SuperLogics
8021/21P, 8024
User 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 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 similar with I-7021 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 : ±0.1% of FSR
- Resolution : ±0.02% of FSR
- Readback Accuracy : ±1% of FSR
- Zero Drift :
  - Voltage output : ±30µV/°C
  - Current output : ±0.2µA/°C
- Span Temperature Coefficient : ±25ppm/°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 : ±0.02% of FSR
- Resolution : ±0.002% of FSR
- Readback Accuracy : ±1% of FSR
- Zero Drift :
  - Voltage output : ±10µV/°C
  - Current output : ±0.2µA/°C
- Span Temperature Coefficient : ±5ppm/°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 : ±0.1% of FSR  
Resolution : ±0.02% of FSR  
Zero Drift :  
  Voltage output : ±30µV/°C  
  Current output : ±0.2µA/°C  
Span Temperature Coefficient :  
  ±20ppm/°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
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 :

1  Address : 01
1  Analog Output Type : 0 to +10V
1  Baudrate : 9600 bps
1  Checksum disable, change immediate, engineer unit format
1  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 \( I = \frac{V}{250} \).

   ![mA-Meter Diagram]

   ![Volt-Meter Diagram]

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. Preform 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.

   ![Volt-Meter](image1)

   Short the current output pin for the readback requirement.

   ![Current Output](image2)

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. Preform 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. -> Refer Sec.2.15.

8. Check the meter and trim the output until 10V match by apply trim command. -> Refer Sec.2.18.

9. Perform 10V Calibration Command. -> Refer Sec.2.17.

10. Repeat 1 to 9 for channel 1, 2 and 3.
1.10 Configuration Tables

Baudrate Setting (CC)

<table>
<thead>
<tr>
<th>Code</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
<th>08</th>
<th>09</th>
<th>0A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baudrate</td>
<td>1200</td>
<td>2400</td>
<td>4800</td>
<td>9600</td>
<td>19200</td>
<td>38400</td>
<td>57600</td>
<td>115200</td>
</tr>
</tbody>
</table>

Analog Output Type Setting (TT)

<table>
<thead>
<tr>
<th>Type Code</th>
<th>30</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. Output</td>
<td>0 mA</td>
<td>4 mV</td>
<td>0 V</td>
<td>-10 V</td>
<td>0 V</td>
<td>-5 V</td>
</tr>
<tr>
<td>Max. Output</td>
<td>20 mA</td>
<td>20 mA</td>
<td>+10 V</td>
<td>+10 V</td>
<td>+5 V</td>
<td>+5 V</td>
</tr>
</tbody>
</table>

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

Data Format Setting (FF)

<table>
<thead>
<tr>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>*1</td>
<td>*2</td>
<td>*3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>V/Second</th>
<th>mA/Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>Immediate</td>
</tr>
<tr>
<td>0001</td>
<td>0.0625</td>
</tr>
<tr>
<td>0010</td>
<td>0.125</td>
</tr>
<tr>
<td>0011</td>
<td>0.25</td>
</tr>
<tr>
<td>0100</td>
<td>0.5</td>
</tr>
<tr>
<td>0101</td>
<td>1.0</td>
</tr>
<tr>
<td>0110</td>
<td>2.0</td>
</tr>
<tr>
<td>0111</td>
<td>4.0</td>
</tr>
<tr>
<td>1000</td>
<td>8.0</td>
</tr>
<tr>
<td>1001</td>
<td>16.0</td>
</tr>
<tr>
<td>1010</td>
<td>32.0</td>
</tr>
<tr>
<td>1011</td>
<td>64.0</td>
</tr>
<tr>
<td>1100</td>
<td>128.0</td>
</tr>
<tr>
<td>1101</td>
<td>256.0</td>
</tr>
<tr>
<td>1110</td>
<td>512.0</td>
</tr>
<tr>
<td>1111</td>
<td>1024.0</td>
</tr>
</tbody>
</table>

### Analog Output Type and Data Format for 8024

<table>
<thead>
<tr>
<th>Type Code</th>
<th>Output Range</th>
<th>Data Format</th>
<th>Max.</th>
<th>Min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0 to 20 mA</td>
<td>Engineer Unit</td>
<td>20.00</td>
<td>00.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of Span</td>
<td>+100.00</td>
<td>+000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hexadecimal</td>
<td>FFF</td>
<td>0000</td>
</tr>
<tr>
<td>31</td>
<td>4 to 20 mA</td>
<td>Engineer Unit</td>
<td>20.00</td>
<td>04.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of Span</td>
<td>+100.00</td>
<td>+000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hexadecimal</td>
<td>FFF</td>
<td>0000</td>
</tr>
<tr>
<td>32</td>
<td>0 to 10 V</td>
<td>Engineer Unit</td>
<td>10.00</td>
<td>00.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of Span</td>
<td>+100.00</td>
<td>+000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hexadecimal</td>
<td>FFF</td>
<td>0000</td>
</tr>
</tbody>
</table>
### Analog Output Type and Data Format for 8024

<table>
<thead>
<tr>
<th>Type Code</th>
<th>Output Range</th>
<th>Data Format</th>
<th>Max.</th>
<th>Min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0 to 20 mA</td>
<td>Engineer Unit</td>
<td>+20.000</td>
<td>+00.000</td>
</tr>
<tr>
<td>31</td>
<td>4 to 20 mA</td>
<td>Engineer Unit</td>
<td>+20.000</td>
<td>+04.000</td>
</tr>
<tr>
<td>32</td>
<td>0 to 10 V</td>
<td>Engineer Unit</td>
<td>+10.000</td>
<td>+00.000</td>
</tr>
<tr>
<td>33</td>
<td>-10 to +10 V</td>
<td>Engineer Unit</td>
<td>+10.000</td>
<td>-10.000</td>
</tr>
<tr>
<td>34</td>
<td>0 to +5 V</td>
<td>Engineer Unit</td>
<td>+05.000</td>
<td>+00.000</td>
</tr>
<tr>
<td>35</td>
<td>-5 to +5 V</td>
<td>Engineer Unit</td>
<td>+05.000</td>
<td>-05.000</td>
</tr>
</tbody>
</table>
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’+‘6’+‘0’+‘0’
= 21h+30h+31h+33h+30h+36h+30h+30h = 1ABh
The checksum is ABh, and [CHK] = “AB”

Response string with checksum : !01300600AB(cr)

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Description</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>%AANNTTCCFF</td>
<td>!AA</td>
<td>Set Module Configuration</td>
<td>Sec.2.1</td>
</tr>
<tr>
<td>$AA2</td>
<td>!AANNTTCCFF</td>
<td>Read Configuration</td>
<td>Sec.2.2</td>
</tr>
<tr>
<td>$AA5</td>
<td>!AAS</td>
<td>Read Reset Status</td>
<td>Sec.2.3</td>
</tr>
<tr>
<td>$AAF</td>
<td>!AA(Data)</td>
<td>Read Firmware Version</td>
<td>Sec.2.4</td>
</tr>
<tr>
<td>$AAM</td>
<td>!AA(Data)</td>
<td>Read Module Name</td>
<td>Sec.2.5</td>
</tr>
<tr>
<td>~AAO(Data)</td>
<td>!AA</td>
<td>Set Module Name</td>
<td>Sec.2.6</td>
</tr>
</tbody>
</table>

# 8021/21P Analog Output Command Sets

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Description</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>#AA(Data)</td>
<td></td>
<td>Output Analog Value</td>
<td>Sec.2.7</td>
</tr>
<tr>
<td>$AA0</td>
<td>!AA</td>
<td>4mA Calibration</td>
<td>Sec.2.8</td>
</tr>
<tr>
<td>$AA1</td>
<td>!AA</td>
<td>20mA Calibration</td>
<td>Sec.2.9</td>
</tr>
<tr>
<td>$AA3VV</td>
<td>!AA</td>
<td>Trim Calibration</td>
<td>Sec.2.10</td>
</tr>
<tr>
<td>$AA4</td>
<td>!AA</td>
<td>Set PowerOn Value</td>
<td>Sec.2.11</td>
</tr>
<tr>
<td>$AA6</td>
<td>!AA(Data)</td>
<td>Last Value Readback</td>
<td>Sec.2.12</td>
</tr>
<tr>
<td>$AA7</td>
<td>!AA</td>
<td>10V Calibration</td>
<td>Sec.2.13</td>
</tr>
<tr>
<td>$AA8</td>
<td>!AA(Data)</td>
<td>Current Readback</td>
<td>Sec.2.14</td>
</tr>
</tbody>
</table>

# 8024 Analog Output Command Sets

(All commands for specified channel N)

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
<th>Description</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>#AAN(Data)</td>
<td></td>
<td>Output Analog Value</td>
<td>Sec.2.15</td>
</tr>
<tr>
<td>$AA0N</td>
<td>!AA</td>
<td>0mA/-10V Calibration</td>
<td>Sec.2.16</td>
</tr>
<tr>
<td>$AA1N</td>
<td>!AA</td>
<td>20mA/10V Calibration</td>
<td>Sec.2.17</td>
</tr>
<tr>
<td>$AA3NVV</td>
<td>!AA</td>
<td>Trim Calibration</td>
<td>Sec.2.18</td>
</tr>
<tr>
<td>$AA4N</td>
<td>!AA</td>
<td>Set PowerOn Value</td>
<td>Sec.2.19</td>
</tr>
<tr>
<td>$AA6N</td>
<td>!AA(Data)</td>
<td>Last Value Readback</td>
<td>Sec.2.20</td>
</tr>
<tr>
<td>$AA7N</td>
<td>!AA</td>
<td>Read PowerOn Value</td>
<td>Sec.2.21.2</td>
</tr>
<tr>
<td>$AA8N</td>
<td>!AA(Data)</td>
<td>Current Value Readback</td>
<td>Sec.2.22</td>
</tr>
<tr>
<td>Command</td>
<td>Response</td>
<td>Description</td>
<td>Section</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>-----------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>~**</td>
<td>No Response</td>
<td>Host OK</td>
<td>Sec.2.25</td>
</tr>
<tr>
<td>~AA0</td>
<td>!AASS</td>
<td>Read Module Status</td>
<td>Sec.2.26</td>
</tr>
<tr>
<td>~AA1</td>
<td>!AA</td>
<td>Reset Module Status</td>
<td>Sec.2.27</td>
</tr>
<tr>
<td>~AA2</td>
<td>!AAVV</td>
<td>Read Host Watchdog Timeout Value</td>
<td>Sec.2.28</td>
</tr>
<tr>
<td>~AA3EVV</td>
<td>!AA</td>
<td>Set Host Watchdog Timeout Value</td>
<td>Sec.2.29</td>
</tr>
<tr>
<td>~AA4</td>
<td>!AA(Data)</td>
<td>Read Safe Value</td>
<td>Sec.2.30</td>
</tr>
<tr>
<td>~AA4N</td>
<td>!AA(Data)</td>
<td>Read Safe Value of Channel N</td>
<td>Sec.2.31</td>
</tr>
<tr>
<td>~AA5</td>
<td>!AA</td>
<td>Set Safe Value</td>
<td>Sec.2.32</td>
</tr>
<tr>
<td>~AA5N</td>
<td>!AA</td>
<td>Set Safe Value of Channel N</td>
<td>Sec.2.33</td>
</tr>
</tbody>
</table>
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
2.2 $AA2

**Description** : Read Configuration

**Syntax** : $AA2[CHK](cr)

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

**Response** :   Valid Command :
!AATTCCFF[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)
TT    type code of module (reference *Sec.1.10*)
CC    baudrate code of module (reference *Sec.1.10*)
FF    data format of module (reference *Sec.1.10*)

**Example** :
Command : $012  
Receive : !01300600

Read configuration of module in address 01, which is an 8021 module, return analog output 0 to 20mA, baudrate 9600bps, no checksum, engineer unit format and output change immediate.

**Related Command** :
*Sec.2.1 %AANNTTCCFF*

**Related Topics** :
*Sec.1.10 Configuration Tables, Sec3.1 INIT* pin Operation
2.3 $AA5

**Description**: Read Reset Status

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

$     delimiter character
AA    address of reading module (00 to FF)
5     command for reading reset status

**Response**:

- **Valid Command**: !AAS[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     reset status, 1 = the module is been reseted, 0 = the module is not been reseted

**Example**:

Command : $015    Receive : !011
Read address 01 reset status, return first read.

Command : $015    Receive : !010
Read address 01 reset status, return no reset occurred.

**Related Topics**:

Sec3.4 Reset Status
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.
2.5 $AAM

**Description** : Read Module Name

**Syntax** : $AAM[CHK](cr)

$          delimiter character
AA        address of reading module (00 to FF)
M         command for reading module name

**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)    Name of module

**Example** :

Command : $01M            Receive : !017021
         Read address 01 module name, return name 8021.

Command : $03M            Receive : !037021P
         Read address 03 module name, return name 8021P.

**Related Command** :

Sec.2.6 ~AAO(Data)
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 : ~01O7021

Receive : !01

Set address 01 module name to 7021, return success.

Command : $01M

Receive : !017021

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
2.8 $AA0

**Description**: Perform 4mA Calibration

**Syntax**: $AA0[CHK](cr)

- $: delimiter character
- AA: address of setting module (00 to FF)
- 0: command for performing 4mA 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: $010  
Receive: !01  
Perform address 01 4mA calibration, return success.

**Related Command**:  
Sec.2.9 $AA1, Sec.2.10 $AA3VV

**Related Topics**:  
Sec.1.9 Calibration

**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 4.88μA 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 module 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
2.15 #AAN(Data)

**Description** : Output Analog Value for Channel N

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

- #: delimiter character
- AA: address of output module (00 to FF)
- N: output channel (0 to 1 for I-7022, 0 to 3 for I-7024)
- (Data): analog output value, reference *Sec.1.10* for its format.

**Response**:
- Valid Command: >[CHK](cr)
- Invalid Command: ?AA[CHK](cr)
- Ignore Command: ![CHK](cr)

Syntax error or communication error may get no response.

- >: delimiter for valid command
- ?: delimiter for invalid command. While the (Data) is out of range, and the output will goto the most closest value in the setting of module’s range.
- !: delimiter for the module’s host watchdog status is set, and the output command will be ignored.

**Example for 8021**:

Command: $012  Receive: !013F0600
Read address 01 configuration, return multi-channel output, 9600 bps and engineer unit format.

Command: $0190  Receive: !0110
Read address 01 channel 0 DA configuration, return 4 to 20mA output and change immediate.
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
2.17 $AA1N

Description:
8024: Perform 20mA/+10V Calibration for Channel N

Syntax: $AA1N[CHK](cr)
- $ delimiter character
- AA address of setting module (00 to FF)
- 1 command for perform 20mA(or +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: $0112 Receive: !01
Perform address 01 channel 1 calibration(20mA or 10.0V for 8024), return success.

Related Command:
Sec.2.16 $AA0N, 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 2.44µA 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
2.22 $AA8N

Description : Current Value of Channel N Readback
Syntax : $AA8N[CHK](cr)
$              delimiter character
AA            address of reading module (00 to FF)
8             command for read current output 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 : $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 : #010+10.000         Receive : !01
Set address 01 channel 0 output 10.0V, return success.
Command : $0160               Receive : !01+10.000
Read address 01 channel 0 last output command value, return
       10.000.
Command : $0180               Receive : !01+01.000
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
2.25 ~**

**Description** : Host OK.
Host sends this command to all modules for broadcasting the information “Host OK”.

**Command** : ~**[CHK](cr)
~ delimiter character
** command for all modules

**Response** : No response.

**Example** :
Command : ~** No response
Send Host OK to all modules.

**Related Command** :
Sec.2.26 ~AA0, Sec.2.27 ~AA1, Sec.2.28 ~AA2, 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
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.

<table>
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<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
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<td>*2</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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, Sec2.29 ~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
2.29 ~AA3EVV

**Description**: Set Host Watchdog Timeout Interval

**Command**: ~AA3EVV[CHK](cr)

- `~` delimiter character
- AA address of setting module (00 to FF)
- 3 command for setting host watchdog timeout value
- E 1=Enable/0=Disable host watchdog
- VV timeout interval, from 01 to FF, each for 0.1 second

**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**: !0100
  - Read address 01 module status, return host watchdog timeout flag is clear and host watchdog is disabled.

- **Command**: ~013164
  - **Receive**: !01
  - Set address 01 host watchdog timeout interval 10.0 seconds and enable host watchdog, return success.

- **Command**: ~012
  - **Receive**: !0164
  - Read address 01 host watchdog timeout interval, return 10.0 seconds.

- **Command**: ~**
  - **Receive**: 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.
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 ~AA3EVV, 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 fault of improper wiring or loads.