

I-7013, I-7013D, I-7033, I-7033D, I-7015 User's Manual

Warranty

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1. Introduction

The I-7000 series is a family of network data acquisition and control modules, providing analog-to-digital, digital-to-analog, digital input/output, timer/counter and other functions. The modules can be remotely controlled using a set of commands. Communication between module and the host is in ASCII via an RS-485 bi-directional serial bus standard. Baud rates are software programmable and speeds up to 115.2K baud can be selected.

The common features of the I-7013/13D, I-7033/33D and I-7015 are as follows:

1. 24-bit sigma-delta ADC to provide excellent accuracy
2. RTD direct connect
3. Software calibration

The I-7013 is a single channel RTD input module. The I-7013D is the I-7013 with a 4 $\frac{1}{2}$ digit LED display. The I-7033 is a 3-channel RTD input module. The I-7033D is the I-7033 with a 4 $\frac{1}{2}$ digit LED display. The I-7015 is a 6-channel RTD input module.

Supported RTD types are:

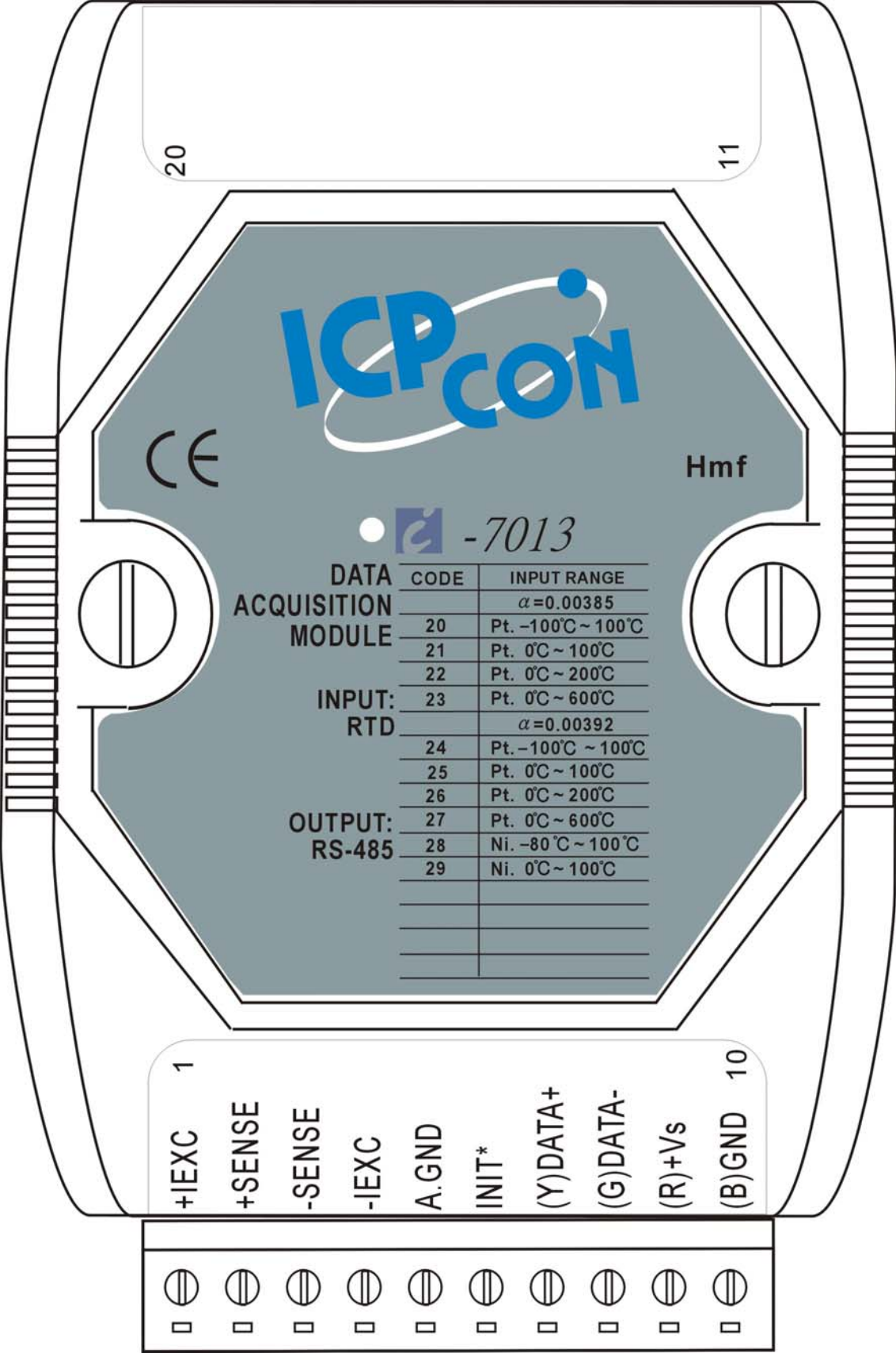
1. Platinum, 100 Ohms at 0°C, $\alpha = 0.00385$
2. Platinum, 100 Ohms at 0°C, $\alpha = 0.003916$
3. Platinum, 1000 Ohms at 0°C, $\alpha = 0.00385$ (I-7033/33D and I-7015)
4. Nickel, 120 Ohms at 0°C, $\alpha = 0.00672$
5. Copper, 100 Ohms at 0°C, $\alpha = 0.00421$ (I-7015 only)
6. Copper, 1000 Ohms at 0°C, $\alpha = 0.00421$ (I-7015 only)
7. Copper, 100 Ohms at 25°C, $\alpha = 0.00427$ (I-7015 only)

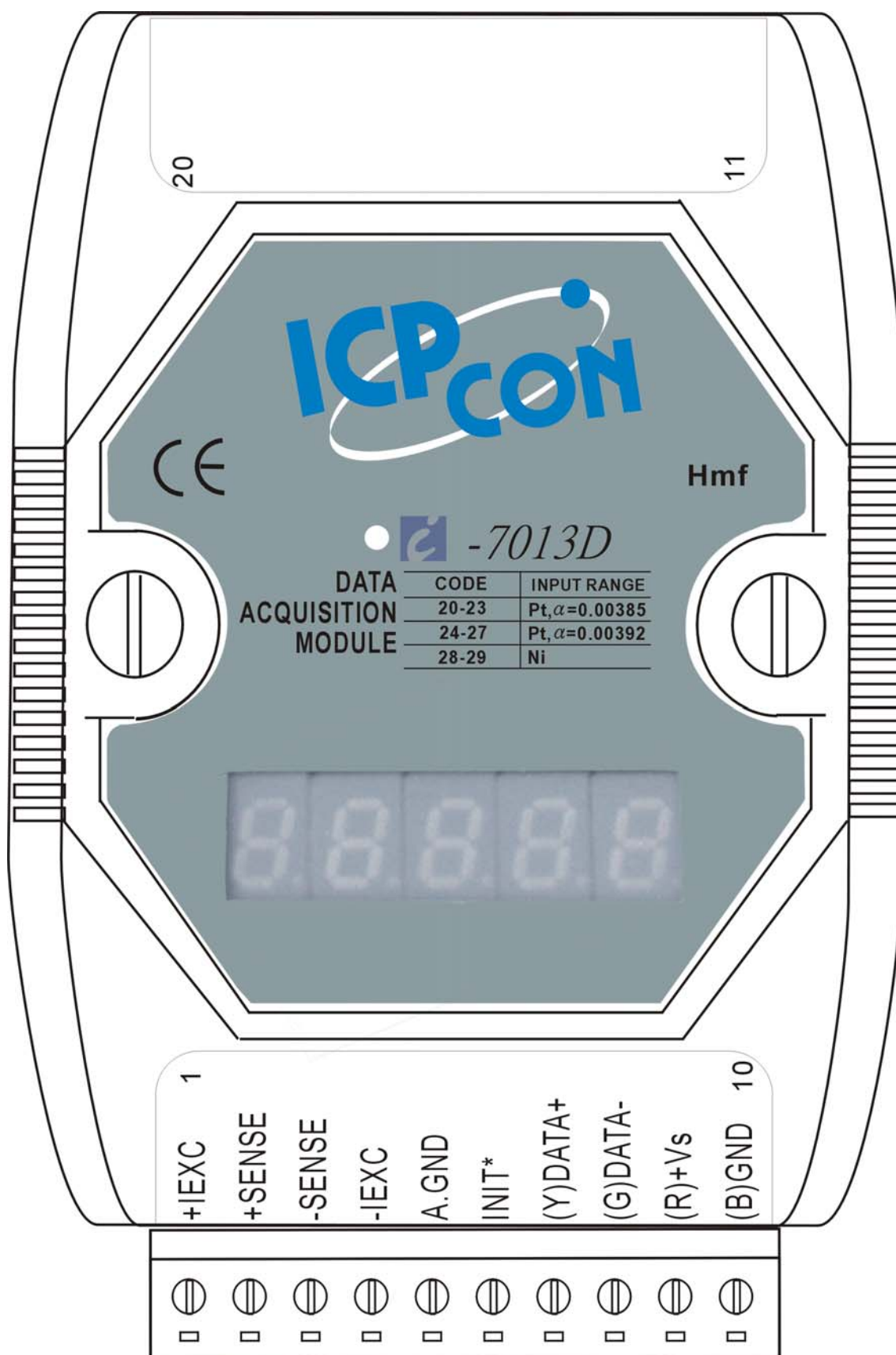
1.1 More Information

Refer to chapter 1 of the “I-7000 Bus Converter User’s Manual” as shown below or visit the ICP DAS website <http://www.icpdas.com> for more information regarding the I-7000 series.

- | |
|--|
| <ul style="list-style-type: none">1.1 The 7000 Series Overview1.2 Related Documentation for the 7000 Series1.3 Common Features of the 7000 Series1.4 The 7000 Series System Network Configuration1.5 7000 Dimensions |
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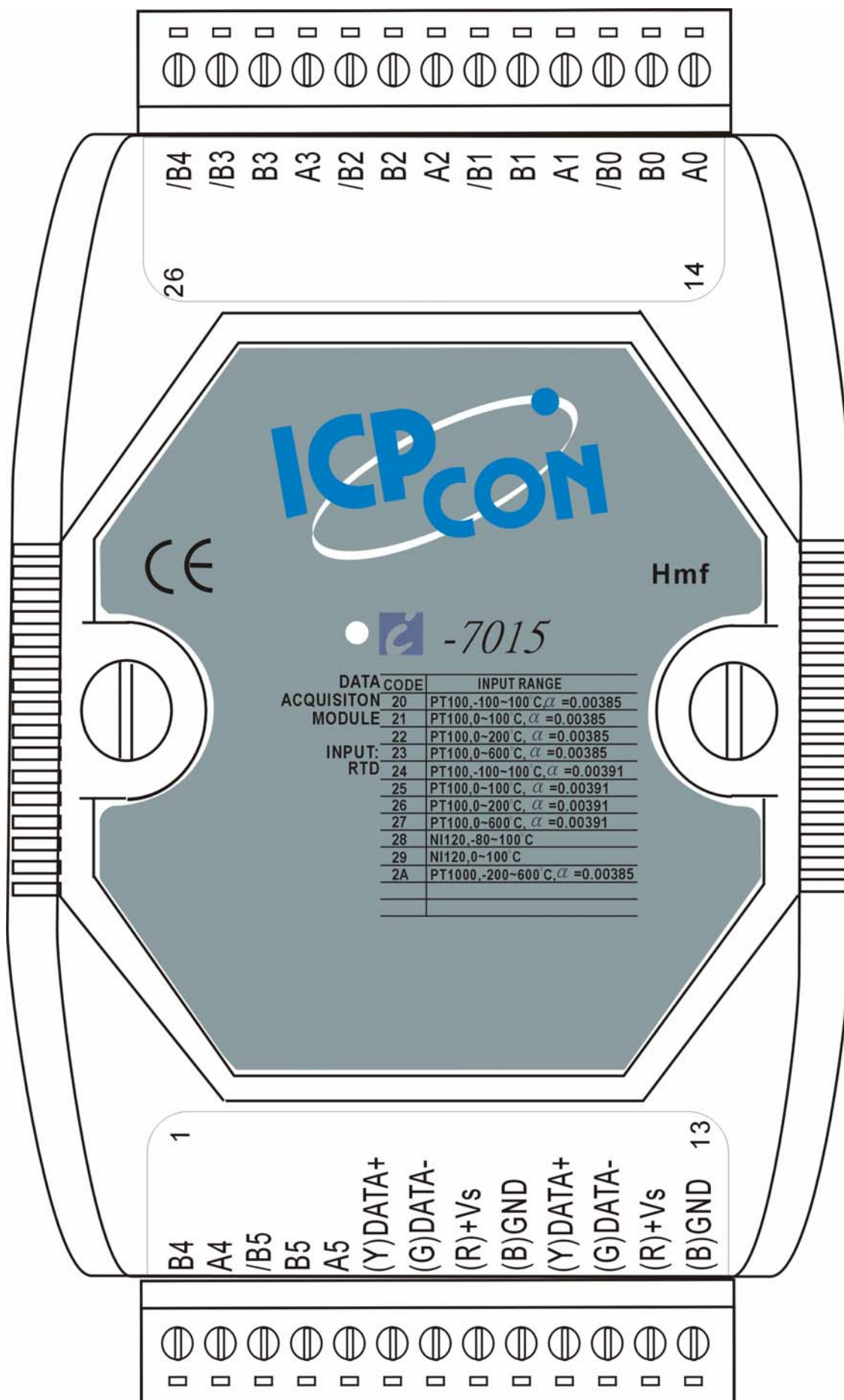
1.2 Pin Assignment









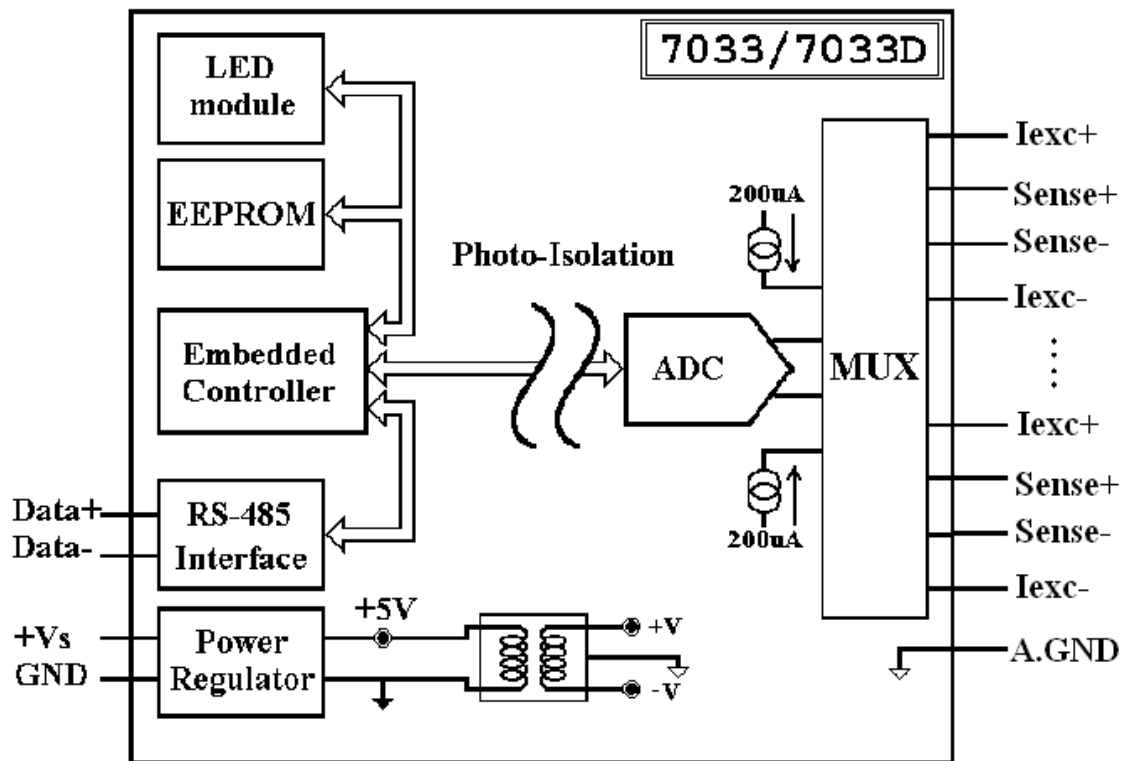
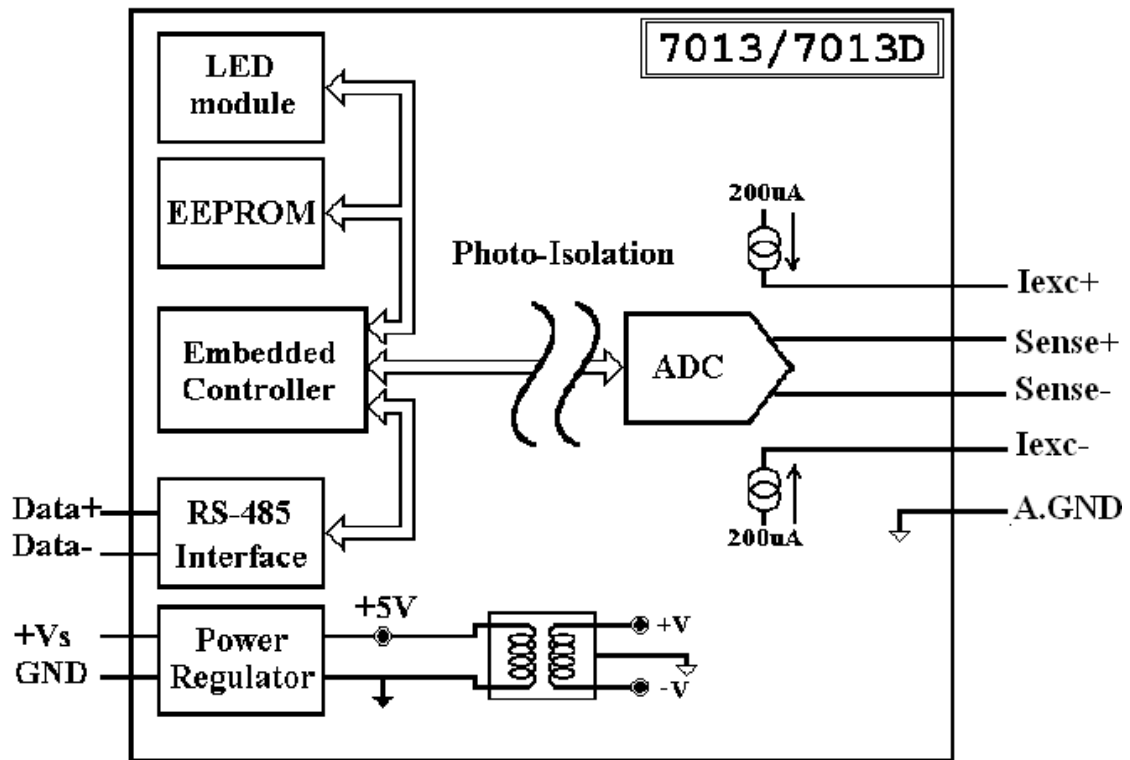


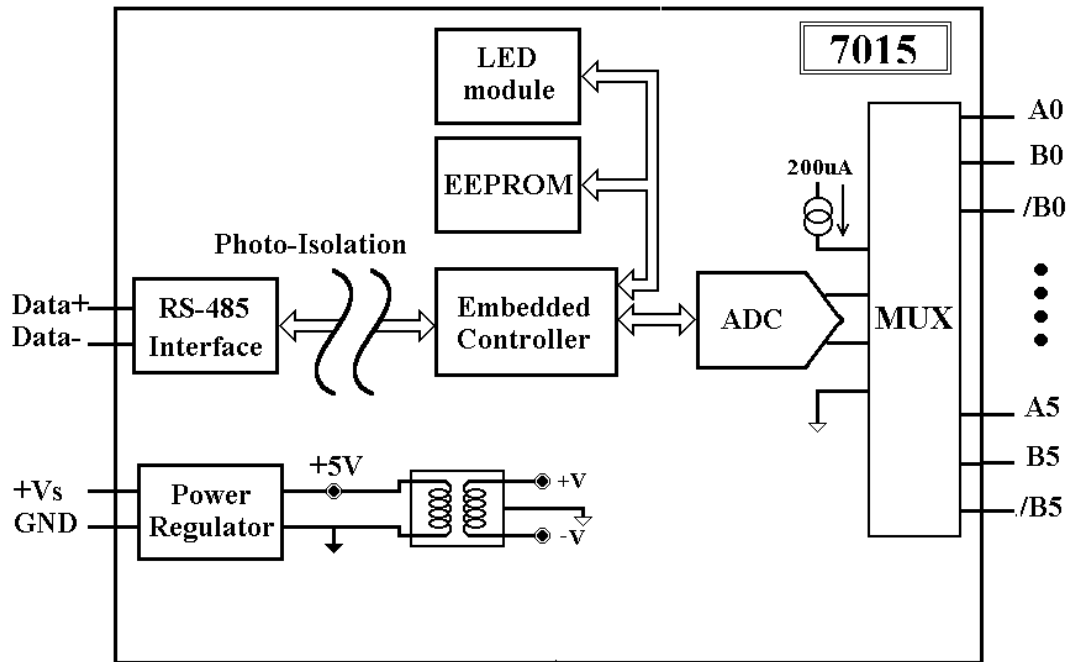
1.3 Specifications

	I-7013/I-7013D	I-7033/I-7033D	I-7015
Analog Input			
Input Channels	1	3	6
Input Type	2/3/4-wire RTD	2/3/4-wire RTD	2/3-wire RTD
RTD Type	Pt100 $\alpha = 0.00385$ Pt100 $\alpha = 0.003916$ Ni120	Pt100 $\alpha = 0.00385$ Pt100 $\alpha = 0.003916$ Ni120 Pt1000 $\alpha = 0.00385$	Pt100 $\alpha = 0.00385$ Pt100 $\alpha = 0.003916$ Ni120 Pt1000 $\alpha = 0.00385$ Cu100 $\alpha = 0.00421$ Cu100 $\alpha = 0.00427$ Cu1000 $\alpha = 0.00421$
Sampling Rate	10 samples/sec	15 samples/sec at 60Hz 12.5 samples/sec at 50Hz	12 samples/sec
Bandwidth	5.24Hz	15.7Hz	5.24Hz
Accuracy	$\pm 0.05\%$	$\pm 0.1\%$	$\pm 0.05\%$
Zero Drift	$0.5 \mu\text{V}/^\circ\text{C}$	$0.5 \mu\text{V}/^\circ\text{C}$	$0.5 \mu\text{V}/^\circ\text{C}$
Span Drift	$20 \mu\text{V}/^\circ\text{C}$	$20 \mu\text{V}/^\circ\text{C}$	$20 \mu\text{V}/^\circ\text{C}$
CMR@50/60Hz	150dB min	150dB min	150dB min
NMR@50/60Hz	100dB min	100dB min	100dB min
LED Display	4 1/2 digits (for I-7013D only)	4 1/2 digits (for I-7033D only)	
Power			
Requirement	+10 to +30 VDC	+10 to +30 VDC	+10 to +30 VDC
Consumption	0.7W for I-7013 1.3W for I-7013D	1.0W for I-7013 1.6W for I-7013D	1.1W

Note: A warm up period of 30 minutes is recommended to achieve the complete performance results described in the specifications.

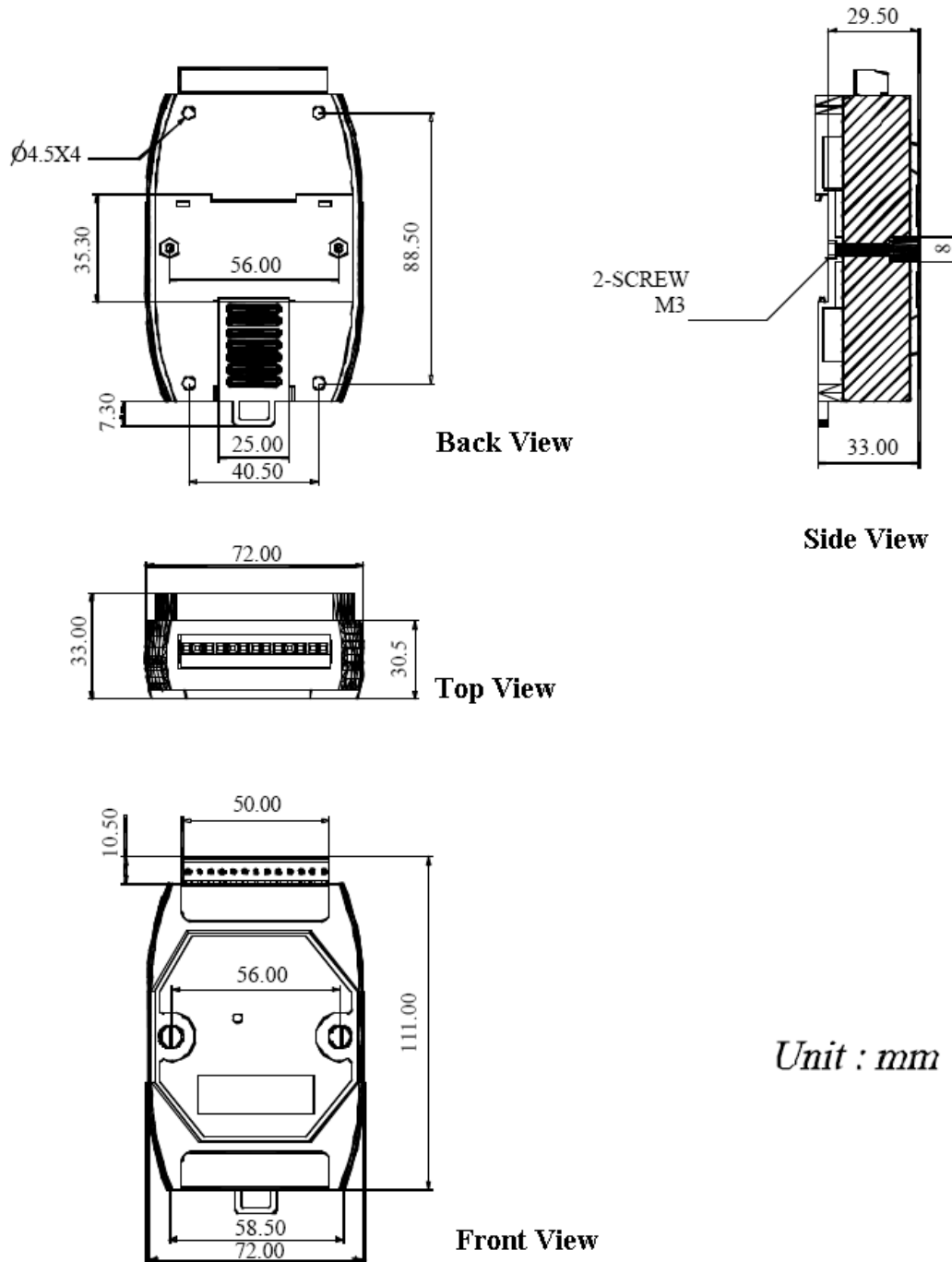
1.4 Block Diagram



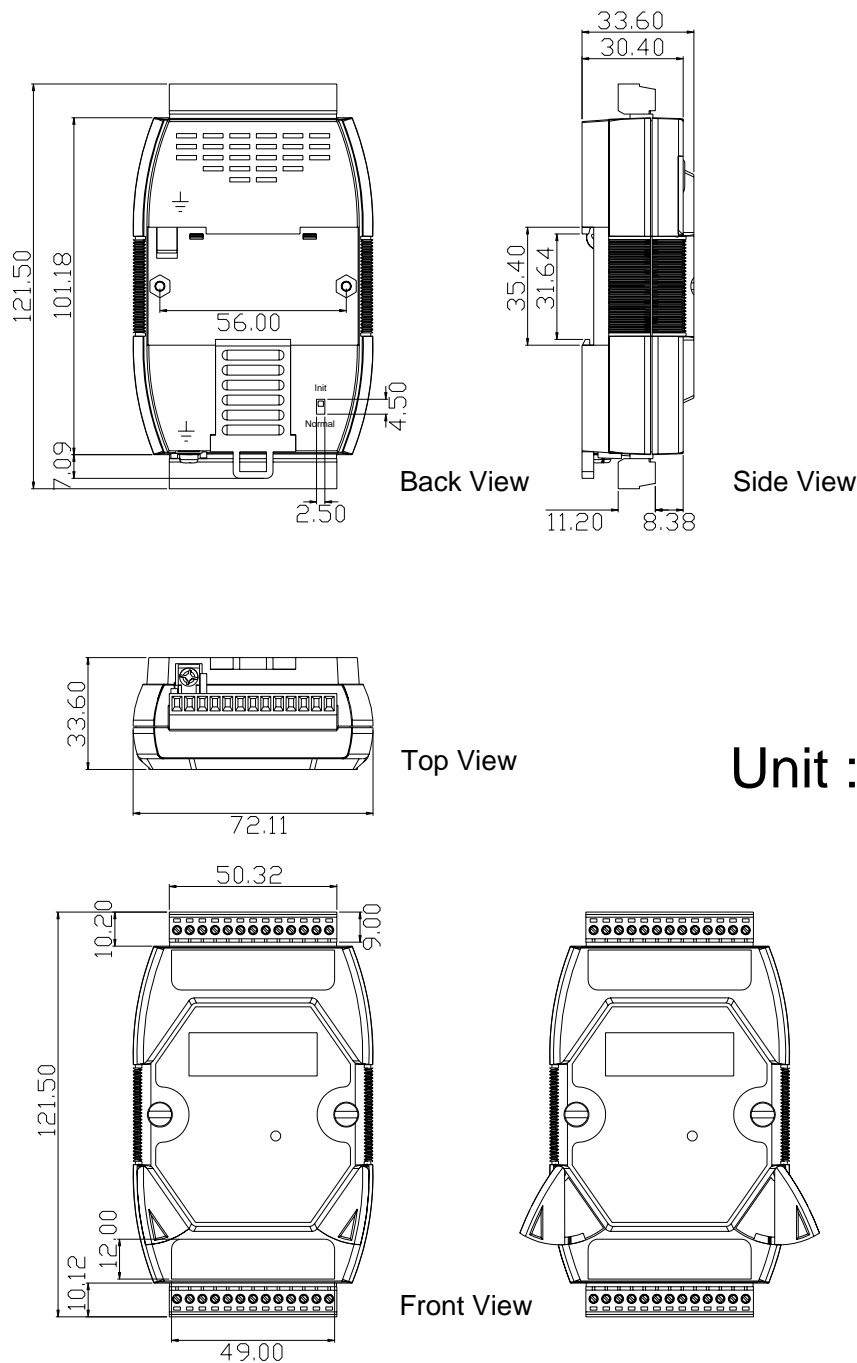


1.5 Dimensions

1.5.1 I-7013, I-7013D, I-7033, I-7033D Dimensions



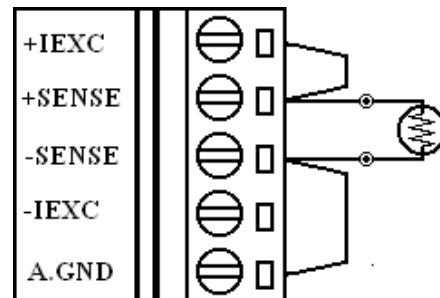
1.5.2 I-7015 Dimensions



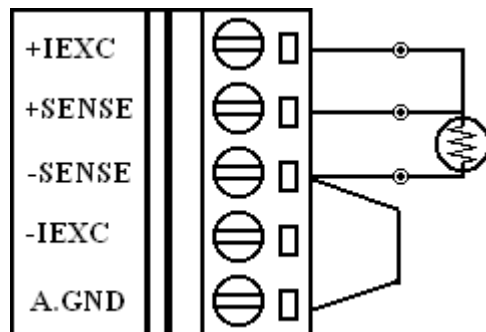
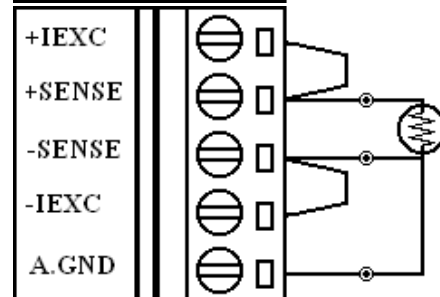
1.6 Wiring

1.6.1 I-7013, I-7013D, I-7033, I-7033D Wiring

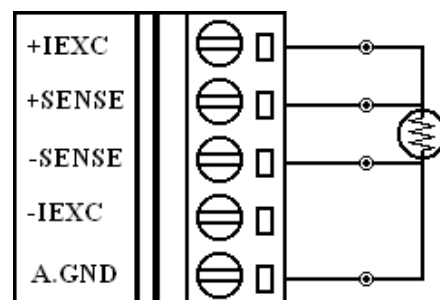
2-wire RTD connection



3-wire RTD connection

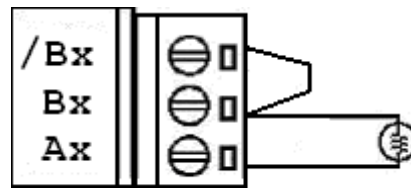


4-wire RTD connection

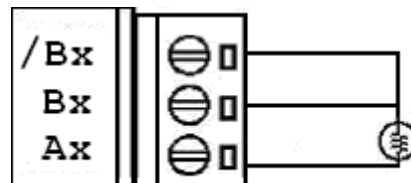


1.6.2 I-7015 Wiring

2-wire RTD connection



3-wire RTD connection



1.7 Quick Start

To install the module, follow the steps below:

1. Connect the RTD sensor. See Section 1.2 for the pin assignment and Section 1.6 for the wiring diagram.
2. Connect the module to the RS-485 network using the DATA+ and DATA- terminals. See Section 1.2 for the pin assignment. If the host is only equipped with an RS-232 interface, then you need an RS-232 to RS-485 converter. Refer to the “**I-7000 Bus Converter User’s Manual**” for more information.
3. Connect the module to the power supply using the +Vs and GND terminals. See Section 1.2 for the pin assignment. Note that the voltage supplied should be in the range of +10 to +30 V_{DC}.
4. Configure the module by sending the %AANNTTCCFF command. See Section 2.1 for details. To configure the I-7015, the \$AA7CiRrr command must also be sent. See Section 2.17 for details. The default settings for the module can be found in Section 1.8.
5. To read data from the input channels, send the #AA or #AAN commands to the module. See Sections 2.3 and 2.4 for details.
6. If the host is a PC with the Windows operating system installed, the DCON Utility can be used to allow easy configuration and reading of data. The DCON Utility can be downloaded from the ICP DAS website <http://www.icpdas.com>. The documentation for the DCON Utility can be found in the “**Getting Started For I-7000 Series Modules**” manual.

Refer to the **“I-7000 Bus Converter User’s Manual”** and **”Getting Started For I-7000 Series Modules”** manuals for more details. The **“Getting Started For I-7000 Series Modules”** manual can be downloaded from the ICP DAS website <http://www.icpdas.com>.

1.8 Default Settings

Default settings for I-7013/13D, I-7033/33D and I-7015 are:

- Module Address: 01
- RTD Type: Type 20, Pt100, -100°C to 100°C
- Baud Rate: 9600 bps
- Checksum disabled, engineering unit format
- Filter at 60Hz rejection (for the I-7013/13D and I-7033/33D. Not used by the I-7015)

1.9 Calibration

Warning: *It is recommended that calibration isn't performed until the process is fully understood.*

The calibration procedure is as follows:

1. Warm up the module for 30 minutes.
2. Set the type code to 20. Refer to Sections 2.1 and 2.17 for details.
3. Enable calibration. Refer to Section. 2.22 for details.
4. Connect the zero calibration resistor.
5. Send the zero calibration command. Refer to Sections 2.6 and 2.7 for details.
6. Connect the span calibration resistor.
7. Send the span calibration command. Refer to Sections 2.5 and 2.8 for details.
8. Repeat steps 3 to 7 three times.

Notes:

1. Use the 2-wire RTD connection to connect the calibration resistor.
2. For the I-7033 and I-7033D, connect the calibration resistor to channel 0.
3. For the I-7015, each channel should be calibrated separately.
4. Step 3 is not needed for the I-7013 and I-7013D version A1.x and A2.x. Use the \$AAF command to access the firmware version. See Section 2.19 for details.
5. For type 2A the only difference is in setting a different type code (step 2), and connecting a different zero/span calibration resistor (steps 4 and 6).

Calibration resistor types used by the I-7013/13D:

Type	Zero Calibration Resistor	Span Calibration Resistor
20 to 29	55 Ohms	375 Ohms

Calibration resistor types used by the I-7033/33D:

Type	Zero Calibration Resistor	Span Calibration Resistor
20 to 29	0 Ohms	375 Ohms
2A	0 Ohms	3200 Ohms

Calibration resistor types used by the I-7015:

Type	Zero Calibration Resistor	Span Calibration Resistor
2B, 2C	0 Ohms	160 Ohms
20 to 29	0 Ohms	320 Ohms
2A, 2D	0 Ohms	3000 Ohms

1.10 Configuration Tables

Baud Rate Setting (CC)

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

RTD Type Setting (TT)

Type Code	RTD Type	Temperature Range °C
20	Platinum 100, $\alpha = 0.00385$	-100 ~ 100
21	Platinum 100, $\alpha = 0.00385$	0 ~ 100
22	Platinum 100, $\alpha = 0.00385$	0 ~ 200
23	Platinum 100, $\alpha = 0.00385$	0 ~ 600
24	Platinum 100, $\alpha = 0.003916$	-100 ~ 100
25	Platinum 100, $\alpha = 0.003916$	0 ~ 100
26	Platinum 100, $\alpha = 0.003916$	0 ~ 200
27	Platinum 100, $\alpha = 0.003916$	0 ~ 600
28	Nickel 120	-80 ~ 100
29	Nickel 120	0 ~ 100
2A	Platinum 1000, $\alpha = 0.00385$	-200 ~ 600
2B	Cu 100 at 0°C, $\alpha = 0.00421$	-20 ~ 150
2C	Cu 100 at 25°C, $\alpha = 0.00427$	0 ~ 200
2D	Cu 1000 at 0°C, $\alpha = 0.00421$	-20 ~ 150

Note:

1. Type 2A is only used in the I-7033/33D and the I-7015.
2. Type 2B, 2C and 2D are only used in the I-7015.

Data Format Setting (FF)

7	6	5	4	3	2	1	0
FS	CS	reserved				DF	

Key	Description
DF	Data format 00: Engineering unit 01: % of FSR (full scale range) 10: 2's complement hexadecimal 11: Ohms
CS	Checksum setting 0: Disabled 1: Enabled
FS	Filter setting for the I-7013/13D and I-7033/33D 0: 60Hz rejection 1: 50Hz rejection This setting is reserved for the I-7015 and should be zero.

Note: The reserved bits should be zero.

RTD Type and Data Format Table

Type code	RTD Type	Data Format	+F.S	-F.S.
20	Platinum 100 $\alpha = 0.00385$ -100 ~ 100°C	Engineering unit	+100.00	-100.00
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohms	+138.50	+060.60
21	Platinum 100 $\alpha = 0.00385$ 0 ~ 100°C	Engineering unit	+100.00	+000.00
		% of FSR	+100.00	+100.00
		2's comp HEX	7FFF	0000
		Ohms	+138.50	+100.00
22	Platinum 100 $\alpha = 0.00385$ 0 ~ 200°C	Engineering unit	+200.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+175.84	+100.00
23	Platinum 100 $\alpha = 0.00385$ 0 ~ 600°C	Engineering unit	+600.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+313.59	+100.00
24	Platinum 100 $\alpha = 0.003916$ -100 ~ 100°C	Engineering unit	+100.00	-100.00
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohms	+139.16	+060.60
25	Platinum 100 $\alpha = 0.003916$ 0 ~ 100°C	Engineering unit	+100.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+139.16	+100.00
26	Platinum 100 $\alpha = 0.003916$ 0 ~ 200°C	Engineering unit	+200.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+177.13	+100.00
27	Platinum 100 $\alpha = 0.003916$ 0 ~ 600°C	Engineering unit	+600.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+317.28	+100.00

Type code	RTD Type	Data Format	+F.S	-F.S.
28	Nickel 120 -80 ~ 100°C	Engineering unit	+100.00	-080.00
		% of FSR	+100.00	-080.00
		2's comp HEX	7FFF	999A
		Ohms	+200.64	+066.60
29	Nickel 120 0 ~ 100°C	Engineering unit	+100.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+200.64	+120.60
2A	Platinum 1000 $\alpha = 0.00385$ -200 ~ 600°C	Engineering unit	+600.00	-200.00
		% of FSR	+100.00	-033.33
		2's comp HEX	7FFF	D556
		Ohms	+3137.1	+0185.2
2B	Cu 100 $\alpha = 0.00421$ -20 ~ 150°C	Engineering unit	+150.00	-020.00
		% of FSR	+100.00	-013.33
		2's comp HEX	7FFF	EEEF
		Ohms	+163.17	+091.56
2C	Cu 100 $\alpha = 0.00427$ 0 ~ 200°C	Engineering unit	+200.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+167.75	+090.34
2D	Cu 1000 $\alpha = 0.00421$ -20 ~ 150°C	Engineering unit	+150.00	-020.00
		% of FSR	+100.00	-013.33
		2's comp HEX	7FFF	EEEF
		Ohms	+1631.7	+0915.6

RTD Over Range/Under Range Reading for the I-7013/13D and I-7033/33D

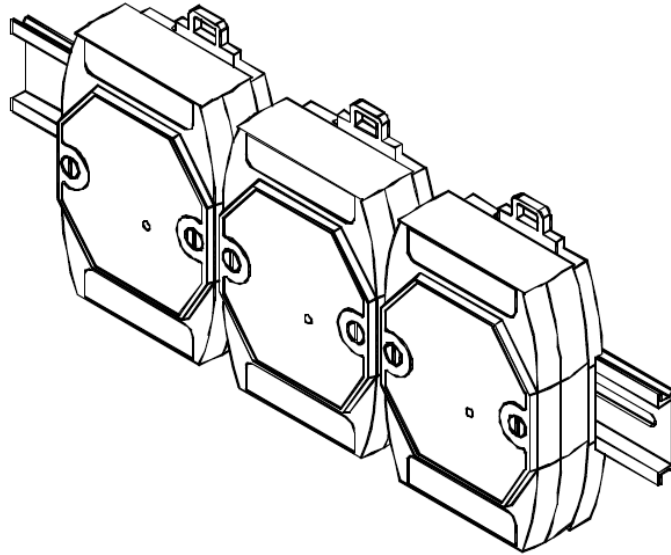
	Over Range	Under Range
Engineering Unit	+9999	-0000
% of FSR	+9999	-0000
2's Complement HEX	7FFF	8000

RTD Over Range/Under Range Reading for the I-7015

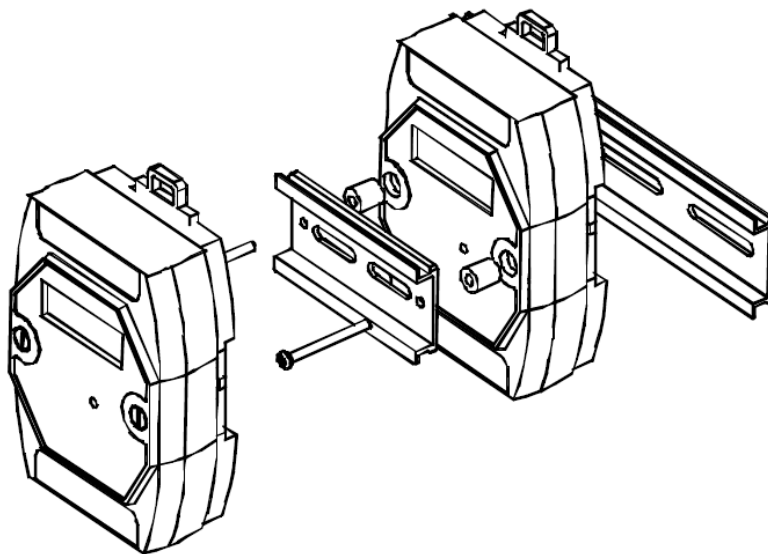
	Over Range	Under Range
Engineering Unit	+999.99	-999.99
% of FSR	+999.99	-999.99
2's Complement HEX	7FFF	8000

1.11 Mounting

1.11.1 Din-Rail Mounting



1.11.2 Piggy Back Mounting



1.12 Technical Support

If you have problems using the I-7000 module and cannot find the help you need in this manual or on our website, please contact ICP DAS Product Support.

Email: support@icpdas.com

Website: <http://www.icpdas.com/service/support.htm>

When calling for technical support, be prepared to provide the following information about your system:

1. Name and serial number: The serial number can be found printed on the barcode label attached to the cover of the module.
2. Firmware version: See Section 2.19 for information regarding the command used to read the firmware version.
3. Host configuration (type and operating system)
4. If the problem is reproducible, please give full details describing the procedure used to reproduce the problem.
5. Specific error messages displayed. If a dialog box with an error message is displayed, please include the full text of the dialog box, including the text in the title bar.
6. If the problem involves other programs or hardware devices, please describe the details of the problem in full.
7. Any comments and suggestions related to the problem are welcome.

We will reply by email within three business days.

2. Commands

All communication with I-7000 modules consists of commands generated by the host and responses transmitted by the I-7000 modules. Each module has a unique ID number which is used for addressing purposes and is stored in nonvolatile memory. The ID is 01 by default and can be changed with a user command. All commands to the modules contain the ID address meaning that only the addressed module will respond. Commands **#**** (Section 2.2) and **~**** (Section 2.27) are sent to all modules, but in these cases, the modules do not reply to the command.

Command Format:

Leading Character	Module Address	Command	[CHKSUM]	CR
-------------------	----------------	---------	----------	----

Response Format:

Leading Character	Module Address	Data	[CHKSUM]	CR
-------------------	----------------	------	----------	----

CHKSUM A 2-character checksum and is present when the checksum setting is enabled. See Section 1.10 and 2.1 for details.

CR End of command character, carriage return (0x0D)

Checksum Calculation:

1. Calculate the ASCII code sum of all the characters in the command/response string except for the carriage return character (CR).
2. The checksum is equal to the sum masked by 0ffh.

Example:

Command string: \$012(CR)

1. Sum of the string = "\$"+"0"+"1"+"2" =
 $24h+30h+31h+32h = B7h$
2. Therefore the checksum is B7h, and so
CHKSUM = "B7"
3. The command string with the checksum = \$012B7(CR)

Response string: !01200600(CR)

1. Sum of the string =
"!"+ "0"+"1"+"2"+"0"+"0"+"6"+"0"+"0" =
 $21h+30h+31h+32h+30h+30h+36h+30h+30h = 1AAh$
2. Therefore the checksum is AAh, and so
CHKSUM = "AA"
3. The response string with the checksum
= !01200600AA(CR)

Note:

All characters should be in upper case.

General Command Sets			
Command	Response	Description	Section
%AANNTTCCFF	!AA	Set Module Configuration	2.1
***	No Response	Synchronized Sampling	2.2
#AA	>(Data)	Read Analog Inputs of All Channels	2.3
#AAN	>(Data)	Read Analog Input of Specified Channel	2.4
\$AA0	!AA	Perform Span Calibration	2.5
\$AA1	!AA	Perform Zero Calibration	2.6
\$AA0Ci	!AA	Perform Single Channel Zero calibration	2.7
\$AA1Ci	!AA	Perform Single Channel Span calibration	2.8
\$AA2	!AANNTTCCFF	Read Module Configuration	2.9
\$AA4	>AAS(Data)	Read Synchronized Data	2.10
\$AA5VV	!AA	Enable/Disable Channel	2.11
\$AA6	!AAVV	Read Channel Enable/Disable Status	2.12
\$AA8	!AAV	Read LED Configuration	2.13
\$AA8V	!AA	Set LED Configuration	2.14
\$AA9(Data)	!AA	Set LED Display Data	2.15
\$AAB	!AANN	Read Channel Diagnostic Status	2.16
\$AA7CiRrr	!AA	Set Single Channel Range Configuration	2.17
\$AA8Ci	!AACiRrr	Read Single Channel Range Configuration	2.18
\$AAF	!AA(Data)	Read Firmware Version	2.19
\$AAM	!AA(Data)	Read Module Name	2.20
~AAO(Name)	!AA	Set Module Name	2.21
~AAEV	!AA	Enable/Disable Calibration	2.22
\$AAS0	!AA	Internal Calibration	2.23
\$AAS1	!AA	Reload Default Calibration Parameters	2.24
~AAI	!AA	Soft INIT	2.25
~AATnn	!AA	Set Soft INIT Timeout	2.26

Host Watchdog Command Sets			
Command	Response	Description	Section
~**	No Response	Host OK	2.27
~AA0	!AASS	Read Host Watchdog Status	2.28
~AA1	!AA	Reset Host Watchdog Status	2.29
~AA2	!AAETT	Read Host Watchdog Timeout Settings	2.30
~AA3ETT	!AA	Set Host Watchdog Timeout Settings	2.31

2.1 %AANNTTCCFF

Description:

Sets the configuration of an analog input module.

Syntax:

%AANNTTCCFF[CHKSUM](CR)

- | | |
|-----------|---|
| % | Delimiter character |
| AA | Address of the module to be configured in hexadecimal format (00 to FF) |
| NN | New address of the module in hexadecimal format (00 to FF) |
| TT | New type code, see Section 1.10 for details. Not used by the I-7015. For the I-7015, use the \$AA7CiRrr command to set the type of each channel, see Section 2.17 for details. |
| CC | New Baud Rate code, see Section 1.10 for details. For the I-7013/13D and I-7033/33D, the INIT* pin must be connected to ground in order to change Baud Rates. In the I-7015, this is achieved by moving the rear slide switch to the INIT position. See Section A.1 for details. |
| FF | Used to set the data format, checksum, and filter settings (Section 1.10). For the I-7013/13D and I-7033/33D, the INIT* pin must be connected to ground in order to change the checksum setting. In the I-7015, this is achieved by moving the rear slide switch to the INIT position. See Section A.1 for details. |

Note: The filter setting is not available in the I-7015.

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

- ! Delimiter for a valid command
- ? Delimiter for an invalid command. If changing the **Baud Rate** or **checksum** settings without connecting the INIT* pin to ground or switching the rear slide switch to the INIT position, the module will return an invalid command.
- AA Address of the module in hexadecimal format (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

- Command: %0102200600 Response: !02
Changes the address of module 01 to 02. The module returns a valid response.
- Command: %0202200603 Response: !02
Sets the data format of module 02 to be 3 (Ohms). The module returns a valid response.
- Command: %0101200A00 Response: ?01
Changes the Baud Rate of module 01 to 115200bps. The module returns an invalid command, because it is not in INIT* mode.

Command: %0101200A00 Response: !01
Changes the Baud Rate of module 01 to 115200bps
and the module is in INIT* mode. The module
returns a valid response.

Related Commands:

Section 2.9 \$AA2, Section 2.25 ~AAI, Section 2.26
~AATnn

Related Topics:

Section 1.10 Configuration Tables, Section A.1 INIT* pin
Operation

Notes:

1. Changes to the address, type code, data format and filter settings take effect immediately after a valid command is received. Changes to the Baud Rate and checksum setting take effect on the next power on reset.
2. For the I-7015, changing the Baud Rate and checksum settings can be achieved by software only and is performed by using the following commands:
 - I. Send a ~AATnn command. See Section 2.26 for details.
 - II. Send a ~AAI command. See Section 2.25 for details.
 - III. Send a %AANNTTCCFF command.
If the command is valid, the Baud Rate and checksum settings will be changed after the module responds with !AA.

Related Commands:

Section 2.10 \$AA4

Notes:

This command is only applicable to the I-7013/13D and I-7015.

2.3 #AA

Description:

Reads the data from all analog input channels.

Syntax:

#AA[CHKSUM](CR)

Delimiter character

AA Address of the module to be read (00 to FF)

Response:

Valid Command: **>(Data)[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

> Delimiter character for a valid command

? Delimiter character for an invalid command

(Data) Data from all analog input channels, see Section 1.10 for the data format. For the I-7015, data from disabled channels is filled with space characters.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: #01 Response: >+026.35

Reads module 01 and receives the data in engineering format.

Command: #02 Response: >4C53

Reads module 02 and receives the data in hexadecimal format.

Command: #03 Response: >-0000

Reads module 03 and the data is under range.

Command: #04 Response: >+025.12+054.12+150.12

Reads module 04, an I-7033, and receives the data from 3 channels.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.9 \$AA2

Related Topics:

Section 1.10 Configuration Tables

2.4 #AAN

Description:

Reads the analog input of channel N.

Syntax:

#AAN[CHKSUM](CR)

Delimiter character
AA Address of the module to be read (00 to FF)
N The channel to be read, zero based.

Response:

Valid Command: **>(Data)[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

> Delimiter character for a valid command
? Delimiter character for an invalid command. An invalid command is returned if the specified channel is incorrect.
(Data) Analog input data of the specified channel, see Section 1.10 for the data format. For the I-7015, if the specified channel is disabled, then the data field will be filled with space characters.
AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: #032	Response: >+025.13
Reads data from channel 2 of module 03.	
Command: #029	Response: ?02
Reads data from channel 9 of module 02. An error is returned because channel 9 is invalid.	

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.9 \$AA2

Related Topics:

Section 1.10 Configuration Tables

Notes:

This command is only applicable to the I-7033/33D and I-7015.

2.5 \$AA0

Description:

Performs a span calibration.

Syntax:

\$AA0[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be calibrated (00 to FF)

0 Command for the span calibration

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$010

Response: !01

Performs a span calibration on module 01 and returns a valid response.

Command: \$020

Response: ?02

Performs a span calibration on module 02. An invalid command is returned because the “enable calibration” command was not sent in advance.

Related Commands:

Section 2.6 \$AA1, Section 2.22 ~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

1. This command is only applicable to the I-7013/13D and I-7033/33D.
2. The “enable calibration” command, ~AAEV, must be sent before this command is used, see Section 1.9 for details.

2.6 \$AA1

Description:

Performs a zero calibration.

Syntax:

\$AA1[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module to be set (00 to FF)
1	Command for the zero calibration

Response:

Valid Command:	!AA[CHKSUM](CR)
Invalid Command:	?AA[CHKSUM](CR)
!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$011	Response: !01
Performs a zero calibration on module 01 and returns a valid response.	
Command: \$021	Response: ?02
Performs a zero calibration on module 02. An invalid command is returned because the “enable calibration” command was not sent in advance.	

Related Commands:

Section 2.5 \$AA0, Section 2.22 ~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

1. This command is only applicable to the I-7013/13D and I-7033/33D.
2. The “enable calibration” command, ~AAEV, must be sent before this command is used, see Section 1.9 for details.

2.7 \$AA0Ci

Description:

Performs a zero calibration on the specified channel.

Syntax:

\$AA0Ci[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be calibrated (00 to FF)

0 Command for the zero calibration

Ci Specifies the channel to be calibrated

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

- Command: \$010C0 Response: !01
Performs a zero calibration on channel 0 of module 01 and returns a valid response.
- Command: \$020C5 Response: !02
Performs a zero calibration on channel 5 of module 02 and returns a valid response.
- Command: \$030C1 Response: ?03
Performs a zero calibration on channel 1 of module 03. An invalid command is returned because the “enable calibration” command was not sent in advance.

Related Commands:

Section 2.8 \$AA1Ci, Section 2.22~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

- 1 This command is only applicable to the I-7015.
- 2 The “enable calibration” command, ~AAEV, must be sent before this command is used, see Section 1.9 for details.

2.8 \$AA1Ci

Description:

Performs a span calibration on the specified channel.

Syntax:

\$AA1Ci[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be calibrated (00 to FF)

1 Command for the span calibration

Ci Specifies the channel to be calibrated

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

- Command: \$011C0 Receive: !01
Performs a span calibration on channel 0 of module 01 and returns a valid response.
- Command: \$021C5 Receive: !02
Performs a span calibration on channel 5 of module 02 and returns a valid response.
- Command: \$031C1 Receive: ?03
Performs a span calibration on channel 1 of module 03. An invalid command is returned because the “enable calibration” command was not sent in advance.

Related Commands:

Section 2.8 \$AA0Ci, Section 2.22 ~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

1. The command is only applicable to the I-7015.
2. The “enable calibration” command, ~AAEV, must be sent before this command is used, see Section 1.9 for details.

2.9 \$AA2

Description:

Reads the module configuration.

Syntax:

\$AA2[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module to be read (00 to FF)
2	Command to read the module configuration

Response:

Valid Command: **!AATTCCFF[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
TT	Type code of the module, see Section 1.10 for details.
CC	Baud Rate code of the module, see Section 1.10 for details.
FF	Data format, checksum setting and filter setting of the module, see Section 1.10 for details.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Command: \$012 Response: !01200600

Command: \$022 Response: !02230602

Reads the configuration of module 02.

Section 2.1 %AANNTTCCFF

Section 1.10 Configuration Tables, Section A.1 INIT* pin Operation

2.10 \$AA4

Description:

Reads the synchronized data that was got by the last #** command.

Syntax:

\$AA4[CHKSUM](CR)

\$ Delimiter character
AA Address of the module to be read (00 to FF)
4 Command to read the synchronized data

Response:

Valid Command: **>AAS(Data)[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command
? Delimiter character for an invalid command
AA Address of the responding module (00 to FF)
S Status of the synchronized data
 1: first read
 0: not the first read
(Data) Synchronized data. See Section 1.10 for the data format. For the I-7015, data from disabled channels is filled with space characters.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$014

Response: ?01

Reads the synchronized data for module 01. An invalid command is returned because the #** command has not been issued in advance.

Command: #**

No response

Sends the synchronized sampling command.

Command: \$014

Response: >011+025.56

Reads the synchronized data for module 01. The module returns the synchronized data and sets the status byte to 1 to indicate that this is the first time the synchronized data has been read.

Command: \$014

Response: >010+25.56

Reads the synchronized data for module 01. The module returns the synchronized data and sets the status byte to 0 to indicate that the synchronized data has been read.

Related Commands:

Section 2.2 #**

Notes:

This command is only applicable to the I-7013/13D and I-7015.

2.11 \$AA5VV

Description:

Specifies the channels to be enabled.

Syntax:

\$AA5VV[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module to be set (00 to FF)
5	Command to set the channels to enabled
VV	A two-digit hexadecimal value, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1 it means that the channel is enabled and 0 means that the channel is disabled.

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command. An invalid command is returned if you try to enable a channel that is not present.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$0153A Response: !01

Enables channels 1, 3, 4, and 5 and disables all other channels of module 01. The module returns a valid response.

Command: \$016 Response: !013A

Reads the channel status of module 01. The module returns a response of 3A, meaning that channels 1, 3, 4, and 5 are enabled and all other channels are disabled.

Related Commands:

Section 2.12 \$AA6

Notes:

This command is only applicable to the I-7015. It is recommended that only the channels that will be used are enabled.

2.12 \$AA6

Description:

Reads the enabled/disabled status of each channel.

Syntax:

\$AA6[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module to be read (00 to FF)
6	Command to read the channel status

Response:

Valid Command: **!AAVV[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
VV	A two-digit hexadecimal value, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1 it means that the channel is enabled and 0 means that the channel is disabled.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$0153A Response: !01

Enables channels 1, 3, 4, and 5 and disables all other channels of module 01. The module returns a valid response.

Command: \$016 Response: !013A

Reads the channel status of module 01 and returns a response of 3A meaning that channels 1, 3, 4, and 5 are enabled and all other channels are disabled.

Related Commands:

Section 2.11 \$AA5VV

Notes:

This command is only applicable to the I-7015.

2.13 \$AA8

Description:

Reads the LED configuration information of a module.

Syntax:

\$AA8[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be read (00 to FF)

8 Command to read the LED configuration

Response:

Valid Command: **!AAV[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

V LED configuration

For the I-7013D

1: the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command.

2: the LED display is controlled by the host.

For the I-7033D

0~2: specifies the channel for which the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command.

3: the LED display is controlled by the host.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$018	Response: !011
Reads the LED configuration of module 01.	
Command: \$028	Response: !012
Reads the LED configuration of module 02.	

Related Commands:

Section 2.14 \$AA8V, Section 2.15 \$AA9(Data)

Notes:

This command is only applicable to the I-7013D and I-7033D.

2.14 \$AA8V

Description:

Sets the LED configuration of a module.

Syntax:

\$AA8V[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be set (00 to FF)

8 Command to set the LED configuration

V LED configuration

For the I-7013D

1: the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command.

2: the LED display is controlled by the host.

For the I-7033D

0~2: specifies the channel for which the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command.

3: the LED display is controlled by the host.

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$0180	Response: !01
Sets the LED configuration of module 01 to 0, and returns a valid response.	
Command: \$0281	Response: !02
Sets the LED configuration of module 02 to 1, and returns a valid response.	

Related Commands:

Section 2.13 \$AA8, Section 2.15 \$AA9(Data)

Notes:

This command is only applicable to the I-7013D and I-7033D.

2.15 \$AA9(Data)

Description:

Sends the data to be shown on the LED display of a module.

Syntax:

\$AA9(Data)[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module (00 to FF)
9	Command to send the LED data
(Data)	Data to be shown on the LED display, consisting of a leading sign character (+,-), 5 decimal digits and a dot character. The first digit should be 0 or 1. There must be a digit preceding the dot character. The module should be in host controlled mode before sending this command. See Section 2.14 for details.

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command or if the module is not in host controlled mode. See Section 2.14 for details.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$019+123.45 Response: !01

The host sends the data “+123.45” to module 01. The module returns a valid response and shows the data on the LED display.

Command: \$029+12.345 Response: ?02

The host sends the data “+12.345” to module 02. The module returns an invalid command because it is not in host controlled mode and LED data cannot be received from the host. See Section 2.14 for details.

Related Commands:

Section 2.13 \$AA8, Section 2.14 \$AA8V

Notes:

This command is only applicable to the I-7013D and I-7033D.

2.16 \$AAB

Description:

Diagnoses the analog inputs for over-range, under-range, and wire opening.

Syntax:

\$AAB[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be diagnosed (00 to FF)

B Command to diagnose the analog inputs

Response:

Valid command: **!AANN[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

NN Represents the diagnostic results of all the analog input channels (00 to FF), where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1 it means that the channel is enabled and it is either over-range, under-range or wire opening. If the bit is 0 it means that the channel is disabled or normal.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$01B

Response: !0101

Diagnoses the analog inputs of module 01. The module returns a valid response and channel 1 is either over-range, under-range or wire opening.

Notes:

This command is only applicable to the I-7015.

2.17 \$AA7CiRrr

Description:

Sets the type code of a channel.

Syntax:

\$AA7CiRrr[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module to be set (00 to FF)
7	Command to set the channel range code
Ci	i specifies the input channel to be set (0-5)
Rrr	rr represents the type code of the channel to be set. Refer to the RTD Type Setting table in Section 1.10.

Response:

Valid command: **!AA [CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command or invalid type code

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$017C0R20

Response: !01

Sets the type code for channel 0 of module 01 to be 20 (PT100, -100~+100°C) and the module returns a valid response.

Command: \$027C5R28

Response: !02

Sets the type code for channel 5 of module 02 to be 28 (Ni120, -80~+100°C) and the module returns a valid response.

Command: \$037C1R30

Response: ?03

Sets the type code for channel 1 of module 03 to be 30. The module returns an invalid response because the type code is invalid.

Related Commands:

Section 2.18 \$AA8Ci

Related Topics:

Section 1.10 Configuration Tables

Notes:

This command is only applicable to the I-7015.

2.18 \$AA8Ci

Description:

Reads the type code information of a channel.

Syntax:

\$AA8Ci[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module to be read (00 to FF)
8	Command to read the type code of a channel
Ci	Specifies which channel to access for the type code information (i=0-5)

Response:

Valid command: **!AA CiRrr[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command or invalid channel
AA	Address of the responding module (00 to FF)
Ci	Specifies which input channel relates to the type code information.
Rrr	Represents the type code of the specified input channel

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$018C0

Response: !01C0R20

Reads the channel 0 input range of module 01 and returns 20 (PT100, -100~+100°C).

Related Commands:

Section 2.17 \$AA7CiRrr

Related Topics:

Section 1.10 Configuration Tables

Notes:

This command is only applicable to the I-7015.

2.19 \$AAF

Description:

Reads the firmware version of a module.

Syntax:

\$AAF[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be read (00 to FF)

F Command to read the firmware version

Response:

Valid command: **!AA(Data)[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

(Data) Firmware version string of the module

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$01F

Response: !01A2.0

Reads the firmware version of module 01, and shows that it is version A2.0.

Command: \$02F

Response: !02B1.1

Reads the firmware version of module 02, and shows that it is version B1.1.

2.20 \$AAM

Description:

Reads the name of a module.

Syntax:

\$AAM[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be read (00 to FF)

M Command to read the module name

Response:

Valid command: **!AA(Data)[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

(Name) Name string of the module

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$01M

Response: !017013

Reads the module name of module 01 and returns the name “7013”.

Command: \$03M

Response: !037033D

Reads the module name of module 03 and returns the name “7033D”.

Related Commands:

Section 2.21 ~AAO(Name)

2.21 ~AAO(Name)

Description:

Sets the name of a module.

Syntax:

~AAO(Name)[CHKSUM](CR)

~ Delimiter character

AA Address of the module to be set (00 to FF)

O Command to set the module name

(Name) New name of the module (max. 6 characters).

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01O7013

Response: !01

Sets the name of module 01 to be “7013” and returns a valid response.

Command: \$01M

Response: !017013

Reads the name of module 01 and returns the name “7013”.

Related Commands:

Section 2.20 \$AAM

2.22 ~AAEV

Description:

Enable/Disable module calibration.

Syntax:

~AAEV[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set (00 to FF)
E	Command to enable/disable calibration
V	1: enable calibration 0: disable calibration

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$010

Response: ?01

Sends the command to perform a span calibration on module 01. An invalid response is returned because the “enable calibration” command has not yet been sent.

Command: ~01E1

Response: !01

Enables calibration on module 01 and returns a valid response.

Command: \$010

Response: !01

Sends the command to perform a span calibration on module 01 and returns a valid response.

Related Commands:

Section 2.5 \$AA0, Section 2.6 \$AA1, Section 2.7 \$AA0Ci, Section 2.8 \$AA1Ci

Related Topics:

Section 1.9 Calibration

2.23 \$AAS0

Description:

Performs an internal calibration on a module.

Syntax:

\$AAS0[CHKSUM](CR)

\$ Delimiter character

AA Address of the module to be calibrated (00 to FF)

S0 Command to perform the internal calibration

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$01S0

Response: !01

Sends the command to perform an internal calibration on module 01 and returns a valid response.

I-7015

Related Commands:

Section 2.24 \$AAS1

Notes:

This command is only applicable to the I-7015.

2.24 \$AAS1

Description:

Reloads the factory default calibration parameters, including the internal calibration parameters.

Syntax:

\$AAS1[CHKSUM](CR)

\$	Delimiter character
AA	Address of the module to be reloaded (00 to FF)
S1	Command to reload the factory default calibration parameters

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: \$01S1	Response: !01
Sends the command to reload the factory default calibration parameters and returns a valid response.	

Related Commands:

Section 2.23 \$AAS0

Related Topics:

Section 1.9 Calibration

Notes:

This command is only applicable to the I-7015.

2.25 ~AAI

Description:

The Soft INIT command is used to enable modification of the Baud Rate and checksum settings using software only.

Syntax:

~AAI[CHKSUM](CR)

~ Delimiter character

AA Address of the module to be set (00 to FF)

I Command to set the Soft INIT

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01I

Response: !01

Sets the soft INIT of module 01 and returns a valid response.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.26 ~AATnn

Related Topics:

Section A.1 INIT* Pin Operation

Notes:

1. This command is only applicable to the I-7015.
2. The ~AATnn command should be sent prior to sending this command, see Section 2.26 for details.

2.26 ~AATnn

Description:

Sets the soft INIT time out value.

Syntax:

~AATnn[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set (00 to FF)
T	Command to set the soft INIT time out
nn	Two hexadecimal digits representing the time out value in seconds. The max time out value is 60 seconds. When changing the Baud Rate or checksum settings without altering the INIT* pin, the ~AAI and %AANNTTCCFF commands should be sent consecutively and the time interval between the two commands should be less than the soft INIT time out. If the soft INIT time out is 0, then the Baud Rate and checksum settings cannot be changed using software only. The power on reset value of the soft INIT time out is 0.

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01I

Response: !01

Sets the soft INIT timeout value of module 01 and returns a valid response.

Command: %0101000700

Response: ?01

Attempts to change the Baud Rate of module 01 to 19200 without first altering the INIT * pin. The module returns an invalid response because the soft INIT time out value is 0.

Command: ~01T10

Response: !01

Sets the soft INIT time out value of module 01 to 16 seconds and returns a valid response.

Command: ~01I

Response: !01

Sets the soft INIT of module 01 and returns a valid response.

Command: %0101000700

Response: !01

Changes the Baud Rate of module 01 to 19200 without first altering INIT * pin. The module returns a valid response.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.25 ~AAI

Related Topics:

Section A.1 INIT* Pin Operation

Notes:

1. This command is only applicable to the I-7015.
2. It is recommended that the soft INIT time out value is reset to 0 once any changes to the Baud Rate and checksum settings have been completed.

2.27 ~**

Description:

Informs all modules that the host is OK.

Syntax:

~**[CHKSUM](CR)

~ Delimiter character

** Host OK command

Response:

No response.

Examples:

Command: ~**	No response
Sends a “Host OK” command to all modules.	

Related Commands:

Section 2.28 ~AA0, Section 2.29 ~AA1, Section 2.30
~AA2, Section 2.31 ~AA3EVV

Related Topics:

Section A.2 Dual Watchdog Operation

2.28 ~AA0

Description:

Reads the host watchdog status of a module.

Syntax:

~AA0[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be read (00 to FF)
0	Command to read the module status

Response:

Valid command: **!AASS[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
SS	Two hexadecimal digits that represent the host watchdog status, where: Bit 7: 0 indicates that the host watchdog is disabled and 1 indicates the host watchdog is enabled, Bit 2: 1 indicates that a host watchdog time out has occurred and 0 indicates that no host watchdog time out has occurred. The host watchdog status is stored in EEPROM and can only be reset by using the ~AA1 command.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~010

Response: !0100

Reads the host watchdog status of module 01 and returns 00, meaning that the host watchdog is disabled and no host watchdog time out has occurred.

Command: ~020

Response: !0284

Reads the host watchdog status of module 02 and returns 84, meaning that the host watchdog is enabled and a host watchdog time out has occurred.

Related Commands:

Section 2.27 ~**, Section 2.29 ~AA1, Section 2.30 ~AA2, Sec 2.31 ~AA3EVV

Related Topics:

Section A.2 Dual Watchdog Operation

2.29 ~AA1

Description:

Resets the host watchdog time out status of a module.

Syntax:

~AA1[CHKSUM](CR)

~ Delimiter character

AA Address of the module to be set (00 to FF)

1 Command to reset the host watchdog time out
 status

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command

? Delimiter character for an invalid command

AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~010

Response: !0104

Reads the host watchdog status of module 01 and shows that a host watchdog time out has occurred.

Command: ~011

Response: !01

Resets the host watchdog time out status of module 01 and returns a valid response.

Command: ~010

Response: !0100

Reads the host watchdog status of module 01 and shows that no host watchdog time out has occurred.

Related Commands:

Section 2.27 ~**, Section 2.28 ~AA0, Section 2.30~AA2, Section 2.31~AA3EVV

Related Topics:

Section A.2 Dual Watchdog Operation

2.30 ~AA2

Description:

Reads the host watchdog time out value of a module.

Syntax:

~AA2[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be read (00 to FF)
2	Command to read the host watchdog time out value

Response:

Valid command : **!AAEVV[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
E	1: the host watchdog is enabled 0: the host watchdog is disabled
AA	Address of the responding module (00 to FF)
VV	Two hexadecimal digits to represent the time out value in tenths of a second, for example, 01 means 0.1 seconds and FF means 25.5 seconds.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~012

Response: !01FF

Reads the host watchdog time out value of module 01 and returns FF, meaning that the host watchdog time out value is 25.5 seconds.

Related Commands:

Section 2.27 ~**, Section 2.28 ~AA0, Section 2.29 ~AA1, Section 2.31 ~AA3E VV

Related Topics:

Section A.2 Dual Watchdog Operation

2.31 ~AA3E VV

Description:

Enable/disable the host watchdog and set the host watchdog time out value of a module.

Syntax:

~AA3E VV[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set (00 to FF)
3	Command to set the host watchdog
E	1: enable the host watchdog 0: disable the host watchdog
VV	Two hexadecimal digits to represent the time out value in tenths of a second, for example, 01 means 0.1 seconds and FF means 25.5 seconds.

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~013164

Response: !01

Enables the host watchdog of module 01 and sets the host watchdog time out value to 10.0 seconds.

The module returns a valid response.

Command: ~012

Response: !0164

Reads the host watchdog time out value of module 01. The module returns 64, meaning that the host watchdog time out value is 10.0 seconds.

Related Commands:

Section 2.27 ~**, Section 2.28 ~AA0, Section 2.29 ~AA1, Section 2.30 ~AA2

Related Topics:

Section A.2 Dual Watchdog Operation

3. Troubleshooting

If you are having difficulty using the I-7000 module, here are some suggestions that may help. If you cannot find the answers you need in these guides, contact ICP DAS Product Support. Contact information is located in Section 1.12.

3.1 Communicating with the module

If you attempt to communicate with the module and receive no response, first check the following:

- Make sure the supplied power is within the range of +10 to +30 V_{DC}. If the supplied power is OK, then the power LED should be on.
- When the module receives a command, the power LED is set to off. The power LED is shown as on after the module responds. This method can be used to check whether the module has received a command sent from the host.
- If possible, use another device to check whether the host can communicate with the device through the same RS-485 network.
- If the host is a PC installed with a Windows operating system, then execute the DCON Utility to determine whether the module can be found. The DCON Utility can be downloaded from the ICP DAS website <http://www.icpdas.com>. The DCON Utility documentation can be found in the "**Getting Started For I-7000 Series Modules**" manual.
- Set the module to "INIT mode" and communicate with the module using the following settings: address 00, Baud Rate 9600bps and no checksum. See Section A.1 for details.

3.2 Reading Data

If the data read from the input channel is not correct, first check the following:

- Make sure the type code and data format settings are correct. For the I-7013/13D and I-7033/33D, the type code is set by using the %AANNTTCCFF command, see Section 2.1 for details. For the I-7015, the type code is set by using the \$AA7CiRrr command, see Section 2.17 for details. The data format is set by using the %AANNTTCCFF command.
- Connect a resistor, instead of the RTD sensor, using the 2-wire RTD connection as shown in Section 1.6. The resistance of the resistor should be within the range as shown in the RTD Type and Data Format Table in Section 1.10. For example, if the type code is set to 20, then the resistance should be larger than 60.6 ohms and less than 138.5 ohms. Change the data format to ohms, see Sections 1.10 and 2.1, and check whether the data reading is correct.
- If the resistance read by the module is still incorrect, then it may be because the calibration parameters stored in the non-volatile memory are corrupted. You can calibrate the module by yourself. Be sure to read Section 1.9 in detail before doing the calibration. For the I-7015, you can send the \$AAS1 command, see Section 2.24 for details, to reload the factory calibration parameters.

A. Appendix

A.1 INIT* Pin Operation

Each I-7000 module has a built-in EEPROM to store configuration information such as module address, type code, Baud Rate, etc. Occasionally, the configuration of a module may be forgotten. To help avoid this problem, the I-7000 has a special mode called “**INIT mode**”. In “**INIT mode**” the configuration of a module is reset as follows, allowing it to be operated as normal.

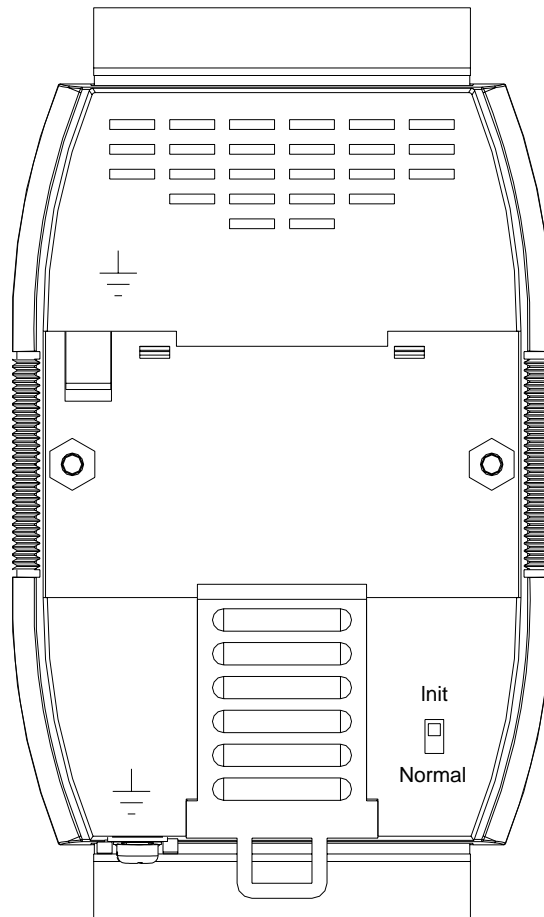
1. Address: 00
2. Baud Rate: 9600 bps
3. No checksum

To access the INIT mode, follow the procedure below

1. Power off the module.
2. Connect the INIT* pin to the GND pin. For the I-7015, slide the switch located on the rear side of the module to the Init position as shown below.
3. Power on the module again.
4. Send the \$002(cr) command at 9600bps to read the configuration of the module.



7015 Rear View:



A.2 Dual Watchdog Operation

Dual Watchdog = Module Watchdog + Host Watchdog

The Module Watchdog is a hardware reset circuit that monitors the operating status of the module. While working in harsh or noisy environments, the module may be shut down by external signals. The circuit allows the module to work continuously without disruption.

The Host Watchdog is a software function that monitors the operating status of the host. Its purpose is to prevent problems due to network/communication errors or host malfunctions. When a host watchdog time out occurs, the module will reset all outputs to a safe state in order to prevent any erroneous operations of the controlled target.

I-7000 series modules include an internal Dual Watchdog, making the control system more reliable and stable.

For more information regarding the Dual Watchdog, please refer to Chapter 5 of the “Getting Started For I-7000 Series Modules” manual that can be downloaded from the ICP DAS website <http://www.icpdas.com>.

A.3 RTD

An RTD (resistance temperature detector) is a temperature detector that senses temperature by measuring the resistance of a material. For RTDs, the resistance increases as the temperature rises and the relationship can be expressed as

$$R = R_0[1 + \alpha_1(T-T_0) + \alpha_2(T-T_0)^2 + \dots + \alpha_n(T-T_0)^n]$$

where R_0 is the resistance at the reference temperature T_0 . Materials used for RTDs can be gold, silver, copper or platinum. The principal advantages of RTDs are their high sensitivity, high repeatability, long-term stability and accuracy for platinum and the low cost for copper and nickel. Nickel offers a higher sensitivity but has smaller linear range than platinum and tends to drift with time. Copper has a broad linear range, but it oxidizes at moderate temperature. Platinum, with a nearly linear temperature versus resistance relationship, offers the best performance and has become the most-used metal for RTDs. The 100-ohm probe, designated as Pt100, is an industry standard. RTDs are recommended for applications where accuracy over a wide temperature range is the most important factor.

A.4 Resistance Measurement

The I-7013/13D, I-7033/33D, and I-7015 modules can be used in resistance measurement. To measure the resistance, connect the resistor using the 2-wire RTD connection as shown in Section 1.6 and set the data format to ohms. To set the data format, you can send the %AANNTTCCFF command, see Section 2.1 for details, to the module, or use the DCON utility, refer to Chapter 2 of the “Getting Started For I-7000 Series Modules” manual that can be downloaded from the ICP DAS website <http://www.icpdas.com>.

The maximum resistances that can be measured are as follows:

For I-7013/13D:

Type Code	Maximum Resistance
20 to 29	375 ohms

For I-7033/33D:

Type Code	Maximum Resistance
20 to 29	375 ohms
2A	3200 ohms

For I-7015:

Type Code	Maximum Resistance
2B, 2C	160 ohms
20 to 29	320 ohms
2A, 2D	3000 ohms