

# **SuperLogics**

## **8021/21P, 8024**

### **User Manual**

#### **Warranty**

All products manufactured by SuperLogics are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

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Date:2001-05

# Table of Contents

<b>1. Introduction .....</b>	<b>6</b>
1.1 More Information.....	6
1.2 Pin Assignment .....	7
1.3 Specifications .....	10
1.4 Block Diagram .....	12
1.5 Jumper Setting .....	14
1.6 Wire Connection.....	14
1.7 Quick Start.....	15
1.8 Default Setting .....	15
1.9 Calibration .....	16
1.10 Configuration Tables .....	22
<b>2. Command .....</b>	<b>26</b>
2.1 %AANNTTCCFF .....	29
2.2 \$AA2 .....	30
2.3 \$AA5 .....	31
2.4 \$AAF .....	32
2.5 \$AAM.....	33
2.6 ~AAO(Data) .....	34
2.7 #AA(Data) .....	35
2.8 \$AA0 .....	37
2.9 \$AA1 .....	38
2.10 \$AA3VV .....	39

2.11	\$AA4	40
2.12	\$AA6	41
2.13	\$AA7	42
2.14	\$AA8	43
2.15	#AAN(Data)	45
2.16	\$AA0N	47
2.17	\$AA1N	48
2.18	\$AA3NVV	49
2.19	\$AA4N	50
2.20	\$AA6N	51
2.21.1	\$AA7N	52
2.21.2	\$AA7N	53
2.22	\$AA8N	54
2.23	\$AA9N	56
2.24	\$AA9NTS	57
2.25	~**	58
2.26	~AA0	59
2.27	~AA1	60
2.28	~AA2	61
2.29	~AA3EVV	62
2.30	~AA4	64
2.31	~AA4N	65
2.32	~AA5	66
2.33	~AA5N	67

<b>3. Application Note .....</b>	<b>68</b>
3.1 INIT* pin Operation .....	68
3.2 Module Status .....	68
3.3 Dual Watchdog Operation .....	69
3.4 Reset Status .....	69
3.5 Analog Output.....	69
3.6 Slew Rate Control .....	70
3.7 Current Readback.....	71



# 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 8021, 8021P, and 8024 are given as following :

- 3000 VDC isolated analog output.
- Programmable PowerOn Value of analog output.
- Programmable slew rate.
- Software calibration.

The 8021 is an analog output module with 12-bit resolution and current readback function. The 8021P is similiar with 8021 but with 16-bit resolution. The 8024 is a 4-channel analog output module, and supports bipolar voltage output.

## 1.1 More Information

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

**1.1 8000 Overview**

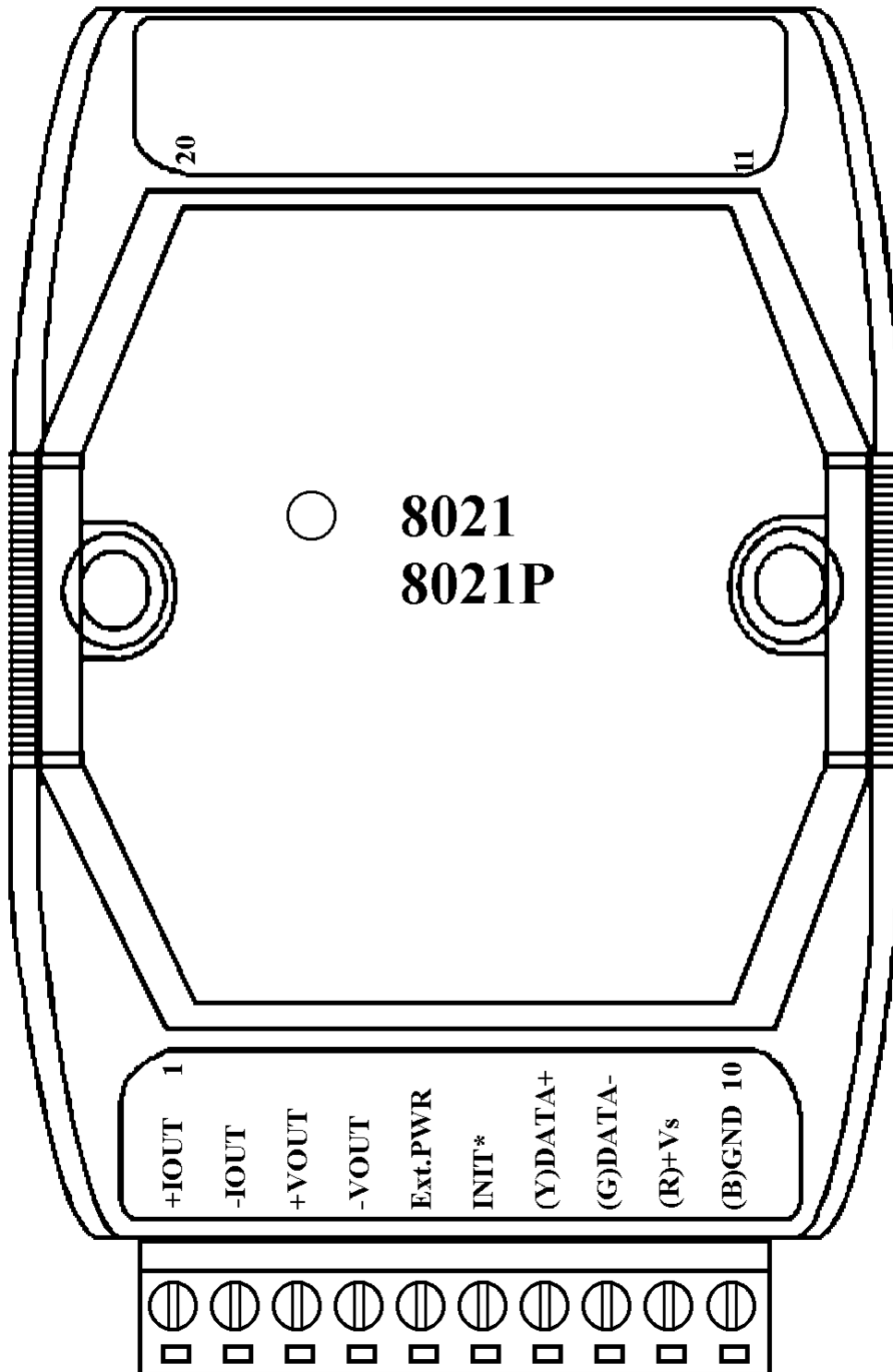
**1.2 8000 Related Documentation**

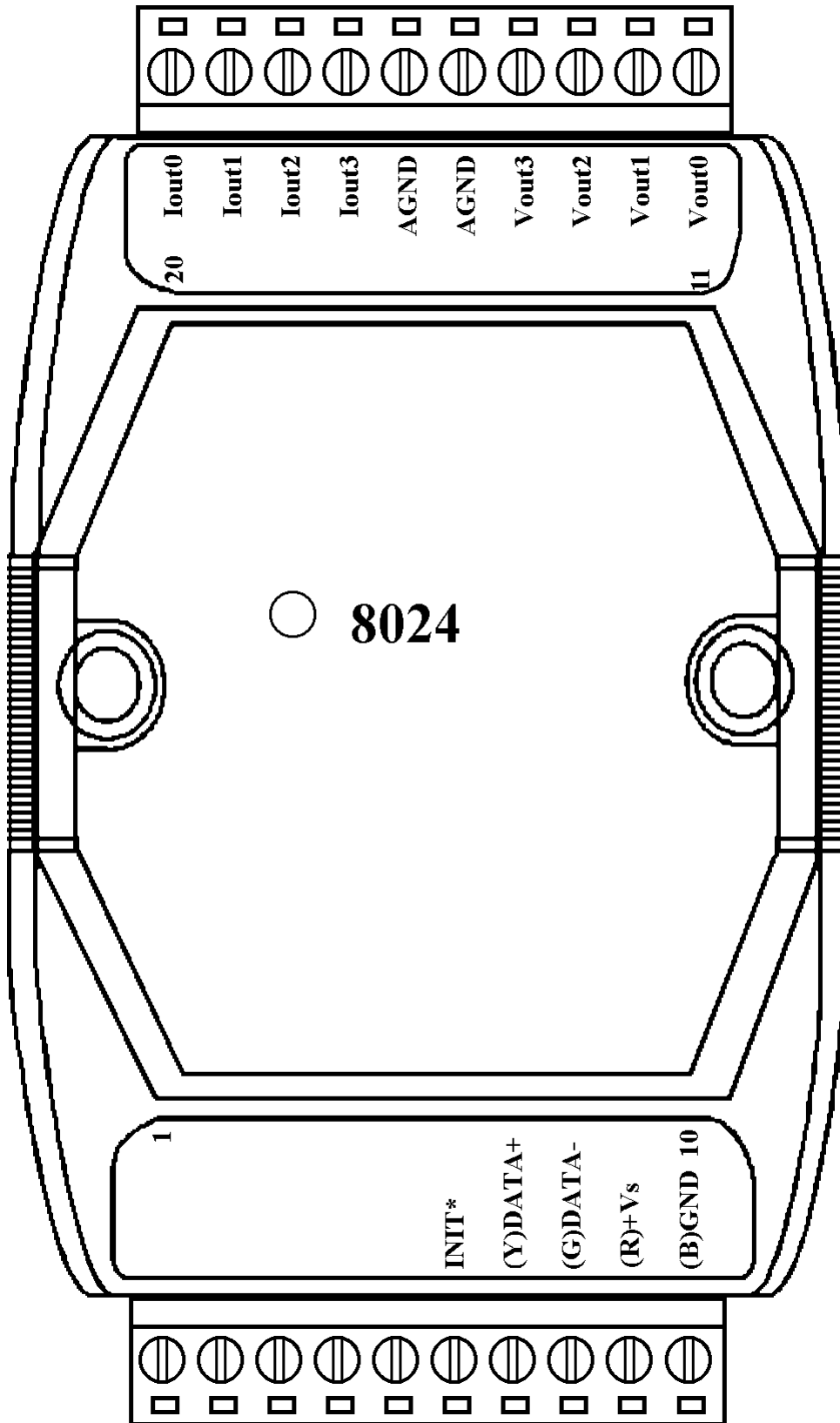
**1.3 8000 Command Features**

**1.4 8000 System Network Configuration**

**1.5 8000 Dimension**

# 1.2 Pin Assignment





# 1.3 Specifications

## 8021

### *Analog Output*

Output Channel : 1

Output Type : mA, V

Accuracy :  $\pm 0.1\%$  of FSR

Resolution :  $\pm 0.02\%$  of FSR

Readback Accuracy :  $\pm 1\%$  of FSR

Zero Drift :

Voltage output :  $\pm 30\mu\text{V}/^\circ\text{C}$

Current output :  $\pm 0.2\mu\text{A}/^\circ\text{C}$

Span Temperature Coefficient :  $\pm 25\text{ppm}/^\circ\text{C}$

Programmable Output Slope :  
0.125 to 1024 mA/Second  
0.0625 to 512 V/Second

Voltage Output : 10mA max.

Current Load Resistance :

Internal power : 500 ohms

External 24V : 1050 ohms

Isolation : 3000VDC

### *Power Supply*

Input : +10 to +30VDC

Consumption : 1.8W

## 8021P

### *Analog Output*

Output Channel : 1

Output Type : mA, V

Accuracy :  $\pm 0.02\%$  of FSR

Resolution :  $\pm 0.002\%$  of FSR

Readback Accuracy :  $\pm 1\%$  of FSR

Zero Drift :

Voltage output :  $\pm 10\mu\text{V}/^\circ\text{C}$

Current output :  $\pm 0.2\mu\text{A}/^\circ\text{C}$

Span Temperature Coefficient :  $\pm 5\text{ppm}/^\circ\text{C}$

Programmable Output Slope :  
0.125 to 1024 mA/Second  
0.0625 to 512 V/Second

Voltage Output : 10mA max.

Current Load Resistance :

Internal power : 500 ohms

External 24V : 1050 ohms

Isolation : 3000VDC

### *Power Supply*

Input : +10 to +30VDC

Consumption : 1.8W

## **8024**

### ***Analog Output***

Output Channel : 4

Output Type : mA, V

Accuracy :  $\pm 0.1\%$  of FSR

Resolution :  $\pm 0.02\%$  of FSR

Zero Drift :

Voltage output :  $\pm 30\mu\text{V}/^\circ\text{C}$

Current output :  $\pm 0.2\mu\text{A}/^\circ\text{C}$

Span Temperature Coefficient :  
 $\pm 20\text{ppm}/^\circ\text{C}$

Programmable Output Slope :

0.125 to 2048 mA/Second

0.0625 to 1024 V/Second

Voltage Output : 5mA max.

Current Load Resistance :

External 24V : 1050 ohms

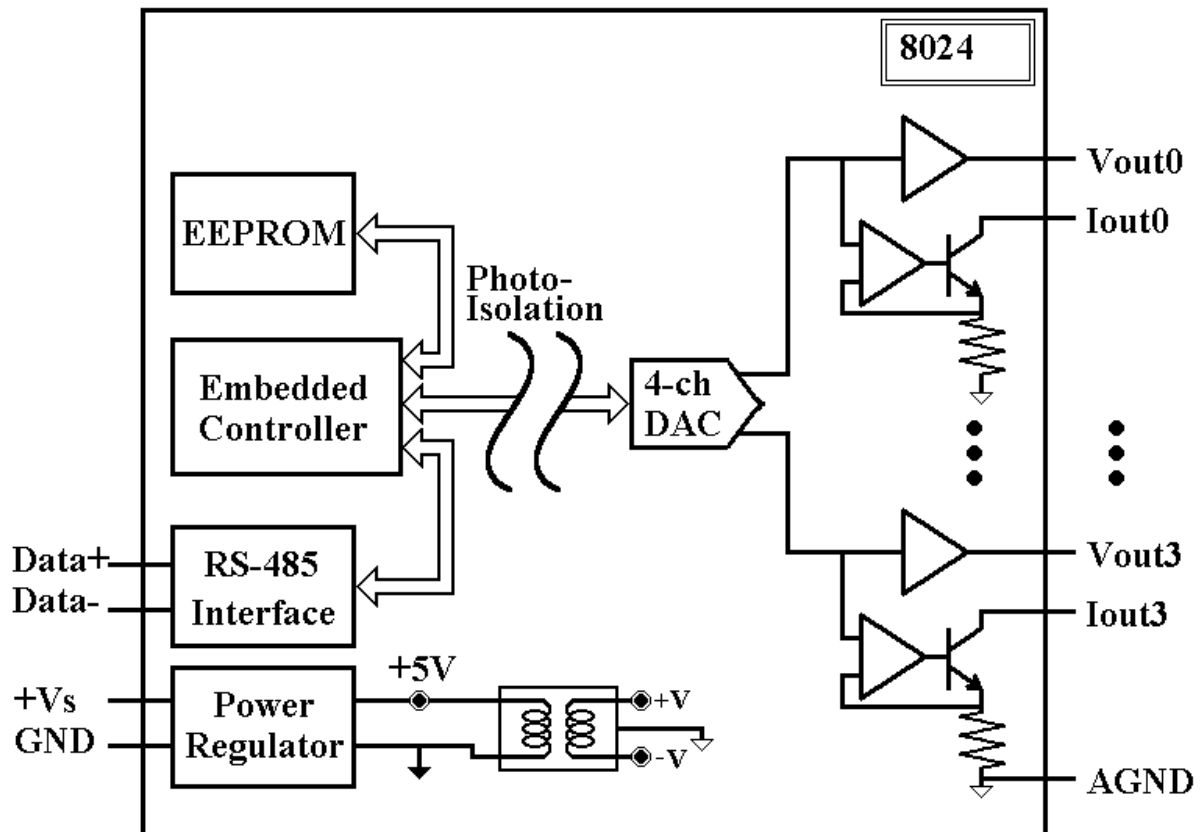
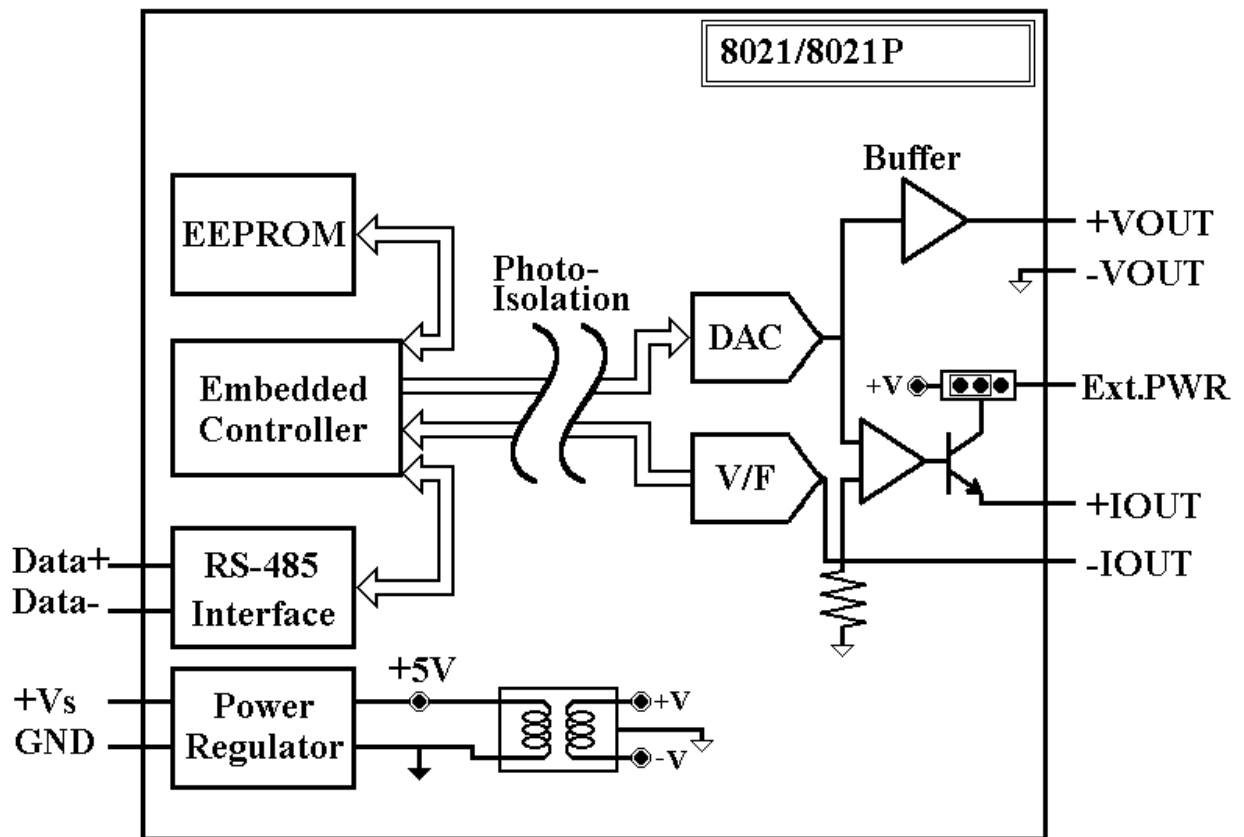
Isolation : 3000VDC

### ***Power Supply***

Input : +10 to +30VDC

Consumption : 2.3W

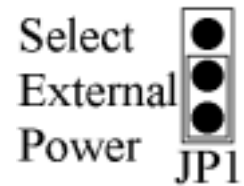
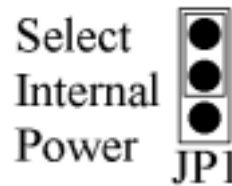
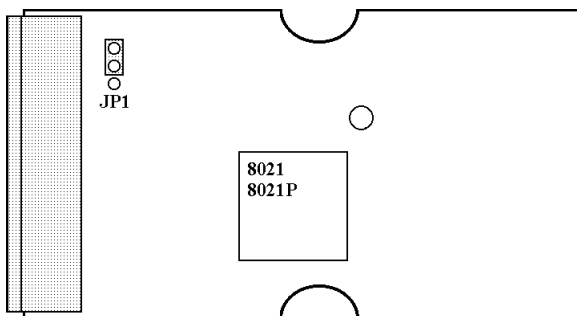
# 1.4 Block Diagram



# 1.5 Jumper Setting

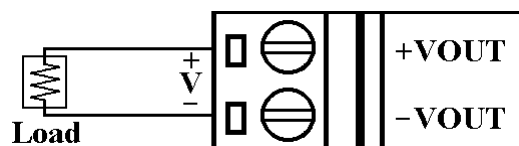
Jumper select the current output power supply of 8021/21P :

1. Select internal power of module : default setting, may drive load up to 500 ohms.
2. Select external power of module : may drive larger load. with 24V power, may drive 1050 ohms.

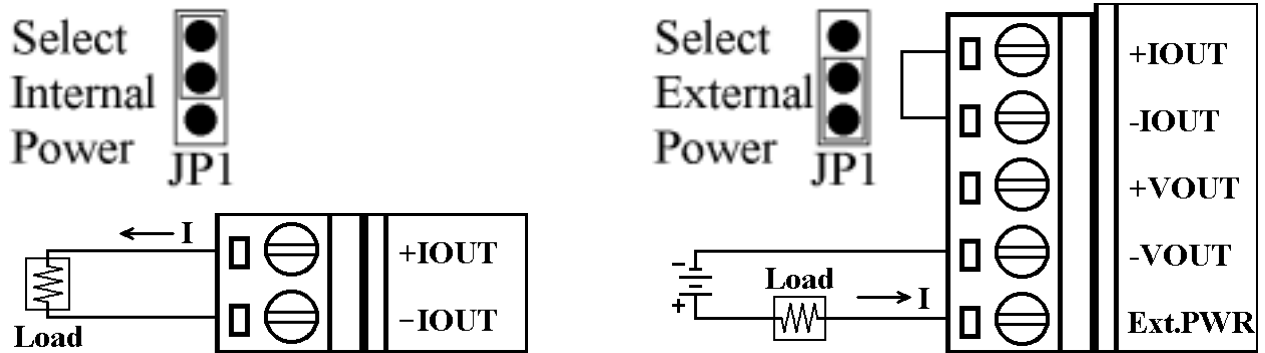


# 1.6 Wire Connection

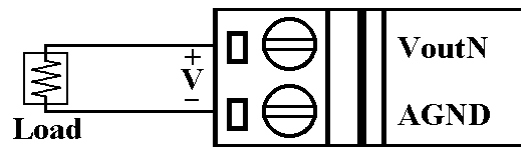
8021/21P Voltage Output Wire Connection



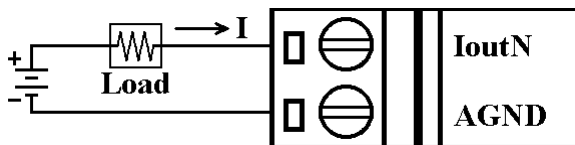
## 8021/21P Current Output Wire Connection



## 8024 Voltage Output Wire Connection



## 8024 Current Output Wire Connection



# 1.7 Quick Start

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

# 1.8 Default Setting

Default setting for 8021, 8021P, and 8024 :

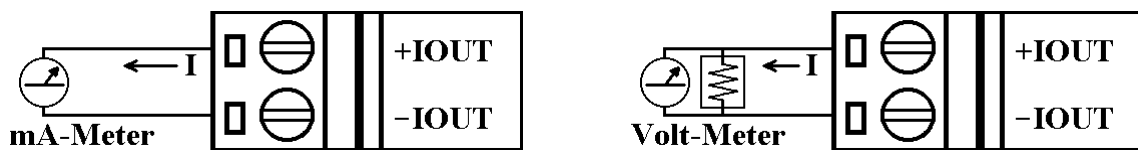
- Address : 01
- Analog Output Type : 0 to +10V
- Baudrate : 9600 bps
- Checksum disable, change immediate, engineer unit format
- 8021, 8021P jumper setting : internal power.

# 1.9 Calibration

*Don't Perform Calibrate Until You Really Understand.*

## 8021/21P Current Output Calibration Sequence :

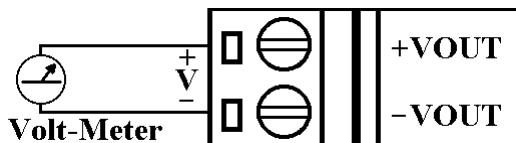
- 1 Set the jumper1 to internal power and connect mA-meter to module's current output. If no mA-meter, you may use Volt-Meter with shunt resistor(250 ohms, 0.1%), and calculate the mA by the Volt-Meter value ( $I = V/250$ ).



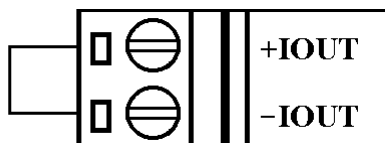
- 2 Warm-Up for 30 minutes.
- 3 Setting type to 30. (0 to 20mA) -> Refer *Sec.2.1.*
- 4 Output 4mA. -> Refer *Sec.2.7.*
- 5 Check the meter and trim the output until 4mA match by apply trim command. -> Refer *Sec.2.10.*
- 6 Perform 4mA Calibration Command. -> Refer *Sec.2.8.*
- 7 Output 20mA. -> Refer *Sec.2.7.*
- 8 Check the meter and trim the output until 20mA match by apply trim command. -> Refer *Sec.2.10*
- 9 Perform 20mA Calibration Command. -> Refer *Sec.2.9.*

## 8021/21P Voltage Output Calibration Sequence :

- 1 Connect volt-meter to module's voltage output.



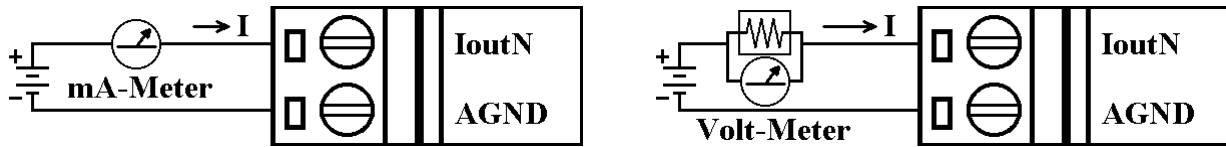
Short the current output pin for the readback requirement.



- 2 Warm-Up for 30 minutes.
- 3 Setting type to 32. (0 to 10V) -> Refer  
*Sec.2.1.*
- 4 Output 10V. -> Refer  
*Sec.2.7.*
- 5 Check the meter and trim the output until  
10V match by apply trim command. -> Refer  
*Sec.2.10.*
- 6 Perform 10V Calibration Command. -> Refer  
*Sec.2.13.*

## 8024 Current Output Calibration Sequence :

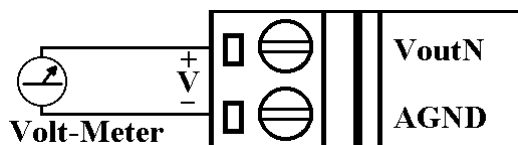
- 1 Connect meter and external power source to module's current output channel 0.



- 2 Warm-Up for 30 minutes.
- 3 Setting type to 30. (0 to 20 mA) -> Refer  
*Sec.2.1.*
- 4 Output 0mA. -> Refer  
*Sec.2.15.*
- 5 Check the meter and trim the output until 0mA match by apply trim command. -> Refer  
*Sec.2.18.*
- 6 Perform 0mA Calibration Command. -> Refer  
*Sec.2.16.*
- 7 Output 20mA. -> Refer  
*Sec.2.15.*
- 8 Check the meter and trim the output until 20mA match by apply trim command. -> Refer  
*Sec.2.18.*
- 9 Perform 20mA Calibration Command. -> Refer  
*Sec.2.17.*
- 10 Repeat 1 to 9 for channel 1, 2 and 3.

## 8024 Current Output Calibration Sequence :

- 1 Connect meter to module's voltage output channel 0.



- 2 Warm-Up for 30 minutes.
- 3 Setting type to 33. (-10 to 10V) -> Refer  
*Sec.2.1.*
- 4 Output -10V. -> Refer  
*Sec.2.15.*
- 5 Check the meter and trim the output until  
-10V match by apply trim command. -> Refer  
*Sec.2.18.*
- 6 Perform -10V Calibration Command. -> Refer  
*Sec.2.16.*
- 7 Output 10V. -> Ref  
*Sec.2.15.*
- 8 Check the meter and trim the output until  
10V match by apply trim command. -> Ref  
*Sec.2.18.*
- 9 Perform 10V Calibration Command. -> Ref  
*Sec.2.17.*
- 10 Repeat 1 to 9 for channel 1, 2 and 3.

# 1.10 Configuration Tables

## Baudrate Setting (CC)

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

## Analog Output Type Setting (TT)

Type Code	30	31	32	33	34	35
Min. Output	0 mA	4 mV	0 V	-10 V	0 V	-5 V
Max. Output	20 mA	20 mA	+10 V	+10 V	+5 V	+5 V

**Note: Type Code 33, 34, 35 are for 8024 only.**

## Data Format Setting (FF)

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

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

\*2 : Slew Rate Control :

for 8021/21P and 8024, Refer *Sec.3.6* for detail

\*3 : 00 = Engineer Unit Format

01 = Percent of Span Format (For 8021/21P)

10 = Hexadecimal Format (For 8021/21P)

## Slew Rate for 8021/21P and 8024

<b>Slew Rate for I-7021/21P and I-7024</b>					
	<b>V/Second</b>	<b>mA/Second</b>		<b>V/Second</b>	<b>mA/Second</b>
0000	Immediate		1000	8.0	16.0
0001	0.0625	0.125	1001	16.0	32.0
0010	0.125	0.25	1010	32.0	64.0
0011	0.25	0.5	1011	64.0	128.0
0100	0.5	1.0	1100	128.0	256.0
0101	1.0	2.0	1101	256.0	512.0
0110	2.0	4.0	1110	512.0	1024.0
0111	4.0	8.0	1111	1024.0	2048.0

## Analog Output Type and Data Format for 8024

<b>Analog Output Type and Data Format for I-7021/21P</b>				
<b>Type Code</b>	<b>Output Range</b>	<b>Data Format</b>	<b>Max.</b>	<b>Min.</b>
30	0 to 20 mA	Engineer Unit	20.000	00.000
		% of Span	+100.00	+000.00
		Hexadecimal	FFF	0000
31	4 to 20 mA	Engineer Unit	20.000	04.000
		% of Span	+100.00	+000.00
		Hexadecimal	FFF	0000
32	0 to 10 V	Engineer Unit	10.000	00.000
		% of Span	+100.00	+000.00
		Hexadecimal	FFF	0000

## Analog Output Type and Data Format for 8024

<b>Analog Output Type and Data Format for I-7024</b>				
<b>Type Code</b>	<b>Output Range</b>	<b>Data Format</b>	<b>Max.</b>	<b>Min.</b>
30	0 to 20 mA	Engineer Unit	+20.000	+00.000
31	4 to 20 mA	Engineer Unit	+20.000	+04.000
32	0 to 10 V	Engineer Unit	+10.000	+00.000
33	-10 to +10 V	Engineer Unit	+10.000	-10.000
34	0 to +5 V	Engineer Unit	+05.000	+00.000
35	-5 to +5 V	Engineer Unit	+05.000	-05.000

## 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)

### Calculate Checksum :

1. Calculate ASCII sum of all characters of command(or response) string except the character return(cr).
2. Mask the sum of string with 0ffh.

### Example :

Command string : \$012(cr)

Sum of string = '\$'+ '0'+ '1'+ '2' = 24h+30h+31h+32h = B7h

The checksum is B7h, and [CHK] = "B7"

Command string with checksum : \$012B7(cr)

Response string : !01300600(cr)

Sum of string : '!'+ '0'+ '1'+ '3'+ '0'+ '0'+ '6'+ '0'+ '0'

= 21h+30h+31h+33h+30h+30h+36h+30h+30h = 1ABh

The checksum is ABh, and [CHK] = "AB"

Response string with checksum : !01300600AB(cr)

General Command Sets			
Command	Response	Description	Section
%AANNTTCCFF	!AA	Set Module Configuration	<i>Sec.2.1</i>
\$AA2	!AANNTTCCFF	Read Configuration	<i>Sec.2.2</i>
\$AA5	!AAS	Read Reset Status	<i>Sec.2.3</i>
\$AAF	!AA(Data)	Read Firmware Version	<i>Sec.2.4</i>
\$AAM	!AA(Data)	Read Module Name	<i>Sec.2.5</i>
~AAO(Data)	!AA	Set Module Name	<i>Sec.2.6</i>

## 8021/21P Analog Output Command Sets

<b>I-7021/21P Analog Output Command Sets</b>			
<b>Command</b>	<b>Response</b>	<b>Description</b>	<b>Section</b>
#AA(Data)	>	Output Analog Value	<i>Sec.2.7</i>
\$AA0	!AA	4mA Calibration	<i>Sec.2.8</i>
\$AA1	!AA	20mA Calibration	<i>Sec.2.9</i>
\$AA3VV	!AA	Trim Calibration	<i>Sec.2.10</i>
\$AA4	!AA	Set PowerOn Value	<i>Sec.2.11</i>
\$AA6	!AA(Data)	Last Value Readback	<i>Sec.2.12</i>
\$AA7	!AA	10V Calibration	<i>Sec.2.13</i>
\$AA8	!AA(Data)	Current Readback	<i>Sec.2.14</i>

## 8024 Analog Output Command Sets

<b>I-7024 Analog Output Command Sets (All commands for specified channel N)</b>			
<b>Command</b>	<b>Response</b>	<b>Description</b>	<b>Section</b>
#AAN(Data)	>	Output Analog Value	<i>Sec.2.15</i>
\$AA0N	!AA	0mA/- 10V Calibration	<i>Sec.2.16</i>
\$AA1N	!AA	20mA/10V Calibration	<i>Sec.2.17</i>
\$AA3NVV	!AA	Trim Calibration	<i>Sec.2.18</i>
\$AA4N	!AA	Set PowerOn Value	<i>Sec.2.19</i>
\$AA6N	!AA(Data)	Last Value Readback	<i>Sec.2.20</i>
\$AA7N	!AA	Read PowerOn Value	<i>Sec.2.21.2</i>
\$AA8N	!AA(Data)	Current Value Readback	<i>Sec.2.22</i>

<b>Host Watchdog Related Command Sets</b>			
<b>Command</b>	<b>Response</b>	<b>Description</b>	<b>Section</b>
~**	No Response	Host OK	<i>Sec.2.25</i>
~AA0	!AASS	Read Module Status	<i>Sec.2.26</i>
~AA1	!AA	Reset Module Status	<i>Sec.2.27</i>
~AA2	!AAVV	Read Host Watchdog Timeout Value	<i>Sec.2.28</i>
~AA3EVV	!AA	Set Host Watchdog Timeout Value	<i>Sec.2.29</i>
~AA4	!AA(Data)	Read Safe Value	<i>Sec.2.30</i>
~AA4N	!AA(Data)	Read Safe Value of Channel N	<i>Sec.2.31</i>
~AA5	!AA	Set Safe Value	<i>Sec.2.32</i>
~AA5N	!AA	Set Safe Value of Channel N	<i>Sec.2.33</i>

## 2.1 %AANNTTCCFF

**Description :** Set module Configuration

**Syntax :** %AANNTTCCFF[CHK](cr)

%            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.1.10*)  
CC           new baudrate for setting module (Ref *Sec.1.10*)  
FF           new data format for setting module (Ref *Sec.1.10*)

*When changing the baudrate or checksum, it is necessary to short the pin INIT\* to ground.*

**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 changing baudrate or checksum setting without shorting INIT\* to ground, the module will return invalid command.

AA           address of response module (00 to FF)

**Example :**

Command : %0102300600            Receive : !02

                 Change address from 01 to 02, return success.

**Related Command :**

*Sec.2.2 \$AA2*

**Related Topics :**

*Sec.1.10 Configuration Tables, Sec.3.1 INIT\* pin Operation*





## 2.4 \$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.



## 2.6 ~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 : ~01O8021                      Receive : !01

Set address 01 module name to 8021, return success.

Command : \$01M                          Receive : !018021

Read address 01 module name, return 8021.

**Related Command :**

*Sec.2.5 \$AAM*

## 2.7 #AA(Data)

**Description :** Output Analog Value

**Syntax :** #AA(Data)[CHK](cr)

# delimiter character

AA address of output module (00 to FF)

(Data) analog output value, reference *Sec.1.10* for its format.

**Response :** Valid Command : >[CHK](cr)

Out of Range : ?[CHK](cr)

Ignore Command : ![CHK](cr)

Syntax error or communication error may get no response.

> delimiter for valid command

? delimiter while the (Data) is out of range, and the output will goto the closest value in the setting of module's range.

! delimiter for the module's host watchdog flag is set, and the output command will be ignored and the output is set to Safe Value.

**Example :**

Command : \$012                      Receive : !01300600

Read address 01 configuration, return output type 0 to 20mA, engineer unit format and output change immediate.

Command : #0105.000                  Receive : >

Output address 01 value 5.0mA, return success.

Command : #0125.000                  Receive : ?01

Output address 01 value 25.0mA, return the value is out of range, and the output is set to the 20.0mA.

Command : \$022

Receive : !02300601

Read address 02 configuration, return output type 0 to 20mA, percent of span format, output change immediate.

Command : #02+050.00

Receive : >

Output address 02 value 50% (=10mA), return success.

Command : \$032

Receive : !02300602

Read address 03 configuration, return output type 0 to 20mA, hexadecimal format, output change immediate.

Command : #03800

Receive : >

Output address 03 value 0x800 (=10mA), return success.

**Related Command :**

*Sec.2.1 %AANNTTCCFF, Sec.2.2 \$AA2*

**Related Topics :**

*Sec.1.10 Configuration Tables, Sec.3.5 Analog Output*

**Note :** The command is for 8021/21P only



## 2.9 \$AA1

**Description :** Perform 20mA Calibration

**Syntax :** \$AA1[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

1 command for performing 20mA 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 : \$011

Receive : !01

Perform address 01 20mA calibration, return success.

**Related Command :**

*Sec.2.8 \$AA0, Sec.2.10 \$AA3VV*

**Related Topics :**

*Sec.1.9 Calibration*

**Note :** The command is for 8021/21P only

## 2.10 \$AA3VV

**Description :** Trim Calibration

**Syntax :** \$AA3VV[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

3 command for trimming calibration

VV 2's complement hexadecimal to trim the analog output value. 00 to 5F to increase 0 to 95 counts, and FF to A1 to decrease 1 to 95 counts. Each count indicates 4.88 $\mu$ A or 2.44mV.

**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 : \$0131F                      Receive : !01

Trim address 01 output to increase 31 counts, return success.

**Related Command :**

*Sec.2.8 \$AA0, Sec.2.9 \$AA1, Sec.2.13 \$AA7*

**Related Topics :**

*Sec.1.9 Calibration*

**Note :** The command is for 8021/21P only

## 2.11 \$AA4

**Description :** Set PowerOn Value

**Syntax :** \$AA4[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

4 command for setting PowerOn Value. Store the current output value as PowerOn Value.

**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 : #0100.000                      Receive : >

Set address 01 output 0.0mA, return success.

Command : \$014                              Receive : !01

Set address 01 PowerOn Value, return success. The module 01 will goto 0.0mA while the moudule power on.

**Related Command :**

*Sec.2.7 #AA(Data)*

**Related Topics :**

*Sec.3.5 Analog Output*

**Note :** The command is for 8021/21P only

## 2.12 \$AA6

**Description :** Last Value Readback

**Syntax :** \$AA6[CHK](cr)

\$ delimiter character

AA address of reading module (00 to FF)

6 command for reading last output command 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) the last output command value. If no output applied to the module, the (Data) is the PowerOn Value of the module. Refer *Sec.1.10* for format.

**Example :**

Command : #0110.000                      Receive : !01

Set address 01 output 10.0, return success.

Command : \$016                              Receive : !0110.000

Read address 01 last output command value, return 10.000.

**Related Command :**

*Sec.2.7* #AA(Data), *Sec.2.14* \$AA8

**Related Topics :**

*Sec.3.7* Current Readback

**Note :** The command is for 8021/21P only

## 2.13 \$AA7

**Description :** Perform 10V Calibration

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

\$ delimiter character

AA address of setting module (00 to FF)

1 command for performing 10V 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

Receive : !01

Perform address 01 10V calibration, return success.

**Related Command :**

*Sec.2.10 \$AA3VV*

**Related Topics :**

*Sec.1.9 Calibration*

**Note :** The command is for 8021/21P only

## 2.14 \$AA8

**Description :** Current Readback

**Syntax :** \$AA6[CHK](cr)

\$ delimiter character

AA address of reading module (00 to FF)

8 command for current readback

**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) the current output value. Refer *Sec.1.9* for format.

**Example :**

Command : \$012                      Receive : !01320614

Read address 01 configuration, return output type 0 to 10V, 9600 bps, engineer unit format and slew rate is 1.0V/Second.

Command : #0110.000                Receive : >

Set address 01 output 10.0V, return success.

Command : \$016                      Receive : !0110.000

Read address 01 last output command value, return 10.000.

Command : \$018                      Receive : !0101.000

Read address 01 current value, return 1.0V.

Command : \$018                      Receive : !0101.500

Read address 01 current value, return 1.5V.

**Related Command :**

*Sec.2.7 #AA(Data), Sec.2.12 \$AA6*

**Related Topics :**

*Sec.3.6 Slew Rate Control, Sec.3.7 Current Readback*

**Note :** The command is for 8021/21P only



Command : #01005.000      Receive : >

Output address 01 channel 0 value 5.0mA, return success.

Command : #01025.000      Receive : ?01

Output address 01 channel 0 value 25mA, return out of range,  
and the output of channel 0 is set to the 20.0mA

### **Example for 8024 :**

Command : \$012                      Receive : !01300600

Read address 01 configuration, return type 0 to 20mA, 9600  
bps and engineer unit format, output change immediate.

Command : #010+05.000      Receive : >

Output address 01 channel 0 value 5.0mA, return success.

Command : #010+25.000      Receive : ?01

Output address 01 channel 0 value 25.0mA, return the value  
is out of range, and the output of channel 0 is set to the 20.0mA.

### **Related Command :**

*Sec.2.1 %AANNTTCCFF, Sec.2.2 \$AA2*

### **Related Topics :**

*Sec.1.10 Configuration Tables, Sec.3.5 Analog Output*

**Note :** The command is for 8024 only

## 2.16 \$AA0N

### Description :

8024 : Perform 0mA/-10V Calibration for Channel N

### Syntax : \$AA0N[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

0 command for performing 4mA (or 0mA/-10V) calibration

N channel to calibrate (0 to 3 for 8024)

**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 : \$0101

Receive : !01

Perform address 01 channel 1 calibration( 0mA or -10.0V for 8024), return success.

### Related Command :

*Sec.2.17 \$AA1N, Sec.2.18 \$AA3NVV*

### Related Topics :

*Sec.1.9 Calibration*

**Note :** The command is for 8024 only



## 2.18 \$AA3NVV

**Description :** Trim Calibration for Channel N

**Syntax :** \$AA3NVV[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

3 command for trimming calibration

N channel to trim (0 to 3 for 8024)

VV 2's complement hexadecimal to trim the analog output value. 00 to 5F to increase 0 to 95 counts, and FF to A1 to decrease 1 to 95 counts. Each count indicates 2.44 $\mu$ A or 1.22mV for 8024.

**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 : \$01321F                      Receive : !01

Trim address 01 channel 2 output 31 counts, return success.

**Related Command :**

*Sec.2.16 \$AA0N, Sec.2.17 \$AA1N*

**Related Topics :**

*Sec.1.9 Calibration*

**Note :** The command is for 8024 only

## 2.19 \$AA4N

**Description :** Set PowerOn Value for Channel N

**Syntax :** \$AA4N[CHK](cr)

\$ delimiter character

AA address of setting module (00 to FF)

4 command for setting PowerOn Value, store the current output value as PowerOn Value.

N channel to set (0 to 3 for 8024)

**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 for 8024 :**

Command : #012+00.000                      Receive : >

Set address 01 channel 2 output 0.0, return success.

Command : \$0142                              Receive : !01

Set address 01 channel 2 PowerOn Value, return success. The PowerOn Value of channel 2 is set to 0.0 now.

**Related Command :**

*Sec.2.15 #AAN(Data), Sec.2.21 \$AA7N*

**Related Topics :**

*Sec.1.10 Configuration Tables, Sec.3.5 Analog Output*

**Note :** The command is for 8024 only

## 2.20 \$AA6N

**Description :** Last Value of Channel N Readback

**Syntax :** \$AA6N[CHK](cr)

\$ delimiter character

AA address of reading module (00 to FF)

6 command for reading last output command value

N channel to readback (0 to 3 for 8024)

**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) the last output command value. Refer *Sec.1.9* for format.

**Example for 8024 :**

Command : #013+10.000                      Receive : !01

Set address 01 channel 3 output 10.0, return success.

Command : \$0163                              Receive : !01+10.000

Read address 01 channel 3 last output command value, return 10.000.

**Related Command :**

*Sec.2.15* #AAN(Data), *Sec.2.22* \$AA8N

**Related Topics :**

*Sec.3.7* Current Readback

**Note :** The command is for 8024 only

## 2.21.2 \$AA7N

**Description :** Read PowerOn Value of Channel N

**Syntax :** \$AA7N[CHK](cr)

\$ delimiter character

AA address of reading module (00 to FF)

7 command for reading PowerOn Value

N channel to readback (0 to 3)

**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) the last output command value. Ref *Sec.1.9* for the format.

**Example :**

Command : \$0170

Receive : !01+00.000

Read address 01 channel 0 PowerOn Value, return +10.0.

**Related Command :**

*Sec.2.19* \$AA4N

**Note :** The command is for 8024 only



Read address 01 channel 0 current value, return 1.0V.

Command : \$0180

Receive : !01+01.500

Read address 01 channel 0 current value, return 1.5V.

**Related Command :**

*Sec.2.15 #AAN(Data), Sec.2.20 \$AA6N*

**Related Topics :**

*Sec.3.7 Current Readback*

**Note :** The command is for 8024 only



## 2.26 ~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. The status will store into EEPROM and only may reset by the command ~AA1.

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

\*1 : Host watchdog enable flag, 0=Disable, 1=Enable

\*2 : Host watchdog timeout flag, 0=Clear, 1=Set

**Example :**

Command : ~010

Receive : !0104

Read address 01 module status, return 04, host watchdog timeout flag is set.

**Related Command :**

*Sec.2.27 ~AA1, Sec.2.29 ~AA3Evv*

**Related Topic :**

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

## 2.27 ~AA1

**Description :** Reset Module Status

**Command :** ~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 :**

Command : ~010                      Receive : !0104

Read address 01 module status, return 04, host watchdog timeout flag is set.

Command : ~011                      Receive : !01

Reset address 01 module status, return success.

Command : ~010                      Receive : !0100

Read address 01 module status, return 00, Module Status is clear.

**Related Command :**

*Sec.2.25 ~\*\*, Sec.2.26 ~AA0*

**Related Topic :**

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

## 2.28 ~AA2

**Description :** Read Host Watchdog Timeout Interval

**Command :** ~AA2[CHK](cr)

~ delimiter character

AA address of reading module (00 to FF)

2 command for reading host watchdog timeout interval

**Response :** Valid Command : !AAEVV[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)

E 1=Enable/0=Disable host watchdog

VV timeout interval in hexadecimal format, count for 0.1 second, 01=0.1 second and FF=25.5 seconds

**Example :**

Command : ~012

Receive : !010FF

Read address 01 host watchdog timeout interval, return host watchdog disable, and time interval is 25.5 seconds.

**Related Command :**

*Sec.2.25 ~\*\*, Sec.2.26 ~AA0, Sec.2.27 ~AA1, Sec.2.29 ~AA3EVV, Sec.2.30 ~AA4, Sec.2.31 ~AA4N, Sec.2.32 ~AA5, Sec.2.33 ~AA5N*

**Related Topic :**

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



Reset the host watchdog timer.

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

Command : ~010

Receive : !0104

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

Command : ~011

Receive : !01

Reset address 01 module status, return success.

**Related Command :**

*Sec.2.25 ~\*\*, Sec.2.26 ~AA0, Sec.2.27 ~AA1, Sec.2.28 ~AA2, Sec.2.30 ~AA4, Sec.2.31 ~AA4N, Sec.2.32 ~AA5, Sec.2.33 ~AA5N*

**Related Topic :**

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

## 2.30 ~AA4

**Description :** Read Safe Value.

**Command :** ~AA4[CHK](cr)

~ delimiter character

AA address of reading module (00 to FF)

4 command for read Safe 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) Safe Value of module. Refer *Sec.1.10* for data format

**Example :**

Command : ~014                      Receive : !0105.000

Read address 01 Safe Value, return 5.0.

**Related Command :**

*Sec.2.25 ~\*\**, *Sec.2.26 ~AA0*, *Sec.2.27 ~AA1*, *Sec.2.28 ~AA2*,  
*Sec.2.29 ~AA3E*, *Sec.2.32 ~AA5*

**Related Topic :**

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

**Note :** The command is for 8021/21P only

## 2.31 ~AA4N

**Description :** Read Safe Value of Channel N

**Command :** ~AA4N[CHK](cr)

~ delimiter character  
AA address of reading module (00 to FF)  
4 command for reading Safe Value  
N channel to read (0 to 3 for 8024)

**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) Safe Value of module. Refer *Sec.1.10* for data format.

**Example for 8024 :**

Command : ~0140                      Receive : !01+00.000

Read address 01 channel 0 Safe Value, return +0.0.

**Related Command :**

*Sec.2.25 ~\*\**, *Sec.2.26 ~AA0*, *Sec.2.27 ~AA1*, *Sec.2.28 ~AA2*,  
*Sec.2.29 ~AA3EVV*, *Sec.2.33 ~AA5N*

**Related Topic :**

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

**Note :** The command is for 8024 only

## 2.32 ~AA5

**Description :** Set Safe Value.

**Command :** ~AA5[CHK](cr)

~ delimiter character

AA address of setting module (00 to FF)

5 command to store current output as Safe Value

**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 : #0100.000                      Receive : !01

Output address 01 value 0.0, return success.

Command : ~015                              Receive : !01

Set address 01 Safe Value, return success.

**Related Command :**

*Sec.2.25 ~\*\*, Sec.2.26 ~AA0, Sec.2.27 ~AA1, Sec.2.28 ~AA2, Sec.2.29 ~AA3Evv, Sec.2.30 ~AA4*

**Related Topic :**

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

**Note :** The command is for 8021/21P only

## 2.33 ~AA5N

**Description :** Set Safe Value of Channel N

**Command :** ~AA5N[CHK](cr)

~ delimiter character  
AA address of setting module (00 to FF)  
5 command to store current output as Safe Value  
N channel to set (0 to 3 for 8024)

**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 for 8024 :**

Command : #010+05.000                      Receive : !01  
Output address 01 channel 0 value +5.0, return success.

Command : ~0150                              Receive : !01  
Set address 01 channel 0 Safe Value, return success.

**Related Command :**

*Sec.2.25 ~\*\*, Sec.2.26 ~AA0, Sec.2.27 ~AA1, Sec.2.28 ~AA2, Sec.2.29 ~AA3EVV, Sec.2.31 ~AA4N*

**Related Topic :**

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

**Note :** The command is for 8024 only

# 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 this 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 outputs goto **Safe Value**. The host watchdog timeout flag is set, and the output command will be ignored. The module’s LED will got to flash and user must reset the Module Status via command to goto normal operation.

## 3.3 Dual Watchdog Operation

**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/communication from problem or host halt. While the timeout occurred, the module will turn the all outputs to Safe Value 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 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 determine the module's working status. When Reset Status is set, that is to say the module is reseted and the output may be changed to the PowerOn Value. When the Reset Status is clear, that is to say the module is not reseted, and the output is not changed.

## 3.5 Analog Output

The module's output have 3 different condition :

<1> **Safe Value.** If the host watchdog timeout is set, the output is set to Safe Value. While the module receive the output

command, like #AA(Data) or #AAN(Data), the module will return ignore(receive:!) and will not change the output to the output command value. **The host watchdog timeout status is set and store into EEPROM while the host watchdog timeout interval expired, and only can be cleared by command ~AA1.** If user want to change the output, need to clear the host watchdog timeout status first, and send output command to change the output to desired value.

<2> **PowerOn Value.** Only the module reseted, and the host watchdog timeout status is clear, the module's output is set to predefined PowerOn Value.

<3> **Output Command Value.** If the host watchdog timeout status is clear, and user send command, #AA(Data) or #AAN(Data), to module to change the output value. The module will return success (receive >). If user set the output value over the maximum value of output range, the output will goto maximum value and return out of range(receive ?AA). If the output value is under the minimum value of output range, the output will goto minimum value and return out of range(receive ?AA).

## 3.6 Slew Rate Control

Slew rate control is to adjust the output slope. Most analog output change is instantaneous. In many applications this characteristic is undesirable and a gradual controlled output slew rate is more appropriate.

The 8021/21P/24 allows programmable slew rate control. While the output command is sent to 8021/21P/24 to change the

analog value, the output will automatically slope to the new value at the specified slew rate. The 8021/21P/24 update the analog output value at 100 conversions per second. The output is smoothly stepped until the final output value is reached.

## 3.7 Current Readback

The 8021/21P have the analog-to-digit converter to monitor the current output signal. The current readback may find the fault of improper wiring or loads while the readback value is far from the output value.

The 8024 don't have the analog-to-digit converter to monitor the current output signal. But the 8024 may response the current digital value transferring to the DAC. It can't indicate the real DAC output value, and can't detect the falut of improper wiring or loads.