1. Introduction

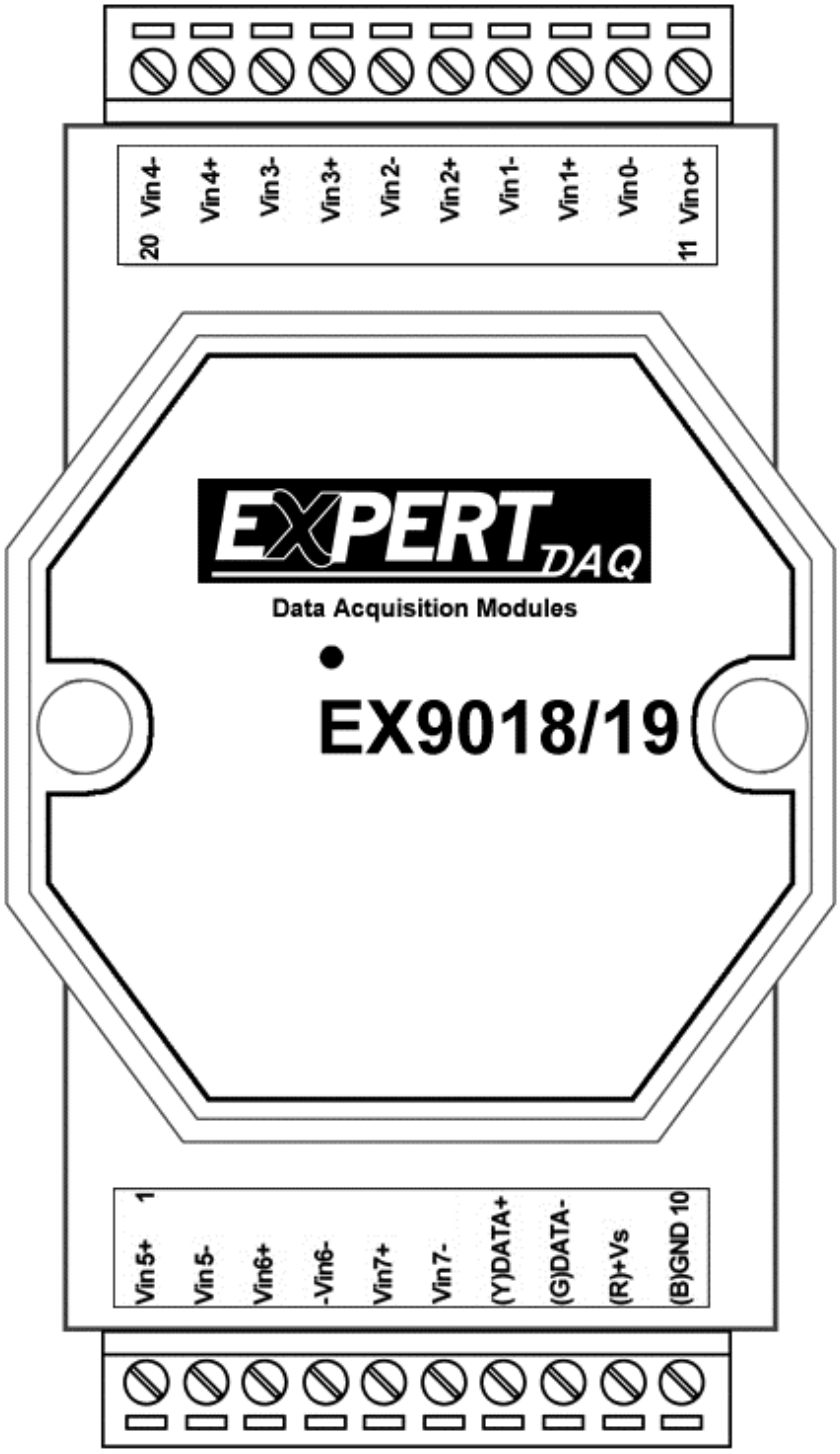
EX-9018/18-M/18BL/18BL-M/19/19-M is a thermocouple input module and 8 input channels are differential type .

Specifications:
Interface: RS-485, 2 wires
Speed (bps): 1200, 2400, 4800, 9600, 19.2K, 38.4K, 15.2K
Analog Input type: Differential input
Analog Channels Numbers: 8
Analog Resolution: 16 bits
Unit Conversion: Thermocouple, mV, V or mA
Thermocouple Type: J, K, T, E, R, S, B, N
Sampling Rate :10 Samples/Second
Bandwidth : 15.7 Hz
Accuracy : ±0.1%
Zero Drift : 0.5μV/°C
Span Drift : 25ppm/℃
CMR@50/60Hz : 150dB
NMR@50/60Hz : 100dB
Input Impedance : 20M Ohms
Voltage Range: ±2.5V, ±1V,±500mV,±100mV,±50mV,±15mV
Current Measurement: ±20mA (with external 125 ohms resistor)
Power supply: +10V to +30V
Thermal couple break line detection (EX9018BL/BL-M/19/19-M only)

Thermocouple Measurement

Two wires composed of dissimilar metal are joined at one end and heated, the open circuit voltage is a function of the junction temperature and the composition of the two metals. All dissimilar metals exhibit this effect. The voltage is called "seebeck voltage". For small changes in temperature the Seebeck Voltage is linearly proportional to temperature.

For measure the Seebeck Voltage directly is not available because we must connect a voltmeter to the thermocouple and the voltmeter leads themselves create a new thermoelectric circuit firstly. Therefore we need to eliminate the junction thermoelectric to measure to correct Seebeck Voltage and this is called "Cold Junction Compensation". For most thermocouples, the Seebeck Voltage is 0V while in 0℃. The simple way to cancel the junction voltage is to put the junction into 0℃ environment and the junction voltage is 0V. In general, this is not a good method for most application. Typical method is to measure the junction temperature by thermistor and measure the junction voltage from the junction temperature that we may get the Seebeck Voltage from measured thermocouple voltage and junction voltage and we may calculate the temperature from the Seebeck Voltage.



EX-9018/18-M/18BL/18BL-M/19/19-M

Specifications

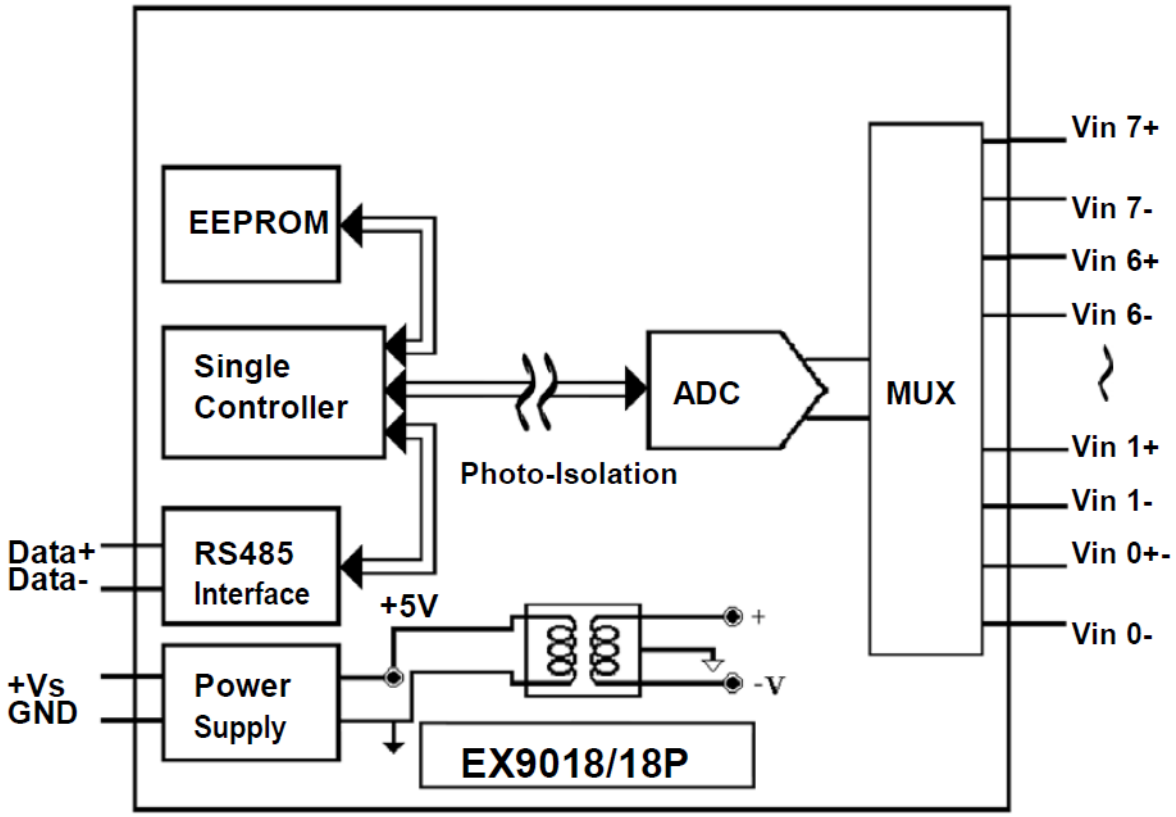
	EX-9018 EX-9018-M	EX-9018BL EX-90018BL-M	EX-9019 EX-9019-M
Interface	RS-485, 2 wires		
Speed(bps)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200		
Analog Input type	Differential input		
Input Channels	8		
Resolution	16 bits		
Individual channel configuration	Not support		Support
Voltage Input	-15mV ~ +15mV - 50mV ~ +50mV - 100mV ~ +100mV - 500mV ~ +500mV - 1V ~ +1V - 2.5V ~ +2.5V		
Current Input	-20mA ~ +20mA (with 125ohms resistor)		
Sensor Input	J, K, T, E, R, S, B, N		
Sampling Rate	10 sample/second		
Bandwidth	15.7Hz		
Accuracy	±0.1%		
Zero Drift	0.5μV/℃		
Span Drift	25ppm/℃		
CMR@50/60Hz	150dB		
NMR@50/60Hz	100dB		
Input Impedance	20M ohms		
Power supply	+10V ~ +30V		
Modbus RTU	EX9018-M	EX9018BL-M	EX9019-M
Thermal couple break line detect	Not support	Support	

Notes:

1. Warm-UP for 30 minutes is recommended before starting operation!
2. EX-9018-M: EX-9018 w/ Modbus function
3. EX-9018BL: EX-9018 w/ Break Line function for Thermocouple
4. EX-9018BL-M: EX-9018BL w/ Modbus function
5. EX-9019: EX-9018BL w/ Individual Channel setting
6. EX-9019-M: EX-9019 w/ Modbus function

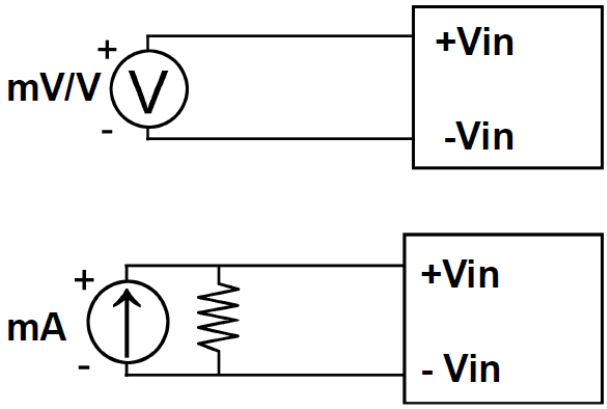
1.2 Wire connection

1.2.1 Block Diagrams:



EX-9018//18BL//19

1.2.2 Wiring diagram for the EX-9018/18BL/19



1.3 Default Settings

Default settings for the EX-9018/18BL/19 modules are as follows:

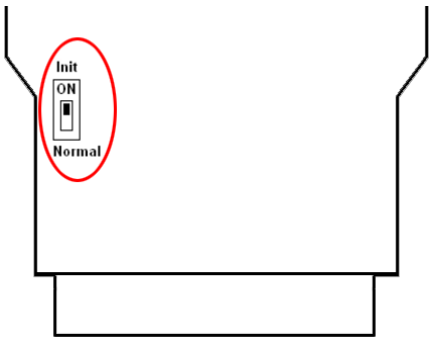
. Module Address: 01
. Analog Input Type: type 0F
. Baud Rate: 9600 bps
. Checksum disabled
. Engineering unit format
. Filter set at 60Hz rejection

Default settings for the EX-9018-M/18BL-M/19-M modules are as follows:
. Protocol: Modbus RTU
. Module Address: 01
. Analog Input Type: type 0F
. Baud Rate: 9600 bps
. Filter set at 60Hz rejection

1.4 INIT* Mode Operation

Each EX9000 module has a build-in EEPROM to store configuration information such as address, type, baudrate and other information. Sometimes, user may forget the configuration of the module. Therefore, the EX9000 have a special mode named "INIT* mode" to help user to resolve the problem. The "INIT* mode" is setting as Address=00, Budrate=9600bps, no Checksum .

Originally, the INIT* mode is accessed by connecting the INIT* terminal to the GND terminal. New EX9000 modules have the INIT* switch located on the rear side of the module to allow easier access to the INIT* mode. For these modules, INIT* mode is accessed by sliding the INIT* switch to the Init position as shown below.



To enable INIT* mode, please following these steps:
Step1. Power off the module
Step2. Connect the INIT* pin with the GND pin.
(or sliding the INIT* switch to the Init* ON position)
Step3. Power on
Step4. Send command $002 (cr) in 9600bps to read the
Configuration stored in the module's EEPROM.

There are commands that require the module to be in INIT* mode. They are:
1. %AANNTTCCFF when changing the Baud Rate and checksum settings. See Section 2.1 for details.
2. $AAPN, See Section 2.19 for details.

1.5 Module Status for DIO, AIO

Power On Reset or **Module Watchdog Reset** will let all output goto **Power On Value**. And the module may accept the host's command to change the output value.

Host Watchdog Timeout will let all output goto **Safe Value**. The module's status(read by command~AA0) will be 04, and the output command will be ignored.

1.6 Dual Watchdog Operation for DIO, AIO

Dual Watchdog=Module Watchdog + Host Watchdog

The Module Watchdog is a hardware reset circuit to monitor the module's operating status. While working in harsh or noisy environment, the module may be down by the external signal. The circuit may let the module to work continues and never halt.

The Host Watchdog is a software function to monitor the host's operating status. Its purpose is to prevent the network from communication problem or host halt. When the timeout interval expired, the module will turn all outputs to predefined Safe Value. This can prevent the controlled target from unexpected situation.

The EX9000 module with Dual Watchdog may let the control system more reliable and stable.

1.7 Reset Status

The Reset Status is set while the module power on or reset by module watchdog and is cleared while the command read Reset Status ($AA5) applied. This is useful for user to check the module's working status. When the Reset Status is set means the module is reset and the output may be changed to the PowerOn Value. When the Reset Status is clear means the module is not resetted and the output is not changed.

1.8 Calibration(Warning: Please don't calibrate before you really understand.)

Set the module of data format to which you wish to calibration first.
Protocol: ASCII mode.
Address: 01
Input type: which type you wish to calibration (If want calibrate the thermocouple type, please set the type to **-50~+50mV** because use the same calibrate parameter)
Filter: which rejection you wish to calibration

Perform Zero Calibration:
1. Send the command "$01501" to **CH0 enable, CH1~7 disable.**
2. Apply zero voltage/current to module's **channel 0** (Vin0+ to Vin0-)
3. Send the command "~01E1" to enable calibration.
4. Send the command "$011" to perform zero calibration.

Perform Span Calibration:
1. Send the command "$01502" to **CH1 enable, CH0 & 2~7 disable.**
2. Apply Span voltage/current to module's **channel 1**

Type code	01	02	03	04	05	06
Span	+15mV	+50mV	+100mV	+1V	+2.5V	+20mA

3. Send the command "~01E1" to enable calibration.
4. Send the command "**~01CALS00550000**" to perform span calibration.
5. Send the command "#011" to check the CH0 input value is correct.
   If the value is over the signal, decrease the value "550000".
   If the value is less the signal, increase the value "550000".
   The value should between **500000~5B0000**, Hexadecimal format.

Note: While calibrate type of current, need connect external shunt resistor, 125ohms, 0.1% to channel1.

1.9 Configuration Tables

Baud Rate Setting (CC)

Code	03	04	05	06	07	08	09	0A
Baud rate	1200	2400	4800	9600	19200	38400	57600	115200

Sensor Type & V/I Range Setting (TT)

Code	**Range**	**Format**	**+F.S.**	**Zero**	**-F.S.**
00	-15~+15mV	Engineer unit	+15.000	+00.000	-15.000
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
01	-50~+50mV	Engineer unit	+50.000	+00.000	-50.000
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
02	-100~+100mV	Engineer unit	+100.00	+000.00	-100.00
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
03	-500~+500mV	Engineer unit	+500.00	+000.00	-500.00
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
04	-1~+1V	Engineer unit	+1.0000	+0.0000	-1.0000
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
05	-2.5~+2.5V	Engineer unit	+2.5000	+0.0000	-2.5000
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
06	-20~+20mA	Engineer unit	+20.000	+00.000	-20.000
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
0E	Type **J** T/C -210~+760℃	Engineer unit	+760.00	+000.00	-210.00
		% of F.S.R.	+100.00	+000.00	-027.63
		2's complement	7FFF	0000	DCA2
0F	Type **K** T/C -270~+1372℃	Engineer unit	+1372.0	+0000.0	-0270.0
		% of F.S.R.	+100.00	+000.00	-019.68
		2's complement	7FFF	0000	E6D0
10	Type **T** T/C	Engineer unit	+400.00	+000.00	-270.00

	-270~+400°C	% of F.S.R.	+100.00	+000.00	-067.50
		2's complement	7FFF	0000	DCA2
11	Type **E** T/C -270~+1000°C	Engineer unit	+1000.0	+000.00	-0270.0
		% of F.S.R.	+100.00	+000.00	-027.00
		2's complement	7FFF	0000	DD71
12	Type **R** T/C 0~+1768°C	Engineer unit	+1768.0	+0000.0	-0000.0
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	0000
13	Type **S** T/C 0~+1768°C	Engineer unit	+1768.00	+0000.0	-0000.0
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	0000
14	Type **B** T/C 0~+1820°C	Engineer unit	+1820.0	+0000.0	-0000.0
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	0000
15	Type **N** T/C -270~+1300°C	Engineer unit	+1300.0	+0000.0	-0270.0
		% of F.S.R.	+100.00	+000.00	-020.77
		2's complement	7FFF	0000	F54D

Data Format Setting (FF)

7	6	5	4	3	2	1	0
FS	CS	reserved				DF	

Key	Description
DF	Data format 00: Engineering unit 01: % of FSR (full scale range) 10: 2's complement hexadecimal
CS	Checksum setting 0: Disabled 1: Enabled
FS	Filter setting 0: 60Hz rejection 1: 50Hz rejection

Note: The reserved bits should be zero.

Burnout (Break line for Thermocouple) status's reading

Engineering Unit	**+9999.9**
% of FSR	**+1315.7**
2's Complement HEX	**7FFF**

2.0 Command set

2.1 %AANNTTCCFF

Description: Set Module Configuration.

Syntax: %AANNTTCCFF[CHK](cr)

%	a delimiter character
AA	address of setting/response module(00 to FF)
NN	new address for setting/response module(00 to FF)
TT	represents the type code. Type code determines the input range. If TT=FF the type of all channels keep no change.
CC	new baudrate for setting module.
FF	new data format for setting module.

IF the configuration with new baudrate or new checksum setting, before using this command, the rear slide switch must be in the ON(INIT*) position. The new setting is saved in the EEPROM and will be effective after the next power-on reset.

Response: Valid Command: **!AA**

Invalid Command: **?AA**

Example:

Command: %0203080602 Receive: !02

Set module address **02** to **03**.

Input type code=**08** (-10~+10V) for all channels

Baudrate=**06** (9600)

Dataformat=**02** (2's complement hexadecimal)

2.2 #AA

Description: Read Analog Input

Syntax: #AA[CHK](cr)

delimiter character

AA address of reading/response module(00 to FF)

Response: Valid Command: >(Data)

(Data) analog input value for its format while use #AA command to EX-9018BL/9019, the data is the combination for each channel respectively.

Example :

Command: #04

Receive:>+051.23+041.53+072.34-023.56+100.00-
051.33+066.46+074.22

The module address 04 is EX-9018BL/9019. Read address 04 for getting data of all 8 channels.

2.3 #AAN

Description : Read Analog Input from channel N

Syntax : #AAN[CHK](cr)

delimiter character

AA address of reading/response module(00 to FF)

N channel to read, from 0 to 7

Response: Valid Command: >(Data)

Invalid Command: ?AA

(Data) analog input value for its format

Example :

Command : #032 Receive : >+025.13

Read address 03 channel 2, get data successfully.

Command : #029 Receive : ?02

Read address 02 channel 9, return error channel number.

2.4 $AA0

Description: Perform Span Calibration

Syntax: $AA0[CHK](cr)

$ delimiter character

AA address of setting/response module (00 to FF)

0 command for performing zero calibration

Response: Valid Command: **!AA**

Invalid Command: **?AA**

Example :

Command : $010 Receive : !01

Perform address 01 zero calibration on channel 0, return success.

Command : $020 Receive : ?02

Perform address 02 zero calibration on channel 2 , return not enable calibration before perform calibration command.

Warning: Pls don't calibrate before you really understand.

2.5 $AA1

Description: Perform Zero Calibration

Syntax: $AA1[CHK](cr)

$ delimiter character

AA address of setting/response module (00 to FF)

1 command for performing span calibration

Response: Valid Command: **!AA**

Invalid Command: **?AA**

Example:

Command: $011 Receive: !01

Perform address 01 span calibration on channel 0, return success.

Command: $021 Receive: ?02

Perform address 02 span calibration on channel 2, return not enable calibration before perform calibration command.

Warning: Pls don't calibrate before you really understand.

2.6 $AA2

Description: Read configuration.

Syntax: $AA2[CHK](cr)

$	delimiter character
AA	address of reading/response module (00 to FF)
2	command for read configuration

Response: Valid Command: **!AATTCCFF**

Invalid Command: **?AA**

TT	type code of module
CC	baudrate code of module
FF	data format of module

Example:

Command: $012 Receive: !01400600

Read the configuration of module 01, input range of -2.5~+2.5V, baudrate 9600, no checksum.

Note: check configuration Tables

2.7 $AA3

Description: Reads cold junction temperature.

Syntax: $AA3[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

4 command to read cold junction temperature

Response: Valid Command: **>(Data)**

Invalid Command: **?AA**

(Data) CJC temperature in degrees Celsius, consisting of a sign byte, '+' or '-' and followed by 5 decimal digits with a fixed decimal point in tenth of a degree

Example:

Command: $013 Receive: >+0030.2

Read address 01 cold junction temperature, and the module responds with +0030.2

2.8 $AA5VV

Description: Set Channel Enable

Syntax: $AA5VV[CHK](cr)

$ delimiter character

AA address of setting/response module (00 to FF)

5 command for set channel enable

VV are two hexadecimal values. The values are interpreted by the module as two binary words (4-bit). The first word represents the status of channel 4~7, and the second word represents the status of channel 0~3. Value 0 means the channel is disabled, value 1 means the channel is enabled.

Response: Valid Command: **!AA**

Invalid Command: **?AA**

Example:

Command :$0152A Receive : !01

Set address 01 to enable channel 1,3,5 and disable channel 0,2,4,6,7 return success.

Command : $016 Receive : !012A

Read address 01 channel status, return channel 1,3,5 are enabled and channel 0,2,4,6,7 are disabled.

2.9 $AA6

Description: Read Channel Status

Syntax: $AA6[CHK](cr)

$ delimiter character

AA address of reading/response module (00 to FF)

6 command for read channel status

Response: Valid Command: **!AAVV**

Invalid Command: **?AA**

VV are two hexadecimal values. The values are interpreted by the module as two binary words (4-bit). The first word represents the status of channel 4~7, and the second word represents the status of channel 0~3. Value 0 means the channel is disabled, value 1 means the channel is enabled.

Example:

Command :$0152A Receive : !01

Set address 01 to enable channel 1,3,5 and disable channel 0,2,4,6,7 return success.

Command : $016 Receive : !012A

Reads Read address 01 channel status, return channel 1,3,5 are enabled and channel 0,2,4,6,7 are disabled.

2.10 $AA7CiRrr
(For EX-9019/19M only)

Description: Sets the type code of a channel individually.

Syntax: $AA7CiRrr[CHK](cr)

$ delimiter character

AA address of setting/response module(00 to FF)

7 set the channel range code

Ci i specifies the input channel to be set

Rrr rr represents the type code of the channel to be set.

Response: Valid comma nd: **!AA**

Invalid command: **?AA**

Example:

Command: $017C3R08 Receive: !01

Sets the type code for channel 3 of module 01 to be 08 (-10~+10V) and the module returns a valid response.

Command: $037C1R40 Receive: ?03

Sets the type code for channel 1 of module 03 to be 40. The module returns an invalid response because the type code is invalid.

2.11 $AA8Ci
(For EX-9019/19M only)

Description: Reads the type code information of a channel.

Syntax: $AA8Ci[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

8 read the type code of a channel

Ci specifies which channel to be access for the type code

Response: Valid command: **!AACiRrr**

Invalid command: **?AA**

i specifies which channel to be access for the type code

rr represents the type code of the channel to be read

Example:

Command: $018C0 Receive: !01C0R03

Reads the type(input range) of channel 0 of module 01 to be 03 (-10~+10V).

2.12 $AA9

Description: Read cold junction offset.

Syntax: $AA9[CHK](cr)

$	delimiter character
AA	address of reading/response module (00 to FF)
9	command for read cold junction offset

Response: Valid Command: **!AAsnnnn**

Invalid Command: **?AA**

S	sign of cold junction offset
nnnn	cold junction offset in 0.01℃ unit

Example:

Command: $019 Receive: !01+0010

Read the cold junction offset is **+0010(Hex)*0.01=+0.16℃**

2.13 $AA9snnnn

Description: Set cold junction offset value.

Syntax: $AA9snnnn[CHK](cr)

$	delimiter character
AA	address of reading/response module (00 to FF)
9	command for set cold junction offset
s	sign of cold junction offset
nnnn	cold junction offset (Hex) in 0.01℃ unit (0000~0999)

Response: Valid Command: **!AA**

Invalid Command: **?AA**

Example:

Command: $019+0010 Receive: !01

Set the cold junction offset to **+0010(Hex)*0.01=+0.16℃**

2.14 $AAB
(For EX-9018BL/18BLM/19/19M only)

Description: Read channel burnout status.

Syntax: $AAB[CHK](cr)

$ delimiter character

AA address of reading/response module (00 to FF)

B diagnose the analog inputs

Response: Valid command: **!AANN**

Invalid command: **?AA**

NN (range 00-FF) is a hexadecimal number that equals the 8-bit parameter, representing the status of analog input channels. Bit value 0 means normal status; and bit value 1 means channel open wiring.

Example:

Command: $01B Receive: !0101

Diagnoses the analog inputs of module 01. The module returns a valid response that channel 0 is open wiring and channel 1~7 are all normal

2.15 ~AACe

Description: Enable/Disable cold junction compensation.

Syntax: ~AACe[CHK](cr)

~	delimiter character
AA	address of reading/response module (00 to FF)
C	command for Enable/Disable CJC
e	e=0 disable CJC, e=1 enable CJC

Response: Valid Command: **!AA**
Invalid Command: **?AA**

Example:

Command: ~01C1 Receive: !01
Enable CJC for all channels.

2.16 $AAF

Description: Read Firmware Version

Syntax: $AAF[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

F command for read firmware version

Response: Valid command: **!AA(Data)**

Invalid command: **?AA**

(Data) Firmware version of module

Example:

Command : $01F Receive : !01M6.92

Read address 01 firmware version, return version M6.92

2.17 $AAM

Description: Read Module Name

Syntax: $AAM[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

M command for read module name

Response: Valid command: **!AA(Data)**

Invalid command: **?AA**

(Data) Name of module

Example:

Command : $01M Receive : !019019

Read address 01 module name, return name 9019.

2.18 $AAP
(For EX-9018M/18BLM/19M only)

Description: Read protocol information of Module

Syntax: $AAP[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

P command for read protocol information of module

Response: Valid command: **!AAS**

Invalid command: **?AA**

S The protocol supported by the module

0: the protocol set in EEPROM is Normal mode

1: the protocol set in EEPROM is ModbusRTU mode

Example:

Command: $01P Response: !010

Reads the communication protocol of module 01 and returns a response of 0 meaning the protocol that will be used at the next power on reset is normal mode.

Command: $01P1 Response: !01

Sets the communication protocol of module 01 to Modbus RTU and returns a valid response. And the next power on reset is in ModbusRTU mode.

2.19 $AAPN
(For EX-9018M/18BLM/19M only)

Description: Set the protocol information of Module

Syntax: $AAPN[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

P command for read protocol information of module

N The protocol supported by the module

0: the protocol set in EEPROM is Normal mode

1: the protocol set in EEPROM is ModbusRTU mode

Response: Valid command: **!AA**

Invalid command: **?AA**

Example:

Command: $01P1 Response: !01

Sets the communication protocol of module 01 to Modbus RTU and returns a valid response. And the next power on reset is in ModbusRTU mode.

2.20 ~AAEV

Description: Enable/Disable Calibration

Syntax: ~AAEV[CHK](CR)

~ delimiter character

AA address of setting/response module (00 to FF)

E command for enable/disable calibration

V 1=Enable/0=Disable calibration

Response: Valid Command: **!AA**

Invalid Command: **?AA**

Example:

Command : $010 Receive: ?01

Perform address 01 span calibration, return the command is invalid before enable calibration.

Command : ~01E1 Receive: !01

Set address 01 to enable calibration, return success.

Command: $010 Receive: !01

Preform address 01 span calibration, return success.

Warning: Pls don't calibrate before you really understand.

2.21 ~AAO(Data)

Description: Set Module Name

Syntax: ~AAO(Data)[CHK](cr)

~ delimiter character

AA address of setting/response module(00 to FF)

O command for set module name

(Data) new name for module, max 6 characters

Response: Valid command: **!AA**

Invalid command: **?AA**

Example:

Command:~01O9019 Receive :!01

Set address 01 module name 9019, return success.

2.22 ~**

Description: Host OK.

Host send this command to all modules for send the information "Host OK"

Syntax: ~[CHK](cr)**

~ delimiter character

** command for all modules

Response: No response.

Example:

Command: ~** No response

2.23 ~AA0

Description: Read Module Host Watchdog Status.

Syntax: ~AA0[CHK](cr)

~ delimiter character

AA address of reading/response module(00 to FF)

0 command for read module status

Response: Valid command: **!AASS**

Invalid command: **?AA**

SS module status, 00=host watchdog timeout status is clear,04=host watchdog timeout status is set. The status will store into EEPROM and only may reset by the command~AA1.

2.24 ~AA1

Description: Reset Module Host Watchdog Status.

Syntax: ~AA1[CHK](cr)

~ delimiter character

AA address of setting/response module(00 to FF)

1 command for reset module status

Response: Valid command: **!AA**

Invalid command: **?AA**

2.25 ~AA2

Description: Read Host Watchdog Timeout Value

Syntax: ~AA2[CHK](cr)

~ delimiter character

AA address of reading/response module(00 to FF)

2 command for read host watchdog timeout value

Response: Valid command : **!AAEVV**

Invalid command: **?AA**

E host watchdog enable status, 1=Enable, 0=Disable

VV timeout value in HEX format, each count is 0.1 second
01=0.1 second and FF=25.5 seconds

2.26 ~AA3EVV

Description: Set Host Watchdog Timeout Value

Syntax: ~AA3EVV[CHK](cr)

~ delimiter character

AA address of setting/response module(00 to FF)

3 command for set host watchdog timeout value

E 1=Enable/0=Disable host watchdog

VV timeout value, from 01 to FF, each for 0.1 second

Response: Valid command: **!AA**

Invalid command: **?AA**

Example:

Command : ~010 Receive : !0100

Read address 01 modules status, return host watchdog timeout status is clear.

Command : ~013164 Receive : !01

Set address 01 host watchdog timeout value 10.0 seconds and enable host watchdog, return success.

Command : ~012 Receive : !01164

Read address 01 host watchdog timeout value, return that host watchdog is enabled, and time interval is 10.0 seconds.

Command : ~** No response

Reset the host watchdog timer.

Wait for about 10 seconds and don't send command~**, the LED of module will go to flash. The flash LED indicates the host watchdog timeout status is set.

Command : ~010 Receive : !0104

Read address 01 module status, return host watchdog timeout status is set.

Command : ~012 Receive : !01064

Read address 01 host watchdog timeout value, return that host watchdog is disabled, and time interval is 10.0 seconds.

Command : ~011 Receive : !01

Reset address 01 host watchdog timeout status, return success And the LED of this module stop flash.

Command : ~010 Receive : !0100

Read address 01 module status, return host watchdog timeout status is clear.

2.27 ~AABOE
(For EX-9018BL/18BLM/19/19M only)

Description: Set Burnout(Break Line for Thermocouple) detect enable/disable of module

Syntax: ~AABOE[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

BO command for Set Burnout(Break Line for Thermocouple) detect enable/disable

E 1=Enable/0=Disable burnout(Break Line for Thermocouple) detect

Response: Valid command: **!AA**

Invalid command: **?AA**

Example:

Command: ~01BO1 Response: !01

Sets the burnout(Break Line for Thermocouple) detect of module 01 to enable.

2.28 ~AAME
(For EX-9018M/18BLM/19M only)

Description: Set the data format of channel's response in ModbusRTU mode

Syntax: ~AAME[CHK](cr)

$ delimiter character

AA address of reading/response module(00 to FF)

M command for Set the data format of response in ModbusRTU mode

E 1=2's complement / 0=engineer unit

Response: Valid command: **!AA**

Invalid command: **?AA**

Example:

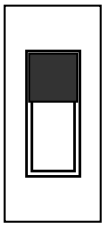
Command: ~01M1 Response: !01

Set the channel's response data format of module 01 to 2's complement in ModbusRTU mode.

EX-9018-M/9018BL-M/9019M Modbus Quick Start

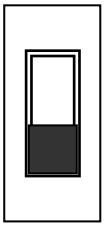
1. The default setting is MODBUS mode after Power On.

2. Sliding the INIT* switch to the Init(ON) position of rear side then Power On will enter INIT* mode (use ASCII command).



3. On ASCII command mode, user can set other setting like Address, Baudrate, …by use ASCII command or EX-9000 utility (Please check the EX-9000 user manual).

4. After change the setting finish, Sliding the INIT* switch to the Normal(1) position of rear side, the new setting will be effective after the next power-on reset.



The Modbus protocol was originally developed for Modicon controllers by Modicon Inc. Detailed information can be found at http://www.modicon.com/techpubs/toc7.html. Visit http://www.modbus.orq to find more valuable information.

9000M series modules support the Modbus RTU protocol. The communication Baud Rates range from 1200bps to 115200bps. The parity, data bits and stop bits are fixed as no parity, 8 data bits and 1stop bit. The following Modbus functions are supported.

This function code is used to read from 1 to 8 continuous analog input channels.

Request

00	Address	1Byte	1 to 247
01	Function code	1Byete	0x04
02-03	Starting channel	2 Bytes	0 to 7 for reading analog inputs
04-05	Number of input Channels(N)	2Bytes	1 to 8;(Starting channel+N)<=8 for reading analog inputs

Response

00	Address	1Byte	1 to 247
01	Function code	1Byete	0x04
02	Byte count	1 Byte	2 x N
03~	Data of input channels	2 x N Bytes	

Error Response

00	Address	1Byte	1 to 247
01	Function code	1Byete	0x84
	Exception code	1 Byte	02:starting channel out of range 03:(starting channel+number of input channels) out of range, incorrect number of bytes received

01(0x01) Read WDT timeout status

Request

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x01
02~03	Starting channel	2 Bytes	0x010D
04~05	Read WDT timeout status	2 Bytes	0x0001

Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x01
02	Byte count	1 Byte	1
03	Read WDT timeout status	1 Byte	0x00 The WDT timeout status is clear 0x01 The WDT timeout status is enable

Error Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x81
02	Exception code	1 Byte	Refer to the Modbus standard for more details.

03(0x03) Read WDT timeout Value

Request

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x03
02~03	Starting channel	2 Bytes	0x01E8
04~05	Read WDT timeout value	2 Bytes	0x0001

Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x03
02	Byte count	1 Byte	2
03~	Read WDT timeout value	**1** Byte	0x0000~0x00FF WDT timeout value, 0~255, in 0.1 second

Error Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x83
02	Exception code	1 Byte	Refer to the Modbus standard for more details.

03(0x03) Send Host OK

Request

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x03
02~03	Starting channel	2 Bytes	0x3038
04~05	Send Host OK	2 Bytes	0x0000

No Response

04(0x04) Send Host OK

Request

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x04
02~03	Starting channel	2 Bytes	0x3038
04~05	Send Host OK	2 Bytes	0x0000

No Response

05(0x05) Set WDT timeout /Clear WDT timeout status

Request

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x05
02~03	WDT timeout	2 Bytes	0x0104 Set WDT timeout enable/disable 0x010D Clear WDT timeout status
04~05	WDT timeout	2 Bytes	0xFF00 for WDT timeout enable 0x0000 for WDT timeout disable 0xFF00 for Clear WDT timeout status

Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x05
02~03	WDT timeout	2 Bytes	The value is the same as byte 02 and 03 of the Request
04~05	WDT timeout	2 Bytes	The value is the same as byte 04 and 05 of the Request

Error Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x85
02	Exception code	1 Byte	Refer to the Modbus standard for more details.

06(0x06) Set WDT timeout Value

Request

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x06
02~03	Starting channel	2 Bytes	0x01E8
04~05	WDT timeout value	2 Bytes	0x0000~0x00FF WDT timeout value, 0~255, in 0.1 second

Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x06
02~03	WDT timeout value	2 Bytes	The value is the same as byte 02 and 03 of the Request
04~05	WDT timeout value	2 Bytes	The value is the same as byte 04 and 05 of the Request

Error Response

00	Address	1 Byte	1-247
01	Function code	1 Byte	0x86
02	Exception code	1 Byte	Refer to the Modbus standard for more details.

9018-M Modbus mapping:

Input register address			
Analog input Value	30001~30008	R	0x0000~0x7FFF
Cold junction temperature	30129	R	hex to dec then / 10
Input type Code	30201~30208	R	0x0000~0x0015
Module name	30483~30484	R	0x0090 0x1800 (9018M, “M”->0)
Channel enable	30221	R	0x0000~0x00FF (0:off, 1:on)
Modbus data format	30269	R	0x0000: engineer format, 0x0001: Hex 2’s comp
Channel offset value	30291~30298	R	0x8000~0x7FFF Hex 2’s comp to dec then / 100
Holding register address			
Analog input Value	40001~40008	R	0x0000~0x7FFF
Cold junction temperature	40129	R	hex to dec then / 10
Input type Code	40201~40208	R	0x0000~0x0015 (check the table of user manual)
Module name	40483~40484	R	0x0090 0x1800 (9018M, “M”->0)
Channel enable	40221	R/W	0x0000~0x00FF (0:off, 1:on)
Modbus data format	40269	R/W	0x0000: engineer format, 0x0001: Hex 2’s comp
Channel offset value	40291~40298	R/W	0x8000~0x7FFF Hex 2’s comp to dec then / 100
Sub-function (0x46)			
Module name	AA 46 00	R	01 46 00 **00 90 18 00**
Set module’s address	AA 46 04 NN 00 00 00	W	NN: new address, 01~F7(1~247) new address is effective after module reboot.

9018BL-M Modbus mapping:

Input register address			
Analog input Value	30001~30008	R	0x0000~0x7FFF
Cold junction temperature	30129	R	hex to dec then / 100
Input type Code	30201~30208	R	0x0000~0x0015
Module name	30483~30484	R	0x0090 0x18B0 (9018BM, “M”->0)
Channel enable	30221	R	0x0000~0x00FF (0:off, 1:on)
Modbus data format	30269	R	0x0000: engineer format, 0x0001: Hex 2’s comp
Burnout status	30281	R	0x0000~0x00FF (0:normal, 1:breakline) Note: only effective in thermocouple type
Channel offset value	30291~30298	R	0x8000~0x7FFF Hex 2’s comp to dec then / 100
Holding register address			
Analog input Value	40001~40008	R	0x0000~0x7FFF
Cold junction temperature	40129	R	hex to dec then / 100
Input type Code	40201~40208	R	0x0000~0x0015 (check the table of user manual)
Module name	40483~40484	R	0x0090 0x18B0 (9018BM, “M”->0)
Channel enable	40221	R/W	0x0000~0x00FF (0:off, 1:on)
Modbus data format	40269	R/W	0x0000: engineer format, 0x0001: Hex 2’s comp
Burnout status	40281	R	0x0000~0x00FF (0:normal, 1:breakline) Note: only effective in thermocouple type
Channel offset value	40291~40298	R/W	0x8000~0x7FFF Hex 2’s comp to dec then / 100
Sub-function (0x46)			
Module name	AA 46 00	R	01 46 00 **00 90 18 B0**
Set module’s address	AA 46 04 NN 00 00 00	W	NN: new address, 01~F7(1~247) new address is effective after module reboot.

9019-M Modbus mapping:

Input register address			
Analog input Value	30001~30008	R	0x0000~0x7FFF
Cold junction temperature	30129	R	hex to dec then / 100
Input type Code	30201~30208	R	0x0000~0x0015
Module name	30483~30484	R	0x0090 0x1900 (9019M, “M”->0)
Channel enable	30221	R	0x0000~0x00FF (0:off, 1:on)
Modbus data format	30269	R	0x0000: engineer format, 0x0001: Hex 2’s comp
Burnout status	30281	R	0x0000~0x00FF (0:normal, 1:breakline) Note: only effective in thermocouple type
Channel offset value	30291~30298	R	0x8000~0x7FFF Hex 2’s comp to dec then / 100
Holding register address			
Analog input Value	40001~40008	R	0x0000~0x7FFF
Cold junction temperature	40129	R	hex to dec then / 100
Input type Code	40201~40208	R/W	0x0000~0x0015 (check the table of user manual)
Module name	40483~40484	R	0x0090 0x1900 (9019M, “M”->0)
Channel enable	40221	R/W	0x0000~0x00FF (0:off, 1:on)
Modbus data format	40269	R/W	0x0000: engineer format, 0x0001: Hex 2’s comp
Burnout status	40281	R	0x0000~0x00FF (0:normal, 1:breakline) Note: only effective in thermocouple type
Channel offset value	40291~40298	R/W	0x8000~0x7FFF Hex 2’s comp to dec then / 100
Sub-function (0x46)			
Module name	AA 46 00	R	01 46 00 **00 90 19 00**
Set module’s address	AA 46 04 NN 00 00 00	W	NN: new address, 01~F7(1~247) new address is effective after module reboot.

MODBUS Engineering Data Format Table

Type Code	Input Type	Min.	Max.	Formula
00	-15mV ~ +15mV	-15000	15000	Volt=(Modbus data)/1000(mV)
01	-50mV ~ +50mV	-5000	5000	Volt=(Modbus data)/100(mV)
02	-100mV ~ +100mV	-10000	10000	Volt=(Modbus data)/100(mV)
03	-500mV ~ +500mV	-5000	5000	Volt=(Modbus data)/10(mV)
04	-1V ~ +1V	-10000	10000	Volt=(Modbus data)/10000(V)
05	-2.5V ~ +2.5V	-25000	25000	Volt=(Modbus data)/10000(V)
06	-20mA ~ +20mA	-20000	20000	Current=(Modbus data)/1000(mA)
0E	Type J: -210°C to 760°C	-2100	7600	Temp.=(Modbus data)/10(°C)
0F	Type K: -270°C to 1372°C	-2700	13720	
10	Type T: -270°C to 400°C	-2700	4000	
11	Type E: -270°C to 1000°C	-2700	10000	
12	Type R: 0°C to 1768°C	0	17680	
13	Type S: 0°C to 1768°C	0	17680	
14	Type B: 0°C to 1820°C	0	18200	
15	Type N: -270°C to 1300°C	-2700	13000	

Example: Assume type of channel is +/-10V and MODBUS data=0x2030(Hex)=8240(Dec)
The voltage of channel is 8240/1000=8.24V

Example: Assume type of channel is +/-500mV and MODBUS data=0xEF1B(Hex)=-4325(Dec)
The voltage of channel is -4235/10=423.5mV

Example: Assume type of channel is +/-20mA and MODBUS data=0x3B84(Hex)=15236(Dec)
The current of channel is 15236/1000=15.236mA

MODBUS Hex 2's complement Data Format Table

Type Code	Input Type	Min.	Max.	Formula
00	-15mV ~ +15mV	8000	7FFF	Volt=(Modbus data*15)/0x7FFF(mV)
01	-50mV ~ +50mV	8000	7FFF	Volt=(Modbus data*50)/0x7FFF(mV)
02	-100mV ~ +100mV	8000	7FFF	Volt=(Modbus data*100)/0x7FFF(mV)
03	-500mV ~ +500mV	8000	7FFF	Volt=(Modbus data*500)/0x7FFF(mV)
04	-1V ~ +1V	8000	7FFF	Volt=(Modbus data*1)/0x7FFF(mV)
05	-2.5V ~ +2.5V	8000	7FFF	Volt=(Modbus data*2.5)/0x7FFF(mV)
06	-20mA ~ +20mA	8000	7FFF	Current=(Modbus data*20)/0x7FFF(mA)
0E	Type J: -210°C to 760°C	DCA2	7FFF	Temp.=(Modbus data*760)/0x7FFF(°C)
0F	Type K: -270°C to 1372°C	E6D0	7FFF	Temp.=(Modbus data*1372)/0x7FFF(°C)
10	Type T: -270°C to 400°C	A99A	7FFF	Temp.=(Modbus data*400)/0x7FFF(°C)
11	Type E: -270°C to 1000°C	DD71	7FFF	Temp.=(Modbus data*1000)/0x7FFF(°C)
12	Type R: 0°C to 1768°C	0000	7FFF	Temp.=(Modbus data*1768)/0x7FFF(°C)
13	Type S: 0°C to 1768°C	0000	7FFF	Temp.=(Modbus data*1768)/0x7FFF(°C)
14	Type B: 0°C to 1820°C	0000	7FFF	Temp.=(Modbus data*1820)/0x7FFF(°C)
15	Type N: -270°C to 1300°C	E56B	7FFF	Temp.=(Modbus data*1300)/0x7FFF(°C)

Example: Assume type of channel is +/-10V and MODBUS data=0x2030(Hex)=8240(Dec)
The voltage of channel is (8240*10)/32767=2.514V

Example: Assume type of channel 1 is +/-500mV and MODBUS data=0xEF1B(Hex)=-4325(Dec)
The voltage of channel is (-4235*500)/32767=-64.622mV

Example: Assume type of channel 1 is +/-20mA and MODBUS data=0x3B84(Hex)=15236(Dec)
The current of channel is (15236*20)/32767=9.299mA