FF (hexadecimal)

M read module name command

(cr) end character, carriage return of the host (0DH).

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

?AA(cr) invalid command or illegal operation

Parameter Description: ! delimiter character, command is valid.

? delimiter character, command is invalid.

AA input Module address

(ModuleName) module name could be ISOADA08, ISO 4021orISO4014 etc which represents the module type user used.

(cr) end character, carriage return of the host (0DH).

More instructions: If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g.: User command **$08M(cr)**

Module response **!08ISO 4021 (cr)**

Description: In the address 08H, the module is ISO4021.

8. Enable or Prohibit Channel Command

Command function: send commands about that enable or prohibit the data acquisition channel of a module

Command Syntax: **$AA5VV(cr)**

Parameter Description: **$** delimiter character

AA module address, value range 00～FF (hexadecimal)

5 the command means that enable or prohibit the data acquisition channel of the module

VV two hexadecimal digits, the 3-0 bit of the first digit represents 7- 4 channel.

The 3-0 bit of the second digit represents 3- 0 channel.

Bit is 0: prohibit the channel

Bit is 1: enable the channel

(cr) end character, carriage return of the host (0DH).

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

?AA(cr) invalid command or illegal operation

Parameter Description: **!** delimiter character: command is valid.

? delimiter character**:** command is invalid.

AA input module address

(cr) end character, carriage return of the host (0DH).

More instructions: If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g: User command **$08501(cr)**

Module response **!08 (cr)**

Description: set channel value to 0x01.

0 refers to 0000, represents prohibit channel 7, channel6, channel 5 and channel 4.

1 refers to 0001, represents enable channel 0, prohibit channel 3, channel 2 and channel 1.

9. Read Channel Status

Command function: Read the channel status of a specified analog input module.

Command Syntax: **$AA6(cr)**

Parameter Description: **$** delimiter character
AA module address, value range 00～FF (hexadecimal)
6 read the channel status command
(cr) end character, carriage return of the host (0DH).

Response： **!AAVV(cr)** command is valid.
?AA(cr) invalid command or illegal operation

Parameter Description: **!** delimiter character : command is valid.
? delimiter character: command is invalid.
AA input module address
VV two hexadecimal digits, the 3-0 bit of the first digit represents 7-4 channel.
The 3-0 bit of the second digit represents 3-0 channel.
Bit is 0: prohibit the channel
Bit is 1: enable the channel
(cr) end character, carriage return of the host (0DH).

More instructions: If there is a syntax error or communication error or address does not exist, the module does not respond.

E.g.: User command **$186 (cr)**
Module response **!1803(cr)**

Description: the current channel status is 0x03.
0x03 refers to 0000 and 0011, means all the channels of module at address 18H have been enabled.

10. Set Communication Protocol Command

Command function: Set the communication protocol of the module as ASCII or Modbus RTU protocol.

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

Parameter Description: **$** delimiter character
AA module address, value range 00～FF (hexadecimal)
P set communication protocol command
V the code of the protocol could be 0 or 1.
0：ASCII character communication protocol
1：Modbus RTU protocol
(cr) end character, carriage return of the host (0DH).

Response：**!AA(cr)** command is valid.
?AA(cr) invalid command or illegal operation

Parameter Description: **!** delimiter character: command is valid.
? delimiter character**:** command is invalid.
AA represents input Module address
(cr) end character, carriage return of the host (0DH).

More instructions: If there is a syntax error or communication error or address does not exist, the module does not respond. Setting communication protocol command is only valid under default status.

E.g.1: User command **$00P1(cr)**
Module response **!00 (cr)**

Description: set communication protocol as Modbus RTU protocol.

E.g.2: User command **$00P0(cr)**
Module response **!00 (cr)**

Description: set communication protocol as ASCII Character protocol.

The Input Range and Data Format

There are four data format which are been used by analog input module:
00: Engineering Units
01: full scale percentage (% of FSR)
10: hexadecimal (complement)
11: ohms (only thermal resistance product could be set)

Input range	Data format	Span +	Zero	Span -	Display Res.
A1: 0-1mA **A5: 0-±1mA**	Engineering Unit	+1.0000	±0.0000	-1.0000	0.1uA
	% of FSR	+100.00	±000.00	-100.00	0.01%
	Complement of hexadecimal	7FFFFF	000000	800000	1LSB
A2: 0-10mA **A6: 0-±10mA**	Engineering Unit	+10.000	±00.000	-10.000	1uA
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB
A3: 0-20mA **A4: 4-20mA** **A7: 0-±20mA**	Engineering Unit	+20.000	±00.000	-20.000	1uA
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB
U1: 0-5V **U5: 0-±5V**	Engineering Unit	+5.0000	±0.0000	-5.0000	100uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB
U2: 0-10V **U6: 0-±10V**	Engineering Unit	+10.000	±00.000	-10.000	1mV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB
U3: 0-75mV	Engineering Unit	+75.000	±00.000	-75.000	1uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB
U4: 0-2.5V	Engineering Unit	+2.5000	±0.0000	-2.5000	100uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB
U7: 0-100mV	Engineering Unit	+100.00	±000.00	-100.00	10uV
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB
A8: customized **U8: customized**	Engineering Unit	+100.00	±000.00	-100.00	0.01%
	% of FSR	+100.00	±000.00	-100.00	0.01%
	complement of hexadecimal	7FFFFF	000000	800000	1LSB

Table 4 Input range and data format

Application Examples:

1. Input range is **A4**: 4~20mA, when input is 4 mA:

	User command	#01(cr)
Engineering Unit	Module response	>+04.000(cr)
% of FSR	Module response	>+020.00(cr)
Complement of hexadecimal	Module response	>199999(cr)

2. Input range is **U1:** 0-05V, when input is 3V.

	User command	#010(cr)
Engineering Unit	Module response	>+3.0000(cr)
% of FSR	Module response	>+060.00(cr)
Complement of hexadecimal	Module response	>4CCCCC(cr)

3. Conversion relations between hexadecimal complement and analog quantity.

When module input is current or voltage input type, user can use following format to do conversion:

X/7FFFFF=Xin/Xf

Instructions:**X:** represents the corresponding complement of hexadecimal of the analog.
Xin: represents the analog signal input of the channel.
Xf: represents the analog of the product in full scale s, like: 20mA.

.

4. When the input is voltage input type, **Xin** represents the voltage input value of the channel **Vin**, **Xf** represents full scale voltage input value.

5. If input is negative voltage or negative current, use it's contrary value and plus 1, then apply to the format above to get corresponding analog value.

Modbus Communication Protocol

MODBUS protocol defines the information structure which could be identified and used by controller. When communicating on the MODBUS network, the protocol allows each controller to know its own device address, and identify the data addressing to it, then decide the effective type and take out data contained in the information. The controller can also organize the response information and use the MODBUS protocol to send out this information.

The controller takes use of master-subordinate technique. That means, only one device (the master) can initiate transmission (the query), and other devices (subordinate ones) respond according to data queried by the master device. A typical master device: host and programmable instrument. Typical subordinate device: programmable controllers.

Master device can communicate with one subordinate device, but also communicate with all subordinate devices by broadcast. For the former situation, the device will respond one message; for the latter, the device will not respond. MODBUS protocol establishes a master query format: device (or broadcast) address, function code, all the data to be sent, and an error detection field.

Response message of subordinate device is also constituted by the MODBUS protocol, including the domain to be act, any data to be returned, and an error detection field. If a error occurred during message reception, or the subordinate device can not perform its command, the subordinate device will create an error message and sent it out as a response
MODBUS transmission: ASCII and RTU

Communication in ASCII mode, each 8 bit byte in a message is sent as two ASCII character. It uses the LRC error detection, the advantage of which is that the interval of sending the character is only 1s without error; while in RTU mode, every 8 bit byte contains two 4 bit of hexadecimal characters. It uses the CRC error detection, and the advantage is at the same baud rate, it can transmit more data than ASCII.

About ASCII mode and RTU data format, more information can be found in the relevant MODBUS communication protocol:

	ASCII mode	RTU mode
Code system	▪ Hexadecimal, ASCII character 0～9，A～F ▪ Every ASCII byte consists of one hexadecimal character	▪ 8 bit binary system, hexadecimal0～9，A～F ▪ Every 8 bit consists of one or two hexadecimal character
Data bit	▪ 1 start bit ▪ 7 data bits，the smallest significance bit significance bit sent firstly ▪ 1 parity check bit，none if there is no calibration ▪ 1 stop bit (with calibration), 2 bits (without calibration)	▪ 1 start bit ▪ 8 data bits, the smallest significance bit significance bit sent firstly ▪ 1 parity check bit，none if there is no calibration ▪ 1 stop bit (with calibration), 2 Bits (without calibration)
Error detection	LRC(Longitudinal rigmarole check)	▪ CRC(circulate rigmarole check)

Note: The module only supports MODBUS RTU transmission, not support MODBUS ASCII transmission.

1. Set Modbus RTU Mode

The default protocol is ASCII character communication protocol. To use MODBUS RTU, user should set the module by following steps:

1. Short circuit CONFIG (the 3rd pin) and GND (the 4th pin)
2. Correctly connect Power and other interface cables.
3. Switch on power supply, module is in default state automatically, communication address is **00**, baud rate is **9600**.
4. The module is to complete initialization, about 1 minutes
5. Send command **$00P1(cr)**(00 represents corresponding module address,check the chapter about setting

communication protocol for reference). Check response, if it is **!00(cr)**, set correctly.

6. Switch off power supply, cut off the connection between CONFIG and GND.
7. Module has been set to MODBUS RTU protocol.

2. Data Format under MODBUS RTU

Host query message specifies the start address of the register to be read and the quantity of registers. The start address of the register addressing is 0000. Checking format is as following:

Slave Address	Function	Starting Address Hi	Starting Address Lo	No. of Points Hi	No. of Points Lo	Error Check(CRC)
01	03	00	00	00	08	44 0C

E.g.: Host send query information Tx： 01 03 00 00 00 08 44 0C

01: device address
03: function code
00 00: the start address of register addressing
00 08: quantity of register
44 0C: CRC check code

3. Subordinate Device Response

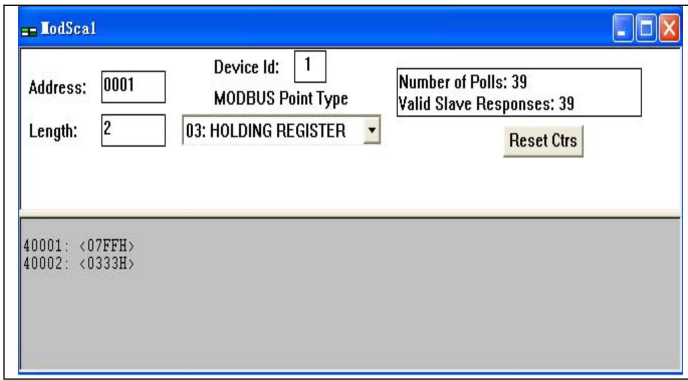
Register data in the response information of subordinate device corresponds to the two bytes of each register; the first byte is high data, the second is the low data. Response format is as following:

Slave Address	Function	Byte Count	Data Hi (Register 40001)	Data Lo (Register 40001)	Data Hi (Register 40002)	Data Lo (Register 40002)	Error Check(CRC)
01	03	10	19	99	00	00	9E 68

E.g.: Subordinate device response information Rx：01 03 10 19 99 00 00 00 00 00 00 00 00 00 04 00 00 00 00 87 69

01: device address
03: function code
10: the quantity of bytes
19 99: the first register data
00 00: the second register data
87 69: CRC check code

The below picture is the register information checked by MODSCAN software and its instruction



ModScal

Address: 0001
Device Id: 1
MODBUS Point Type
Length: 2
03: HOLDING REGISTER
Number of Polls: 39
Valid Slave Responses: 39
Reset Ctrs

```
40001: <07FFH>
40002: <0333H>
```

Instructions:

Address: the start address of the register
Device ID: module address
Length is the number of registers been read
MODBUS Point Type: Modbus function type selection
40001: corresponds to register data, analog input value of channel 0
40002: corresponds to register data, analog input value of channel 1

4. Instructions of Register

Address 4X	Data	R/W	Description
40001	IN0	Read only	Measured Value of Channel 0
40002	IN1	Read only	Measured Value of Channel 1
40211	Module Name	Read only	Higher bits：0x40 Lower bits：0x21
40221	Channel Status	Read/Write	Higher bits：0x00 Lower bits：Channel Status (0x03)

Table 5 Modbus RTU register Instructions

Mode Calibration

The calibration of modules must be done based on ASCII character communication protocol. In the MODBUS protocol, the module does not support calibration.

The product has been calibrated before delivery, and the user can directly use it without calibration. User could recalibrate the module via the calibration function of the product. During the calibration, analog input module needs to be connected with the appropriate input signal on the channel which as to be calibrated. Different input range requires different input signal.

In order to improve calibration accuracy, it is recommended to use the following equipments:
1. A stable output, low noise DC voltage/current signal source.
2. One five and a half bits or a higher-precision voltage/current measuring instruments to monitor the accuracy of the input signal.

The Calibration Process

1. Select the input channel to be calibrated and connect to the corresponding input signal according to the input range of the module. Select the correct input range, different input range requires different calibration voltage.
2. For ISO 4021 module, the Zero is calibrated when the input is 0, full scale is calibrated when input 120% of FSR. For example, when the input is 4-20mA, to do zero calibration, input is 0mA, full scale calibration, input is 24mA. When the input is 0-5V, zero calibration, input is 0V, full scale calibration, input is 6V.
3. Input zero signal to the channel of the module which requires to be calibrated, usually 0mA or 0V.
4. When the signal is stable, send offset calibration $ AA1N command (N represents the channel code currently being calibrated, 0 or 1) to the analog input module.
5. Input voltage/current signal with 120% of FSR to the channel of the module which requires to be calibrated.
6. When the signal is stable, send gain calibration $ AA0N command (N represents the channel code currently being calibrated, 0 or 1) to the analog input module.
7. Complete the Calibration .

Dimension (Unit:mm)

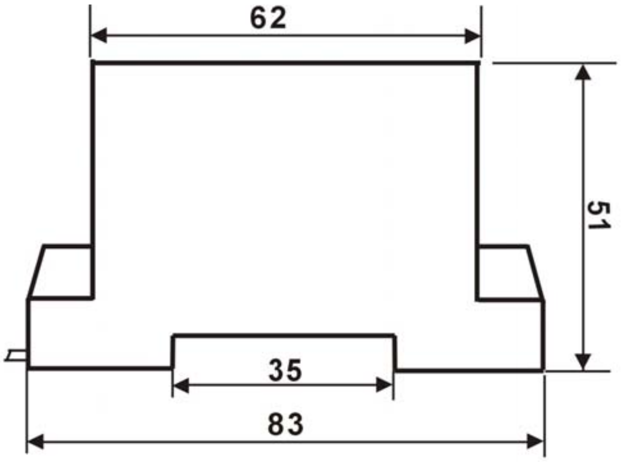


Fig. 6 Front Point of View

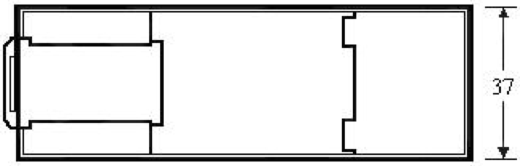


Fig. 7 Bottom Point of View