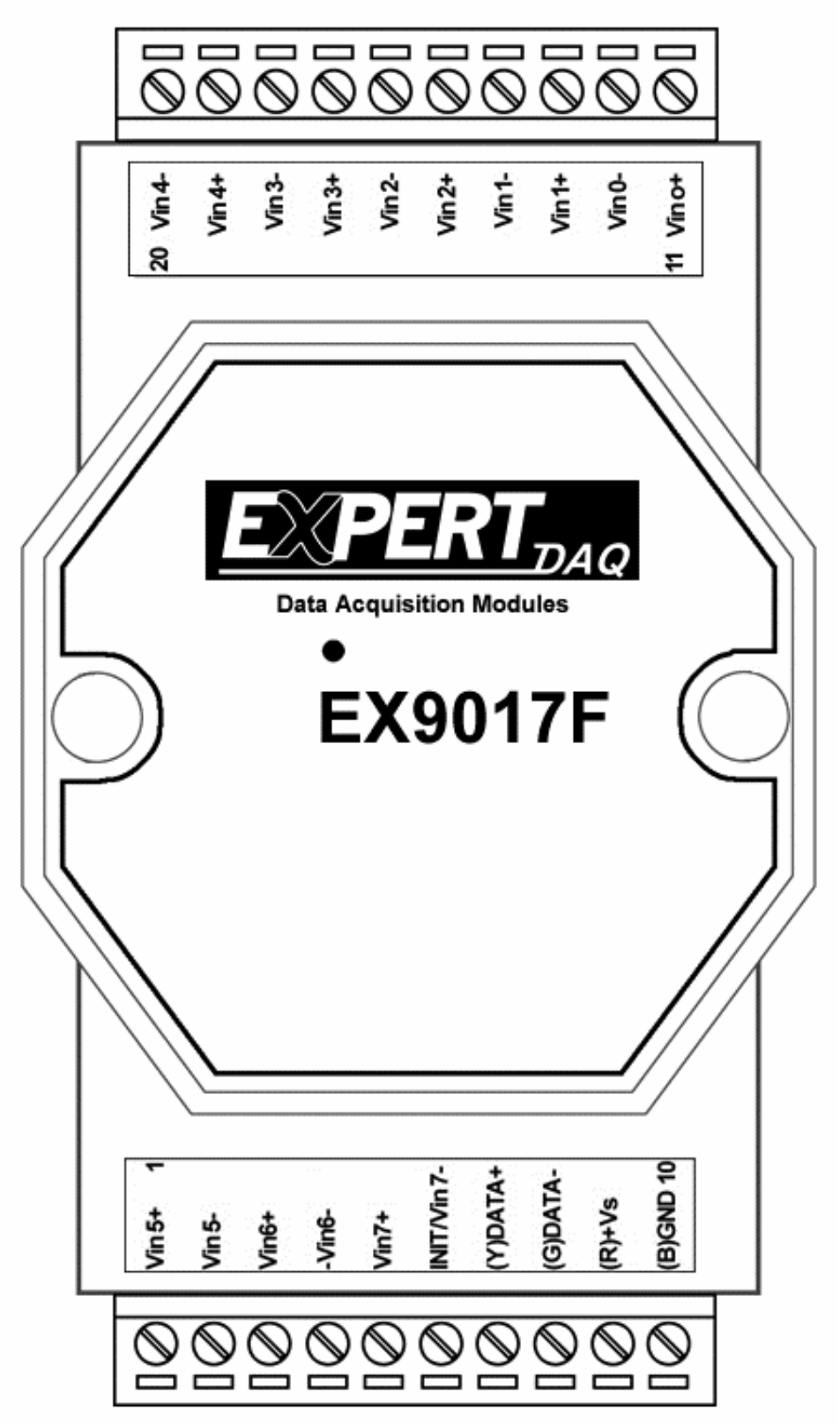
1. Introduction

EX-9017 series is a analog input module with 8 input channels. It can select 8 channels all are differential type or 6 of the eight channels are differential & other two are single ended type.

Specifications:
Interface: RS-485, 2 wires
Speed (bps): 1200, 2400, 4800, 9600, 19.2K, 38.4K, 15.2K
Analog Input type: 8 differential/ 6 differential & 2 single ended
Analog Channels Numbers: 8
Analog Resolution:16 bits (12bits for 9017F series)
Unit Conversion: **+/-10V,+/-5V,+/-1V,+/-500mV,+/-150mV,+/-20mA**
Sampling Rate :10 Samples/Second
Bandwidth : 15.7 Hz
Accuracy : ±0.1%
Zero Drift : 0.5μV/°C
Span Drift : 25ppm/°C
CMR@50/60Hz : 150dB
NMR@50/60Hz : 100dB
Input Impedance : 20M Ohms
Current Measurement: ±20mA (with external 125 ohms resistor)
Power supply: +10V to +30V


20 Vin4-
Vin4+
Vin3-
Vin3+
Vin2-
Vin2+
Vin1-
Vin1+
Vin0-
11 Vin0+
EXPERT DAQ
Data Acquisition Modules
EX9017F
Vin5+ 1
Vin5-
Vin6+
-Vin6-
Vin7+
INIT/Vin7-
(Y)DATA+
(G)DATA-
(R)+Vs
(B)GND 10

Specifications

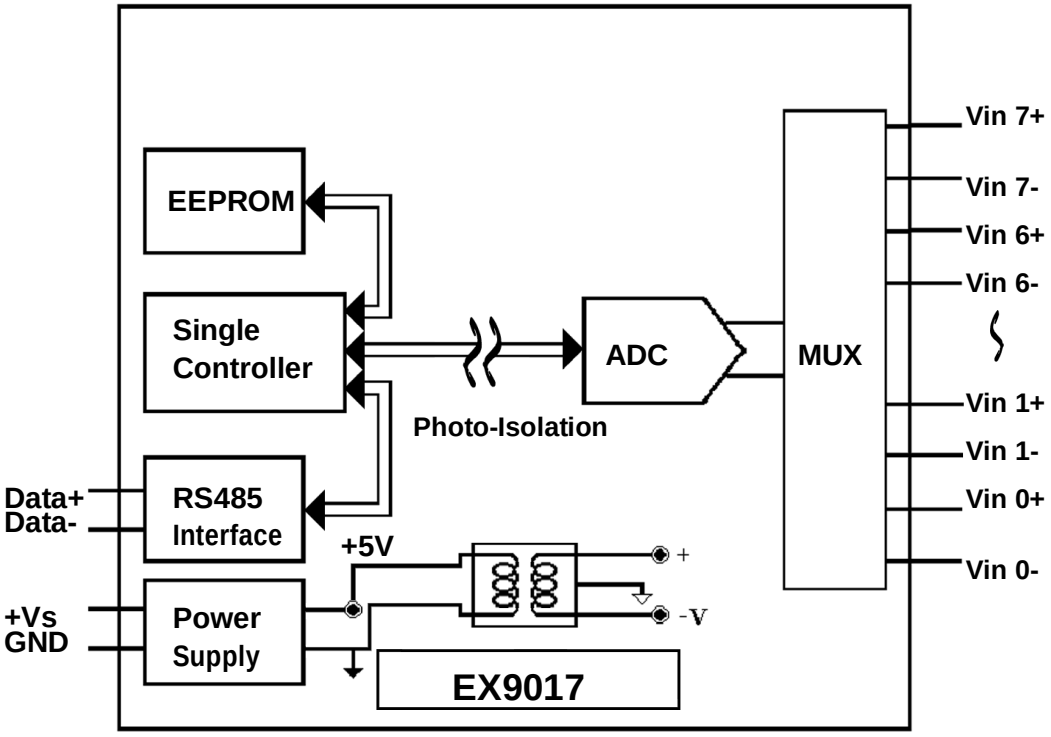
	EX-9017F EX-9017F-M	EX-9017R EX-9017R-M	EX-9017FR EX-9017FR-M
Interface	RS-485, 2 wires		
Speed(bps)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200		
Analog Input type	6 differential input & 2 single ended input		
Input Channels	8		
Resolution	16/12 bits	16 bits	16/12 bits
Voltage Input	-10V ~ +10V -5V ~ +5V -1V ~ +1V -500mV ~ +500mV -150mV ~ +150mV		
Current Input	-20mA ~ +20mA (with 125ohms resistor)		
Sampling Rate	10/50Hz	10Hz	10/50Hz
Bandwidth	15.7Hz		
Accuracy	±0.1%		
Zero Drift	0.5μV/°C		
Span Drift	25ppm/°C		
CMR@50/60Hz	150dB		
NMR@50/60Hz	100dB		
Input Impedance	20M ohms		
Power supply	+10V ~ +30V		
Modbus RTU	EX9017F-M	EX9017R-M	EX9017FR-M
Over voltage protection	Not support	240Vrms	

Notes:

1. Warm-UP for 30 minutes is recommended before starting operation!
2. EX-9017-M: EX-9017 w/ Modbus function
3. EX-9017F: EX-9017 w/ fast mode (12bits)
4. EX-9017F-M: EX-9017F w/ Modbus function
5. EX-9017FR: EX-9017 w/ fast mode (12bits) & 240Vrms over voltage protection
6. EX-9017FR-M: EX-9017FR w/ Modbus function

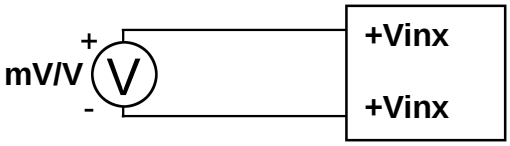
1.2 Wire connection

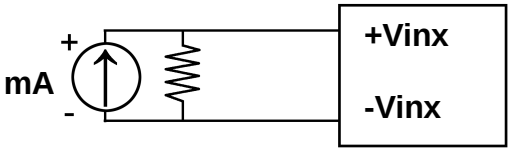
1.2.1 Block Diagrams



1.2.2 Wiring diagram for the EX-9017 series

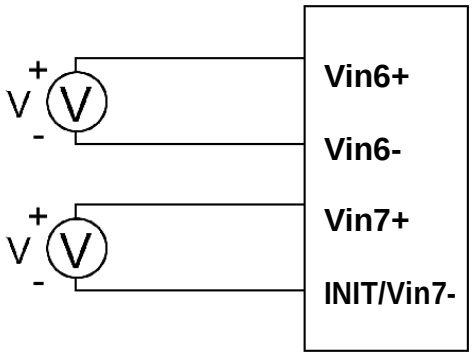
EX9017F Analog I/P Channel 0 to 5 wire connection

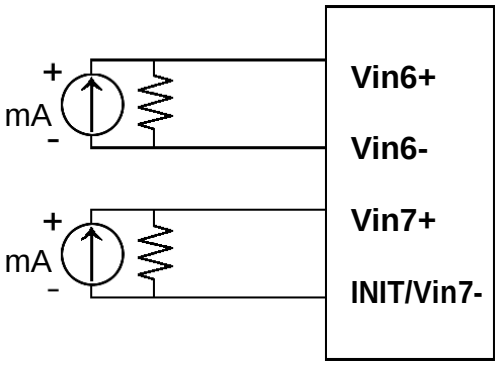




EX9017/17F Analog I/P Channel 6 and 7 wire connection, while the jumper JP1 setting is 8 differential mode.

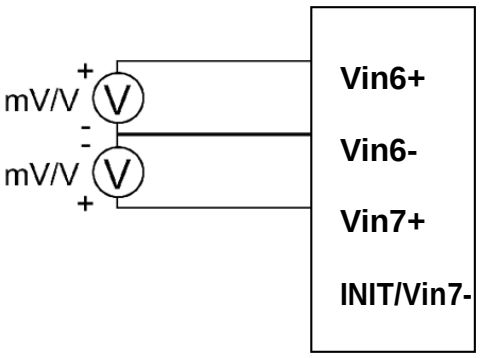
JP1

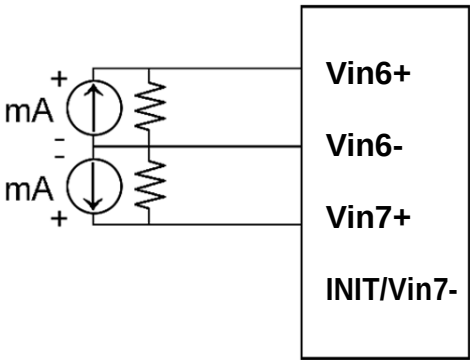




EX9017F Analog I/P Channel 6 and 7 wire connection, while the jumper JP1 setting is Init* mode.

JP1





1.3 Default Settings

Default settings for the EX-9017/17F/17R/17FR modules are as follows:

. Module Address: 01
. Analog Input Type: type 05
. Baud Rate: 9600 bps
. Checksum disabled
. Engineering unit format
. Filter set at 60Hz rejection

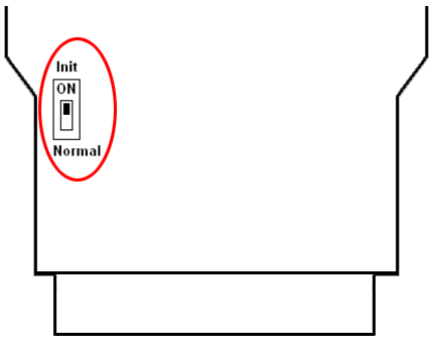
Default settings for the EX-9017-M/17F-M/17R-M/17FR-M modules are as follows:

. Protocol: Modbus RTU
. Module Address: 01
. Analog Input Type: type 05
. 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 2.12 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 rested and the output is not changed.

1.8 Calibration

Calibration Requirement for EX9017 series. While calibrate type 0D, the EX9017 series need connect external shunt resistor, 125Ohms, 0.1%

Type code	08	09	0A	0B	0C	0D
Zero Input	0V	0V	0V	0mV	0mV	0mA
Span	+10V	+5V	+1V	+500mV	+150mV	+20mA

Calibration Sequence:

1. Connect calibration voltage/current to module's channel 0.
2. Warm-Up for 30 minutes
3. Set the input type of module which you wish to calibration.
4. Enable Calibration (P.24)
5. Apply Zero Calibration Voltage
6. Preform Zero Calibration Command (P.16)
7. Apply Span Calibration Voltage
8. Perform Span Calibration Command (P.15)
9. Repeat step4 to step 8 three times.

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

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.
08	-10~+10V	Engineer unit	+10.000	+00.000	-10.000
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
09	-5~+5V	Engineer unit	+5.0000	+0.0000	-5.0000
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
0A	-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
0B	-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
0C	-150~+150mV	Engineer unit	+150.00	+000.00	-150.00
		% of F.S.R.	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
0D	-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

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.

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 EX9017F, the data is the combination for each channel respectively.

Example :

Command :#01 Receive : >+02.635

Read address 01, get data successfully.

Command : #02 Receive : >4C53

Read address 02, get data in HEX format successfully.

Command : #04

Receive:>+05.123+04.153+07.234-02.356+10.000-05.133+02.345+08.234

The module address 04 is EX9017. 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: !01080600

Read the configuration of module 01, input range of -10~+10V, baudrate 9600, no checksum.

Note: check configuration Tables

2.7 $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.

2.8 $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.

2.9 $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

2.10 $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 : !019017

Read address 01 module name, return name 9017.

2.11 $AAP
(For EX-9017M/17FM/17RM/17FRM 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.

2.12 $AAPN
(For EX-9017M/17FM/17RM/17FRM 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.

2.13 ~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.

2.14 ~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:~01O9017 Receive :!01

Set address 01 module name 9017, return success.

2.15 ~**

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

2.16 ~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.

2.17 ~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**

2.18 ~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

2.19 ~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.

EX9017-M/17F-M/17R-M/17FR-M Quick Start

1. **The default setting is MODBUS mode after Power On.**
2. **Using INIT pin to contact with GND pin then Power On will enter Normal mode.**
3. **Command: $00P0 is set EX9017-M to Normal mode after Repower On. On normal mode, user can set other setting like Address, Baudrate, ….. (Please check the EX9000 user manual).**
4. **Command: $AAP1 is set to MODBUS mode after Repower On.**
5. **Under Normal mode that Command: $AAP can check which mode it is after Repower On.**

   Response:

   !AA10=Normal

   !AA11=MODBUS

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.

1. 04(0x4) READ INPUT CHANNELS

This function code is used to read from 0 to 7 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

Address Mapping

9017-M				
Address	Hex	Channel	Content	Attribute
30001	0H	0	Analog input Value	Read
30002	1H	1	Analog input Value	Read
30003	2H	2	Analog input Value	Read
30004	3H	3	Analog input Value	Read
30005	4H	4	Analog input Value	Read
30006	5H	5	Analog input Value	Read
30007	6H	6	Analog input Value	Read
30008	7H	7	Analog input Value	Read