

8016

User's Manual

Warranty

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1. Introduction

8000 is a family of network data acquisition and control modules. They provide analog-to-digital, digital-to-analog, digital input/output, timer/counter and other functions. These modules can be remote controlled by a set of commands. The basic features of 8016 are given as following :

- 3000 VDC isolated analog input.
- 24-bits sigma-delta ADC to provide excellent accuracy.
- 16-bit DAC supply excitation voltage for strain gauge.
- Software calibration.
- Linear Mapping.

1.1 More Information

Refer to “**8000 Bus Converter User Manual**” chapter 1 for more information as following:

1.1 8000 Overview

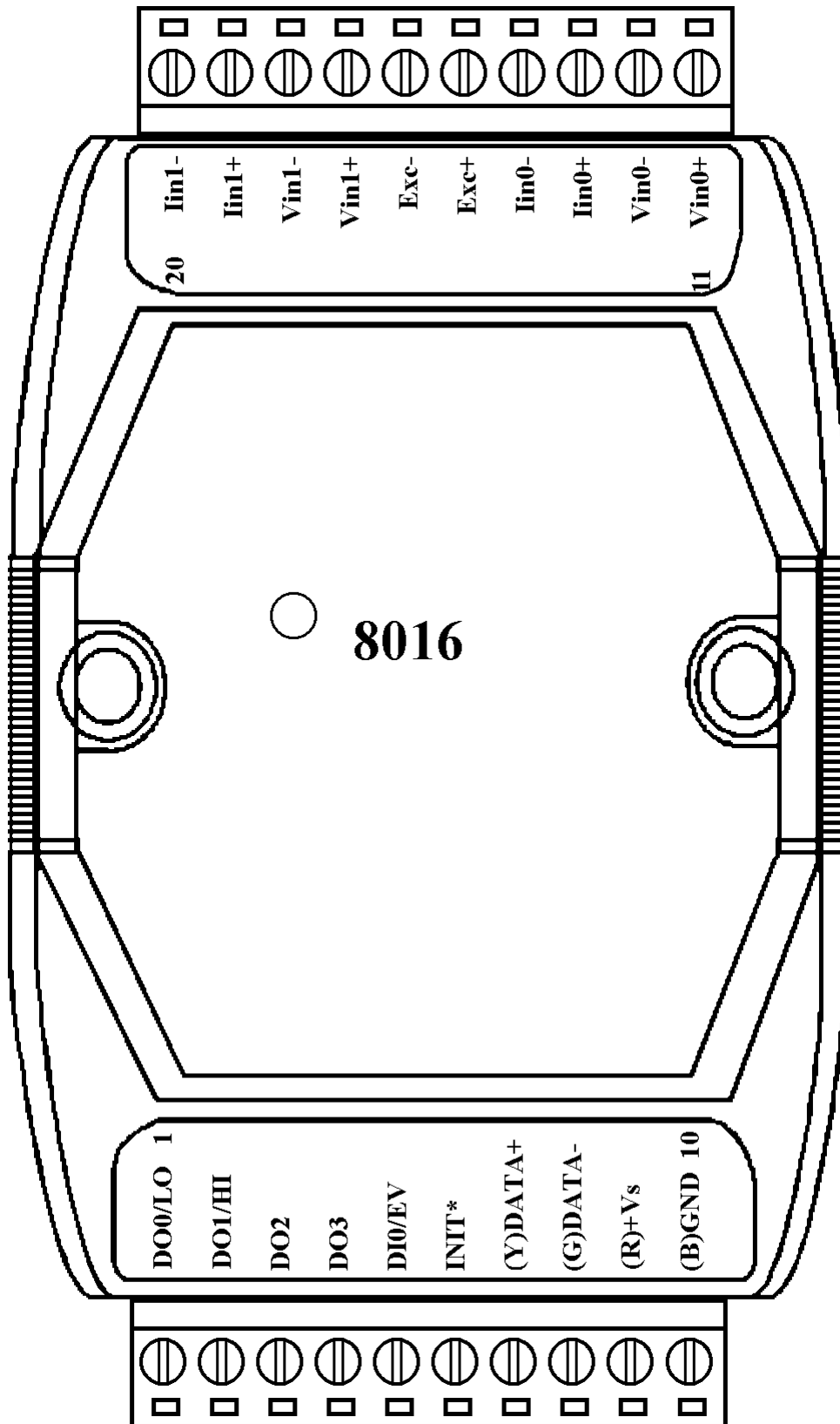
1.2 8000 Related Documentation

1.3 8000 Command Features

1.4 8000 System Network Configuration

1.5 8000 Dimension

1.2 Pin Assignment



1.3 Specifications

8 0 1 6

Analog Input

Input Channel : 2

Analog Input Type :
mV, V, mA

Sampling Rate :
10 Samples/Second

Bandwidth : 5.24 Hz

Accuracy : $\pm 0.05\%$

Zero Drift : $0.5\mu\text{V}/^\circ\text{C}$

Span Drift : $25\text{ppm}/^\circ\text{C}$

CMR@50/60Hz : 150dB

NMR@50/60Hz : 100dB

Input Impedance : 20M Ohms

Isolation : 3000VDC

Excitation Voltage Output

Output Channel : 1

Output Range : 0 to +10V

Max Output Load : 40mA

Accuracy : $\pm 0.05\%$ of FSR

Drift : $\pm 50\text{ppm}/^\circ\text{C}$

Output Impedance : 12 Ohms

Isolation : 3000VDC

Digital Output

4 channel

Open Collector to 30V

Output Load : sink 30mA max

Power Dissipation : 300mW

Digital Input

1 channel

Logic Level 0 : +1V max

Logic Level 1 : +3.5 to 30V

Event Counter

Max Input Frequency : 50 Hz

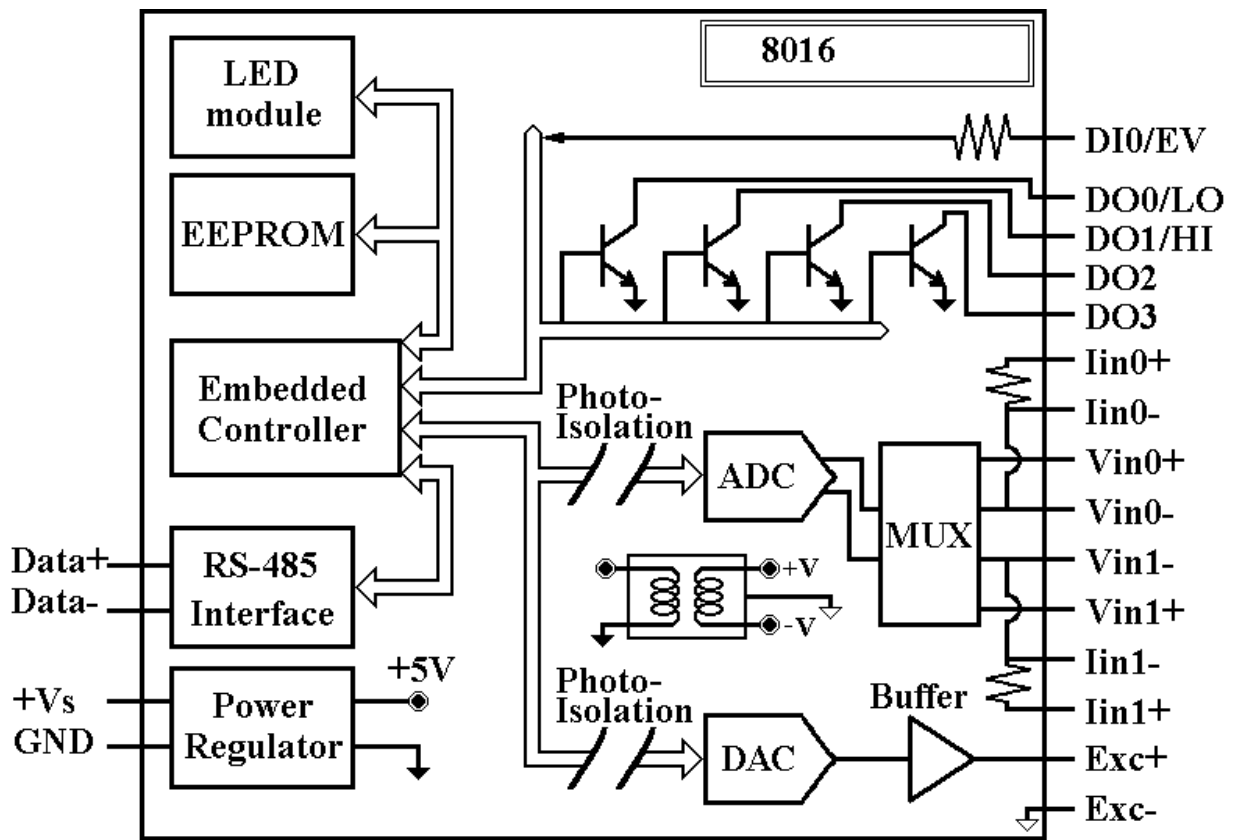
Min. Pulse Width : 1 mS

Power Supply

Input : +10 to +30VDC

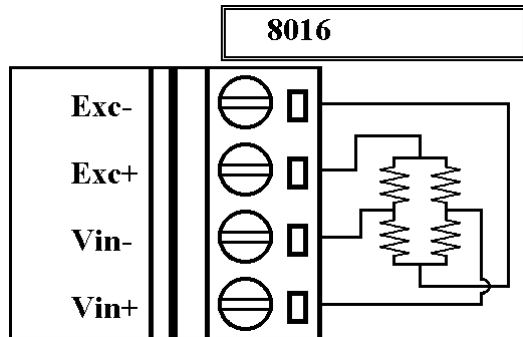
Consumption :
2.4W for 8016

1.4 Block Diagram

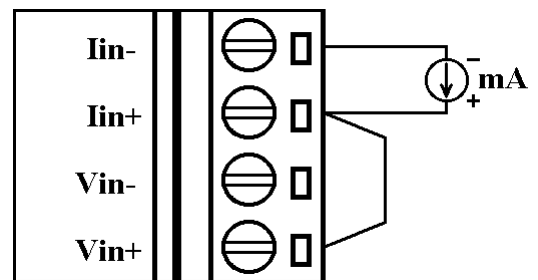
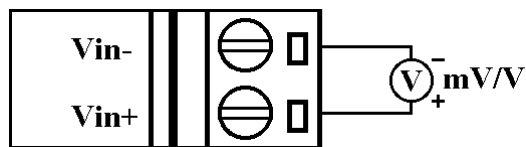


1.5 Wire Connection

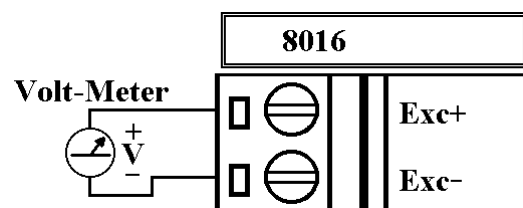
Bridge Sensor/Load Cell/Strain Gauge Wire Connection



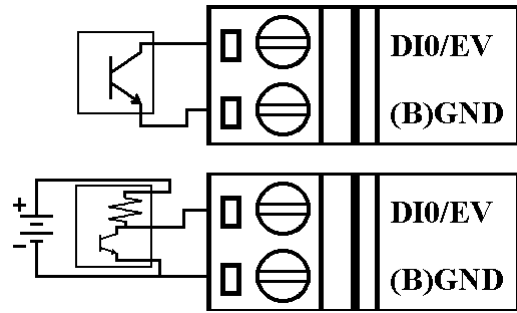
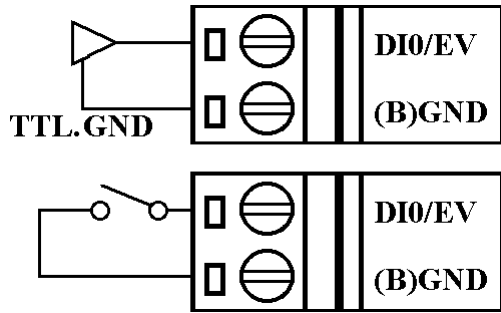
Analog Input Wire Connection



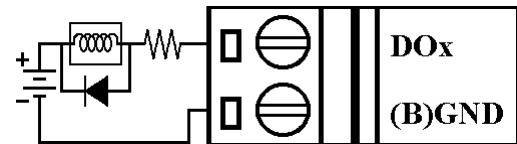
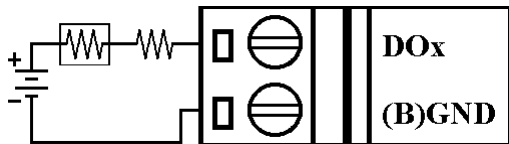
Analog Output Wire Connection



Digital Input Wire Connection



Digital Output Wire Connection



1.6 Quick Start

Refer to “8000 Bus Converter User Manual” and “Getting Start” for more detail.

1.7 Default Setting

Default setting for 8016 :

- Address : 01
- Analog Input Type : Type 05, -2.5 to +2.5 V
- Baudrate : 9600 bps
- Checksum disable, engineer unit format, 60Hz filter

1.8 Calibration

Don't Perform Calibrate Until You Really Understand.

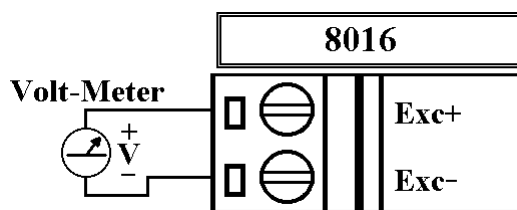
Analog Input Calibration Requirement for 8016

Type Code	00	01	02	03	04	05	06
Zero Input	0 mV	0 mV	0 mV	0 mV	0 V	0 V	0 mA
Span Input	+15 mV	+50 mV	+100 mV	+500 mV	+1 V	+2.5 V	+20 mA

Calibration Sequence :

- 1 Connect calibration voltage/current to module's input channel 0. (Wire connect ref *Sec.1.5*)
- 2 Warm-Up for 30 minutes
- 3 Setting Type to 00 -> Ref
Sec.2.1.
- 4 Enable Calibration -> Ref
Sec.2.16.
- 5 Apply Zero Calibration Voltage

- 6 Perform Zero Calibration Command -> Ref *Sec.2.5.*
- 7 Apply Span Calibration Voltage
- 8 Perform Span Calibration Command -> Ref *Sec.2.4.*
- 9 Repeat step4 to step8 three times.
10. Perform step1 to step9 for each type with change the step3:setting type, step5:zero calibration voltage, step7:span calibration voltage.



Excitation Voltage Calibration Requirement for 8016

Calbration Sequence :

- 1 Connect voltmeter to module's excitation output pin.
- 2 Warm-Up for 30 minutes.
- 3 Output 0V. -> Ref *Sec.2.18*
- 4 Trim the output until the value in voltmeter is closest to 0V.
-> Ref *Sec.2.20*
- 5 Perform Excitation Voltage Zero Calibration.
-> Ref *Sec.2.21*
- 6 Output 10V. -> Ref *Sec.2.18*
- 7 Trim the output until the value in voltmeter is closest to 10V.
-> Ref *Sec.2.20*
- 8 Perform Excitation Voltage Span Calibration.
-> Ref *Sec.2.22*

1.9 Configuration Tables

Configuration Table of 8016

Baudrate Setting (CC)

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

Analog Input Type Setting (TT)

00 : -15mV to +15mV

01 : -50mV to +50mV

02 : -100mV to +100mV

03 : -500mV to +500mV

04 : -1V to +1V

05 : -2.5V to +2.5V

06 : -20mA to +20mA

Data Format Setting (FF)

7	6	5	4	3	2	1	0
*1	*2	0	0	0	0	*3	

*1 : Filter Select : 0 = 60Hz rejection

1 = 50Hz rejection

*2 : Checksum Bit : 0=Disable, 1=Enable

*3 : 00 = Engineer Unit Format

01 = Percent Format

10 = 2's Complement HEX Format

Analog input type and data format table

Type Code	Input Range	Data Format	+F.S.	Zero	-F.S.
00	-15 to +15 mV	Engineer Unit	+15.000	+00.000	-15.000
		% of FSR	+100.00	+000.00	-100.00
		2's complement HEX	7FFF	0000	8000
01	-50 to +50 mV	Engineer Unit	+50.000	+00.000	-50.000
		% of FSR	+100.00	+000.00	-100.00
		2's complement HEX	7FFF	0000	8000
02	-100 to +100 mV	Engineer Unit	+100.00	+000.00	-100.00
		% of FSR	+100.00	+000.00	-100.00
		2's complement HEX	7FFF	0000	8000
03	-500 to +500 mV	Engineer Unit	+500.00	+000.00	-500.00
		% of FSR	+100.00	+000.00	-100.00
		2's complement HEX	7FFF	0000	8000
04	-1 to +1 V	Engineer Unit	+1.0000	+0.0000	-1.0000
		% of FSR	+100.00	+000.00	-100.00
		2's complement HEX	7FFF	0000	8000
05	-2.5 to +2.5 V	Engineer Unit	+2.5000	+0.0000	-2.5000
		% of FSR	+100.00	+000.00	-100.00
		2's complement HEX	7FFF	0000	8000
06	-20 to +20 mA	Engineer Unit	+20.000	+00.000	-20.000
		% of FSR	+100.00	+000.00	-100.00
		2's complement HEX	7FFF	0000	8000

2. Command

Command Format : **(Leading)(Address)(Command)[CHK](cr)**

Response Format : **(Leading)(Address)(Data)[CHK](cr)**

[CHK] 2-character checksum

(cr) end-of-command character, character return(0x0D)

General Command Sets			
Command	Response	Description	Section
%AANNTTCFF	!AA	Set Module Configuration	<i>Sec.2.1</i>
***	No Response	Synchronized Sampling	<i>Sec.2.2</i>
#AA	>(Data)	Read Analog Input	<i>Sec.2.3</i>
\$AA0	!AA	Perform Span Calibration	<i>Sec.2.4</i>
\$AA1	!AA	Perform Zero Calibration	<i>Sec.2.5</i>
\$AA2	!AANNTTCFF	Read Configuration	<i>Sec.2.6</i>
\$AA3	!AAN	Read Channel Select	<i>Sec.2.7</i>
\$AA3N	!AA	Set Channel Select	<i>Sec.2.8</i>
\$AA4	>AAS(Data)	Read Synchronized Data	<i>Sec.2.9</i>
\$AA8	!AAV	Read LED Configuration	<i>Sec.2.10</i>
\$AA8V	!AA	Set LED Configuration	<i>Sec.2.11</i>
\$AA9(Data)	!AA	Set LED Data	<i>Sec.2.12</i>
\$AAF	!AA(Data)	Read Firmware Version	<i>Sec.2.13</i>
\$AAM	!AA(Data)	Read Module Name	<i>Sec.2.14</i>
~AAO(Data)	!AA	Set Module Name	<i>Sec.2.15</i>
~AAEV	!AA	Enable/Disable Calibration	<i>Sec.2.16</i>

Excitation Voltage Command Sets			
Command	Response	Description	Section
\$AA6	!AA(Data)	Get Excitation Voltage Output Value	<i>Sec.2.17</i>
\$AA7(Data)	!AA	Excitation Voltage Output	<i>Sec.2.18</i>
\$AAS	!AA	Start-Up Voltage Output Configuration	<i>Sec.2.19</i>
\$AAEVV	!AA	Excitation Voltage Trim Calibration	<i>Sec.2.20</i>
\$AAA	!AA	Excitation Voltage Zero Calibration	<i>Sec.2.21</i>
\$AAB	!AA	Excitation Voltage Span Calibration	<i>Sec.2.22</i>

Digital Input/Output, Alarm and Event Counter Command Sets			
Command	Response	Description	Section
@ AADI	!AASOOII	Read Digital I/O and Alarm Status	<i>Sec.2.23</i>
@ AADO(Data)	!AA	Set Digital Output	<i>Sec.2.24</i>
@ AAEAT	!AA	Enable Alarm	<i>Sec.2.25</i>
@ AAHI(Data)	!AA	Set High Alarm	<i>Sec.2.26</i>
@ AALO(Data)	!AA	Set Low Alarm	<i>Sec.2.27</i>
@ AADA	!AA	Disable Alarm	<i>Sec.2.28</i>
@ AACA	!AA	Clear Latch Alarm	<i>Sec.2.29</i>
@ AARH	!AA(Data)	Read High Alarm	<i>Sec.2.30</i>
@ AARL	!AA(Data)	Read Low Alarm	<i>Sec.2.31</i>
@ AARE	!AA(Data)	Read Event Counter	<i>Sec.2.32</i>
@ AACE	!AA	Clear Event Counter	<i>Sec.2.33</i>

Linear Mapping Command Sets			
Command	Response	Description	Section
@AA6	!AA(SL)(SH)	Read Source Low/High Values for Linear Mapping	<i>Sec.2.34</i>
@AA6(SL)(SH)	!AA	Set Source Low/High Values for Linear Mapping	<i>Sec.2.35</i>
@AA7	!AA(TL)(TH)	Read Target Low/High Values for Linear Mapping	<i>Sec.2.36</i>
@AA7(TL)(TH)	!AA	Set Target Low/High Values for Linear Mapping	<i>Sec.2.37</i>
@AAA	!AAV	Read Linear Mapping Enable/Disable	<i>Sec.2.38</i>
@AAAV	!AA	Enable/Disable Linear Mapping	<i>Sec.2.39</i>

Host Watchdog Related Command Sets			
Command	Response	Description	Section
~**	No Response	Host OK	<i>Sec.2.40</i>
~AA0	!AASS	Read Module Status	<i>Sec.2.41</i>
~AA1	!AA	Reset Module Status	<i>Sec.2.42</i>
~AA2	!AATT	Read Host Watchdog Timeout Interval	<i>Sec.2.43</i>
~AA3ETT	!AA	Set Host Watchdog Timeout Interval	<i>Sec.2.44</i>
~AA4	!AAPPSS	Read PowerOn Value and Safe Value	<i>Sec.2.45</i>
~AA5PPSS	!AA	Set PowerOn Value and Safe Value	<i>Sec.2.46</i>

2.1 %AANNTTCCFF

Description : Set Module Configuration

Syntax : %AANNTTCCFF[CHK](cr)

% a delimiter character

AA address of setting module(00 to FF)

NN new address for setting module(00 to FF)

TT new type for setting module (Ref *Sec.1.9*)

CC new baudrate for setting module (Ref *Sec.1.9*). It is needed to short INIT* to ground while change baudrate. (Ref *Sec.3.1*)

FF new data format for setting module (Ref *Sec.1.9*). It is needed to short INIT* to ground while change checksum setting. (Ref *Sec.3.1*)

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command. While change baudrate or checksum setting without short INIT* to ground, the module will return invalid command.

AA address of response module(00 to FF)

Example :

Command : %0102050600 Receive : !02

Change address from 01 to 02, return success.

Command : %0202050602

Receive : !02

Change data format from 00 to 02, return success.

Related Command :

Sec.2.6 \$AA2

Related Topics :

Sec.1.9 Configuration Tables, Sec.3.1 INIT pin Operation*

2.2 #**

Description : Synchronized Sampling

Syntax : #**[CHK](cr)

a delimiter character

** synchronized sampling command

Response : No response

Example :

Command : #** No response

Send synchronized sampling command.

Command : \$014 Receive : >011+025.123

First read, get status=1.

Command : \$014 Receive : >010+025.123

Second read, get status=0.

Related Command :

Sec.2.9 \$AA4

2.7 \$AA3

Description : Read Channel Select

Syntax : \$AA3[CHK](cr)

\$ delimiter character

AA address of reading module (00 to FF)

3 command for reading channel select

Response : Valid Command : !AAN[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

N channel selected. The analog input command is applied to the channel N.

Example :

Command : \$013

Receive : !010

Read address 01 channel select, return channel 0 is selected.

Related Command :

Sec2.8 \$AA3N

Note : The command is for 8016 only

2.13 \$AAF

Description : Read Firmware Version

Syntax : \$AAF[CHK](cr)

\$ delimiter character

AA address of reading module (00 to FF)

F command for reading firmware version

Response : Valid Command : !AA(Data)[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

(Data) firmware version of module

Example :

Command : \$01F Receive : !01A2.0

Read address 01 firmware version, return version A2.0.

Command : \$02F Receive : !01B1.1

Read address 02 firmware version, return version B1.1.

2.15 ~AAO(Data)

Description : Set Module Name

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

~ delimiter character

AA address of setting module (00 to FF)

O command for setting module name

(Data) new name for module, max 6 characters

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : ~01O7016 Receive : !01

Set address 01 module name to 7016, return success.

Command : \$01M Receive : !017016

Read address 01 module name, return 8016.

Related Command :

Sec.2.14 \$AAM

2.17 \$AA6

Description : Get Excitation Voltage Value

Syntax : \$AA6[CHK](cr)

\$ delimiter character

AA address of reading module (00 to FF)

6 command for reading excitation voltage value

Response : Valid Command : !AA(Data)[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

(Data) exciataion voltage value, engineer unit format

Example :

Command : \$017+05.123 Receive : !01

Set address 01 exciataion 5.123V, return success.

Command : \$016 Receive : !01+05.123

Read address 01 excitation voltage, return 5.123V.

Related Command :

Sec.2.18 \$AA7(Data)

Related Topic :

Sec.1.8 Calibration

2.18 \$AA7

Description : Excitation Voltage Output

Syntax : \$AA7(Data)[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

7 command for setting excitation voltage

(Data) excitation voltage value, engineer unit format

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : \$017+05.123 Receive : !01

Set address 01 exciataion 5.123V, return success.

Command : \$016 Receive : !01+05.123

Read address 01 excitation voltage, return 5.123V.

Related Command :

Sec.2.17 \$AA6

Related Topic :

Sec.1.8 Calibration

2.19 \$AAS

Description : Start-Up Voltage Output Configuration

Syntax : \$AAS[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

S command for setting Start-Up Voltage

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : \$017+05.123 Receive : !01

Set address 01 exciataion 5.123V, return success.

Command : \$01S Receive : !01

Set address 01 Start-Up Voltage, return success. The moudle's Start-Up Voltage is 5.123V now.

Related Command :

Sec.2.18 \$AA7(Data)

Related Topic :

Sec.1.8 Calibration

2.20 \$AAEVV

Description : Excitation Voltage Trim Calibration

Syntax : \$AAEVV[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

E command for performing trim calibration

VV trim value, 01~7F is increase 1~127 counts, and FF~80 is decrease 1~128 counts. Each count is about 0.2 mV.

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : \$017+05.123 Receive : !01

Set address 01 exciataion 5.123V, return success.

Command : \$01E03 Receive : !01

Trim address 01 excitation voltage +0.6mV, return success.

Related Command :

Sec.2.18 \$AA7(Data), Sec.2.21 \$AAA, Sec.2.22 \$AAB

Related Topic :

Sec.1.8 Calibration

2.21 \$AAA

Description : Excitation Voltage Zero Calibration

Syntax : \$AAA[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

A command for excitation voltage zero calibration

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : \$017+00.000 Receive : !01

Set address 01 excitation 0V, return success.

Command : \$01A Receive : !01

Perform address 01 zero calibration, return success.

Related Command :

Sec.2.18 \$AA7(Data), Sec.2.20 \$AAEVV, Sec.2.22 \$AAB

Related Topic :

Sec.1.8 Calibration

2.22 \$AAB

Description : Excitation Voltage Span Calibration

Syntax : \$AAB[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

B command for excitation voltage span calibration

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : \$017+10.000 Receive : !01

Set address 01 excitation 10V, return success.

Command : \$01B Receive : !01

Perform address 01 span calibration, return success.

Related Command :

Sec.2.18 \$AA7(Data), Sec.2.20 \$AAEVV, Sec.2.21 \$AAA

Related Topic :

Sec.1.8 Calibration

2.23 @AADI

Description : Read Digital I/O and Alarm Status

Syntax : @AADI[CHK](cr)

@ delimiter character

AA address of reading module (00 to FF)

DI command for reading digital input and alarm status

Response : Valid Command : !AASOOII[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

S alarm enable status, 0=alarm disable, 1=momentary alarm enabled, 2=latch alarm enabled.

OO digital output status

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
DO0	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On
DO1	Off	Off	On	On	Off	Off	On	On	Off	Off	On	On	Off	Off	On	On
DO2	Off	Off	Off	Off	On	On	On	On	Off	Off	Off	Off	On	On	On	On
DO3	Off	Off	Off	Off	Off	Off	Off	Off	On	On	On	On	On	On	On	On

II digital input status, 00=input low level, 01=input high level.

Example :

Command : @01DI

Receive : !0100001

Read address 01 digital input, return alarm disable, digital outputs all off, and digital input high level.

Related Command :

Sec.2.24 @AADO(Data), Set.2.25 @AAEAT, Sec.2.28 @AADA

Related Topic :

Sec.3.6 High/Low Alarm

2.24 @AADO(Data)

Description : Set Digital Output

Syntax : @AADO(Data)[CHK](cr)

@ delimiter character

AA address of setting module (00 to FF)

DO command for setting digital output

(Data) output value.00=DO0, DO1 off; 01=DO0 on, DO1 off;
02=DO0 off, DO1 on; 03=DO0, DO1 on; 10=DO2, DO3
off; 11=DO2 on, DO3 off; 12=DO2 off, DO3 on; 13=DO2,
DO3 on.

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no re-
sponse.

! delimiter for valid command

? delimiter for invalid command. When the alarm is en-
abled, the command will return invalid.

AA address of response module(00 to FF)

Example :

Command : @01DO00 Receive : !01

Set address 01 digital output 00, return success.

Related Command :

Sec.2.23 @AADI, Set.2.25 @AAEAT, Sec.2.28 @AADA

Related Topic :

Sec.3.6 High/Low Alarm

2.25 @AAEAT

Description : Enable Alarm

Syntax : @AAEAT[CHK](cr)

@ delimiter character

AA address of setting module (00 to FF)

EA command for enable alarm.

T alarm type, M=momentary alarm, L=latch alarm.

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @01EAM Receive : !01

Set address 01 enable momentary alarm, return success.

Related Command :

Sec.2.28 @AADA, Sec.2.29 @AACCA

Related Topic :

Sec.3.6 High/Low Alarm

2.26 @AAHI(Data)

Description : Set High Alarm

Syntax : @AAHI[CHK](cr)

@ delimiter character

AA address of setting module (00 to FF)

HI command for setting high alarm value

(Data) high alarm values, data format is in engineer unit format.

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @01HI+2.5000 Receive : !01

Set address 01 high alarm +2.5000, return success.

Related Command :

Sec.2.25 @AAEAT, Sec.2.30 @AARH

Related Topic :

Sec.3.6 High/Low Alarm

2.27 @AALO(Data)

Description : Set Low Alarm

Syntax : @AALO(Data)[CHK](cr)

@ delimiter character

AA address of setting module (00 to FF)

LO command for setting low alarm value

(Data) low alarm values, data format is in engineer unit format.

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @01LO-2.5000 Receive : !01

Set address 01 low alarm -2.5000, return success.

Related Command :

Sec.2.25 @AAEAT, Sec.2.31 @AARL

Related Topic :

Sec.3.6 High/Low Alarm

2.28 @AADA

Description : Disable Alarm

Syntax : @AADA[CHK](cr)

@ delimiter character

AA address of setting module (00 to FF)

DA command for disable alarm

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @01DA Receive : !01

Disable address 01 alarm, return success.

Related Command :

Sec.2.25 @AAEAT

Related Topic :

Sec.3.5 Digital Output

2.29 @AACCA

Description : Clear Latch Alarm

Syntax : @AACCA[CHK](cr)

@ delimiter character

AA address of setting module (00 to FF)

CA command for clear latch alarm

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @01DI Receive : !0120101

Read address 01 digital input, return latch alarm mode, low alarm active.

Command : @01CA Receive : !01

Clear address 01 latch alarm, return success.

Command : @01DI Receive : !0120001

Read address 01 digital input, return latch alarm mode, no alarm active.

Related Command :

Sec.2.23 @AADI, Sec.2.25 @AAEAT, Sec.2.28 @AADA

Related Topic :

Sec.3.6 High/Low Alarm

2.30 @AARH

Description : Read High Alarm

Syntax : @AARH[CHK](cr)

@ delimiter character

AA address of reading module (00 to FF)

RH command for reading high alarm

Response : Valid Command : !AA(Data)[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command.

? delimiter for invalid command.

AA address of response module(00 to FF)

(Data) high alarm value in engineer unit format.

Example :

Command : @01RH Receive : !01+2.5000

Read address 01 high alarm, return +2.5000.

Related Command :

Sec.2.26 @AAHI

Related Topic :

Sec.3.6 High/Low Alarm

2.31 @AARL

Description : Read Low Alarm

Syntax : @AARL[CHK](cr)

@ delimiter character

AA address of reading module (00 to FF)

RL command for reading low alarm

Response : Valid Command : !AA(Data)[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command.

? delimiter for invalid command.

AA address of response module(00 to FF)

(Data) low alarm value in engineer unit format.

Example :

Command : @01RL Receive : !01-2.5000

Read address 01 low alarm, return -2.5000.

Related Command :

Sec.2.27 @AALO

Related Topic :

Sec.3.6 High/Low Alarm

2.32 @AARE

Description : Read Event Counter

Syntax : @AARE[CHK](cr)

@ delimiter character

AA address of reading module (00 to FF)

RE command for reading event counter

Response : Valid Command : !AA(Data)[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

(Data) event counter value, from 00000 to 65535.

Example :

Command : @01RE Receive : !0101234

Read address 01 event counter, return 1234.

Related Command :

Sec.2.33 @AACE

Related Topic :

Sec.3.4 Digital Input and Event Counter

2.35 @AA6(SL)(SH)

Description : Set Source Low/High Values for Linear Mapping

Syntax : @AA6(SL)(SH)[CHK](cr)

@ delimiter character
AA address of setting module (00 to FF)
6 command for setting source values
SL source low level value in engineer unit format
SH source high level value in engineer unit format

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @016-2.5000+2.5000 Receive : !01

Set address 01 source value -2.5 to +2.5, return success.

Related Command :

*Sec.2.34 @AA6, Sec.2.36 @AA7, Sec.2.37 @AA7(TL)(TH),
Sec.2.38 @AAA, Sec.2.39 @AAAV.*

Related Topic :

Sec.3.7 Linear Mapping

2.36 @AA7

Description : Read Target Low/High Values for Linear Mapping

Syntax : @AA7[CHK](cr)

@ delimiter character

AA address of reading module (00 to FF)

7 command for reading target values

Response : Valid Command :

!AA(TL)(TH)[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

TL target low values in engineer unit format.

TH target high values in engineer unit format.

Example :

Command : @017

Receive : !01-02.500+02.500

Read address 01 target value, return from -2.5 to +2.5.

Related Command :

Sec.2.34 @AA6, Sec.2.35 @AA6(SL)(SH), Sec.2.37 @AA7(TL)(TH), Sec.2.38 @AAA, Sec.2.39 @AAAV.

Related Topic :

Sec.3.7 Linear Mapping

2.37 @AA7(TL)(TH)

Description : Set Target Low/High Values for Linear Mapping

Syntax : @AA7(TL)(TH)[CHK](cr)

@ delimiter character
AA address of setting module (00 to FF)
7 command for setting target values
TL target low level value in engineer unit format
TH target high level value in engineer unit format

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @017-02.500+02.5000 Receive : !01

Set address 01 target value -2.5 to +2.5, return success.

Related Command :

Sec.2.34 @AA6, Sec.2.35 @AA6(SL)(SH), Sec.2.37 @AA7(TL)(TH), Sec.2.38 @AAA, Sec.2.39 @AAAV.

Related Topic :

Sec.3.7 Linear Mapping

2.38 @AAA

Description : Read Linear Mapping Status

Syntax : @AAA[CHK](cr)

@ delimiter character

AA address of reading module (00 to FF)

A command for reading linear mapping status

Response : Valid Command : !AAV[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

V 0=disable linear mapping, 1=enable linear mapping

Example :

Command : @01A

Receive : !011

Read address 01 linear mapping status, return enable.

Related Command :

Sec.2.34 @AA6, Sec.2.35 @AA6(SL)(SH), Sec.2.36 @AA7, Sec.2.37 @AA7(TL)(TH), Sec.2.39 @AAAV.

Related Topic :

Sec.3.7 Linear Mapping

2.39 @AAAV

Description : Enable/Disable Linear Mapping

Syntax : @AAAV[CHK](cr)

@ delimiter character

AA address of setting module (00 to FF)

A command for enable/disable linear mapping

V 0=disable linear mapping, 1=enable linear mapping

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : @01A0 Receive : !01

Disable address 01 linear mapping, return success.

Related Command :

Sec.2.34 @AA6, Sec.2.35 @AA6(SL)(SH), Sec.2.36 @AA7, Sec.2.37 @AA7(TL)(TH), Sec.2.38 @AAA.

Related Topic :

Sec.3.7 Linear Mapping

2.41 ~AA0

Description : Read Module Status

Syntax : ~AA0[CHK](cr)

~ delimiter character

AA address of reading module (00 to FF)

0 command for reading module status

Response : Valid Command : !AASS[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

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

Example :

Refer *Sec.2.44 ~AA3EVV* example.

Related Command :

*Sec.2.40 ~***, *Sec.2.42 ~AA1*, *Sec.2.43 ~AA2*, *Sec.2.44 ~AA3EVV*, *Sec.2.45 ~AA4*, *Sec.2.46 ~AA5PPSS*

Related Topic :

Sec.3.2 Module Status, *Sec.3.3 Dual Watchdog Operation*

2.42 ~AA1

Description : Reset Module Status

Syntax : ~AA1[CHK](cr)

~ delimiter character

AA address of setting module (00 to FF)

1 command for reset module status

Response : Valid Command : !AA[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Refer *Sec.2.44 ~AA3EVV* example.

Related Command :

*Sec.2.40 ~***, *Sec.2.41 ~AA0*, *Sec.2.43 ~AA2*, *Sec.2.44 ~AA3EVV*,

Sec.2.45 ~AA4, *Sec.2.46 ~AA5PPSS*

Related Topic :

Sec.3.2 Module Status, *Sec.3.3 Dual Watchdog Operation*

2.43 ~AA2

Description : Read Host Watchdog Timeout Interval

Syntax : ~AA2[CHK](cr)

~ delimiter character

AA address of reading module (00 to FF)

2 command for reading host watchdog timeout interval

Response : Valid Command : !AAVV[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

VV timeout interval in HEX format, each count stand for 0.1 second, 01=0.1 second and FF=25.5 second

Example :

Refer *Sec.2.44 ~AA3EVV* example.

Related Command :

*Sec.2.40 ~***, *Sec.2.41 ~AA0*, *Sec.2.42 ~AA1*, *Sec.2.44 ~AA3EVV*, *Sec.2.45 ~AA4*, *Sec.2.46 ~AA5PPSS*

Related Topic :

Sec.3.2 Module Status, *Sec.3.3 Dual Watchdog Operation*

Command : ~**

Receive : no response

Reset the host watchdog timer.

Wait for 10 seconds and don't send command ~**, the LED of this module will go to flash.

Command : ~010

Receive : !0104

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

Command : ~011

Receive : !01

Reset address 01 module status, return success. The LED of module will stop flash.

Related Command :

*Sec.2.40 ~**, Sec.2.41 ~AA0, Sec.2.42 ~AA1, Sec.2.43 ~AA2, Sec.2.45 ~AA4, Sec.2.46 ~AA5PPSS*

Related Topic :

Sec.3.2 Module Status, Sec.3.3 Dual Watchdog Operation

2.45 ~AA4

Description : Read PowerOn Value and Safe Value

Syntax : ~AA4[CHK](cr)

~ delimiter character

AA address of reading module (00 to FF)

4 command for reading PowerOn Value and Safe Value

Response : Valid Command : !AAPPSS[CHK](cr)

Invalid Command : ?AA[CHK](cr)

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

PP PowerOn Value, refer table for data format

SS Safe Value, refer table for data format

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
DO0	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On
DO1	Off	Off	On	On	Off	Off	On	On	Off	Off	On	On	Off	Off	On	On
DO2	Off	Off	Off	Off	On	On	On	On	Off	Off	Off	Off	On	On	On	On
DO3	Off	Off	Off	Off	Off	Off	Off	Off	On	On	On	On	On	On	On	On

Example :

Command : ~0150003

Receive : !01

Set address 01 PowerOn Value is DO0 to DO3 off, Safe Value is DO0,DO1 on, DO2,DO3 off return success.

Command : ~014

Receive : !010003

Read address 01 PowerOn/Safe Value, return PowerOn Value is DO0 to DO3 off, Safe Value is DO0, DO1 on, DO2, DO3 off.

Related Command :

Sec.2.46 ~AA5PPSS

Related Topic :

Sec.3.2 Module Status, Sec.3.3 Dual Watchdog Operation

2.46 ~AA5PPSS

Description : Set PowerOn Value and Safe Value

Syntax : ~AA5PPSS[CHK](cr)

~ delimiter character
AA address of setting module (00 to FF)
5 command for setting PowerOn Value and Safe Value
PP PowerOn Value, refer table for data format
SS Safe Value, refer table for data format

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
DO0	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On
DO1	Off	Off	On	On	Off	Off	On	On	Off	Off	On	On	Off	Off	On	On
DO2	Off	Off	Off	Off	On	On	On	On	Off	Off	Off	Off	On	On	On	On
DO3	Off	Off	Off	Off	Off	Off	Off	Off	On	On	On	On	On	On	On	On

Response : Valid Command : **!AA[CHK](cr)**

Invalid Command : **?AA[CHK](cr)**

Syntax error or communication error may get no response.

! delimiter for valid command

? delimiter for invalid command

AA address of response module(00 to FF)

Example :

Command : ~0150003 Receive : !01

Set address 01 PowerOn Value is DO0 to DO3 off, Safe Value is DO0,DO1 on, DO2,DO3 off return success.

Command : ~014

Receive : !010003

Read address 01 PowerOn/Safe Value, return PowerOn Value is DO0 to DO3 off, Safe Value is DO0, DO1 on, DO2, DO3 off.

Related Command :

Sec.2.45 ~AA4

Related Topic :

Sec.3.2 Module Status, Sec.3.3 Dual Watchdog Operation

3. Application Note

3.1 INIT* pin Operation

Each 8000 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 8000 have a special mode named “**INIT mode**”, to help user to resolve the problem. The “**INIT mode**” is setting as **Address=00, baudrate=9600bps, no checksum**

To enable INIT mode, please follow these steps:

Step1. Power off the module

Step2. Connect the INIT* pin with the GND pin.

Step3. Power on

Step4. Send command \$002(cr) in 9600bps to read the configuration stored in the module’s EEPROM.

Refer to “**8000 Bus Converter User Manual**” *Sec.5.1* and “**Getting Start**” for more information.

3.2 Module Status

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

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

3.3 Dual Watchdog Operation

Dual Watchdog = Module Watchdog + Host Watchdog

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

The Host Watchdog is a software function to monitor the host's operation status. Its purpose is to prevent from the network/communication problem or host halt. While the timeout interval expired, the module will turn the all output to safe state to prevent from unexpected problem of controlled target.

The 8000 module with Dual Watchdog may let the control system more reliable and stable.

3.4 Digital Input and Event Counter

The digital input DI0 may work as event counter. The counter updates while the input changes from high level to low level. The counter is 16-bit width and useful for low speed count, frequency is lower than 50Hz.

3.5 Digital Output

When the module power on, the host watchdog timeout status is checked first. If the status is set, the digital outputs (DO0 to DO3) of module will set to Safe Value. If the status is clear, the digital outputs will set to PowerOn Value.

If the host watchdog timeout status is set, the module will ignore the digital output command @AADO(Data).

3.6 High/Low Alarm

The analog input module 8016 equips with the high alarm and low alarm function. When the alarm function is enabled, the digital output DO0 is the low alarm indicator, DO1 is the high alarm indicator, and the digital output command to change the DO0 and DO1 is ignored. The alarm function is to compare the analog input value with given high alarm value and low alarm value. There are two alarm types as follows :

- **Momentary Alarm** : the alarm status is cleared while the analog input is not exceed the alarm value.

If Analog Input Value $>$ High Alarm, DO1(High alarm) is on, else DO1 is off.

If Analog Input Value $<$ Low Alarm, DO0(Low alarm) is on, else DO0 is off.

- **Latch Alarm** : the alarm is cleared only the user send command to clear.

If Analog Input Value $>$ High Alarm, DO1(High alarm) is on, else if Analog Input Value $<$ Low Alarm, DO0(Low alarm) is on.

3.7 Linear Mapping

Linear mapping function is to translate the input value to the desired output value. The linear mapping is a mechanism that convert the analog input value into physical quantity.

Linear mapping have some values to given : mapping source low value (SL) to target low value(TL), source high value(SH) to

target high value(TH). For input value(AI), the output value is :

if $AI < SL$, output value = -19999. (under limit)

else if $AI > SH$, output value = +19999. (over limit)

else output value = $(AI-SL)/(SH-SL) * (TH-TL) + TL$

For example, if we connect a load cell to a 8016, and the sensor output is -5mV while the input weight is 0 kg, 40mV while the input weight is 25kg. We want to read the weight directly. We have the source values, -5 to 40mV, and target values, 0 to 25kg. Suppose the 8016 is address 01, and baud 9600 bps, no-checksum.

1. Set the 8016 to read $\pm 50mV$ type.

Command : *%0101010600*

Receive : *!01*

(Ref *Sec.2.1 %AANNTTCCFF*)

2. Set the source low value(SL)=-5 and source high value(SH)=40.

Command : *@016-05.000+40.000*

Receive : *!01*

(Ref *Sec.2.35 @AA6(SL)(SH)*)

3. Set the target low value(TL)=0 and target high value(TH)=25.

Command : *@017+000.00+025.00*

Receive : *!01*

(Ref *Sec.2.37 @AA7(TL)(TH)*)

4. Enable linear mapping function.

Command : *@01A1*

Receive : *!01*

(Ref *Sec.2.39 @AAAV*)

Then we'll get the weight value from 8016 directly for command #AA.