CD-7021/CB7021P

&

CB-7022, CB-7024

User's Manual

Table of Contents

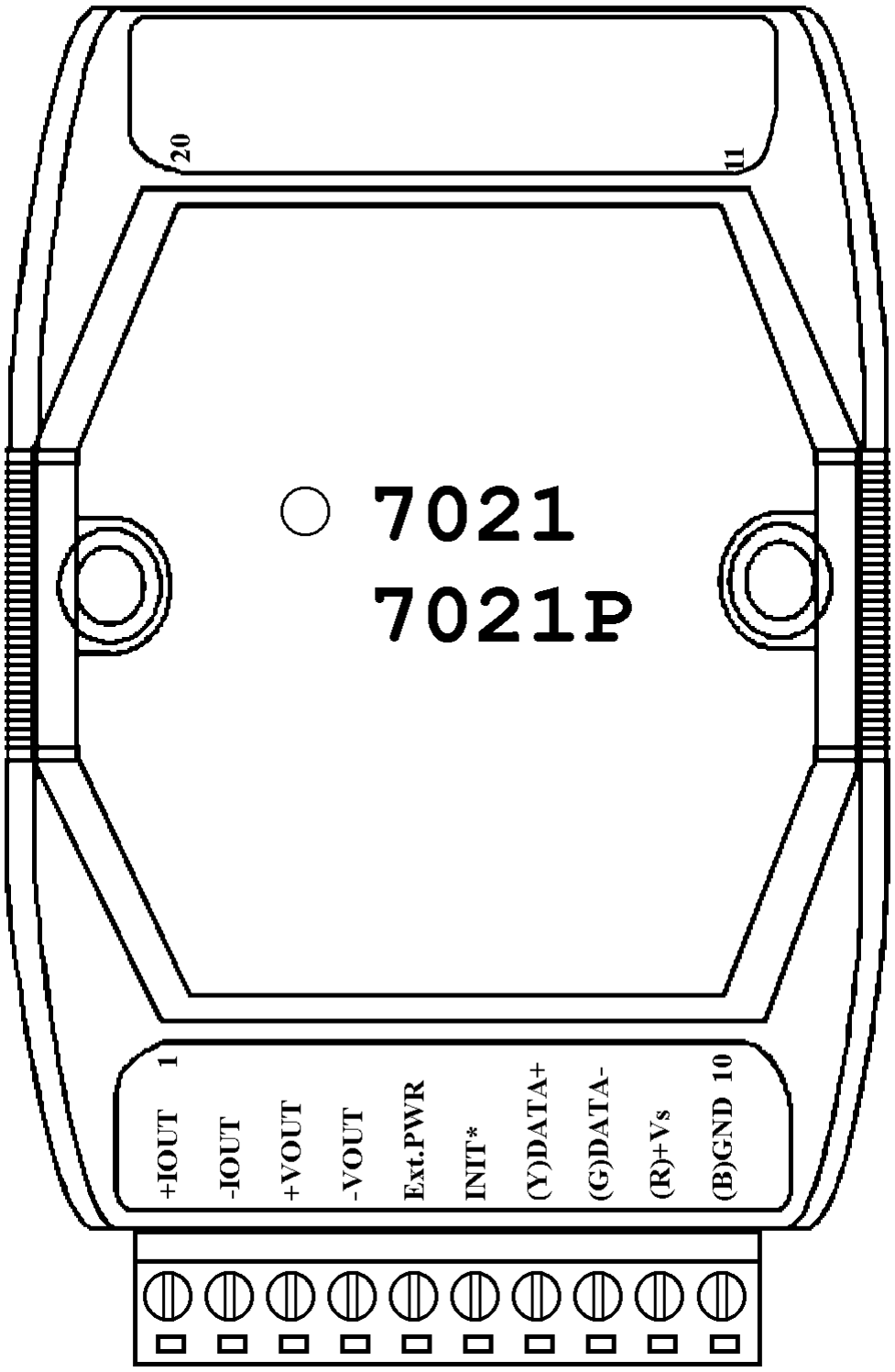
1. Introduction

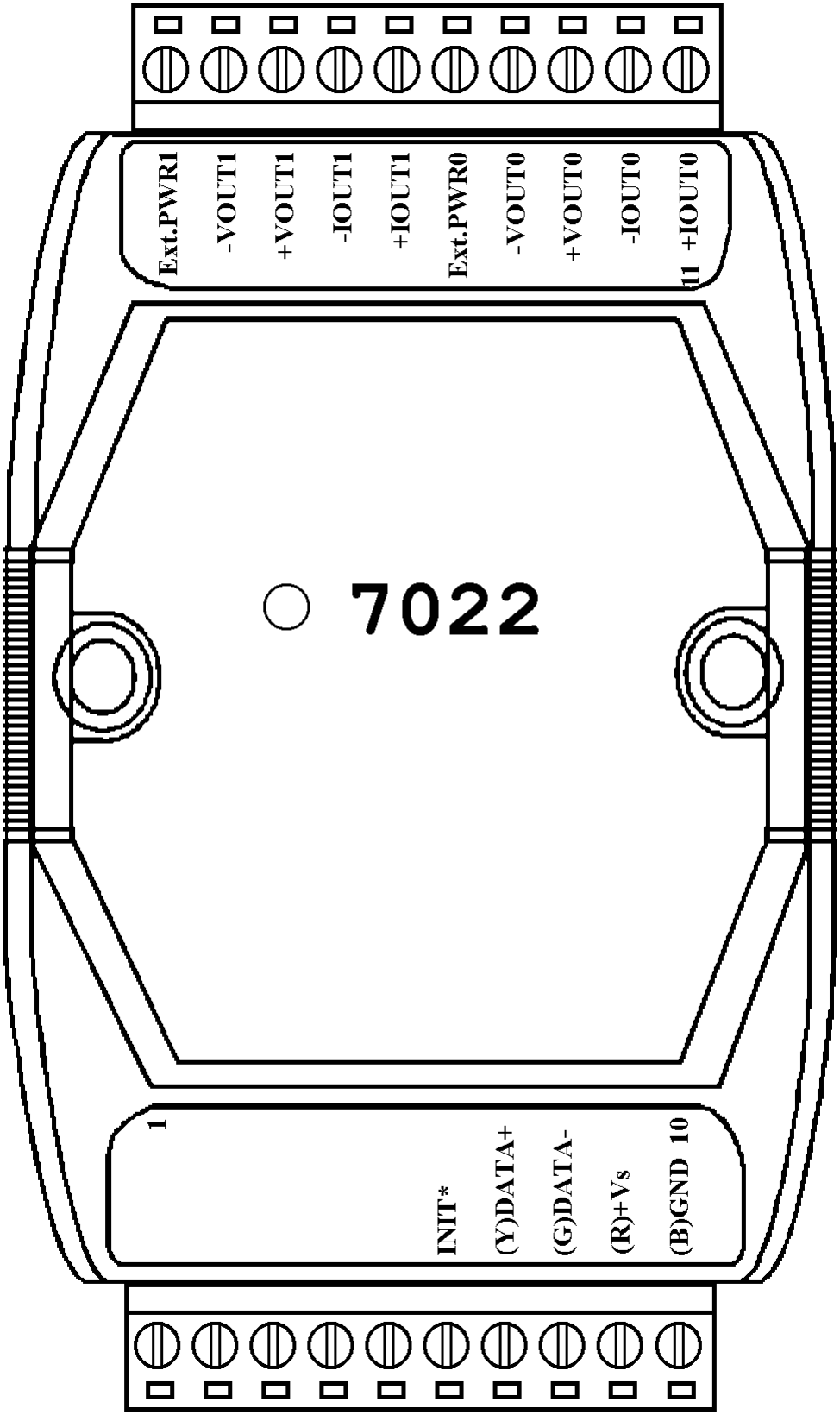
CB-7000 is a family of network data acquisition and control modules. They provide analog-to-digital, digital-to-analog, digital input/output, timer/counter and other functions. These modules can be remote controlled by a set of commands. The basic features of CB-7021, CB-7021P, CB-7022 and CB-7024 are given as following:

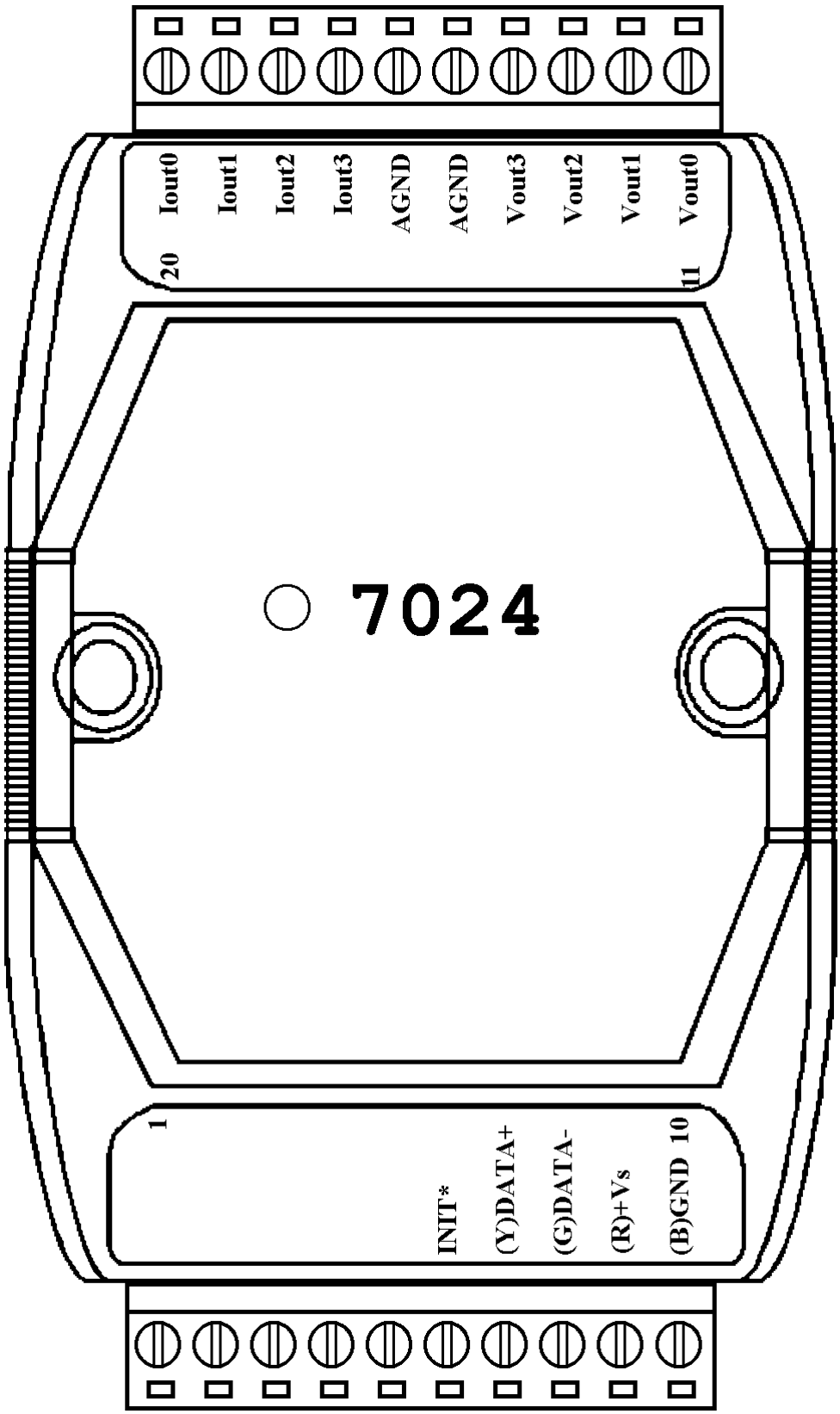
- 3000 VDC isolated analog output.
- Programmable PowerOn Value of analog output.
- Programmable slew rate.
- Software calibration.

The CB-7021 is an analog output module with 12-bit resolution and current readback function. The CB-7021P is similar with CB-7021 but with 16-bit resolution. The CB-7022 is the dual channel version of CB-7021. The CB-7024 is a 4-channel analog output module, and supports bipolar voltage outputs.

1.1 Pin Assignment




Ext.PWR1
-VOUT1
+VOUT1
-IOUT1
+IOUT1
Ext.PWR0
-VOUT0
+VOUT0
-IOUT0
+IOUT0
7022
1
INIT*
(Y)DATA+
(G)DATA-
(R)+Vs
(B)GND
10


Iout0
Iout1
Iout2
Iout3
AGND
AGND
Vout3
Vout2
Vout1
Vout0
20
11
7024
1
INIT*
(Y)DATA+
(G)DATA-
(R)+Vs
(B)GND
10

1.2 Specifications

CB-7021

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: @ 10 mA max.

Current Load Resistance:

Internal power: 500 ohms

External 24V: 1050 ohms

Isolation: 3000VDC

Power Supply

Input: +10 to +30VDC

Consumption: 1.8 W.

CB-7021P

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: @ 10 mA max.

Current Load Resistance:

Internal power: 500 ohms

External 24V: 1050 ohms

Isolation: 3000VDC

Power Supply

Input: +10 to +30VDC

Consumption: 1.8 W.

CB-7022

Analog Output

Output Channel: 2

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: @ 10 mA max.

Current Load Resistance:

Internal power: 500 ohms

External 24V: 1050 ohms

Isolation: 3000VDC

Channel-to-channel isolation

Power Supply

Input: +10 to +30VDC

Consumption: 3.0 W.

CB-7024

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: @ 5 mA max.

Current Load Resistance:

External 24V: 1050 ohms

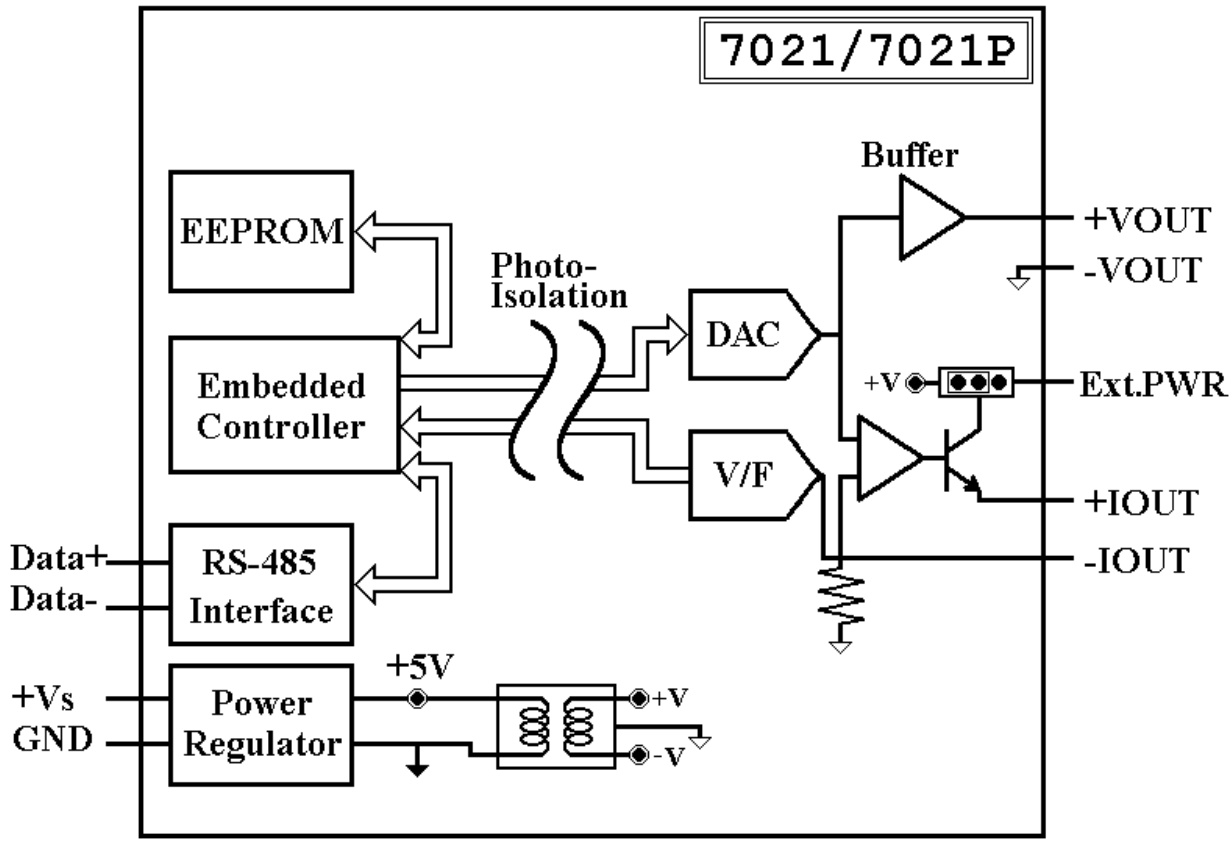
Isolation: 3000VDC

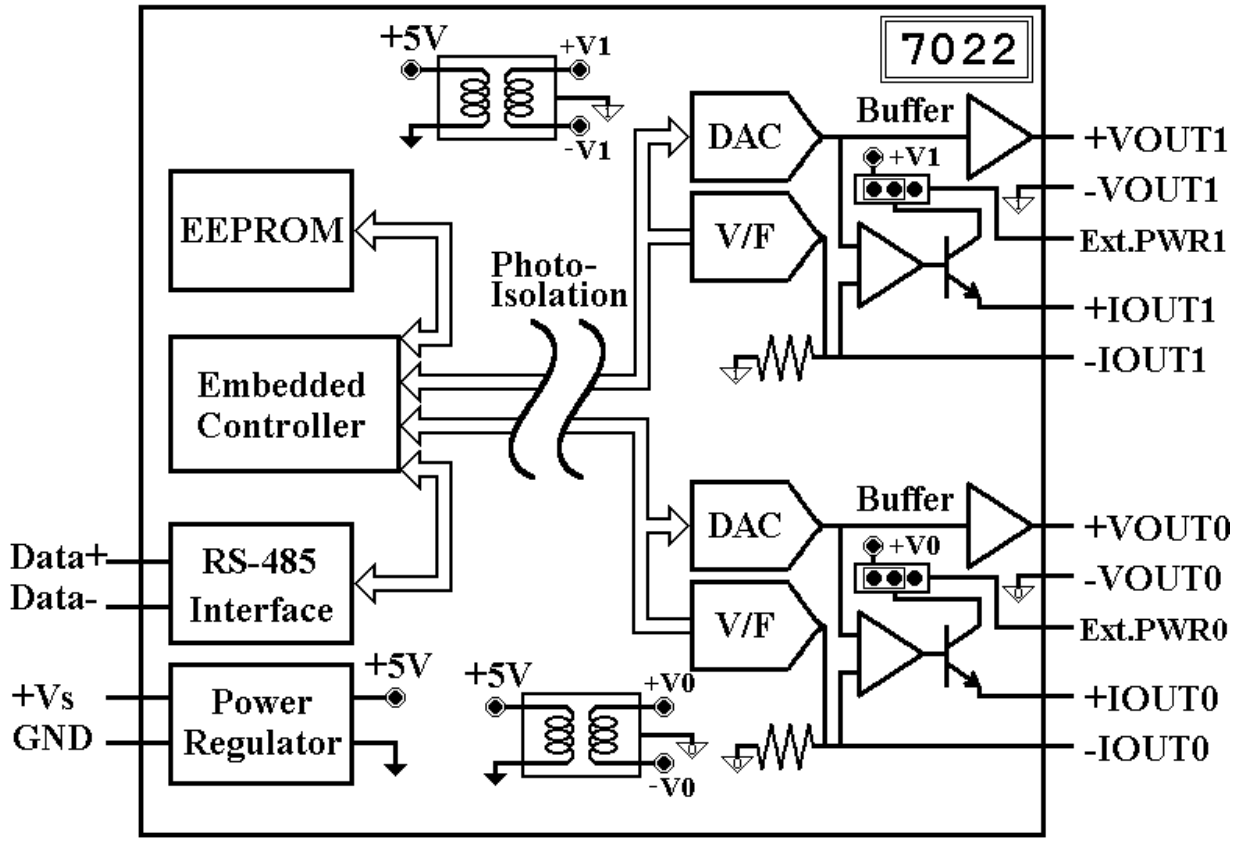
Power Supply

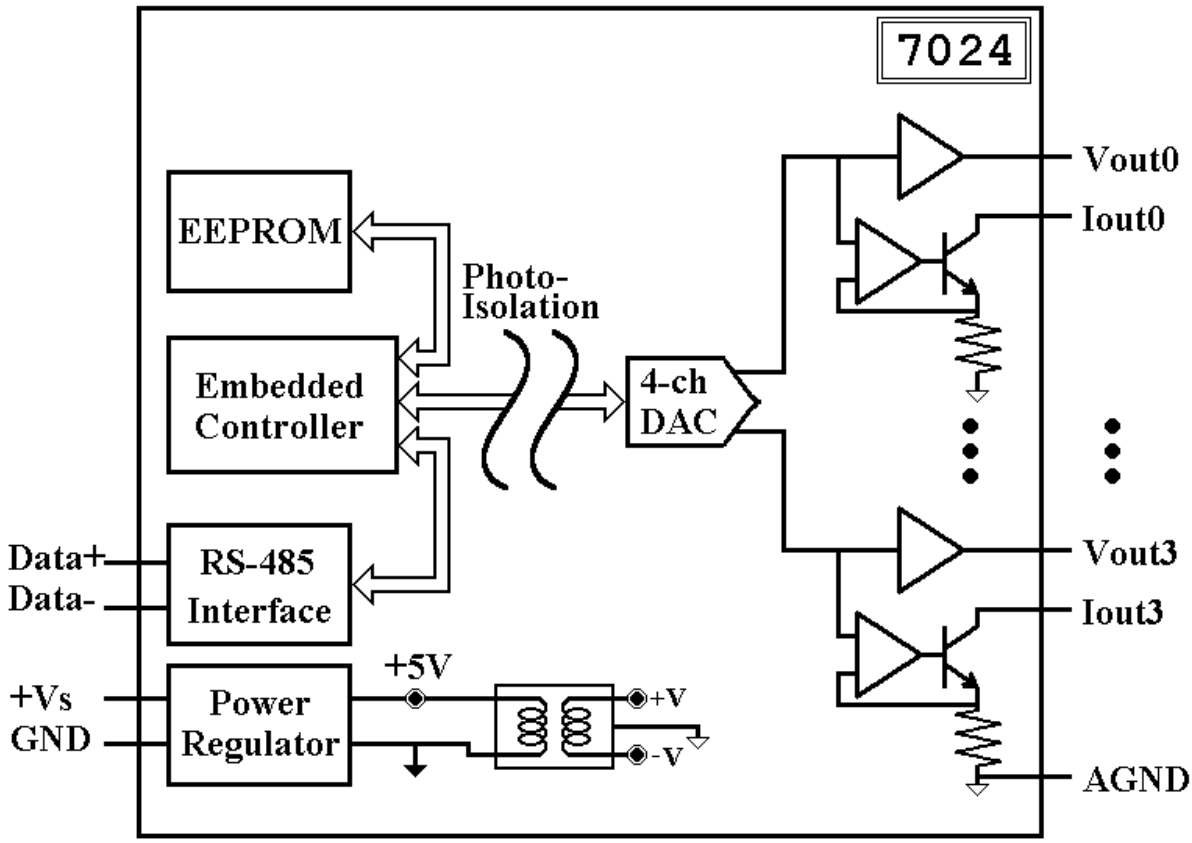
Input: +10 to +30VDC

Consumption: 2.3 W.

1.3 Block Diagram



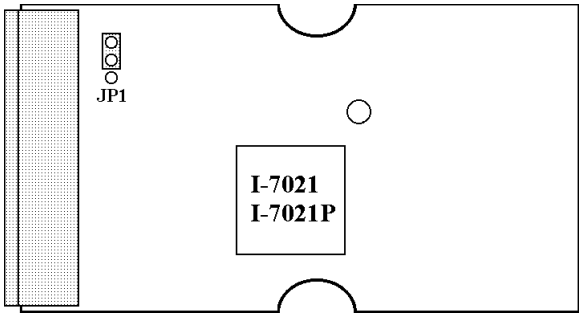



7024
EEPROM
Photo-
Isolation
Embedded
Controller
4-ch
DAC
Vout0
Iout0
Vout3
Iout3
AGND
Data+
Data-
RS-485
Interface
+Vs
GND
Power
Regulator
+5V
+V
-V

1.4 Jumper Setting

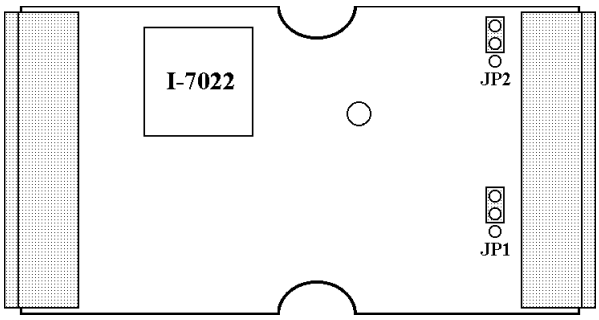
Jumper-selectthecurrentoutputpowersupplyofCB-7021/21P:

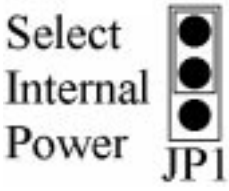
1. Select internal power of module. The default setting can drive a load of up to 500 ohms.
2. Select external power of module: can drive larger load. With 24V power, it can drive 1050 ohms.



Jumper select the current output power supply of CB-7022:

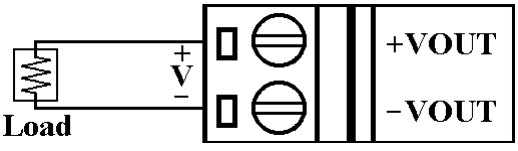
1. JP1 for channel 0 setting, and JP2 for channel 1 setting.
2. Select internal power: 500 ohms load max.
3. External power: 1050 ohms with external +24VDC power



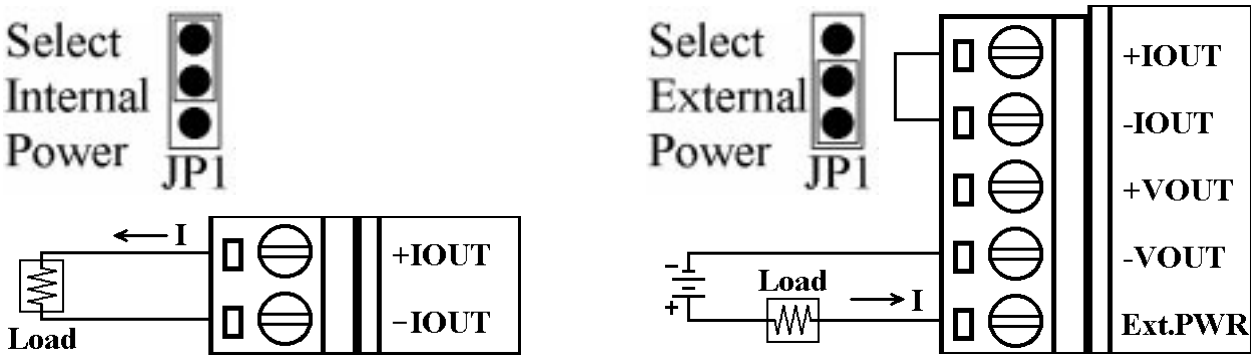


1.5 Wire Connection

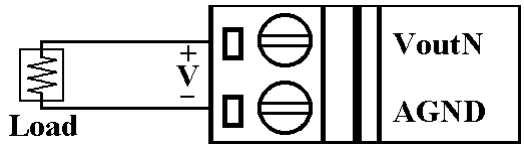
CB-7021/21P/22 VoltageOutputWireConnection



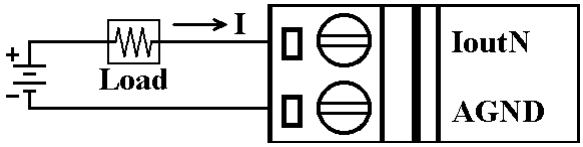
CB-7021/21P/22 Current Output Wire Connection



CB-7024 Voltage Output Wire Connection



CB-7024 Current Output Wire Connection



1.6 Quick Start

Referto“**CB-7000 Bus Converter User Manual**”and “**Getting Started**” for more detail.

1.7 Default Setting

DefaultsettingforCB-7021,CB-7021P,CB-7022andCB-7024:

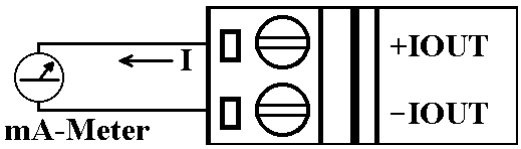
- Address: 01
- Analog Output Type: 0 to +10V
- Baud rate: 9600 bps
- Checksum disable, change immediate, engineer unit format
- CB-7021, CB-7021P, CB-7022 jumper setting: internal power

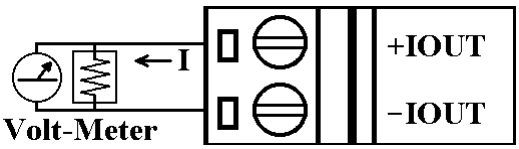
1.8 Calibration

Don't Perform Calibration Until You Understand Procedure.

CB-7021/21P Current Output Calibration Sequence:

1. Set the jumper 1 to internal power and connect milliammeter to module's current output. If a milliammeter in not available, use Volt Meter with shunt resistor (250 ohms, 0.1%). Calculate the output current by the Volt Meter value (I = V/250).

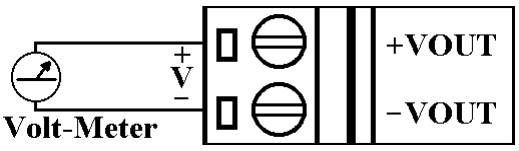




2. Warm-Up for 30 minutes.
3. Setting type to 30. (0 to 20 mA) Refer *Sec. 2.1.*
4. Program output for 4 mA. Refer *Sec. 2.7.*
5. Check the meter and trim the output until 4 mA match by apply trim command. Refer *Sec. 2.10.*
6. Preform 4 mA Calibration Command. Refer *Sec. 2.8.*
7. Program output for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

CB-7021/21P Voltage Output Calibration Sequence:

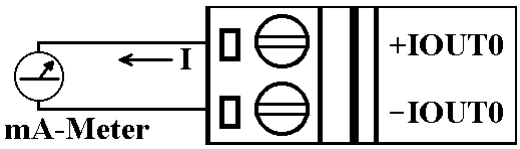
1. Connect voltmeter to module's voltage output.

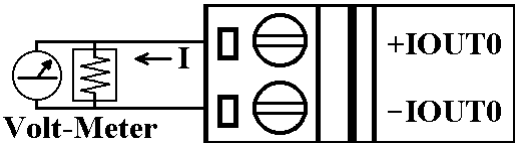


2. Warm-Up for 30 minutes.
3. Set type to 32. (0 to 10V) Refer *Sec. 2.1.*
4. Program output for 10V. Refer *Sec. 2.7.*
5. Check Refer *Sec. 2.13.*

CB-7022 Current Output Calibration Sequence:

1. Set the jumper to internal power and connect milliammeter to module's current output channel 0. If a milliammeter is not available, use a 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. Set output type to 0. (0 to 20mA) Refer *Sec. 2.24.*
4. Program output for 4 mA. Refer *Sec. 2.15.*

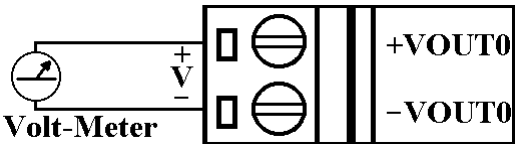




5. Check the meter and trim the output for 4 mA match by using trim command. Refer *Sec. 2.18.*
6. Preform 4 mA Calibration Command. Refer *Sec. 2.16.*
7. Program output 20 mA. Refer *Sec. 2.15.*
8. Check the meter and trim the output until 20 mA match by using trim command. Refer *Sec. 2.18.*
9. Perform 20 mA Calibration Command. Refer *Sec. 2.17.*
10. Repeat step 1 to 9 for channel 1.

CB-7022 Voltage Output Calibration Sequence:

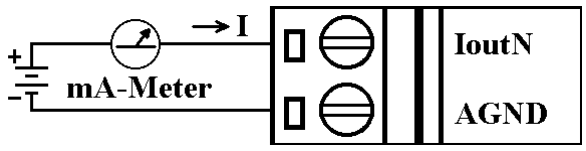
1. Connect voltmeter to module's voltage output.

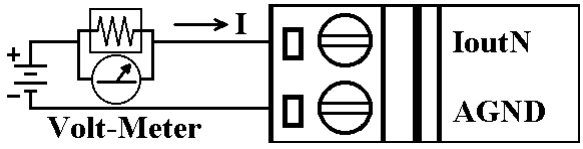


2. Warm-Up for 30 minutes.
3. Set output type to 2. (0 to 10V) -> Refer *Sec. 2.24.*
4. Program output 10V. -> Refer *Sec. 2.15.*
5. Check the meter and trim the output for 10V match by using trim command.-> Refer *Sec. 2.18.*
6. Perform 10V Calibration Command. -> Refer *Sec. 2.21.*
7. Repeat step 1 to 6 for channel 1.

CB-7024 Current Output Calibration Sequence:

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

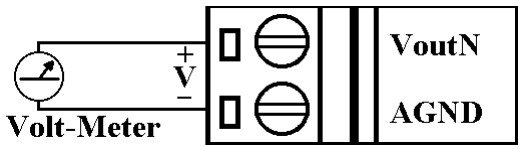




2. Warm-Up for 30 minutes.
3. Set type to 30. (0 to 20 mA) -> Refer *Sec. 2.1.*
4. Program output for 0 mA. -> Refer *Sec. 2.15.*
5. Check the meter and trim the output for 0 mA match by using trim command. -> Refer *Sec. 2.18.*
6. Perform 0 mA Calibration Command. -> Refer *Sec. 2.16.*
7. Program output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

CB-7024 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 for −10V match by using trim command. -> Refer *Sec. 2.18.*
6. Perform −10V Calibration Command. -> Refer *Sec. 2.16.*
7. Program output for 10V. Refer *Sec. 2.15.*
8. Check the meter and trim the output for 10V match by using 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.

1.9 Configuration Tables

Baud rate 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	3F
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	For I-7021/21P/24			For I-7024 only			For I-7022 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 CB-7021/21P and CB-7024, Refer *Sec. 3.6* for details

for CB-7022, set to 0

*3: 00 = Engineering Unit Format

01 = Percent of Span Format (For CB-7021/21P/22)

10 = Hexadecimal Format (For CB-7021/21P/22)

Slew Rate for I-7021/21P and I-7024						
	V/Second	mA/Second			V/Second	mA/Second
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
Note	The config 1111 is for I-7024 only					

Analog Output Type and Data Format for I-7021/21P				
Type Code	Output Range	Data Format	Max.	Min.
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 I-7022				
Output Type	**Output Range**	**Data Format**	**Max.**	**Min.**
0	0 to 20 mA	Engineer Unit	20.000	00.000
		% of Span	+100.00	+000.00
		Hexadecimal	FFF	0000
1	4 to 20 mA	Engineer Unit	20.000	04.000
		% of Span	+100.00	+000.00
		Hexadecimal	FFF	0000
2	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 I-7024				
Type Code	**Output Range**	**Data Format**	**Max.**	**Min.**
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

DA Configuration of CB-7022

Analog Output Type (T)

0 0 mA to 20 mA current output

1 4 mA to 20 mA current output

2 0V to 10V voltage output

Slew Rate Control (S)

0 Immediate change

1 0.0625V/Second or 0.125 mA/Second

2 0.125V/Second or 0.25 mA/Second

3 0.25V/Second or 0.5 mA/Second

4 0.5V/Second or 1.0 mA/Second

5 1.0V/Second or 2.0 mA/Second

6 2.0V/Second or 4.0 mA/Second

7 4.0V/Second or 8.0 mA/Second

8 8.0V/Second or 16 mA/Second

9 16V/Second or 32 mA/Second

A 32V/Second or 64 mA/Second

B 64V/Second or 128 mA/Second

C 128V/Second or 256 mA/Second

D 256V/Second or 512 mA/Second

E 512V/Second or 1024 mA/Second

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 returns(0x0D)

Calculate Checksum:

1. Calculate ASCII sum of all characters of command (or response) string except the character returns(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	***Sec.2.1***
$AA2	!AANNTTCCFF	Read Configuration	***Sec.2.2***
$AA5	!AAS	Read Reset Status	***Sec.2.3***
$AAF	!AA(Data)	Read Firmware Version	***Sec.2.4***
$AAM	!AA(Data)	Read Module Name	***Sec.2.5***
~AAO(Data)	!AA	Set Module Name	***Sec.2.6***

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

I-7022 Analog Output Command Sets (All command for specificied channel N)			
Command	**Response**	**Description**	**Section**
#AAN(Data)	>	Output Analog Value	***Sec.2.15***
$AA0N	!AA	4mA Calibration	***Sec.2.16***
$AA1N	!AA	20mA Calibration	***Sec.2.17***
$AA3NVV	!AA	Trim Calibration	***Sec.2.18***
$AA4N	!AA	Set PowerOn Value	***Sec.2.19***
$AA6N	!AA(Data)	Last Value Readback	***Sec.2.20***
$AA7N	!AA	10V Calibration	***Sec.2.21.1***
$AA8N	!AA(Data)	Current Readback	***Sec.2.22***
$AA9N	!AATS	Read DA Configuration	***Sec.2.23***
$AA9NTS	!AA	Set DA Configuration	***Sec.2.24***

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

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

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 baud rate for setting module (Ref *Sec. 1.10*)

FF New data format for setting module (Ref *Sec. 1.10*)

When changing the baud rate or checksum, short the INIT* pin 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 baud rate or checksum setting without shorting INIT* to ground, the module will returns an invalid command message.

AA Address of response module (00 to FF)

Example:

Command: %0102300600 Receive: !02

Change address from 01 to 02, returns successful.

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 comm. 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 Baud rate 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 CB-7021 module, returns analog output 0 to 20 mA, baud rate 9600bps, no checksum, engineering 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 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 reset; 0 = the module is not been reset.

Example:

Command: $015 Receive: !011

Read address 01 reset status, returns first read.

Command: $015 Receive: !010

Read address 01 reset status, returns 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, returns version A2.0.

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

Read address 02 firmware version, returns 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, returns name 7021.

Command: $03M Receive: !037021P

Read address 03 module name, returns name 7021P.

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, returns successfulful.

Command: $01M Receive: !017021

Read address 01 module name, returns 7021.

Related Command:

Sec. 2.5 $AAM

2.7 #AA(Data)

Description: Output Analog Value

Note: The command is for CB-7021/21P only.

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: **?AA[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 go to 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.
AA	Address of response module (00 to FF)

Example:

Command: $012 Receive: !01300600

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

Command: #0105.000 Receive: >

Output address 01 value 5.0 mA, returns successful.

Command: #0125.000 Receive: ?01

Output address 01 value 25.0 mA, returns the value is out of

range, and the output is set to 20.0 mA.

Command: $022 Receive: !02300601

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

Command: #02+050.00 Receive: >

Output address 02 value 50% (=10 mA), returns successful.

Command: $032 Receive: !02300602

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

Command: #03800 Receive: >

Output address 03 value 0x800 (=10 mA), returns successful.

Related Command:

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

Related Topics:

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

2.8 $AA0

Description: Perform 4 mA Calibration

Note: The command is for CB-7021/21P only.

Syntax: $AA0[CHK](cr)

$	Delimiter character
AA	Address of setting module (00 to FF)
0	command for performing 4 mA 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 4 mA calibration, returns successful.

Related Command:

Sec. 2.9 $AA1, *Sec. 2.10* $AA3VV

Related Topics:

Sec. 1.9 Calibration

2.9 $AA1

Description: Perform 20 mA Calibration

Note: The command is for CB-7021/21P only.

Syntax: $AA1[CHK](cr)

$	Delimiter character
AA	Address of setting module (00 to FF)
1	command for performing 20 mA 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 20 mA calibration, returns successful.

Related Command:

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

Related Topics:

Sec. 1.9 Calibration

2.10 $AA3VV

Description: Trim Calibration

Note: The command is for CB-7021/21P only.

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 comm. 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, returns successful.

Related Command:

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

Related Topics:

Sec. 1.9 Calibration

2.11 $AA4

Description: Set PowerOn Value

Note: The command is for CB-7021/21P only.

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 0.0 mA, returns successful.

Command: $014 Receive: !01

Set address 01 PowerOn V alue, returns successful. The module 01 will go to 0.0 mA with module power on.

Related Command:

Sec. 2.7 #AA(Data)

Related Topics:

Sec. 3.5 Analog Output

2.12 $AA6

Description: Last Value Readback

Note: The command is for CB-7021/21P only.

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 to *Sec. 1.10* for formatting.

Example:

Command: #0110.000 Receive: !01

Set address 01 output 10.0, returns successful.

Command: $016 Receive: !0110.000

Read address 01 last output command value, returns 10.000.

Related Command:

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

Related Topics:

Sec. 3.7, Current Readback

2.13 $AA7

Description: Perform 10V Calibration

Note: The command is for CB-7021/21P only.

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, returns successful.

Related Command:

Sec. 2.10 $AA3VV

Related Topics:

Sec. 1.9 Calibration

2.14 $AA8

Description: Current Readback

Note: The command is for CB-7021/21P only.

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 to *Sec. 1.9* for format.

Example:

Command: $012 Receive: !01320614

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

Command: #0110.000 Receive: !01

Set address 01 output 10.0V, returns successful.

Command: $016 Receive: !0110.000

Read address 01 last output command value, returns 10.000.

Command: $018 Receive: !0101.000

Read address 01 current value, returns 1.0V.

Command: $018 Receive: !0101.500

Read address 01 current value, returns 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

2.15 #AAN(Data)

Description: Output Analog Value for Channel N

Note: The command is for CB-7022 and CB-7024 only.

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

#	Delimiter character
AA	Address of output module (00 to FF)
N	Output channel (0 to 1 for CB-7022, 0 to 3 for CB-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. When the (Data) is out of range, and the output will go to the closest value in the module's range.
!	Delimiter for the module's host watchdog status is set, and the output command will be ignored.
AA	Address of response module (00 to FF)

Example for CB-7022:

Command: $012 Receive: !013F0600

Read address 01 configuration, returns multichannel output, 9600 bps and engineering unit format.

Command: $0190 Receive: !0110

Read address 01, channel 0 DA config., returns 4 to 20 mA. output and change immediate.

Command: #01005.000 Receive: >

Output address 01 channel 0 value 5.0 mA, returns successful.

Command: #01025.000 Receive: ?01

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

Example for CB-7024:

Command: $012 Receive: !01300600

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

Command: #010+05.000 Receive: >

Output address 01 channel 0 value 5.0 mA, returns successful.

Command: #010+25.000 Receive: ?01

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

Related Command:

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

Related Topics:

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

2.16 $AA0N

Description:

CB-7022: Perform 4 mA Calibration for Channel N

CB-7024: Perform 0 mA/-10V Calibration for Channel N

Note: The command is for CB-7022 and CB-7024 only.

Syntax: $AA0N[CHK](cr)

$ Delimiter character

AA Address of setting module (00 to FF)

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

N channel to calibrate (0 to 1 for CB-7022, 0 to 3 for CB-7024)

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 (4 mA for CB-7022, 0 mA or -10.0V for CB-7024), returns successful.

Related Command:

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

Related Topics:

Sec. 1.9 Calibration

2.17 $AA1N

Description:

CB-7022: Perform 20 mA Calibration for Channel N

CB-7024: Perform 20 mA/+10V Calibration for Channel N

Note: The command is for CB-7022 and CB-7024 only.

Syntax: $AA1N[CHK](cr)

$ Delimiter character

AA Address of setting module (00 to FF)

1 Command for perform 20 mA (or +10V) calibration

N Channel to calibrate (0 to 1 for CB-7022, 0 to 3 for CB-7024)

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 (20 mA for CB-7022, 20 mA or 10.0V for CB-7024), returns successful.

Related Command:

Sec. 2.16 $AA0N, *Sec. 2.18* $AA3NVV

Related Topics:

Sec. 1.9 Calibration

2.18 $AA3NVV

Description: Trim Calibration for Channel N

Note: The command is for CB-7022 and CB-7024 only

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 1 for CB-7022, 0 to 3 for CB-7024)

VV 2's complement hex to trim output value. 00 to 5F to increase 0 to 95 counts, and FF to A1 to decrease 1 to 95 counts. A count = 4.88μA/2.44mV for CB-7022 and 2.44μA or 1.22mV for CB-7024.

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

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

Syntax or comm. error may not get 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, returns OK

Related Command:

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

Related Topics:

Sec. 1.9 Calibration

2.19 $AA4N

Description: Set PowerOn Value for Channel N

Note: The command is for CB-7022 and CB-7024 only.

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 1 for CB-7022, 0 to 3 for CB-7024)

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

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

Syntax error or communication error may not get response.

! Delimiter for valid command

? Delimiter for invalid command

AA Address of response module (00 to FF)

Example for CB-7024:

Command: #012+00.000 Receive: >

Set address 01 channel 2 output 0.0, returns successful.

Command: $0142 Receive: !01

Set address 01 channel 2 PowerOn Value, returns successful. The Power-On 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

2.20 $AA6N

Description: Last Value of Channel N Readback

Note: The command is for CB-7022 and CB-7024 only.

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 1 for CB-7022, 0 to 3 for CB-7024)

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

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

Syntax or comm. error may not get response.

! Delimiter for valid command

? Delimiter for invalid command

AA Address of response module (00 to FF)

(Data) Last output command value. See *Sec. 1.9* for format.

Example for CB-7024:

Command: #013+10.000 Receive: !01

Set address 01 channel 3 output 10.0, returns successful.

Command: $0163 Receive: !01+10.000

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

Related Command:

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

Related Topics:

Sec. 3.7, Current Readback

2.21.1 $AA7N

Description: Perform 10V Calibration for Channel N

Note: The command is for CB-7022 only.

Syntax: $AA7N[CHK](cr)

$	Delimiter character
AA	Address of reading module (00 to FF)
7	command for performing 10V calibration
N	channel to calibrate (0 to 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
AA	Address of response module (00 to FF)

Example:

Command: $0170 Receive: !01

Perform address 01 channel 0 10V calibration, returns successful.

Related Command:

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

Related Topics:

Sec. 1.9, Calibration

2.21.2 $AA7N

Description: Read PowerOn Value of Channel N

Note: The command is for CB-7024 only.

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 not get response.

!	Delimiter for valid command
?	Delimiter for invalid command
AA	Address of response module (00 to FF)
(Data)	Last output command value. See *Sec. 1.9* for the format.

Example:

Command: $0170 Receive: !01+00.000

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

Related Command:

Sec. 2.19, $AA4N

2.22 $AA8N

Description: Current Value of Channel N Readback

Note: The command is for CB-7022 and CB-7024 only.

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 1 for CB-7022, 0 to 3 for CB-7024)

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

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

Syntax error or communication error may not get response.

! Delimiter for valid command

? Delimiter for invalid command

AA Address of response module (00 to FF)

(Data) Last output command value. See *Sec. 1.9* for format.

Example for CB-7024:

Command: $012 Receive: !01320614

Read address 01 configuration, returns 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, returns successful.

Command: $0160 Receive: !01+10.000

Read address 01 channel 0 last output command value, returns 10.000.

Command: $0180 Receive: !01+01.000

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

Command: $0180 Receive: !01+01.500

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

Related Command:

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

Related Topics:

Sec. 3.7, Current Readback

2.23 $AA9N

Description: Read DA Configuration of Channel N

Note: The command is for CB-7022 only.

Syntax: $AA9N[CHK](cr)

$	Delimiter character
AA	Address of reading module (00 to FF)
9	Command for reading DA configuration
N	Channel to read DA configuration (0 to 1)

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

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

Syntax error or communication error may not get a response.

!	Delimiter for valid command
?	Delimiter for invalid command
AA	Address of response module (00 to FF)
T	Analog output type. See *Sec. 1.10* for format.
S	Analog output slew rate. See *Sec. 1.10* for format.

Example:

Command: $0190 Receive: !0110

Read address 01 channel 0 DA configuration, returns 4 to 20 mA output and change immediate.

Related Command:

Sec. 2.24, $AA9NTS

2.24 $AA9NTS

Description: Set DA Configuration of Channel N

Note: The command is for CB-7022 only.

Syntax: $AA9NTS[CHK](cr)

$ Delimiter character

AA Address of reading module (00 to FF)

9 Command for setting DA configuration

N Channel to set DA configuration (0 to 1)

T Analog output type. Refer *Sec. 1.10* for type select

S Analog output slew rate. Refer *Sec. 1.10* for slew rate select

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

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

Syntax error or communication error may not get a response.

! Delimiter for valid command

? Delimiter for invalid command

AA Address of response module (00 to FF)

Example:

Command: $019121 Receive: !01

Set address 01 channel 1 DA configuration: 0 to 10V output and slew rate 0.625V/Second, returns successful.

Related Command:

Sec. 2.23 $AA9N

2.25 ~**

Description: Host OK.

Host sends this command to all modules broadcasting that the host is 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 not get 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, returns 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 or communication error may not get a 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, returns 04, host watchdog timeout flag is set.

Command: ~011 Receive: !01

Reset address 01 module status, returns successful.

Command: ~010 Receive: !0100

Read address 01 module status, returns 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 or communication error may not get a 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, returns 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, returns 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, returns successful.

Command: ~012 Receive: !0164

Read address 01 host watchdog timeout interval, returns 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, returns host watchdog timeout flag is set and host watchdog is disabled.

Command: ~011 Receive: !01

Reset address 01 module status, returns successful.

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.

Note: The command is for CB-7021/21P only.

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 not get a 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, returns 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

2.31 ~AA4N

Description: Read Safe Value of Channel N

Note: The command is for CB-7022 and CB-7024 only.

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 1 for CB-7022, 0 to 3 for CB-7024)

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

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

Syntax error or communication error may not get a 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 CB-7024:

Command: ~0140 Receive: !01+00.000

Read address 01 channel 0 Safe Value, returns +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

2.32 ~AA5

Description: Set Safe Value.

Note: The command is for CB-7021/21P only.

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 or communication error may not get a 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, returns successful.

Command: ~015 Receive: !01

Set address 01 Safe Value, returns successful.

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

2.33 ~AA5N

Description: Set Safe Value of Channel N

Note: The command is for CB-7022 and CB-7024 only.

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 1 for CB-7022, 0 to 3 for CB-7024)

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

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

Syntax or communication error may not get a response.

!	Delimiter for valid command
?	Delimiter for invalid command
AA	Address of response module (00 to FF)

Example for CB-7024:

Command: #010+05.000 Receive: !01

Output address 01 channel 0 value +5.0, returns successful.

Command: ~0150 Receive: !01

Set address 01 channel 0 Safe Value, returns successful.

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

3. Application Note

3.1 INIT* pin Operation

Each CB-7000 module has a build-in EEPROM to store configuration information such as address, type, baud rate and other information. Sometimes, a user may forget the configuration of the module. Therefore, the CB-7000 have a special mode named "**INIT mode**", to help user to resolve this problem. The "**INIT mode**" is setting as **Address=00, baud rate=9600bps, no checksum.**

To enable INIT mode, please follow these steps:

Step 1. Power-down the module.

Step 2. Connect the INIT* pin with the GND pin.

Step 3. Power-up the module.

Step 4. Send command $002(cr) in 9600 bps to read the configuration stored in the module's EEPROM.

Refer to "**7000 Bus Converter User Manual**" *Sec. 5.1* and "**Getting Started**" for more information.

3.2 Module Status

Power-On Reset or **Module Watchdog Reset** will put all outputs to the **PowerOn Value**. The module can accept the host's command to change the output value.

Host Watchdog Timeout puts all outputs to **the Safe Value**. The host watchdog timeout flag is set, and an output command will be ignored. The module's LED will flash. The user must reset the Module Status via command to go to normal operation.

3.3 Dual Watchdog Operation

Dual Watchdog = Module Watchdog + Host Watchdog

The Module Watchdog is a hardware reset circuit used to monitor the module's operating status. While working in harsh or noisy environment, the module may go down caused by a noise signal. The outputs go to the **PowerOn Value**. The module can accept the host's command to change the output value.

The Host Watchdog is a software function to monitor the host's operating status. Its purpose is to detect a network/ communication problem or a halted host. If a timeout occurs, the module will place all outputs to their **Safe Value** to prevent any problem in the controlled unit/process.

The CB-7000 module with Dual W atchdog makes the control system more reliable and safer

3.4 Reset Status

The Reset Status is set when the module is powered-on or is reset by the Module Watchdog. It is cleared when the command Read Reset Status ($AA5) sent. This is useful for user to determine the module's working status. When Reset Status is set (the module is reset) the output is changed to the PowerOn V alue. When the Reset Status is clear (the module is not reset) the output is not changed.

3.5 Analog Output

The module's output have three different condition:

<1> **Safe Value**. If the host watchdog times-out, the output

is set to **Safe Value**. When the module receives the output command, such as #AA(Data) or #AAN(Data), the module will returns ignore (receive:!) and will not change the output to the output command value. **The host watchdog timeout status is set and stored in EEPROM while the host watchdog timeout interval expired, and can only be cleared by command ~AA1.** If the user wants to change the output, he must first clear the host watchdog timeout status, then send an output command to change the output to the desired value.

<2> **PowerOn Value**. When the module is reset, and/or when the host watchdog timeout status is clear, the module's output is set to predefined **PowerOn** Value.

<3> **Output Command Value**. When the host watchdog timeout status is clear , the user sends command #AA(Data) or #AAN(Data), to the module to change the output value. The module will returns successful (receive >). If user sets the output value over the maximum value of output range, the output will go to maximum value and returns an out-of-range (receive ?AA) reply. If the output value is under the minimum value of output range, the output will go to minimum value and returns out-of-range (receive ?AA).

3.6 Slew Rate Control

Slew rate control is used to adjust the output rate-of-change. Most analog output changes are step-changes. In many applications, this characteristic is undesirable. A gradual output change under slew rate control is more appropriate.

The CB-7021/21P/22/24 provides programmable slew rate control. When an output command is sent to CB-7021/21P/22/24 to change the analog value, the output automatically drives to the new value at the specified slew rate. The CB-7021/21P/22/24 updates the analog output value at 100 conversions per second. The programmed slew rate sets the value of each 10 ms step change. Thus, the output is smoothly stepped until the final output value is reached. Refer to the specifications for the minimum and maximum slew rates.

3.7 Current Readback

The CB-7021/21P/22 have an analog-to-digit converter to monitor the current output signal. The current readback will indicate an open wiring or load when the readback value is far from the transmitted output value.

The CB-7024 does not have the analog-to-digit converter to monitor the current output signal. But, the CB-7024 can returns the current digital value transferred to the DAC.

NOTE: The CB-7024 can' t read the actual DAC output current value , thus can't detect faulty wiring or loads.

For your notes.

For your notes.

For Your Notes.

EC Declaration of Conformity

We, Measurement Computing Corp., declare under sole responsibility that the product:

CB-7021/22/24 Digital Output Modules

Part Number Description

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

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