ZB-2024 Series

User Manual

Warranty

All products manufactured by ICP DAS are under warranty regarding defective materials for a period of one year from the date of delivery to the original purchaser.

Warning

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Table of Contents

1. Introduction

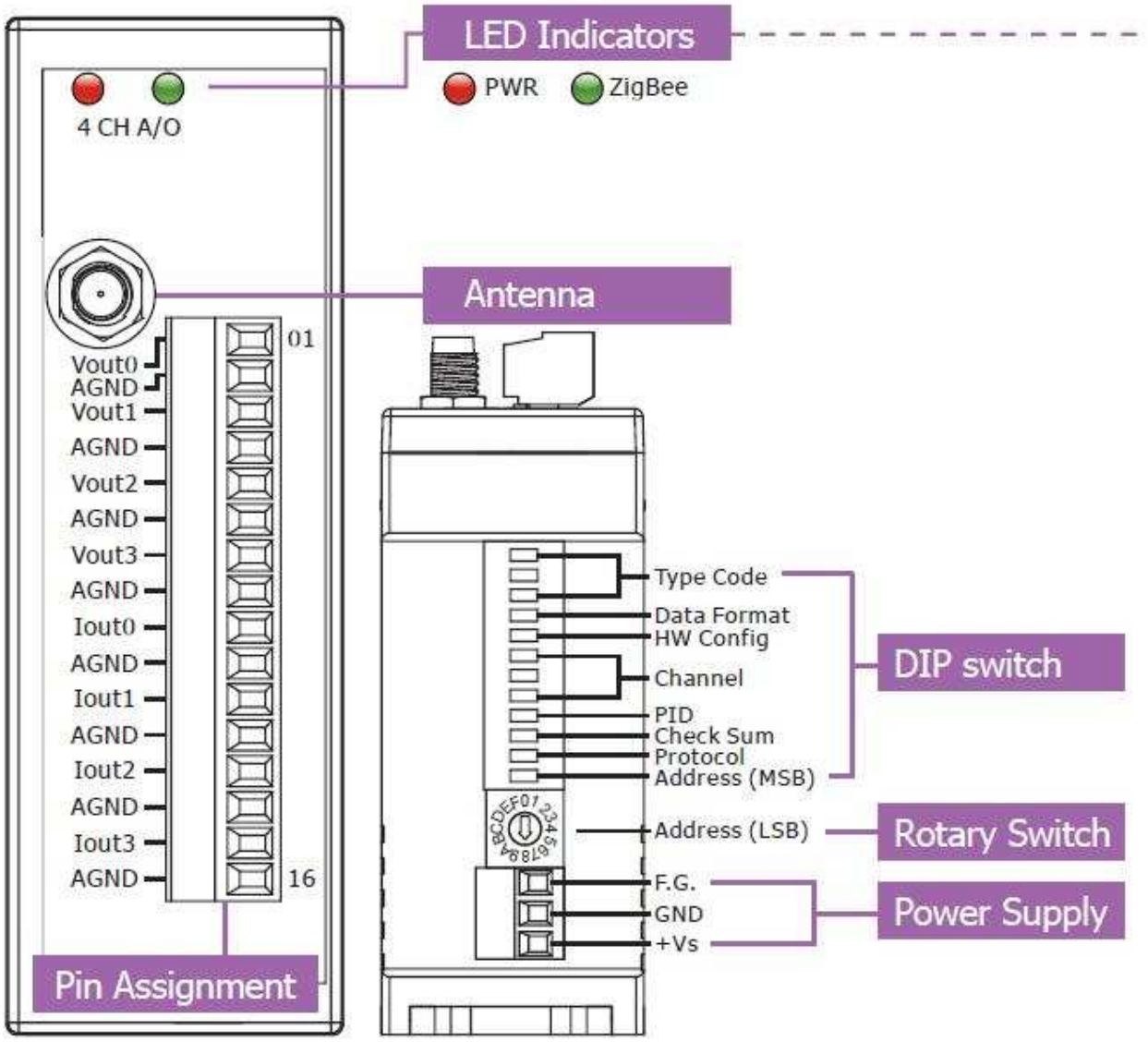
The ZB-2000 series is a family of wireless ZigBee data acquisition modules that provide analog-to-digital, digital-to-analog, digital input/output, timer/counter and other functions. These modules can be remotely controlled using a set of DCON or Modbus RTU commands. The ZB-2024 series provide 4-channel analog output that can be configured via hardware. Refer to Section 1.5 “Switch Descriptions” for details.

The ZB-2000 series modules are not able to operate as standalone modules and need to be connected to a ZigBee host device, such as the ZB-2550(P)(-T) or the ZB-2570(P)(-T), in order to communicate with the other ZB-2000 series modules. For more information, refer to the “ZigBee Converter Quick Start“ guide available at the following address:

http://ftp.icpdas.com/pub/cd/usbcd/napdos/zigbee/zigbee_converter/

1.1. Pin Assignments

ZB-2024 Series



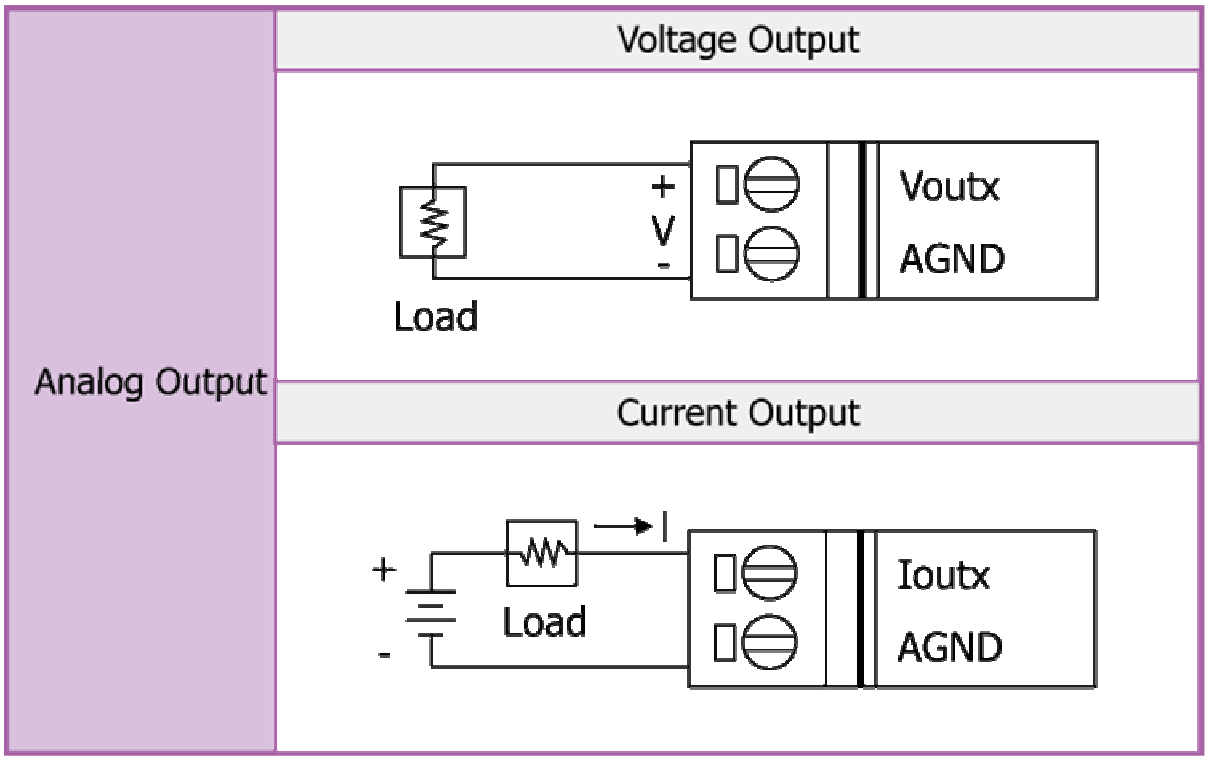
1.2. Specifications

Models	**ZB-2024-T**	**ZB-2024-PA**
Analog Output		
Output Channels	4	
Output Type	0 ~ +10 VDC, -10 VDC ~ +10 VDC, 0 ~ +5 VDC, -5 VDC ~ +5 VDC, 0 ~ +20 mA, +4 mA ~ +20 mA	
Resolution	12-bit	
Accuracy	+/-0.1% of FSR	
Zero Drift	+/-30 μV/°C	
Span Drift	+/-25 ppm/°C	
Programmable Output Slope	0.125 to 2048 mA/ second	
	0.0625 to 1024 V/ second	
Voltage Output Capability	10 V @10 mA	
Current Load Resistance	External +24 V power : 1050 Ohms	
Power-on and Safe Values	Yes	
Intra-module Isolation, Field to Logic	2500 V_{DC}	
ESD Protection	+/-4 kV Contact for each channel	
Communication Interface		
Wireless	ZigBee, IEEE 802.15.4 Standard	
Transmission power	4 dBm	22 dBm
Antenna 2.4 GHz-	3 dBi Omni-Directional antenna	5 dBi Omni-Directional antenna
Transmission range (LOS)	100 m	700 m(Typical) 1 km(Max.)
Certification	CE/FCC,FCC ID	No
Max. Slaves in a zigbee network	254	
ZB-100R/ZB-100T Supported	Yes	
Protocols	Supports DCON and Modbus RTU Protocols	
Hot Swap	By Rotary and DIP switch	

LED Indicators	
Power	1 LED, red
ZigBee Communication	1 LED, green
Powe	
Power Consumption	2.3 W max.
Mechanical	
Flammability	Fire Retardant Materials (UL94-V0 Level)
Dimensions (W x L x H)	33 mm x 87 mm x 107 mm
Installation	DIN-Rail
Environment	
Operating Temperature	-25 °C ~ +75 °C
Storage Temperature	-30 °C ~ +80 °C
Humidity	10 ~ 90% RH, non-condensing

1.3. Wire Connections

ZB-2024 Series



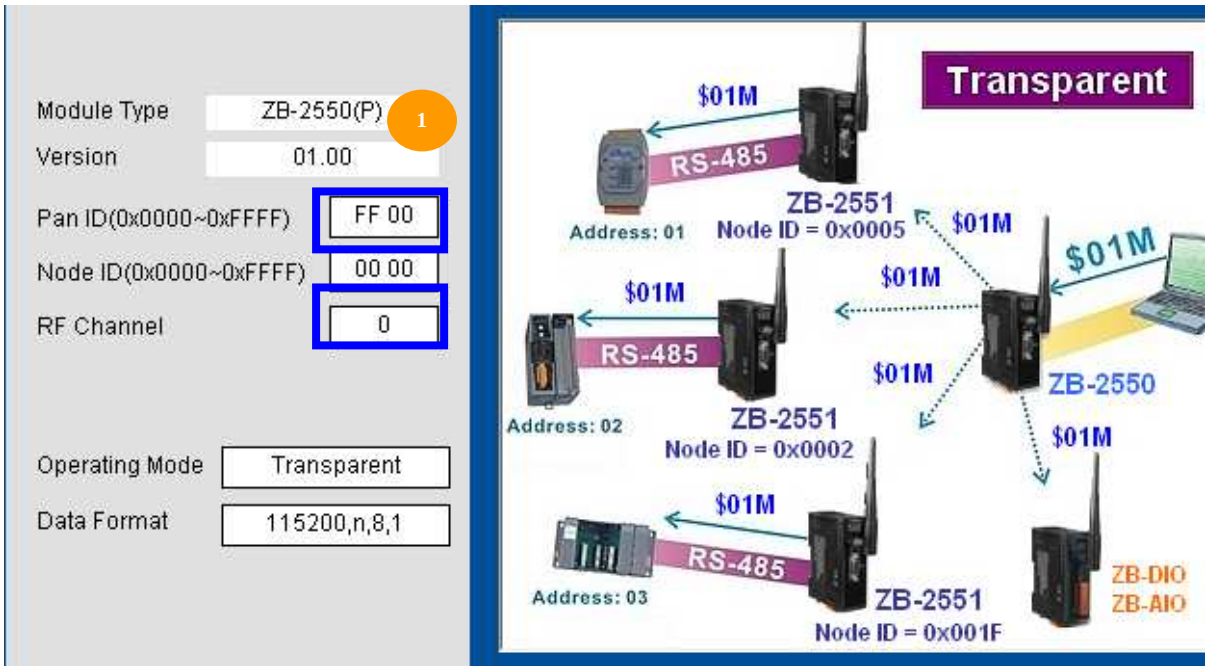
1.4. Quick Start

This Quick Start document describes the methods used to quickly set up and test ZB-2000 series modules using the ICP DAS DCON Utility.

First, you must set the ZigBee configuration of ZB-2570(P)(-T)/ZB-2550(P)(-T) before using any ZB-2000 modules because the ZB-2570(P)(-T)/ZB-2550(P)(-T) is a ZigBee Net Server. For more information about the ZB-2570(P)(-T)/ZB-2550(P)(-T), please refer to the “ZigBee Converter Quick Start“ quide available at the following address:

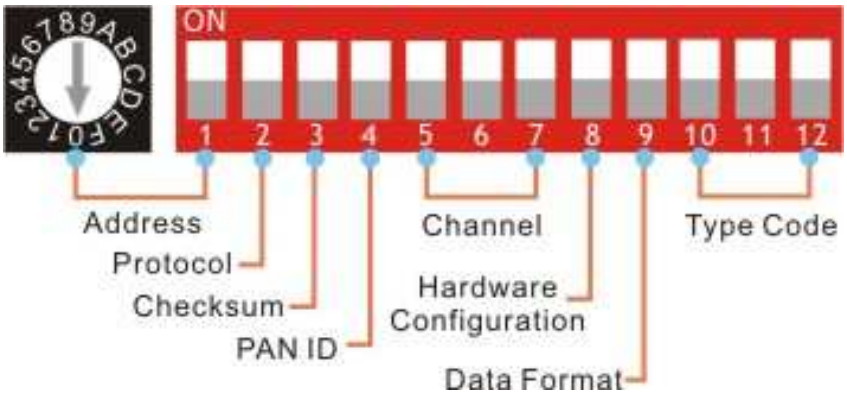
http://ftp.icpdas.com/pub/cd/usbcd/napdos/zigbee/zigbee_converter

If you have already installed the ZB-257x/ZB-255x series Utility, you only need to set the “PAN ID” and the “ZB RF Channel” for the ZB-2570(P)(-T)/ZB-2550(P)(-T) so that it is the same as the ZB-AIO setting. The ZB-AIO will then operate correctly.



1.5. Switch Descriptions

The ZB-2024 series module contains 12 dip switch and a Rotary switch that are used to configure the module.



The following gives a description of the function and usage of each dip switch:

1. **Address:** The module address is defined using two components. The first is dip switch 1 and the second is a 16-position rotary switch. The address is a hexadecimal value that allows you set addresses mapping from 0x01 to 0x1F (0x00 is used for initialization mode). Dip switch 1 is used to define the high 4 bits of the address value, and the 16-position rotary switch is used to define the low 4 bits of the address.
   The address value is equal to the ZigBee PAN ID value. A unique Node ID should be set for all ZigBee slave devices, such as ZigBee IO modules, ZigBee converters and ZigBee repeaters. The ZB-2024 series module will switch to INIT mode when the address value is 0. Refer to Section 1.7 “INIT Mode” for more information.
2. **Protocol:** Dip switch 2 is used to define the protocol. When set to the ON position, it means that the “Modbus RTU” protocol will be enabled, and when set to the OFF position, it denotes that the “DCON” protocol will be used.
3. **Checksum:** Dip switch 3 is used to define whether a checksum will be used. When set to the ON positon, the checksum will be enabled, and when set to the OFF position, the checksum will be

disabled. This option is only effective when the DCON protocol is enabled.

4. **PAN ID:** Dip switch 4 is used to define the ZigBee network PAN ID. Only the values 0xFF00 or 0xFF01 are valid for ZigBee IO series module. 0xFF01 is selected by moving the dip switch to the ON position and 0xFF00 is selected by moving the dip switch to the OFF position.
5. **Channel:** Dip switches 5-7 are used to define the ZigBee operating channel. The configuration is as follows:

Switch Value	Channel	Switch Value	Channel	Switch Value	Channel
	0		1		2
	3		4		9
	14		15		

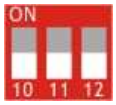
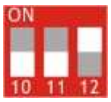
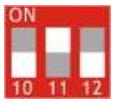
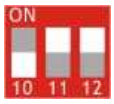
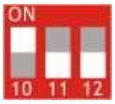
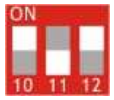
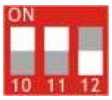
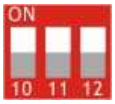
6. **Hardware configuration:** Dip switch 8 is used to define whether the type code of the ZB-2024 series module is to be configured using firmware or hardware. The ON position indicates that configuration is via hardware, and the OFF position denotes that configuration is performed via firmware. The differences between firmware and hardware configuration are as follows:

Type Code is set to firmware configuration	Type Code is set to hardware configuration
Allows different type codes to be set for each channel.	All channels will use the same type code that is defined using the values set via dip switches 10-12.
The type code value is configured with the value stored in EEPROM.	The type code value is configured based on the dip switch of the ZB-2024 series.
The data format is configured using software commands.	The data format is configured using a dip switch. Data format configuration commands are ignored in this mode.

When a command is used to read the current type code, the value that is stored in the EEPROM of the ZB-2024 series will be returned.	When a command is used to read the current type code, the value that has been configured via dip switches of the ZB-2024 series will be returned.

7. **Data Format:** Dip switch 9 is used to define the data format used by the ZB-2024 series modue. The ON position indicates that hex format will be used, and the OFF position indicates engineering format will be used. This dip switch is only applicable when the “Hardware configuration” dip switch is in the ON position.
8. **Type Code:** Dip switches 10-12 are used to define the input type code for the ZB-2024 series module, as shown below.

ZB-2024 Series

Switch Value	Type Code	Switch Value	Type Code	Switch Value	Type Code
	0x00		0x01		0x02
	0x03		0x04		0x05
	0x05		0x05		

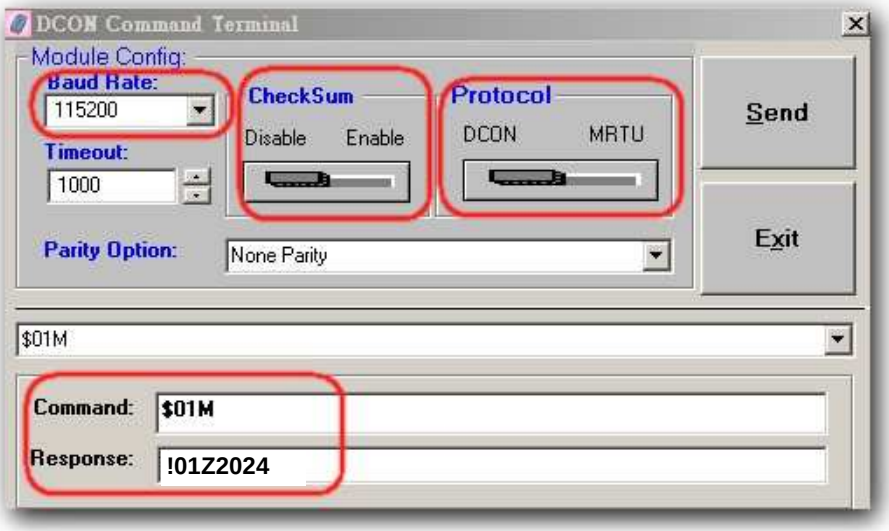
1.6. Connection

A ZigBee host must already exist in a ZigBee network. If you want to communicate with ZB-2000 IO modules, you need to use a ZB-2550(P)(-T) or a ZP-2570(P) host o connect to your controller.

To create a ZigBee network, the “Channel” and “PAN ID” parameters of all ZigBee modules should be individually configured to the same value.

For instance, use the software utility to configure the PAN ID of the ZB-2550(P)(-T) as 0xFF00 and the Channel as 0. Then set dip switches 4-7 on the ZB-2024 series module to the OFF position to set the PAN ID to 0xFF00 and the Channel to 0. Based on the above configuration, the ZB-2550(P)(-T) host and the ZB-2024 series module will then be able to communicate with each other. Set dip switches 2 and 3 to the OFF position to set the protocol for the module to DCON and disable the checksum.

Moving the rotary switch on the ZB-2024 series module to position 1 will set the module address to 0x01. You can then use the “DCON Utility” on the Host PC that is connected to the ZB-2550(P)(-T) host to send a command to the ZB-2024 series module. The response you receive should be similar to that shown below:



The ZB-2024 series is a command-based data acquisition module. A number of commands are provided that can be used to configure and set the analog output. Refer to Section 2 for details.

The ZB-2024 series module also support the Modbus RTU protocol. The configuration command format for the Modbus RTU is as follows:

Field ❶	Field ❷	Field ❸	Field ❹ ~ Field *n	Field (❹+*n)
Module Address	Function code	Sub function	Configuration field	CRC16

*n: This value depends on the Sub-function code.

Eg: To set channels 0, 1, 2 and 3 to enabled and channels 4, 5, 6 and 7 to disabled, the following command should be sent:

01 46 26 0F BA 69

The supported analog I/O commands are as follows:

Function Code	Description
0x01	Read coils
0x02	Read discrete inputs
0x03	Read multiple registers
0x04	Read multiple input registers
0x05	Write single coils
0x0F	Write multiple coils

Eg: To read the current analog input value for channels 0 to 7, the following command should be sent:
01 03 00 00 00 07 04 08

Eg: To set the filter to 50Hz, the following command should be sent:
01 05 01 02 FF 00 2C 06

To install the ZigBee analog I/O module, follow the steps below:
1. Connect the analog input.

2. Connect the ZigBee analog I/O module to the power supply using the +Vs and GND terminals.
3. In order to output the analog output channels when using the DCON protocol, send a #AAN(Data) command to the module. See Section 2.2 for details. When using the Modbus RTU protocol, use the Function 06h or 10h to set the output for channels. See Sections 3.1 and Section 3.2 for details.

1.7. INIT Mode

Each ZigBee module has an internal EEPROM that is used to store its configuration, such as it's address, ZigBee PAN ID, ZigBee channel numbers, etc. If you forget the module's configuration information, you can use INIT mode to reset the ZB-2024 series module to the default settings, then you can re-configure the module. To change to INIT mode, you only need to adjust the address value to 0.

The default settings for ZB analog I/O modules are:

- Protocol: DCON
- Module Address: 0
- Checksum: Disabled

1.8. Type and Data Format Tables

Type Code	Output Type	Data Format	+F.S.	-F.S.
0	0 to +20 mA	Engineering units	+20.000	+00.000
		% of FSR	+100.00	+000.00
		2's comp HEX	FFFF	0000
1	+4 to +20 mA	Engineering units	+20.000	+04.000
		% of FSR	+100.00	+000.00
		2's comp HEX	FFFF	0000
2	0 to +10 V	Engineering units	+10.000	+00.000
		% of FSR	+100.00	+000.00
		2's comp HEX	FFFF	0000
3	-10 to +10 V	Engineering units	+10.000	-10.000
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000
4	0 to +5 mV	Engineering units	+5.0000	+0.0000
		% of FSR	+100.00	+000.00
		2's comp HEX	FFFF	0000
5	-5 to +5 V	Engineering units	+5.0000	-5.0000
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000

Slew Rate Control

0 Immediate chang
1 0.0625 V/Second or 0.125 mA/Second
2 0.125 V/Second or 0.25 mA/Second
3 0.25 V/Second or 0.5 mA/Second
4 0.5 V/Second or 1.0 mA/Second
5 1.0 V/Second or 2.0 mA/Second
6 2.0 V/Second or 4.0 mA/Second
7 4.0 V/Second or 8.0 mA/Second
8 8.0 V/Second or 16 mA/Second
9 16 V/Second or 32 mA/Second
A 32 V/Second or 64 mA/Second
B 64 V/Second or 128mA/Second
C 128 V/Second or 256 mA/Second
D 256 V/Second or 512 mA/Second
E 512 V/Second or 1024 mA/Second
F 1024 V/Second or 2048 mA/Second

Data Format Settings (FF)

7	6	5	4	3	2	1	0
Reserved	CS	Reserved				DF	

Key	Description
DF	Data Format 00: Engineering units 01: % of FSR 10: 2’s Complement Hexadecimal
CS	Checksum Settings 0: Disabled 1: Enabled

Note: Reserved bits should be zero.

1.9. Calibration

Warning: Performing calibration is not recommended until the process is fully understood.

1.9.1 Analog Output

The calibration procedure is as follows:

1. Warm up the module for 30 minutes.
2. Set the type code to the type you want to calibrate. Refer to Section 2.13 for details.
3. Enable calibration. Refer to Section 2.26 for details.
4. Set the analog output to zero. Refer to Section 2.2 for details.
5. Check the meter and trim the output until zero output. Refer to Section 2.6 for details.
6. Send the analog output zero calibration command. Refer to Section 2.3 for details.
7. Set the span analog output. Refer to Section 2.2 for details.
8. Check the meter and trim the output until the span output. Refer to Section 2.11 for details.
9. Send the analog output span calibration command. Refer to Section 2.4 for details.

Notes:

1. Connect the calibration voltage to the specific channel you are calibrating.
2. Calibration voltages and currents are shown below.

Calibration voltages:

Type Code	0	1	2	3	4	5
Zero Output	0 mA	4mA	0 V	0 V	0 V	0 V
Span Output	+20 mV	+20 mA	+10 V	+10 V	+5 V	+5 V

1.10.Technical Support

Should you encounter any problems while using the ZB-2024 series module, and are unable to 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 requesting technical support, be prepared to provide the following information about your system:

1. Module 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 Sections 2.14 and 3.3.2 for information regarding the command used to identify 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. Any 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.

ICP DAS will reply to your request by email within three business days.

2. DCON Protocol

All communication with ZB analog I/O modules consists of commands generated by the host and responses transmitted by the ZB analog I/O module. Each module has a unique ID number that is used for addressing purposes and is stored in non-volatile memory. The ID is 01 by default and can be changed by transmitting the prescribed user command. All commands to the modules contain the ID address, meaning that only the addressed module will respond. The only exception to this is command ~**(Section 2.17) which is sent to all modules, but in this case, 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 which is present when the checksum setting is enabled. See Section 1.8 (Type and Data Format Settings) 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	Sets the configuration of the module	2.1
#AAN(Data)	>	Sets the analog output of a specific channel	2.5
$AA0N	!AA	Performs an analog output zero calibration	2.3
$AA1N	!AA	Performs an analog output span calibration	2.4
$AA2	!AANNTTCCFF	Reads the configuration of the module	2.5
$AA3NVV	!AA	Trims the analog output calibration	2.6
$AA4N	!AA	Sets the analog output power-on value	2.7
$AA5	!AAS	Reads the reset status of the module	2.8
$AA6N	!AA(Data)	Reads the last analog output value	2.9
$AA7N	!AA(Data)	Reads the analog output power-on value	2.10
$AA8N	!AA(Data)	Reads the current analog output value	2.11
$AA9N	!AATS	Reads the analog output configurations	2.12
$AA9NTS	!AA	Set the analog output configurations	2.13
$AAB	!AA	Detects the status of the wire connection	2.14
$AAF	!AA(Data)	Reads the firmware version information	2.15
$AAM	!AA(Data)	Reads the name of the module	2.16
$AAS1	!AA	Reloads the default calibration parameters	2.17
~AAEV	!AA	Enables/Disables calibration	2.27
~AAO(Data)	!AA	Sets the name of the module	2.28
Host Watchdog Command Sets			
Command	**Response**	**Description**	**Section**
~**	No Response	Informs all modules that the host is OK	2.18
~AA0	!AASS	Reads the status of the Host Watchdog	2.19
~AA1	!AA	Resets the status of the Host Watchdog	2.20
~AA2	!AAETT	Reads the Host Watchdog timeout settings	2.21
~AA3EVV	!AA	Sets the Host Watchdog timeout settings	2.22
~AA4N	!AA(Data)	Reads the analog output safe value for a specific channel	2.23
~AA5N	!AA	Sets the analog output safe value for a	2.24

		specific channel	
~AA6PN(Data)	!AA	Sets the analog output power-on value directly for a specific channel	2.25
~AA6SN(Data)	!AA	Sets the analog output safe value directly for a specific channel	2.26

2.1. %AANNTTCCFF

Description:

This command is used to set the configuration for a specified module.

Syntax:

%AANNTTCCFF[CHKSUM](CR)

%	Delimiter character
AA	The address of the module to be configured in hexadecimal format (00 to 1F)
NN	The new address of the module in hexadecimal format (00 to 1F)
TT	Not used by the ZB-2024 series module (Reserved) and should be set 00
CC	Not used by the ZB-2024 series module (Reserved) and should be set 00
FF	The command used to set the data format, checksum and filter settings for the module, See Section 1.8 for details.

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter for a valid response
?	Delimiter for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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: %0202000A80 Response: !02

Sets the data format for module 02 to 80 (50Hz rejection) and engineering data format, and returns a valid response.

Related Commands:

Section 2.5 $AA2

Related Topics:

Section 1.8 Type and Data Format Tables

2.2. #AAN(Data)

Description:

This command is used to set the analog output value for channel N of a specified module.

Syntax:

#AAN(Data)[CHKSUM](CR)

#	Delimiter character
AA	The address of the module to be set in hexadecimal format (00 to 1F)
N	The channel to be set, zero based
(Data)	The analog output value, see Section 1.8 for details of the data format

Response:

>	Delimiter character for a valid response
?	Delimiter character for an invalid response indicating that the output value is out of range. The output will revert to the closest value set in the module's output range.
!	Delimiter character for an invalid response indicating that the module's Host Watchdog flag has been set. The output command will be ignored and the output will be set to the safe value.

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: $0190300 Response: !01

Reads the configuration of module 01 and returns a valid response indicating an output type of 0 to 20mA and any changes are immediate.

Command: #010+05.000 Response: >

Sets the output value for channel 0 of module 01 to 5.0 mA and returns a valid response.

Command: #010+25.000 Response: ?

Attempts to set the output value for channel 0 of module 01 to 25.0 mA, but returns an invalid response because the output value is out of range.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.5 $AA2

Related Topics:

Section 1.8 Type and Data Format Tables

2.3. $AA0N

Description:

This command is used to perform an analog output zero calibration on channel N of a specified module.

Syntax:

$AA1[CHKSUM](CR)

$	Delimiter character
AA	The address of the module to be calibrated in hexadecimal format (00 to 1F)
0	The command to perform the analog output zero calibration
N	The channel to be calibrated, zero based

Response:

Valid Response: !AA[CHKSUM](CR)
Invalid Response: ?AA[CHKSUM](CR)

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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: $0101 Response: ?01

Attempts to send the command to perform an analog output zero calibration on channel 1 of module 01, but returns an invalid response because the “enable calibration” command, ~AAEV, was not sent in advance.

Command: ~01E1 Response: !01

Enables calibration on module 01 and returns a valid response.

Command: $0101 Response: !01

Sends the command to perform an analog output zero calibration on channel 1 of module 01 and returns a valid response.

Related Commands:

Section 2.4 $AA1N, Section 2.6 $AA3NVV, Section 2.27 ~AAEV

Related Topics:

Section 1.9 Calibration

2.4. $AA1N

Description:

This command is used to perform an analog output span calibration on channel N of a specified module.

Syntax:

$AA1N[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be calibrated in hexadecimal format (00 to 1F)
1 The command to perform the analog output span calibration
N The channel to be calibrated, zero based

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)

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: $0111 Response: ?01

Attempts to send the command to perform a span calibration on channel 1 of module 01, but returns an invalid response because the “enable calibration” command, ~AAEV, was not sent in advance.

Command: ~01E1 Response: !01

Enables calibration on module 01 and returns a valid response.

Command: $0111 Response: !01

Sends the command to perform a span calibration on channel 1 of module 01 and returns a valid response.

Related Commands:

Section 2.3 $AA0N, Section 2.6 $AA3NVV, Section 2.27 ~AAEV

Related Topics:

Section 1.9 Calibration

2.5. $AA2

Description:

This command is used to read the configuration of a specified module.

Syntax:

$AA2[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be read in hexadecimal format (00 to 1F)
2 The command to read the configuration of the mdoule

Response:

Valid Response: !AATTCCFF[CHKSUM](CR)
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)
TT Not used by the ZB-2024 series module and should be 00 (Reserved)
CC Not used by the ZB-2024 series module and should be 0A (Reserved)
FF The data format, checksum settings and filter settings for the module. See Section 1.8 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.

Examples:

Command: $012 Response: !01000A00

Reads the configuration of module 01 and returns a valid response indicating that the Baud Rate is 115200, the data format is engineering format and the checksum is disabled.

Command: $022 Response: !02000A02

Reads the configuration of module 02 and returns a valid response indicating that the Baud Rate is 115200, the data format is 2's complement Hex format and the checksum is disabled.

Related Commands:

Section 2.1 %AANNTTCCFF

Related Topics:

Section 1.8 Type and Data Format Tables

2.6. $AA3NVV

Description:

This command is used to trim the analog output calibration for channel N of a specified module.

Syntax:

$AA3NVV[CHKSUM](CR)

$ Delimiter character

AA The address of the module to be set in hexadecimal format (00 to 1F)

3 The command to trim the analog output calibration of the module

N The channel to be calibrated, zero based

VV A two-digits hexadecimal value that presents the analog output calibration trim value. A value of 01 to 5F will increase the analog output calibration value by 1 to 95, and a value of FF to A1 will decrease the analog output calibration value by 1 to 95.

Response:

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

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

! Delimiter character for a valid response

? Delimiter character for an invalid response

AA The address of the responding module in hexadecimal format (00 to 1F)

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: $01301F Response: !01

Trims the output for channel 0 of module 01 and increases the analog output calibration value by 31. The module returns a valid response.

Command: $013060 Response: ?01

Attempts to trim the output for channel 0 of module 01 and increase the calibration value by 96. An invalid response is returned because the value is out of range.

Related Commands:

Section 2.3 $AA0N, Section 2.4 $AA1N, Section 2.27 ~AAEV

Related Topics:

Section 1.9 Calibration

2.7. $AA4N

Description:

This command is used to set the current analog output as the power-on value for channel N of a specified module.

Syntax:

$AA4N[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be set in hexadecimal format (00 to 1F)
4 The command to set the power-on value, and store the current output value as the power-on value
N The channel to be set, zero based

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)

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+00.000 Response: >

Sets the analog output for channel 2 of module 01 to 0 V and returns a valid response.

Command: $0142 Response: !01

Sets the power-on value for channel 2 of module 01 to 0 V and returns a valid response. The power-on value for channel 2 is set to 0 V immediately.

Command: $014F Response: ?01

Attempts to set the power-on value for channel 15 of module 01, but returns an invalid response because channel 15 does not exist.

Related Commands:

Section 2.2 #AAN(Data)

2.8. $AA5

Description:

This command is used to read the reset status of a specified module.

Syntax:

$AA5[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be read in hexadecimal format (00 to 1F)
5 The command to read the reset status

Response:

Valid Response: **!AAS[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)
S The reset status of the module
0: This is not the first time the command has been sent since the module was powered on, which denotes that there has been no module reset since the last $AA5 command was sent.
1: This is the first time the command has been sent since the module was powered on.

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: $015 Response: !011

Reads the reset status of module 01. The module returns a valid response indicating that it is the first time the $AA5 command has been sent since the module was powered on.

Command: $015 Response: !010

Reads the reset status of module 01. The module returns a valid response indicating that there has been no module reset since last $AA5 command was sent.

2.9. $AA6N

Description:

This command is used to read the value of the last analog output command from channel N of a specified module.

Syntax:

$AA6N[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be read in hexadecimal format (00 to 1F)
6 The command to read the value of the last analog output command
N The channel to be read, zero based

Response:

Valid Response: **!AA(DATA)[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response or an invalid type code
AA The address of the responding module in hexadecimal format (00 to 1F)
(Data) The value of the last analog output 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: #011+10.000 Response: !01

Sets the value of the analog output for channel 1 of module 01 to +10.000 and returns a valid response.

Command: $0161 Response: !01+10.000

Reads the value of the last analog output command for channel 1 of module 01 and returns a valid response with a value of +10.000.

Command: $016F Response: ?01

Attempts to read the value of the last analog output for channel 15 of module 01, but returns an invalid response because channel 15 does not exist.

Related Commands:

Section 2.2 #AAN(Data), Section 2.11 $AA8N, Section 2.13 $AA9TS

2.10.$AA7N

Description:

This command is used to read the analog output power-on value for channel N of a specified module.

Syntax:

$AA7N[CHKSUM](CR)

$	Delimiter character
AA	The address of the module to be read in hexadecimal format (00 to 1F)
7	The command to read the power-on value
N	The channel to be read, zero based

Response:

Valid Response: **!AA(Data)[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for a invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)
(Data)	The analog output power-on value

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: $0170 Response: !01+10.000

Reads the analog output power-on value for channel 0 of module 01, and returns a valid response with a value of +10.000.

Command: $017F Response: ?01

Attempts to read the analog output power-on value for channel 15 of module 01, but returns an invalid response because analog output channel 15 does not exist.

Related Commands:

Section 2.2 #AAN(Data), Section 2.7 $AA4N

2.11.$AA8N

Description:

This command is used to read the current analog output value for channel N of a specified module.

Syntax:

$AA8N[CHKSUM](CR)

$	Delimiter character
AA	The address of the module to be read in hexadecimal format (00 to 1F)
8	The command to read the current analog output value
N	The channel to be read, zero based

Response:

Valid Response: **!AA(Data)[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for a invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)
(Data)	The current analog output value

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+01.000

Reads the current analog output value for channel 0 of module 01, and returns a valid response with a value of +01.000 V.

Command: $018F Response: ?01

Attempts to read the current analog output value for channel 15 of module 01, but returns an invalid response because that analog output channel 15 does not exist.

Related Commands:

Section 2.2 #AAN(Data), Section 2.9 $AA6N

2.12.$AA9N

Description:

This command is used to read the configuration of the analog output for channel N of a specified module.

Syntax:

$AA9N[CHKSUM](CR)

$	Delimiter character
AA	The address of the module to be read in hexadecimal formatg (00 to 1F)
9	The command to read the configuration of the analog output
N	The channel to be read, zero based

Response:

Valid Response: **!AATS[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)
T	The analog output type. Refer to the Analog output Type Settings table in Section 1.8 for details.
S	The analog output slew rate. Refer to the Analog output Slew Rate Control in Section 1.8 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.

Examples:

Command: $019030 Response: !01

Sets the configuration of the analog output for channel 0 of module 01 to an output range of -10 V to +10 V and any changes are immediate. The module returns a valid response.

Command: $0190 Response: !0130

Reads the configuration of the analog output for channel 0 of module 01 and returns a valid response indicating that the output is -10 V to +10 V and any changes are immediate

Command: $019F Response: ?01

Attempts to read the configuration of the analog output for channel 15 of module 01, but returns an invalid response because that analog output channel 15 does not exist.

Related Commands:

Section 2.13 $AA9NTS

Related Topics:

Section 1.8 Type and Data Format Tables

2.13.$AA9NTS

Description:

This command is used to set the configuration of the analog output for channel N of a specified module.

Syntax:

$AA9NTS[CHKSUM](CR)

$	Delimiter character
AA	The address of the module to be set in hexadecimal format (00 to 1F)
9	The command to set the configuration of the analog output
N	The channel to be set, zero based
T	The analog output type. Refer to the Analog output Type Settings table in Section 1.8 for details.
S	The analog output slew rate. Refer to the Analog output Slew Rate Control in Section 1.8 for details.

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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: $019131 Response: !01

Sets the configuration of the analog output for channel 1 of module 01 to an output range of -10 V to 10V and a slew rate of 0.625 V/Second, and returns a valid response.

Command: $0191 Response: !0131

Reads the configuration of the analog output for channel 1 of module 01 and returns a valid response indicating that the output range is -10 V to +10 V and the slew rate is 0.625 V/Second.

Command: $019F31 Response: ?01

Attempts to set the configuration of the analog output for channel 15 of module 01 to an output range of -10 V to 10V and a slew rate of 0.625 V/Second, but returns an invalid response because analog output channel 15 does not exist.

Related Commands:

Section 2.12 $AA9N

Related Topics:

Section 1.8 Type and Data Format Tables

2.14.$AAB

Description:

This command is used to detect the status of the wire connection for a specified module.

Syntax:

$AAB[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be read in hexadecimal format (00 to 1F)
B The command to detect the status of the wire connection

Response:

Valid Response: **!AAVV[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)
VV A two-digit hexadecimal value that presents the wire connection status, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 0, it denotes that the wire for the channel is connected, and 1 denotes that the wire for the channel is disconnected.

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

Detects the status of the wire connection for channel 0 of module 01, and returns a valid response indicating that the wire for analog output channel 0 is disconnected.

2.15.$AAF

Description:

This command is used to read the firmware version information for a specified module.

Syntax:

$AAF[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be read in hexadecimal format (00 to 1F)
F The command to read the firmware version information

Response:

Valid Response: **!AA(Data)[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)
(Data) A string indicating the firmware version informat for 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 information for module 01 and returns a valid response showing that it is version A2.0.

2.16.$AAM

Description:

This command is used to read the name of a specified module.

Syntax:

$AAM[CHKSUM](CR)

$ Delimiter character
AA The address of the module to be read in hexadecimal format (00 to 1F)
M The command to read the name of the module

Response:

Valid Response: **!AA(Data)[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)
(Data) A string showing the name 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: !01Z2024

Reads module 01 and returns a valid response with the name "Z2024".

Related Commands:

Section 2.28 ~AAO(Data)

2.17.$AAS1

Description:

This command is used to reload the factory default calibration parameters for a specified module, including the internal calibration parameters.

Syntax:

$AAS1[CHKSUM](CR)

$ Delimiter character

AA The address of the module where the default calibration parameters are to be reloaded in hexadecimal format (00 to 1F)

S1 The command to reload the factory default calibration parameters

Response:

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

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

! Delimiter character for a valid response

? Delimiter character for an invalid response

AA The address of the responding module in hexadecimal format (00 to 1F)

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 a command to module 01 to reload the factory default calibration parameters and returns a valid response.

Related Commands:

Section 2.3 $AA0N, Section 2.4 $AA1N, Section 2.27 ~AAEV

Related Topics:

Section 1.9 Calibration

2.18.~**

Description:

This command is used to Inform all modules on the network that the host is OK

Syntax:

~[CHKSUM](CR)**

~ Delimiter character
**** The “Host OK” command

Response:

There is no response to this command.

Examples:

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

Related Commands:

Section 2.19 ~AA0, Section 2.20 ~AA1, Section 2.21 ~AA2, Section 2.22 ~AA3ETT, Section 2.23 ~AA4N

2.19.~AA0

Description:

This command is used to read the status of the Host Watchdog for a specified module.

Syntax:

~AA0[CHKSUM](CR)

~ Delimiter character

AA The address of the module to be read in hexadecimal format (00 to 1F)

0 The command to read the status of the module's Host Watchdog

Response:

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

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

! Delimiter character for a valid response

? Delimiter character for an invalid response

AA The address of the responding module in hexadecimal format (00 to 1F)

SS A two-digits hexadecimal value that represents the status of the Host Watchdog, where:

Bit 2: 0 indicates that no Host Watchdog timeout has occurred and 1 indicates that a Host Watchdog timeout has occurred.
The status of the Host Watchdog is stored in EEPROM and can only be reset using the ~AA1 command.

Bit 7: 0 indicates that the Host Watchdog is disabled and 1 indicates that the Host Watchdog is enabled.

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 status of the Host Watchdog for module 01 and returns a valid response with a value of 00, meaning that the Host Watchdog is disabled and no Host Watchdog time out has occurred.

Command: ~020 Response: !0204

Reads the status of the Host Watchdog for module 02 and returns a valid response with a value of 04, meaning that a Host Watchdog timeout has occurred.

Related Commands:

Section 2.18 ~**, Section 2.20 ~AA1, Section 2.21 ~AA2, Section 2.22 ~AA3ETT

Related Topics:

Section 5.1 Default Watchdog Operation

2.20.~AA1

Description:

This command is used to reset the timeout status of the Host Watchdog for a specified module.

Syntax:

~AA1[CHKSUM](CR)

~	Delimiter character
AA	The address of the module to be reset in hexadecimal format (00 to 1F)
1	The command to reset the timeout status of the Host Watchdog

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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 status of the Host Watchdog for module 01 and returns a valid response with a value of 04, meaning that a Host Watchdog timeout has occurred.

Command: ~011 Response: !01

Resets the Host Watchdog timeout status for module 01 and returns a valid response.

Command: ~010 Response: !0100

Reads the status of the Host Watchdog for module 01 and returns a valid response showing that no Host Watchdog timeout has occurred.

Related Commands:

Section 2.18 ~**, Section 2.19 ~AA0, Section 2.21 ~AA2, Section 2.22 ~AA3EVV

Related Topics:

Section 5.1 Default Watchdog Operation

2.21.~AA2

Description:

This command is used to read the Host Watchdog timeout value for a specified module.

Syntax:

~AA2[CHKSUM](CR)

~ Delimiter character
AA The address of the module to be read in hexadecimal format (00 to 1F)
2 The command to read the Host Watchdog timeout value

Response:

Valid Response: **!AAEVV[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

! Delimiter character for a valid response
? Delimiter character for an invalid response
AA The address of the responding module in hexadecimal format (00 to 1F)
E 0: The status of the Host Watchdog is disabled
1: The status of the Host Watchdog is enabled
VV A two-digits hexadecimal value that represents the Host Watchdog timeout 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: ~013164 Response: !01

Enables the Host Watchdog for module 01 and sets the Host Watchdog timeout value to 10.0 seconds. The module returns a valid response.

Command: ~012 Response: !011FF

Reads the Host Watchdog timeout value for module 01 and returns a valid response with a value of 1FF, meaning that the Host Watchdog is enabled and the Host Watchdog timeout value is 25.5 seconds.

Related Commands:

Section 2.18 ~**, Section 2.19 ~AA0, Section 2.20 ~AA1, Section 2.22~AA3ETT

Related Topics:

Section 5.1 Default Watchdog Operation

2.22.~AA3EVV

Description:

This command is used to enable or disable the Host Watchdog for a specified module and to set the Host Watchdog timeout value

Syntax:

~AA3EVV[CHKSUM](CR)

~	Delimiter character
AA	The address of the module to be set in hexadecimal format (00 to 1F)
3	The command to set the Host Watchdog
E	The Command to enable or disable the Host Watchdog 0: Disables the Host Watchdog 1: Wnable the Host Watchdog
VV	A two-digits hexadecimal value that represents the Host Watchdog timeout value in tenths of a second, for example, 01 means 0.1 seconds and FF means 25.5 seconds.

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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 for module 01 and sets the Host Watchdog timeout value to 10.0 seconds. The module returns a valid response.

Command: ~012 Response: !01164

Reads the Host Watchdog timeout value for module 01 and returns a valid response with a value of 164, meaning that the Host Watchdog is enabled and the Host Watchdog timeout value is 10.0 seconds.

Related Commands:

Section 2.18 ~**, Section 2.19 ~AA0, Section 2.20 ~AA1, Section 2.21 ~AA2

Related Topics:

Section 5.1 Default Watchdog Operation

2.23.~AA4N

Description:

This command is used to read the analog output safe value for channel N of a specified module.

Syntax:

~AA4N[CHKSUM](CR)

~	Delimiter character
AA	The address of the module to be read in hexadecimal format (00 to 1F)
4	The command to read the analog output safe value
N	The channel to be read, zero based

Response:

Valid Response: **!AA(Data)[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module ion hexadecimal format (00 to 1F)
(Data)	The analog output value. See Section 1.8 for details of the data format.

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+06.000 Response: >

Sets the analog outputs for channel 0 of the module 01 to 6 V and returns a valid response.

Command: ~0150 Response: !01

Sets the current analog output value for channel 0 of module 01 as the safe value and returns a valid response.

Command: ~0140 Response: !01+06.000

Reads the analog output safe value for channel 0 of module 01 and returns a valid response with a value of 6 V.

Command: ~014F Response: ?01

Attempts to read the analog output safe value for channel 15 of module 01, but returns an invalid response because channel 15 does not exist.

Related Commands:

Section 2.2 #AAN(Data), Section 2.24 ~AA5N

Related Topics:

Section 1.8 Type and Data Format Tables

2.24.~AA5N

Description:

This command is used to set the current analog output as the safe value for channel N of a specified module.

Syntax:

~AA5N[CHKSUM](CR)

~	Delimiter character
AA	The address of the module to be set in hexadecimal format (00 to 1F)
5	The command to set the analog output safe value
N	The channel to be set, zero based

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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+06.000 Response: >

Sets the analog outputs for channel 0 of module 01 to 6 V and returns a valid response.

Command: ~0150 Response: !01

Sets the current analog output value for channel 0 of module 01 as the safe value and returns a valid response.

Command: ~0140 Response: !01+06.000

Reads the analog output safe value for channel 0 of module 01 and returns a valid response with a value of 6 V.

Command: ~015F Response: ?01

Attempts to set the current analog output value for channel 15 of module 01 as the safe value, but returns an invalid response because channel 15 does not exist.

Related Commands:

Section 2.2 #AAN(Data), Section 2.23 ~AA4N

Related Topics:

Section 1.8 Type and Data Format Tables

2.25.~AA6PN(Data)

Description:

This command is used to set the analog output power-on value for channel N of a specified module.

Syntax:

~AA6PN(Data)[CHKSUM](CR)

~	Delimiter character
AA	The address of the module to be set in hexadecimal format (00 to 1F)
6P	The command to set the analog output power-on value
N	The channel to be set, zero based
(Data)	The analog output value. See the Section 1.8 for details of the data format.

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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: ~016P1+05.000 Response: !01

Sets the analog output power-on value for channel 1 of module 01 to 5 V and returns a valid response.

Command: ~016P0+25.000 Response: ?01

Attempts to set the analog output power-on value for channel 0 of module 01 to 25 V, but returns an invalid response because the output value is out of range.

Command: $0171 Response: !01+05.000

Reads the power-on value for channel 1 of module 01 and returns a valid response with a value of +05.000 (+5 V).

Related Commands:

Section 2.7 $AA4N, Section2.10 $AA7N

Related Topics:

Section 1.8 Type and Data Format Tables

2.26.~AA6SN(Data)

Description:

This command is used to set the analog output safe value for channel N of a specified module.

Syntax:

~AA6SN(Data)[CHKSUM](CR)

~	Delimiter character
AA	The address of the module to be set in hexadecimal format (00 to 1F)
6P	The command to set the analog output safe value
N	The channel to be set, zero based
(Data)	The analog output safe value. See the Section 1.8 for details of the data format.

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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: ~016S1+05.000 Response: !01

Sets the analog output safe value for channel 1 of module 01 to 5 V and returns a valid response.

Command: ~016S0+25.000 Response: ?01

Attempts to set the analog output safe value for channel 0 of module 01 to 25V, but returns an invalid response because the output value is out of range.

Command: ~0141 Response: !01+05.000

Reads the safe value for channel 1 of module 01 and returns a valid response with a value of +05.000 (+5 V).

Related Commands:

Section 2.23 ~AA4N, Section2.24 ~AA5N

Related Topics:

Section 1.8 Type and Data Format Tables

2.27.~AAEV

Description:

This command is used to enable or disable calibration on a specified module.

Syntax:

~AAEV[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set in hexadecimal format (00 to 1F)
E	The command to set the status of the calibration
V	0: Disables calibration 1: Enables calibration

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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

Attempts to send the command to perform a span calibration on module 01, but returns an invalid response because the “enable calibration” command, ~AAEV, was not sent in advance.

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 2.3 $AA0N, Section 2.4 $AA1N

Related Topics:

Section 1.9 Calibration

2.28.~AAO(Data)

Description:

This command is used to set the name of a specified module.

Syntax:

~AAO(Data)[CHKSUM](CR)

~	Delimiter character
AA	The address of the module to be set in hexadecimal format (00 to 1F)
O	The command to set the name of the module
(Data)	New name of the module (max. 6 characters)

Response:

Valid Response: **!AA[CHKSUM](CR)**
Invalid Response: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	The address of the responding module in hexadecimal format (00 to 1F)

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: ~01OZ2024 Response: !01

Sets the name of module 01 to “Z2024” and returns a valid response.

Command: $01M Response: !01Z2024

Reads module 01 and returns a valid response with the name“Z2024”.

Related Commands:

Section 2.16 $AAM

3. Modbus RTU Protocol

The Modbus protocol was developed by Modicon Inc., and was originally developed for Modicon controllers. Detailed information can be found at http://www.modicon.com/techpubs/toc7.html. You can also visit http://www.modbus.org to find more valuable information.

Function code	Description	Section
06 (0x06)	Sets an analog output channel	3.1
16 (0x10)	Sets an analog output channels	3.2
70 (0x46)	Reads/writes the module settings	3.3

Error Responses

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	Function code | 0x80
02	Exception code	1 Byte	01

Note: If a CRC mismatch occurs, the module will not respond.

3.1. Function 06 (0x06) - Set an Analog Output Channel

This function code is used to set the analog output for a specific channel of a specified module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x06
02 ~ 03	Starting channel	2 Bytes	0 to 3
04 ~ 05	Value of the analog output	2 Bytes	Data in 2’s complement hex format or engineering format

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x06
02	Byte count	1 Byte	0 to 3
03	Input channel data	1 Byte	Data in 2’s complement hex format or engineering format

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x86
02	Exception code	1 Byte	03: The analog output value is out of range or a Host Watchdog timeout has occurred.

3.2. Function 16 (0x10) - Read the analog output Channels

This function code is used to read from contiguous analog output channels.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x10
02 ~ 03	Starting channel	2 Bytes	0 to 3
04 ~ 05	Number of channels	2 Bytes	1 to 4
06	Byte count	1 Byte	C = Number of channels x 2
07 ~	The value of the analog output	C Bytes	Data in 2's complement hex format or engineering format

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x10
02 ~ 03	Starting channel	2 Bytes	0 to 3
04 ~ 05	Number of channels	2 Bytes	1 to 4

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x90
02	Exception code	1 Byte	03: The analog output value is out of range or a Host Watchdog timeout has occurred.

3.3. Function 70 (0x46) - Read/Write Module Settings

This function code is used to either read or change the settings of the module. The following sub-function codes are supported.

Sub-function Code	Description	Section
00 (0x00)	Reads the name of the module	3.3.1
32 (0x20)	Reads the firmware version information	3.3.2

If the module does not support the sub-function code specified in the message, then it will respond as follows.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	02: Indicates an invalid sub-function code

3.3.1 Sub-function 00 (0x00) - Read the name of the module

This sub-function code is used to read the name of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub-function code	1 Byte	0x00

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub-function code	1 Byte	0x00
03 ~ 06	Module name	4 Bytes	0x5A 0x20 0x24 0x00

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: An incorrect number of bytes were received

3.3.2 Sub-function 32 (0x20) - Read the firmware version information

This sub-function code is used to read the firmware version information for a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub-function code	1 Byte	0x20

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub-function code	1 Byte	0x20
03	Major version	1 Byte	0x00 ~ 0xFF
04	Minor version	1 Byte	0x00 ~ 0xFF
05	Reserved	1 Byte	0x00
06	Build version	1 Byte	0x00 ~ 0xFF

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: An incorrect number of bytes were received

3.4. Address Mappings

The address mappings are as follows:

Address	Description	Attribute
00260	Modbus Host Watchdog mode 0: The same as I-7000 series modules 1: The analog output and digital output commands can be used to clear the Host Watchdog timeout status	R/W
00261	Enables or disables the Host Watchdog 0: disabled 1: enabled	R/W
00269	Modbus data format 0: hexadecimal 1: engineering	R/W
00270	The Host Watchdog timeout status. Write 1 to clear the Host Watchdog timeout status	W
00272	The factory calibration parameters, write 1 to load	W
00273	The reset status 0: not the first time the status has been read after being powered on 1: the first time the status has been read after being powered on	R
00284	Enables ordisables calibration 0: disabled 1: enabled	R/W
10225 ~ 10228	Status of the wire connection 0: connected 1: disconnected	R
30065 ~ 30068	The analog output current readback	R
40033 ~ 40036	The analog output for channels 0 to 3	R/W
40097 ~ 40100	The analog output safe value for channels 0 to 3	R/W
40193 ~ 40196	The analog output power-on value for channels 0 to 3	R/W

40289 ~ 40292	The slew rate for channels 0 to 3	R/W
40417 ~ 40420	The analog output type code for channels 0 to 3	R/W
40481 ~ 40482	The firmware version information	R
40483 ~ 40484	The name of the module	R
40485	The module address, valid range: 0x1 ~ 0x1F	R
40486	Bits 5:0 Baud Rate, 0x0A Bits 7:6 Reserved	R
40489	The Host Watchdog timeout value, 0 ~ 255, in 0.1s	R/W
40492	The Host Watchdog timeout count, write 0 to clear	R/W
40673 ~ 40676	Trims the analog output for channels 0 to 3	W
40769 ~ 40772	The analog input calibration 0x5A45: zero calibration 0x5350: span calibration	W
40801 ~ 40802	The analog output calibration 0x5A45: zero calibration 0x5350: span calibration	W

Notes:

The command to load the factory calibration parameters takes about 3 seconds to be processed. The next command should not be sent before this time has elapsed.

3.5. Engineering Data Format Table

The Modbus protocol supports engineering data format, and the type code information is as follows.

Type Code	Analog Input Type	-F.S.	+F.S.
0	0 to +20 mA	0000	20000
1	+4 to +20 mA	4000	20000
2	0 to +10 V	0000	10000
3	-10 to +10 V	-10000	10000
4	0 to +5 V	0000	5000
5	-5 to +5 V	-5000	5000

4. Troubleshooting

If you are having difficulty using the ZB-2024 series modules, here are some suggestions that may help. If you cannot find the answers you need in this guide, contact ICP DAS Product Support. Contact information is located in Section 1.10.

4.1. Communicating with the module

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

- Ensure that the supplied power is within the range of +10 to +30 V DC. If the supplied power is correct, then the power LED should be on.
- When the module receives a command, the power LED will be set to “off”. The power LED will again be 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 that is known to be functional to check whether the host can communicate with the device through the same ZigBee network.
- If the host is a PC installed with a Windows operating system installed, then execute the DCON Utility to determine whether the module can be found. The DCON Utility can be downloaded from the ICP DAS website at http://www.icpdas.com. The documentation for DCON Utility can be found in the ”**Getting Started For I-7000 Series Modules**” manual.

5. Appendix

5.1. 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 module Watchdog reset 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 timeout occurs, the module will reset all outputs to a safe state in order to prevent the controlled target from performing any erroneous operations.

ZB-2000 series modules include an internal Dual Watchdog, making the control system more reliable and stable.