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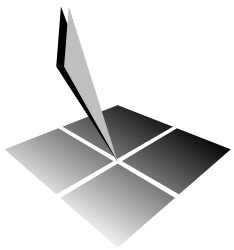
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FieldPoint™

FP-1000/1001 Programmer Reference Manual

NATIONAL INSTRUMENTS™

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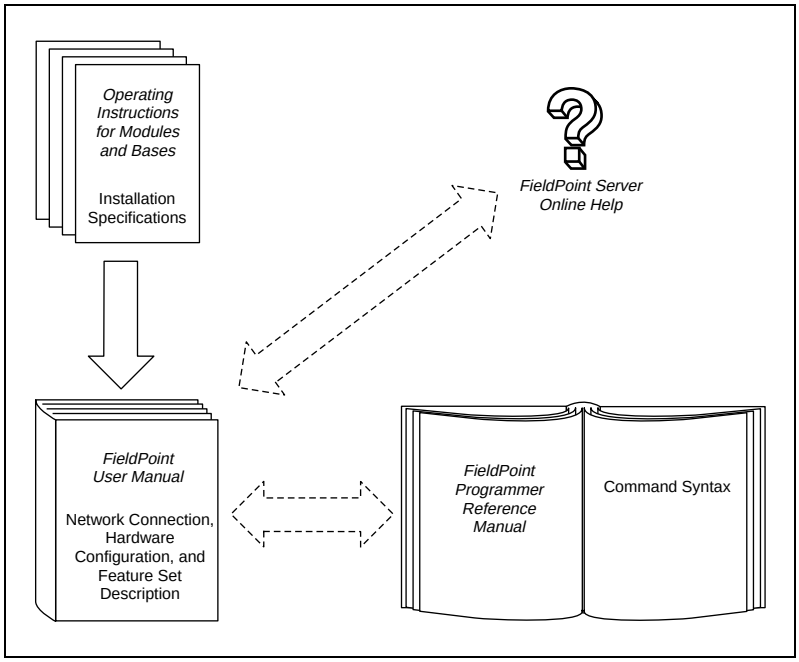
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About This Manual

This manual describes the FieldPoint command set, including syntax, responses, and examples. If you choose to use the FieldPoint server software, which takes care of building the commands and parsing the responses, refer instead to the FieldPoint server online help.

How To Use the Manual Set



Conventions

The following conventions appear in this manual:

0x	Numbers preceded by 0x are in hexadecimal form.
[ ]	Square brackets enclose optional items—for example, [`response`].
	This icon denotes a note, which alerts you to important information.

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bold	Bold text denotes items that you must select or click on in the software, such as menu items and command names.
italic	Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.
`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.
`monospace italic`	Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- Operating instructions for network modules, terminal bases, and I/O modules
- FieldPoint Server Online Help

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1

FieldPoint Commands Overview

This chapter gives an overview of the FieldPoint commands and describes the syntax used in the FieldPoint commands.

The protocol and syntax for the FieldPoint commands uses ASCII characters and is compatible with the Optomux protocol, enabling FieldPoint modules and Optomux devices to coexist on a network.

FieldPoint commands are of two types: standard and extended. The set of standard commands is a subset of Optomux commands that is provided for compatibility with existing Optomux servers or host software. After you have configured a FieldPoint module, you can use a generic Optomux server to communicate with it.

FieldPoint extended commands support FieldPoint modules more completely, and National Instruments recommends that you use the extended commands whenever possible. The standard command descriptions include a list of the recommended extended commands.

If you are using the FieldPoint server software, you do not need to know the detailed information given in this manual, because the FieldPoint Server takes care of building the commands and parsing the responses for you.

Command Fields

All FieldPoint commands have the syntax described in this section and contain the following five fields.

[*start*][*address*][*command*][*checksum*][*end*]

[*start*] Each command starts with the “>” character (ASCII value 62).

[*address*] Two ASCII-hex characters. Immediately following the [*start*] field, each command must specify the address of the module that the command is intended for. This field can be between 00–F9 for networks built with the FP-1000 and FP-1001 FieldPoint network modules.

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[*command*] Immediately following the [*address*] field is the body of the command. This field is composed of four subfields, some of which may not be required for all FieldPoint commands. The [*command*] field includes the following subfields:

[*cmdchars*] One or two ASCII-hex characters. All FieldPoint commands must contain this subfield.

Standard commands have a single command character (within the range "A"–"Z" or "a"–"i"). Extended commands have two characters and always begin with the "!" character (ASCII value 33). The second command character is the FieldPoint extended command character (within the range "A"–"Z" or "a"–"z").

[*position*] Zero to four ASCII-hex characters. Some FieldPoint commands do not contain this subfield.

This field specifies the FieldPoint module positions (channels) that are targeted or affected by the command. Each bit in this field represents one channel, for a maximum of 16 channels per FieldPoint module. Bit 15 represents channel 15, and bit 0 represents channel 0. Standard commands may contain zero to four characters in this field, while extended commands standardize this field to either no characters (when the command does not specify individual channels) or four characters (when the command does specify individual channels).

[*modifier*] Zero or more ASCII-hex characters. Some FieldPoint commands do not contain this subfield. This field is used by commands that support multiple execution features.

[*data*] Zero or more ASCII-hex characters. Some FieldPoint commands do not contain this subfield. This field contains command-specific characters.

[*checksum*] Two ASCII-hex characters. This field enables error checking for the command. This field is calculated by adding the numeric values of all the characters in the [*address*] and [*command*] fields and determining the modulo-256 of the sum. The modulus (remainder) of the division is converted to two ASCII-hex characters to form the [*checksum*] field.

If error checking is not required, this field should contain two question marks, "??". This option enables simpler command formation during debugging and interactive operations.

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[*end*] One ASCII-hex character. This field indicates the end of the command. Either a carriage return (ASCII value 13) or a "." (ASCII value 46) can be used in this field.

In the description of the individual commands later in this manual, only the fields that are relevant to the command are described. The [*start*] field, the [*address*] field, the [*checksum*] field, and the [*end*] field are not described for each command because they have the same syntax for all commands. The individual command descriptions include their use of the [*command*] field and its subfields.

Syntax Example

This section describes an example using the standard command for **Write Analog Outputs**. Consider the following command:

```
>33J0011456??.
```

This command directs the FieldPoint module at address 0x33 to set the outputs for channel-4 and channel-0 to 0x456.

The > character is the [*start*] field, 33 is the [*address*] field, and J0011456 is the [*command*] field.

Within the [*command*] field, J is the [*cmdchar*] subfield, 0011 is the [*position*] subfield, and 456 is the [*data*] subfield. Note that this command does not use a [*modifier*] subfield.

Note that "??" characters are shown in the command example to indicate that the [*checksum*] field has not yet been calculated. The checksum calculation includes the [*address*] field and the [*command*] field. The checksum calculation is as follows:

Characters:	3	3	J	0	0	1	1	4	5	6
Numeric Values:	51	51	74	48	48	49	49	52	53	54
Numeric Sum:	529									
Modulus:	17 (or hex 11)									
Checksum:	11									

Thus the checksum characters are 1 followed by 1. The two question marks should be replaced by this actual checksum, to yield the completed command as follows:

```
>33J001145611.
```

In this example, the "." character is the [*end*] field.

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2

FieldPoint Responses

This chapter describes the success and error responses that might be sent by a FieldPoint module when it receives a command.

FieldPoint Success Responses

The success response to a FieldPoint command (standard or extended) can take one of the following two forms:

- A[*cr*]—This success response indicates that the command was executed successfully, and no other information is required in the response. No checksum is sent within this type of success response.
- A[*response data*][*checksum*][*cr*]—This type of success response is for commands that require certain information from the module. A [*checksum*] field is returned with this type of success response. The [*checksum*] field is calculated by adding the numeric values of all the characters in the [*response data*] field and determining the modulo-256 of the sum. The modulus (remainder) of the division is converted to two ASCII-hex characters to form the [*checksum*] field. This is the same calculation as described earlier in Chapter 1, *FieldPoint Commands Overview*.

FieldPoint Error Responses

A FieldPoint module returns an error response when an erroneous condition is detected during the reception or execution of a command. FieldPoint modules return only the standard errors (N00 through N07) in response to all standard commands, which enables FieldPoint modules to work with host software that is written for the Optomux protocol. In response to the extended commands, FieldPoint modules return either standard or extended errors, depending on which is most appropriate.

The error response to a FieldPoint command (standard or extended) has the following form: N[*error number*][*cr*] where [*error number*] is two ASCII-hex characters. The error numbers are listed and described in this chapter.

No checksum is returned within a FieldPoint error response.

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Standard Error Responses

The error numbers in Table 2-1 can be sent by a FieldPoint module in response to either standard or extended FieldPoint commands. The error tags are abbreviations used only in this manual, in place of the error numbers, to help make reading easier.

Table 2-1. FieldPoint Standard Error Responses

Error Number (Hex)	Error Tag	Description
00	E_PUCLR_EXP	**Power Up Clear** expected. The command was ignored. A command other than **Power Up Clear** was attempted after power-up or power failure. Once the error is received by the host, it is unnecessary to send the **Power Up Clear** command, because the next command is executed normally. If this error message is received, the FieldPoint network module has gone through its power-up sequence and has reset all characteristics to defaults. If SnapShot is enabled, the module is configured in accordance with the stored SnapShot information.
01	E_INVALID_CMD	Undefined command. The command character was not a legal command character, or the addressed module does not support this command. The command was ignored.
02	E_BAD_CHECKSUM	Checksum error. The checksum received in the command did not match the calculated checksum of the characters in the command. The command was ignored.
03	E_INBUF_OVRFLO	Input buffer overrun. The received command was too long. The command was ignored.
04	E_ILLEGAL_CHAR	Non-printable ASCII character received. Only characters from ASCII value 33 to 127 are permitted within commands. The command was ignored.
05	E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.

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Table 2-1. FieldPoint Standard Error Responses (Continued)

Error Number (Hex)	Error Tag	Description
06	E_WATCHDOG_TMO	Communications link network watchdog timed out. The command was ignored.
07	E_INV_LIMS_GOT	Specified limits invalid for the command. This includes notification that an invalid digit (hex or decimal) was received.

Extended Error Responses

Table 2-2 lists the FieldPoint extended error responses, which can be sent by a FieldPoint module in response to only extended FieldPoint commands. The error tags are abbreviations used only in this manual, in place of the error numbers, to help make reading easier.

Table 2-2. FieldPoint Extended Error Responses

Error Number (Hex)	Error Tag	Description
80	E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
81	E_BAD_ADDRESS	The command is valid, but the addressed module does not support the command received.
82	E_INBUF_FRMERR	The FieldPoint network module detected a serial framing error in the command. The command was ignored.
83	E_NO_MODULE	The addressed module does not exist.
84	E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified. The command was ignored.
85	E_INV_RANGE	One or more ranges specified in the command either do not exist or do not support the setting specified. The command was ignored.
86	E_INV_ATTR	One or more attributes specified in the command either do not exist or do not support the setting specified. The command was ignored.

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Table 2-2. FieldPoint Extended Error Responses (Continued)

Error Number (Hex)	Error Tag	Description
88	E_HOTSWAP	The module has been hot-swapped since it was last sent a command. This response is sent only if the network module is enabled to report hot-swaps, and if the hot-swap occurred after hot-swap reporting mode was enabled. The command was ignored. This error number can be sent in response to a standard command if you have enabled hot-swap reporting for the bank.
89	E_ADDR_NOT_SAME	The module addressed by the **Resend Last Response** is not the same as the module addressed by the previous command.
8A	E_NO_RESEND_BUF	The response to the last command is unavailable.
8B	E_HW_FAILURE	An irrecoverable fault has occurred.
8C	E_UNKNOWN	An unidentifiable error condition has occurred.

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3

FieldPoint Command Directory

This chapter provides a directory for the standard and extended FieldPoint commands.

If you are using the FieldPoint server software, you do not need to know the detailed information given in this manual, because the FieldPoint Server takes care of building the commands and parsing the responses for you.

The standard FieldPoint commands are provided for compatibility with generic Optomux servers or host software. National Instruments recommends that you use the extended commands whenever possible. The standard command descriptions include a list of the recommended extended commands.

Table 3-1 lists all of the FieldPoint standard commands by type. Refer to Chapter 4, *Standard FieldPoint Command Descriptions*, for detailed descriptions of each of the standard commands.

Table 3-2 lists all of the FieldPoint extended commands by type. Refer to Chapter 5, *Extended FieldPoint Command Descriptions*, for detailed descriptions of each of the extended commands.

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Table 3-1. Standard FieldPoint Commands and Syntax

Command Type and Name	Command Syntax	Success Response
Utility Commands:		
Power Up Clear	A	A
Reset	B	A
Configuration Commands:		
Set Turn-around Delay	C	A
Identify Optomux Type	F	A[*type*]
Configure Positions	G[*positions*]	A
Configure As Inputs	H[*positions*]	A
Configure As Outputs	I[*positions*]	A
Read Module Configuration	j	A[*config*]
Watchdog Commands:		
Set Analog Watchdog Delay	D[*positions*][*wdgTmo*]	A
Set Analog Watchdog Data	m[*positions*][*data*]	A
Enhanced Discrete Watchdog	m[*positions*][*wdgTmo*]	A
Discrete Commands:		
Write Outputs	J[*positions*]	A
Activate Outputs	K[*positions*]	A
Deactivate Outputs	L[*positions*]	A
Read ON/OFF Status	M	A[*data*]
Analog Commands:		
Write Analog Outputs	J[*positions*][*data*]	A
Read Analog Outputs	K[*positions*]	A[*data*]
Read Analog Inputs	L[*positions*]	A[*data*]
Update Analog Outputs	S[*positions*][*data*]	A

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Table 3-2. Extended FieldPoint Commands and Syntax

Command Type and Name	Command Syntax	Success Response
Utility Commands:		
Read Module ID	!A	A[*modID*]
Read All Module IDs	!B	A[*number*][*modarray*]
HotSwap Reporting Mode	!b[*flag*]	A
Resend Last Response	!c	A
Read Firmware Revision	!e	
Read Module Status	!N	A[*mod_status*]
Read Channel Status	!O[*positions*]	A[*chnl_status*]
Read Bank Status	!P	A[*bank_status*]
Reset Module	!Z	A
Execute Channel Command	!n[*positions*]{[*command type*][*command*] *pairs*}	A
Configuration Commands:		
Set Attributes	!D[*positions*]{[*attrMask*][*rangeMask*][*settings*] triplets}	A
Get Attributes	!E[*positions*]{[*attrMask*][*rangeMask*] *pairs*}	A{[*settings*] *array*}
Discrete Commands:		
Read Discrete	!J	A[*data*]
Read Discrete with Status	!K	A[*status*][*data*]
Write Discrete	!L[*positions*][*data*]	A
Write Discrete with Status	!M[*positions*][*data*]	A[*status*]
Analog Commands:		
Read 16-bit Data	!F[*positions*]	A[*data*]
Read 16-bit Data with Status	!G[*positions*]	A[*status*][*data*]
Write 16-bit Data	!H[*positions*][*data*]	A[*positions*][*data*]
Write 16-bit Data with Status	!I[*positions*][*data*]	A[*status*]

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Table 3-2. Extended FieldPoint Commands and Syntax (Continued)

Command Type and Name	Command Syntax	Success Response
Watchdog Commands:		
Set Watchdog Delay	!Q[*wdgTmo*]	A[*wdgTmo*]
Set Discrete Watchdog Data	!R[*positions*][*wdgData*]	A
Set 16-bit Watchdog Data	!S[*positions*][*wdgData*]	A
Set Watchdog Data Status	!T[*positions*][*mask*]	A
Get Watchdog Info	!U	A[*moduleInfo*] [*chnlEnable*] [*chnlWdgData*]
SnapShot/Programmable Power-Up Commands:		
Store Attributes	!f[*positions*]{[*attrMask*] [*rangeMask*][*settings*] *triplets*}	A
Store 16-bit Data	!g[*positions*][*data*]	A
Store Discrete	!h[*positions*][*data*]	A
Store Discrete Watchdog Data	!i[*positions*][*wdgData*]	A
Store 16-bit Watchdog Data	!j[*positions*][*wdgData*]	A
Store Watchdog Data Status	!k[*positions*][*mask*]	A
Store Watchdog Enable	!l[*wdgTmo*]	A
Store Watchdog Delay	!V[*wdgTmo*]	A
Store SnapShot	!W	A
Use SnapShot	!X[*flag*]	A[*flag*]
Read SnapShot Status	!Y	A[*status*]

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4

Standard FieldPoint Command Descriptions

This chapter describes each standard FieldPoint command in detail. The commands are listed in alphabetical order by command characters.

If you do not know the command characters of the command you need, refer to Chapter 3, *FieldPoint Command Directory*, for help.

If you are using the FieldPoint server software, you do not need to know the detailed information given in this manual, because the FieldPoint Server takes care of building the commands and parsing the responses for you.

The standard FieldPoint commands are provided for compatibility with generic Optomux servers or host software. National Instruments recommends that you use the extended commands whenever possible. The standard command descriptions include a list of the recommended extended commands.

In this chapter, the [*start*] field, the [*address*] field, the [*checksum*] field and [*end*] field are not described for each command since they have the same syntax for all commands. The individual commands describe their use of the [*command*] field and its sub-fields.

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Power Up Clear [cmdchars] = A

Description

Power Up Clear should be the first command issued to a FieldPoint module. This command prevents the FieldPoint module from returning a power-up clear expected error (E_PONCLR_EXP) message in response to the first command following application of power.

This command functions only if it is the first command sent after power-up. If this command is sent to a module after the first command has been sent, the module responds with a success response. A power-up clear expected error is returned if any other command is sent first. After a power-up clear expected error is returned this command does not need to be sent; the next command executes normally.

This command has no effect on the FieldPoint module operation or setup; the power-up clear expected error provides an indication to the host that there has been a power failure and that the FieldPoint module has been reset to power-up configuration.

Syntax

A

Success Response

A

Error Responses

E_INV_LIMS_GOT Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33A??[cr]`

This example sends **Power Up Clear** to the FieldPoint module at address 51 (0x33). “??” is the [*checksum*] field.

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Reset [cmdchars] = B

Recommended Extended Command

National Instruments recommends that you use the **Reset Module** extended command (!Z) instead of the **Reset** command.

Description

The **Reset** command resets all of the operating characteristics of the addressed FieldPoint module to power-up conditions. If the SnapShot feature is enabled, the user-defined power-up settings are automatically written to the FieldPoint module. Otherwise, the FieldPoint module is initialized with its factory default settings. By default, turn-around delay and watchdog are disabled.

Syntax

B

Success Response

A

Error Responses

E_INV_LIMS_GOT Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33B??[*cr*]

This example resets FieldPoint module at address 51 (0x33) to its power-up conditions.

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Set Turn-around Delay [cmdchars] = C

Description

The **Set Turn-around Delay** command tells the FieldPoint module to wait for a specified time before responding to commands sent from the host.

Syntax

C[*data*]

[*data*] Specifies the delay time as shown in the following table.

[data] Value	Delay
0	No Delay
1	10 ms
2	100 ms
3	500 ms

If no delay is specified, 0 is assumed. On power-up, the turn-around delay time is zero.

Success Response

A

Error Responses

E_INV_LIMS_GOT Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33C2??[*cr*]

This command sets the turn-around delay of the FieldPoint module at address 51 (0x33) to 100 ms.

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Set Analog Watchdog Delay [cmdchars] = D

Recommended Extended Commands

National Instruments recommends that you use either the **Set Watchdog Delay** (`!Q`) or **Use Watchdog Delay** (`!T`) extended commands instead of the **Set Analog Watchdog Delay** command.

Description

The **Set Analog Watchdog Delay** command sets up the timeout value for the FieldPoint bank watchdog timer. In addition, this command enables the channels in the addressed FieldPoint module to take a predetermined action if the watchdog timer expires.

Note A FieldPoint bank has a common timeout value for all the modules within the bank. Therefore, the watchdog timer value for the bank is always set to the most recent timeout value specified for a module in the bank. For more flexibility, use the recommended extended commands.

Syntax

`D[positions][wdgTmo]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel must be enabled to source (or disabled from sourcing) a pre-specified value if the network watchdog timer expires. A zero in any bit means that the corresponding channel’s enabled/disabled setting is not changed.

If a channel is targeted by this field, and `[wdgTmo]` ≥ 20, it is enabled to source its pre-specified value. If a channel is targeted by this field, and `[wdgTmo]` = 0, it is disabled from sourcing its pre-specified value.

If one or more targeted channels are input channels, they are not affected.

Note The pre-specified value(s) for the channel(s) must be set up using the **Set Analog Watchdog Data** command before this command is sent.

`[wdgTmo]` Zero to four ASCII-hex characters. The watchdog timer is set to be 10 times the number of milliseconds specified in this field.

Non-zero delays of less than 200 ms (0 < `[wdgTmo]` < 20) result in an error. A `[wdgTmo]` of 0 disables the module from being affected by a watchdog timer expiration. In addition, all the targeted channels are disabled from

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sourcing their pre-specified values. If no [*wdgTmo*] is specified, 0 is assumed.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33D00011F4??[*cr*]

This command instructs the FieldPoint analog module at address 51 (0x33) to set the watchdog timeout value to 5 s.

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Identify Optomux Type [cmdchars] = F

Description

The **Identify Optomux Type** command returns the addressed FieldPoint module's type.

Syntax

F

Success Response

A[*type*]

[*type*] Specifies the module type as shown in the following table.

[type] Value	Module Type
00	Discrete FieldPoint Module (Responds to the discrete Optomux commands)
01	Analog FieldPoint Module (Responds to analog Optomux commands)

Error Responses

Refer to Chapter 2, *FieldPoint Responses*, for possible error responses, error numbers, and error descriptions.

Example

>33F??[*cr*]

This command reads the FieldPoint module at address 51 (0x33).

A0161cr

This response from the FieldPoint module identifies an analog module.

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Configure Positions [cmdchars] = G

Description

The **Configure Positions** command verifies whether the specified channels of the addressed FieldPoint module are inputs or outputs. You do not need to use this command before reading or writing to FieldPoint modules.

Syntax

G[*positions*]

[*positions*] Zero to four ASCII-hex characters, specifying the direction of the module's channels. A "1" in any bit means that the corresponding channel is expected to be an output. A zero in any bit means that the corresponding channel is expected to be an input.

If one to three characters are sent, the channels corresponding to the missing bits are not verified.

If no characters are sent, "FFFF" is assumed.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33G1133??[*cr*]

This command instructs the FieldPoint module at address 51 (0x33) to verify that channels 0, 1, 4, 5, 8, and 12 are outputs. All other channels are expected to be inputs.

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Configure As Inputs [cmdchars] = H

Description

The **Configure As Inputs** command verifies that the specified channels of the addressed FieldPoint module are inputs. You do not need to use this command for operation of the FieldPoint input modules.

Syntax

H[*positions*]

[*positions*] Zero to four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel is targeted, and is expected to be an input. A zero in any bit means that the corresponding channel is not to be verified.

If one to three characters are sent, the channels corresponding to the missing bits are not verified. Missing characters are assumed to be “0”.

If no characters are sent, “FFFF” is assumed.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33H5??[*cr*]

This command verifies that channels 0 and 2 on the FieldPoint module at address 51 (0x33) are inputs.

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Configure As Outputs [cmdchars] = I

Description

The **Configure As Outputs** command verifies that the specified channels of the addressed FieldPoint module are outputs. You do not need to use this command before writing to the FieldPoint output modules.

Syntax

I[*positions*]

Note This command is an uppercase I, not a lowercase L.

[*positions*] Zero to four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel is targeted, and is expected to be an output. A zero in any bit means that the corresponding channel is not to be verified.

If one to three characters are sent, the channels corresponding to the missing bits are not verified. Missing characters are assumed to be “0”.

If no characters are sent, “FFFF” is assumed.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33I5??[*cr*]

This command verifies that channels 0 and 2 on the FieldPoint module at address 51 (0x33) are outputs.

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Write Outputs [cmdchars] = J

Recommended Extended Commands

National Instruments recommends that you use either the **Write Discrete** (`!L`) or **Write Discrete with Status** (`!M`) extended command instead of the **Write Outputs** command.

Description

The **Write Outputs** command drives outputs ON or OFF on channels of the addressed FieldPoint module.

Syntax

`J[positions]`

`[positions]` Zero to four ASCII-hex characters, specifying the desired output levels for the channels. A “1” in any bit means that the corresponding channel is to be turned ON. A zero in any bit means that the corresponding channel is to be turned OFF.

Channels that are inputs are not affected.

If one to three characters are sent, the channels corresponding to the missing bits are left unchanged.

If no characters are sent, “FFFF” is assumed.

Success Response

`A`

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33J0??[cr]`

This command turns OFF outputs 0, 1, 2, and 3 on the FieldPoint module at address 51 (0x33); module positions 4–15 are not affected.

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Write Analog Outputs [cmdchars] = J

Recommended Extended Commands

National Instruments recommends that you use either the **Write 16-bit Data** (`!H`) or **Write 16-bit Data with Status** (`!I`) commands instead of the **Write Analog Outputs** command.

Description

The **Write Analog Outputs** command sets the targeted channels on the addressed module to a specified output level. The output level is a 12-bit value, and all the targeted output channels are set to this output level. This command sets the most significant 12 bits of channels that have greater that 12-bit resolution. For 16-bit resolution, use the extended FieldPoint commands.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`J[positions][data]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel is to be set to the output level specified by `[data]`. A zero in any bit means that the corresponding channel is not targeted by this command.

Targeted channels that are inputs are not affected.

`[data]` Three ASCII-hex characters. This field specifies a 12-bit value, and all the targeted channels are set to this value. The value is between 0x000 (0 decimal) and 0xFFF (4095 decimal). The 0x000 represents the zero-scale level and 0xFFF represents the full-scale level for the channels.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

This example assumes that the FieldPoint module at address 51 (0x33) has 0–5 V range for channels 1 and 0. This example sets channels 1 and 0 to 1.25 V. The [*data*] field is calculated as follows:

(1.25 V – 0 V)/5 V * 4095 = 1024 decimal = 400 hex

The command becomes:

`>33J0003400??[cr]`

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Read Module Configuration [cmdchars] = j

Description

The **Read Module Configuration** command reads the current direction (input or output) of all the channels of the addressed FieldPoint module.

Syntax

`j`

Success Response

`A[config]`

`[config]` Four ASCII-hex characters, specifying the direction of the channels in the module. A “1” in any bit means that the corresponding channel is configured as an output. A zero in any bit means that the corresponding channel is configured as an input.

If a channel does not exist, it is reported to be an input.

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33j??cr`

This command is sent from the host to a 16-channel FieldPoint module at address 51 (0x33), requesting the current configuration of all the positions.

`A0000[cs][cr]`

This is a response from the FieldPoint module indicating that all positions are configured as inputs.

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Activate Outputs [cmdchars] = K

Recommended Extended Commands

National Instruments recommends that you use either the **Write Discrete** (`!L`) or **Write Discrete with Status** (`!M`) extended command instead of the **Activate Outputs** command.

Description

The **Activate Outputs** command drives outputs ON on targeted channels of the addressed FieldPoint module.

Syntax

`K[positions]`

`[positions]` Zero to four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel is to be turned ON. A zero in any bit means that the corresponding channel is not affected.

Channels that are inputs are not affected.

If one to three characters are sent, the channels corresponding to the missing bits are left unchanged.

If no characters are sent, “FFFF” is assumed.

Success Response

`A`

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33K55CC??[cr]`

This command instructs the FieldPoint module at address 51 (0x33) to turn ON outputs at positions 2, 3, 6, 7, 8, 10, 12, and 14. All other positions are not affected.

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Read Analog Outputs [cmdchars] = K

Recommended Extended Commands

National Instruments recommends that you use either the **Read 16-bit Data** (!F) or **16-bit Data with Status** (!G) extended commands instead of the **Read Analog Outputs** command.

Description

The **Read Analog Outputs** command reads the output levels driven by the targeted channels on the addressed module. Each level value is a 12-bit value, and is the same as described in the **Write Analog Outputs** command. This command reads the most significant 12 bits of channels that have greater than 12-bit resolution. For 16-bit resolution, use the extended FieldPoint commands.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

K[*positions*]

[*positions*] Zero to four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel is to be read. A zero in any bit means that the corresponding channel is not targeted by this command.

If one to three characters are sent, the channels corresponding to the missing bits are not read.

If no characters are sent, FFFF is assumed.

Success Response

A[*data*]

[*data*] Three ASCII-hex characters per targeted channel. This field specifies one 12-bit value for each of the targeted output channels. The first value (three characters) is for the channel corresponding to the most significant “1” in the [*positions*] field, and so on.

Each level value is a 12-bit value, and is the same as described in the **Write Analog Outputs** command.

Targeted channels that are inputs return “???” as their output levels.

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Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33K380??[cr]`

This command requests the values for positions 7, 8, and 9 of the FieldPoint module at address 51 (0x33).

`A000BE2???[cs][cr]`

This response indicates that position 9 is an output with a value of 0x000 hex, position 8 is an output with a value of 0xBE2, and position 7 is configured as an input.

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Deactivate Outputs [cmdchars] = L

Recommended Extended Commands

National Instruments recommends that you use either the **Write Discrete** (`!L`) or **Write Discrete with Status** (`!M`) extended command instead of the **Deactivate Outputs** command.

Description

The **Deactivate Outputs** command drives outputs OFF on targeted channels of the addressed FieldPoint module.

Syntax

`L[positions]`

`[positions]` Zero to four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel is to be turned OFF. A zero in any bit means that the corresponding channel is not affected.

Channels that are inputs are not affected.

If one to three characters are sent, the channels corresponding to the missing bits are left unchanged.

If no characters are sent, “FFFF” is assumed.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33L6??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to turn OFF outputs at positions 1 and 2.

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Read Analog Inputs [cmdchars] = L

Recommended Extended Commands

National Instruments recommends that you use either the **Read 16-bit Data** (`!F`) or **Read 16-bit Data with Status** (`!G`) extended command instead of the **Read Analog Inputs** command.

Description

The **Read Analog Inputs** command reads the levels of the targeted channels on the addressed module. Each level value is a four-character value.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`L[positions]`

`[positions]` Zero to four ASCII-hex characters, specifying the channels targeted by this command. A "1" in any bit means that the corresponding channel is to read. A zero in any bit means that the corresponding channel is not targeted by this command.

If one to three characters are sent, the channels corresponding to the missing bits are not read.

If no characters are sent, FFFF is assumed.

Success Response

`A[data]`

`[data]` Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant "1" in the `[positions]` field, and so on.

The first (most significant) character is a "1". The next three characters specify a 12-bit value, and all the targeted channels are set to this value. The value is between 0x000 (0 decimal) and 0xFFF (4095 decimal). The 0x000 represents the zero-scale level and 0xFFF represents the full-scale level for the channels.

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You can alternately treat all four characters as a single number. Since that single number would be between 0x100 and 0x1FFF, you should subtract an offset of 0x1000 from the number to get the actual level of the channel.

Targeted channels that are outputs return "????" as their levels.

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33L5??[cr]`

This command reads the values of positions 0 and 2 from a FieldPoint module at address 51 (0x33).

`A10001888[cs][cr]`

This response from the FieldPoint module indicates a value of 0x1000 for position 2 and a value of 0x1888 for position 0. Both values are valid readings in the range of 0x1000 to 0x1FFF.

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Read ON/OFF Status [cmdchars] = M

Recommended Extended Commands

National Instruments recommends that you use either the **Read Discrete** (!J) or **Read Discrete with Status** (!K) extended command instead of the **Read ON/OFF Status** command.

Description

The **Read ON/OFF Status** command reads the levels of all the channels in the addressed FieldPoint module.

Syntax

M

Success Response

A[*data*]

[*data*] Four ASCII-hex characters, specifying the channel levels. A “1” in any bit means that the corresponding channel is ON. A zero in any bit means that the corresponding channel is OFF.

If a channel does not exist, its output level is reported as OFF.

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33MD9[*cr*]

This command is sent from the host to the FieldPoint module at address 51 (0x33), requesting the ON/OFF status of all positions.

A0AC2[*cs*][*cr*]

This is a response from the FieldPoint module indicating that positions 1, 6, 7, 9, and 11 are ON, and that all others are OFF.

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Set Analog Watchdog Data [cmdchars] = m

Recommended Extended Command

National Instruments recommends that you use the **Set 16-bit Watchdog Data** (!R) extended command instead of the **Set Analog Watchdog Data** command.

Description

The **Set Analog Watchdog Data** command sets up the pre-specified levels that the channels in the addressed FieldPoint module must be set to if the watchdog timer expires. This command can only be sent to an analog FieldPoint module. This command should be sent prior to enabling the module's watchdog timer function.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

m[*positions*][*data*]

[*positions*] Four ASCII-hex characters, specifying the channels targeted by this command. A "1" in any bit means that the command is pre-specifying an output value for the corresponding channel. A zero in any bit means that the corresponding channel is not targeted by this command.

If a targeted channel is an input, the FieldPoint module responds with an error.

[*data*] Three ASCII-hex characters per targeted channel. This field specifies a 12-bit value, and all the targeted channels are set to this value. The value is between 0x000 (0 decimal) and 0xFFF (4095 decimal). The 0x000 represents the zero-scale level and 0xFFF represents the full-scale level for the channels.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

```
>33m0081A20555??[cr]
```

This command instructs the FieldPoint module at address 51 (0x33) to output the value 0xA20 to position 7 and a value of 0x555 to output position 0 when a serial watchdog timeout occurs.

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Enhanced Discrete Watchdog [cmdchars] = m

Recommended Extended Commands

National Instruments recommends that you use the **Set Watchdog Delay** (!Q), **Set Discrete Watchdog Data** (!R), or **Set Watchdog Data** (!T) extended commands instead of the **Enhanced Discrete Watchdog** command.

Description

The **Enhanced Discrete Watchdog** command sets up the timeout value for the FieldPoint bank's watchdog timer. In addition, this command sets up the levels that the output channels in the addressed FieldPoint module must be set to if the watchdog timer expires. This command can only be sent to a discrete FieldPoint module.



Note A FieldPoint bank has a common timeout value for all the modules within the bank. Therefore, the watchdog timer value for the bank is always set to the most recent timeout value specified for a module in the bank. For more flexibility, use the recommended extended commands.

Syntax

m[*positions*][*wdgTmo*]

[*positions*] Four ASCII-hex characters, pre-specifying the levels which the output channels must source if the bank's watchdog timer expires. A "1" in any bit means that the corresponding channel must be turned ON if the network watchdog timer expires. A zero in any bit means that the corresponding channel must be turned OFF if the network watchdog timer expires.

If a channel is targeted by this field, and [*wdgTmo*] ≥ 20, it is enabled to source its pre-specified value. If a channel is targeted by this field, and [*wdgTmo*] = 0, it is disabled from sourcing its pre-specified value.

If one or more targeted channels are input channels, they are not affected.



Note All output channels of the discrete module are affected by this command.

[*wdgTmo*] Zero to four ASCII-hex characters. The watchdog timer is set equal to 10 times the number of milliseconds specified in this field. Non-zero delays of less than 200 ms ([*wdgTmo*] < 20) result in an error. A [*wdgTmo*] of 0 disables the module from being affected by a watchdog timer expiration. In addition, all the channels are disabled from sourcing their pre-specified values. If no [*wdgTmo*] is specified, 0 is assumed.

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Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33m0A841F4??[cr]`

This command instructs the FieldPoint discrete module at address 51 (0x33) to turn ON output channels 11, 9, 7, and 2 and turn OFF all other output channels if there is no activity on the serial line for five seconds. This example assumes that the positions indicated were previously configured as outputs.

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Update Analog Outputs [cmdchars] = S

Recommended Extended Commands

National Instruments recommends that you use either the **Write 16-bit Data** (`!H`) or **Write 16-bit Data with Status** (`!I`) extended command instead of the **Update Analog Outputs** command.

Description

The **Update Analog Outputs** command sets the targeted channels on the addressed module to specified output levels. The command specifies a level for each targeted output channel. Each level value is a 12-bit value, and is the same as described in the **Write Analog Outputs** command. This command sets the most significant 12 bits of channels that have greater than 12-bit resolution. For 16-bit resolution, use the extended FieldPoint commands.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`S[positions][data]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel is to be set to the output level specified by `[data]`. A zero in any bit means that the corresponding channel is not targeted by this command.

Targeted channels that are inputs are not affected.

`[data]` Three ASCII-hex characters per targeted channel. This field specifies one 12-bit value for each of the targeted channels. The first value (three characters) is for the channel corresponding to the most significant “1” in the `[positions]` field, and so on.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

```
>33S0224FFF0C01F0??[cr]
```

This command instructs the FieldPoint module at address 51 (0x33) to write 0x1F0 to position 2, 0x0C0 to position 5, and 0xFFF to position 9.

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5

Extended FieldPoint Command Descriptions

This chapter describes each extended FieldPoint command in detail. The commands are listed in alphabetical order by command characters.

If you do not know the command characters of the command you need, refer to Chapter 3, *FieldPoint Command Directory*, for help.

If you are using the FieldPoint server software, you do not need to know the detailed information given in this manual, because the FieldPoint Server takes care of building the commands and parsing the responses for you.

In this chapter the [*start*] field, the [*address*] field, the [*checksum*] field and [*end*] field are not described for each command since they have the same syntax for all commands. The individual commands describe their use of the [*command*] field and its sub-fields.

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Read Module ID

[cmdchars] = !A

Description

The **Read Module ID** command reads the module ID for the addressed module. Use the **Read All Module IDs** command (`!B`) to read all the module IDs for a bank.

Syntax

`!A`

Success Response

`A[`*`modID`*`]`

[*modID*] Four ASCII-hex characters. It is a 16-bit number representing the module ID as shown in the following table.

[modID] Value	Module Name
0001	FP-1000
0002	FP-1001
0101	FP-AI-110
0102	FP-AO-200
0103	FP-DI-330
0104	FP-DO-400
0105	FP-DI-301
0106	FP-DO-401
0107	FP-TC-120
0108	FP-RLY-420
0109	FP-DI-300
010A	FP-AI-100
010B	FP-RTD-122
010C	FP-AI-111
010D	FP-CTR-500
010E	FP-PWM-520

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[modID] Value	Module Name
010F	FP-AO-210
0110	FP-DO-410
0111	FP-DO-403
FFFF	Empty Base

Error Responses

E_NO_MODULE The addressed module does not exist.
E_INV_LIMS_GOT Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!A??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to return its module ID.

`A0101[cs][cr]`

This response from the FieldPoint module indicates that its module ID is 0x0101 (an FP-AI-110 module).

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Read All Module IDs [cmdchars] = !B

Description

The **Read All Module IDs** command reads the number of modules in the bank, and the module IDs for the network module and all the modules in the bank. This command should be sent to a network module only. Use the **Read Module ID** command (`!A`) to read the module ID for a single module.

Syntax

`!B`

Success Response

A[*number*][*mod array*]

[*number*] Two ASCII-hex characters representing the number of modules in the bank, including the network module.

[*mod array*] Four ASCII-hex characters per module in the bank representing the module ID. The first entry (four characters) is the ID of the network module that was addressed. Each subsequent entry corresponds to the module at the next higher address in the bank.

Each module ID is four ASCII-hex characters. It is a 16-bit number representing the module ID as shown in the following table.

[modID] Value	Module Name
0001	FP-1000
0002	FP-1001
0101	FP-AI-110
0102	FP-AO-200
0103	FP-DI-330
0104	FP-DO-400
0105	FP-DI-301
0106	FP-DO-401
0107	FP-TC-120
0108	FP-RLY-420

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[modID] Value	Module Name
0109	FP-DI-300
010A	FP-AI-100
010B	FP-RTD-122
010C	FP-AI-111
010D	FP-CTR-500
010E	FP-PWM-520
010F	FP-AO-210
0110	FP-DO-410
0111	FP-DO-403
FFFF	Empty Base

Error Responses

E_NO_MODULE	The addressed module does not exist.
E_BAD_ADDRESS	The command is valid, but the addressed module does not support the command received.
E_INV_LIMS_GOT	Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>00!B??[cr]`

This command requests the FieldPoint network module at address 0x00 to return the IDs of all the modules in its bank.

`A03000101020103[cs][cr]`

This response from the network module indicates that there are three modules in the bank with module IDs 0x0001(FP-1000 module), 0x0102 (FP-AO-200 module), and 0x0103 (FP-DI-330 module).

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HotSwap Reporting Mode [cmdchars] = !b

Description

The **HotSwap Reporting Mode** command enables or disables reporting of hot-swapped modules within the bank. This command can be sent to a FieldPoint network module only. The reporting mode is also stored in the SnapShot information when the **Store SnapShot** command is issued.

Hot-Swap Reporting

Some systems require notification whenever an I/O module is hot-swapped. You can enable or disable hot-swap reporting for the bank. By default, hot-swap reporting is disabled.

If the hot-swap reporting mode is enabled for the bank, the E_HOTSWAP response is sent in response the first command sent to an I/O module after a hot-swap has occurred. In this way, the E_HOTSWAP response is similar to a E_PUCLR_EXP error response, but it indicates that the I/O module has been reconfigured to match the needs of your system as opposed to only being reset to power-up settings.

The enabled/disabled state of the hot-swap reporting mode is stored when the **Store SnapShot** command is issued. Therefore, upon power-up, the hot-swap reporting mode is restored if the SnapShot feature is enabled.

Syntax

`!b[`*`flag`*`]`

[*flag*] One ASCII-hex character as shown in the following table.

[flag] Value	Description
0	Disables the reporting of module hot-swap occurrences for the bank.
1	Enables the reporting of module hot-swap occurrences for the bank.

Success Response

A

Error Responses

E_BAD_ADDRESS The command is valid, but the addressed module does not support the command received.

E_INV_LIMS_GOT Specified limits invalid for the command.

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Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>00!b1??[cr]`

This command tells the FieldPoint module at address 0x00 to enable the reporting of hot-swapped modules within its bank.

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Resend Last Response [cmdchars] = !c

Description

The **Resend Last Response** command asks the addressed module to resend its last response without performing the command again. If the module addressed by this command is not the same as the one addressed by the previous command, an error is returned. You may issue this command multiple times.

Syntax

```
!c
```

Success Response

The last response is sent again.

Error Responses

E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ADDR_NOT_SAME	The specified module is not the same as the module addressed by the previous command.
E_ NO_RESEND_BUF	The response to the last command is unavailable.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

```
>33!c??[cr]
```

This command tells the FieldPoint module at address 51 (0x33) to resend the response it had sent to the previous command.

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Set Attributes [cmdchars] = !D

Description

The **Set Attributes** command sets the specified attributes and range for each specified channel of the addressed module.

Syntax

`!D[positions]{[attrMask][rangeMask][settings] triplets}`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s attributes and/or range are to be set. A zero in any bit means that the corresponding channel is not targeted by this command.

`{[attrMask][rangeMask][settings] triplets}`

For each “1” bit in the `[positions]` field, there must be a `[attrMask][rangeMask][settings]` triplet. The first of these triplets corresponds to the most significant “1” in the `[positions]` field, and so on. There can be up to 16 triplets in this command, one for each channel that is targeted by the `[positions]` field.

`[attrMask]` Four ASCII-hex characters. This field is a 16-bit mask for the attributes of the channel. The most significant bit in this mask corresponds to attribute 15, while the least significant bit corresponds to attribute 0. A “1” in any bit means that the corresponding attribute is targeted to be set. A zero in any bit means that the corresponding attribute is not affected. If an attribute is targeted, an entry must be supplied in the `[settings]` field in this triplet

`[rangeMask]` One ASCII-hex character. If this character is a “1”, the range is targeted to be set. If this character is a “0” then the range is not affected. If the range is targeted, an entry must be supplied in the `[settings]` field in this triplet.

`[settings]` Two ASCII-hex characters per entry. For each “1” bit in the preceding `[attrMask]` field, there is one entry in this field. If the `[rangeMask]` field is a “1”, an additional entry for the range must be included. Each entry is one Setting ID byte and is represented by two ASCII-hex characters. The first (most significant) entry in `[settings]` corresponds to the first “1” set in the `[attrMask]` field, and so on. If a range

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entry is included, it is the last entry in this field. Refer to the following tables for valid [*settings*] entries for attributes and ranges.

Module Name	Attribute Name	[attrMask] Entry	Attribute Setting	[settings] Entry
FP-AI-110 FP-AI-111	Filter Setting	0001	60 Hz Filter 50 Hz Filter 500 Hz Filter	00 01 02
FP-TC-120 (Input Channels)	Thermocouple Type	0001	J Type K Type T Type E Type R Type S Type N Type B Type	00 01 02 03 04 05 06 07
FP-TC-120 (Cold-Junction Channel)	Cold-Junction Compensation Temperature	0001	Internal Sensor 0 °C 25 °C	00 01 02
FP-RTD-122	RTD Type	0001	Pt100, α=0.00375 Pt100, α=0.00385 Pt100, α=0.003911 Pt100, α=0.003916 Pt100, α=0.003920 Pt100, α=0.003926 Pt1000, α=0.00375 Pt1000, α=0.00385 Pt1000, α=0.003911 Pt1000, α=0.003916 Pt1000, α=0.003920 Pt1000, α=0.003926	00 01 02 03 04 05 06 07 08 09 0A 0B

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Module Name	Attribute Name	[attrMask] Entry	Attribute Setting	[settings] Entry
FP-CTR-500 (Count Channels)	Terminal Count	0003	Integer from 0 to 65535	0000 to FFFF
	Count Source	0004	External Count Input Previous Channel 1 kHz Reference 32 kHz Reference	00 01 02 03
	Gate Source	0008	Gate Input 0 Gate Input 1 Gate Input 2 Gate Input 3 Always Disabled Always Enabled	00 01 02 03 04 05
	Read/Reset Mode	0010	Do Not Reset on Read Reset on Read	00 01
	Noise Rejection	0020	200 Hz 50 kHz	03 04
FP-CTR-500 (Output Channels)	Output Source	0001	Counter Channel 0 Counter Channel 1 Counter Channel 2 Counter Channel 3 Counter Channel 4 Counter Channel 5 Counter Channel 6 Counter Channel 7 Discrete Data	00 01 02 03 04 05 06 07 08
	Output Mode	0002	Toggle, Reset Off Toggle, Reset On On Pulse Off Pulse	00 01 02 03
FP-PWM-520	Period (ms)	0003	Number of Milliseconds from 1 to 65535	0001 to FFFF

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Module Name	Range	[settings] Entry
FP-AI-100	0–24 mA 3.5–24 mA ± 24 mA ± 6 V 0–6 V ± 1.2 V 0–1.2 V 0–18 V ± 30 V 0–30 V ± 15 V	00 01 02 05 06 07 08 0E 0F 11 12
FP-AI-110	0–21 mA 3.5–21 mA ±21 mA ±10.4 V 0–10.4 V ±5.2 V 0–5.2 V ±1.04 V 0–1.04 V ±325 mV ±65 mV	00 01 02 03 04 05 06 07 08 09 0A
FP-AI-111	0–21 mA 3.5–21 mA ± 21 mA	00 01 02
FP-TC-120 (Input Channels)	± 50 mV ± 25 mV –20, +80 mV ± 100 mV 0–2048 K –270, +1770 °C -454, +3218 °F	0A 0B 0C 0D 20 21 22
FP-TC-120 (Cold-Junction Channel)	223–358 K –50, +85 °C –58, +185 °F	23 24 25

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Module Name	Range	[settings] Entry
FP-RTD-122	73–1123 K –200, +850 °C –328, +1562 °F 0-400 Ω 0-4000 Ω	26 27 28 30 31
FP-AO-200	0–21 mA 3.5–21 mA	00 01
FP-AO-210	0–10.2 V	04
FP-DI-300 FP-DI-301 FP-DI-330 FP-DO-400 FP-DO-401 FP-DO-403 FP-DO-410 FP-RLY-420 FP-CTR-500 (Gate Channels) FP-CTR-500 (Output Channels)	Boolean	10
FP-CTR-500 (Count Channels)	0–65535 Counts	40
FP-PWM-520	0–100%	38

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_INV_ATTR	One or more attributes specified in the command either do not exist or do not support the setting specified.

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E_INV_RANGE	One or more ranges specified in the command either do not exist or do not support the setting specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

```
>33!D0001000112244??[cr]
```

This command sets attribute 0 and range of channel 0 of the FieldPoint module at address 51 (0x33). The attribute is set to 0x22 and the range is set to 0x44.

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Get Attributes [cmdchars] = !E

Description

The **Get Attributes** command reads the current settings of the specified attributes and range for each specified channel of the addressed module.

Syntax

`!E[positions]{[attrMask][rangeMask] pairs}`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s attributes and/or range are to be set. A zero in any bit means that the corresponding channel is not targeted by this command.

`{[attrMask][rangeMask] pairs}`

For each “1” bit in the `[positions]` field, there must be a `[attrMask][rangeMask]` pair. The first of these pairs corresponds to the most significant “1” in the `[positions]` field, and so on. There can be up to 16 pairs in this command, one for each channel that is targeted by the `[positions]` field.

`[attrMask]` Four ASCII-hex characters. This field is a 16-bit mask for the attributes of the channel. The most significant bit in this mask corresponds to attribute 15, while the least significant bit corresponds to attribute 0. A “1” in any bit means that the corresponding attribute is targeted to be read. A zero in any bit means that the corresponding attribute is not targeted.

`[rangeMask]` One ASCII-hex character. If this character is a “1”, the range is targeted to be read. If this character is a “0” then the range is not targeted.

Success Response

`A{[settings] array}`

`{[settings] array}` For each “1” bit in the `[positions]` field, there is a `[settings]` array in the response. The first `[settings]` array corresponds to the most significant “1” in the `[positions]` field, and so on. There can be up to 16 `[settings]` arrays in this response, one for each channel that is targeted by the `[positions]` field.

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[*settings*] Two ASCII-hex characters per entry. For each “1” bit in the [*attrMask*] field, there is one entry in this response field. If the [*rangeMask*] field is a “1”, an additional entry for the range is included in this response field. Each entry is one setting ID byte and is represented by two ASCII-hex characters. The first entry in [*settings*] corresponds to the first (most significant) “1” set in the [*attrMask*] field, and so on. If a range is targeted, it is the last entry in this field. Refer to the following tables for valid [*settings*] entries for attributes and ranges.

Module Name	Attribute Name	[attrMask] Entry	Attribute Setting	[settings] Entry
FP-AI-110 FP-AI-111	Filter Setting	0001	60 Hz Filter 50 Hz Filter 500 Hz Filter	00 01 02
FP-TC-120 (Input Channels)	Thermocouple Type	0001	J Type K Type T Type E Type R Type S Type N Type B Type	00 01 02 03 04 05 06 07
FP-TC-120 (Cold-Junction Channel)	Cold-Junction Compensation Temperature	0001	Internal Sensor 0 °C 25 °C	00 01 02
FP-RTD-122	RTD Type	0001	Pt100, α=0.00375 Pt100, α=0.00385 Pt100, α=0.003911 Pt100, α=0.003916 Pt100, α=0.003920 Pt100, α=0.003926 Pt1000, α=0.00375 Pt1000, α=0.00385 Pt1000, α=0.003911 Pt1000, α=0.003916 Pt1000, α=0.003920 Pt1000, α=0.003926	00 01 02 03 04 05 06 07 08 09 0A 0B

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Module Name	Attribute Name	[attrMask] Entry	Attribute Setting	[settings] Entry
FP-CTR-500 (Count Channels)	Terminal Count	0003	Integer from 0 to 65535	0000 to FFFF
	Count Source	0004	External Count Input Previous Channel 1 kHz Reference 32 kHz Reference	00 01 02 03
	Gate Source	0008	Gate Input 0 Gate Input 1 Gate Input 2 Gate Input 3 Always Disabled Always Enabled	00 01 02 03 04 05
	Read/Reset Mode	0010	Do Not Reset on Read Reset on Read	00 01
	Noise Rejection	0020	200 Hz 50 kHz	03 04
FP-CTR-500 (Output Channels)	Output Source	0001	Counter Channel 0 Counter Channel 1 Counter Channel 2 Counter Channel 3 Counter Channel 4 Counter Channel 5 Counter Channel 6 Counter Channel 7 Discrete Data	00 01 02 03 04 05 06 07 08
	Output Mode	0002	Toggle, Reset Off Toggle, Reset On On Pulse Off Pulse	00 01 02 03
FP-PWM-520	Period (ms)	0003	Number of Milliseconds from 1 to 65535	0001 to FFFF

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Module Name	Range	[settings] Entry
FP-AI-100	0–24 mA 3.5–24 mA ± 24 mA ± 6 V 0–6 V ± 1.2 V 0–1.2 V 0–18 V ± 30 V 0–30 V ± 15 V	00 01 02 05 06 07 08 0E 0F 11 12
FP-AI-110	0–21 mA 3.5–21 mA ±21 mA ±10.4 V 0–10.4 V ±5.2 V 0–5.2 V ±1.04 V 0–1.04 V ±325 mV ±65 mV	00 01 02 03 04 05 06 07 08 09 0A
FP-AI-111	0–21 mA 3.5–21 mA ± 21 mA	00 01 02
FP-TC-120 (Input Channels)	± 50 mV ± 25 mV –20, +80 mV ± 100 mV 0–2048 K –270, +1770 °C -454, +3218 °F	0A 0B 0C 0D 20 21 22
FP-TC-120 (Cold-Junction Channel)	223–358 K –50, +85 °C –58, +185 °F	23 24 25

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Module Name	Range	[settings] Entry
FP-RTD-122	73–1123 K –200, +850 °C –328, +1562 °F 0-400 Ω 0-4000 Ω	26 27 28 30 31
FP-AO-200	0–21 mA 3.5–21 mA	00 01
FP-AO-210	0–10.2 V	04
FP-DI-300 FP-DI-301 FP-DI-330 FP-DO-400 FP-DO-401 FP-DO-403 FP-DO-410 FP-RLY-420 FP-CTR-500 (Gate Channels) FP-CTR-500 (Output Channels)	Boolean	10
FP-CTR-500 (Count Channels)	0–65535 Counts	40
FP-PWM-520	0–100%	38

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_INV_ATTR	One or more attributes specified in the command either do not exist or do not support the setting specified.
E_INV_RANGE	One or more ranges specified in the command either do not exist or do not support the setting specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

>33!E00110000100001??[*cr*]

This command tells the FieldPoint module at address 51 (0x33) to return the current range settings of channels 4 and 0.

A4411[*cs*][*cr*]

This response indicates that channel 4 has its range set to 0x44, and channel 0 has its range set to 0x11.

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Read Firmware Revision [cmdchars] = !e

Description

The **Read Firmware Revision** command returns the firmware revision code for the FieldPoint network module.

Syntax

```
!e
```

Success Response

```
A[revision]
```

`[revision]` Four ASCII-hex characters that specify the revision level.

Error Responses

E_NO_MODULE The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

```
>00!e??[cr]
```

This command requests the firmware revision of the network module at address 0.

```
A0021[cs][cr]
```

This response indicates that the revision number is 0021.

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Read 16-bit Data [cmdchars] = !F

Description

The **Read 16-bit Data** command reads data from targeted input and output channels of the addressed module. Each data value is a 16-bit value.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`!F[positions]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s data is to be read. A zero in any bit means that the corresponding channel is not targeted by this command.

Success Response

`A[data]`

`[data]` Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant “1” in the `[positions]` field, and so on.

Each set of four characters represents an unsigned 16-bit number.

Targeted channels that are discrete channels return “????” as their data values.

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

`>33!F0003??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to return the values of channels 1 and 0.

`A01234567[cs][cr]`

This response from the analog module indicates that the level of channel 1 is 0x0123 and that of channel 0 is 0x4567. If the addressed module had discrete channels, the response would be `A????????[cs][cr]`.

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Store Attributes [cmdchars] = !f

Description

The **Store Attributes** command stores the specified attributes and range for each specified channel of the addressed module into non-volatile memory for use as power-up settings.

Syntax

`!f[positions]{[attrMask][rangeMask][settings] triplets}`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s attributes and/or range are to be set. A zero in any bit means that the corresponding channel is not targeted by this command.

`{[attrMask][rangeMask][settings] triplets}`

For each “1” bit in the `[positions]` field, there must be a `[attrMask][rangeMask][settings]` triplet. The first of these triplets corresponds to the most significant “1” in the `[positions]` field, and so on. There can be up to 16 triplets in this command, one for each channel that is targeted by the `[positions]` field.

`[attrMask]` Four ASCII-hex characters. This field is a 16-bit mask for the attributes of the channel. The most significant bit in this mask corresponds to attribute 15, while the least significant bit corresponds to attribute 0. A “1” in any bit means that the corresponding attribute is targeted to be set. A zero in any bit means that the corresponding attribute is not affected. If an attribute is targeted, an entry must be supplied in the `[settings]` field in this triplet

`[rangeMask]` One ASCII-hex character. If this character is a “1”, the range is targeted to be set. If this character is a “0” then the range is not affected. If the range is targeted, an entry must be supplied in the `[settings]` field in this triplet.

`[settings]` Two ASCII-hex characters per entry. For each “1” bit in the preceding `[attrMask]` field, there is one entry in this field. If the `[rangeMask]` field is a “1”, an additional entry for the range must be included. Each entry is one Setting ID byte and is represented by two ASCII-hex characters. The first (most significant) entry in `[settings]` corresponds to the first “1” set in the `[attrMask]` field, and so on. If a range

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entry is included, it is the last entry in this field. Refer to the following tables for valid [*settings*] entries for attributes and ranges.

Module Name	Attribute Name	[attrMask] Entry	Attribute Setting	[settings] Entry
FP-AI-110 FP-AI-111	Filter Setting	0001	60 Hz Filter 50 Hz Filter 500 Hz Filter	00 01 02
FP-TC-120 (Input Channels)	Thermocouple Type	0001	J Type K Type T Type E Type R Type S Type N Type B Type	00 01 02 03 04 05 06 07
FP-TC-120 (Cold-Junction Channel)	Cold-Junction Compensation Temperature	0001	Internal Sensor 0 °C 25 °C	00 01 02
FP-RTD-122	RTD Type	0001	Pt100, α=0.00375 Pt100, α=0.00385 Pt100, α=0.003911 Pt100, α=0.003916 Pt100, α=0.003920 Pt100, α=0.003926 Pt1000, α=0.00375 Pt1000, α=0.00385 Pt1000, α=0.003911 Pt1000, α=0.003916 Pt1000, α=0.003920 Pt1000, α=0.003926	00 01 02 03 04 05 06 07 08 09 0A 0B

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Module Name	Attribute Name	[attrMask] Entry	Attribute Setting	[settings] Entry
FP-CTR-500 (Count Channels)	Terminal Count	0003	Integer from 0 to 65535	0000 to FFFF
	Count Source	0004	External Count Input Previous Channel 1 kHz Reference 32 kHz Reference	00 01 02 03
	Gate Source	0008	Gate Input 0 Gate Input 1 Gate Input 2 Gate Input 3 Always Disabled Always Enabled	00 01 02 03 04 05
	Read/Reset Mode	0010	Do Not Reset on Read Reset on Read	00 01
	Noise Rejection	0020	200 Hz 50 kHz	03 04
FP-CTR-500 (Output Channels)	Output Source	0001	Counter Channel 0 Counter Channel 1 Counter Channel 2 Counter Channel 3 Counter Channel 4 Counter Channel 5 Counter Channel 6 Counter Channel 7 Discrete Data	00 01 02 03 04 05 06 07 08
	Output Mode	0002	Toggle, Reset Off Toggle, Reset On On Pulse Off Pulse	00 01 02 03
FP-PWM-520	Period (ms)	0003	Number of Milliseconds from 1 to 65535	0001 to FFFF

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Module Name	Range	[settings] Entry
FP-AI-100	0–24 mA 3.5–24 mA ± 24 mA ± 6 V 0–6 V ± 1.2 V 0–1.2 V 0–18 V ± 30 V 0–30 V ± 15 V	00 01 02 05 06 07 08 0E 0F 11 12
FP-AI-110	0–21 mA 3.5–21 mA ±21 mA ±10.4 V 0–10.4 V ±5.2 V 0–5.2 V ±1.04 V 0–1.04 V ±325 mV ±65 mV	00 01 02 03 04 05 06 07 08 09 0A
FP-AI-111	0–21 mA 3.5–21 mA ± 21 mA	00 01 02
FP-TC-120 (Input Channels)	± 50 mV ± 25 mV –20, +80 mV ± 100 mV 0–2048 K –270, +1770 °C -454, +3218 °F	0A 0B 0C 0D 20 21 22
FP-TC-120 (Cold-Junction Channel)	223–358 K –50, +85 °C –58, +185 °F	23 24 25

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Module Name	Range	[settings] Entry
FP-RTD-122	73–1123 K –200, +850 °C –328, +1562 °F 0-400 Ω 0-4000 Ω	26 27 28 30 31
FP-AO-200	0–21 mA 3.5–21 mA	00 01
FP-AO-210	0–10.2 V	04
FP-DI-300 FP-DI-301 FP-DI-330 FP-DO-400 FP-DO-401 FP-DO-403 FP-DO-410 FP-RLY-420 FP-CTR-500 (Gate Channels) FP-CTR-500 (Output Channels)	Boolean	10
FP-CTR-500 (Count Channels)	0–65535 Counts	40
FP-PWM-520	0–100%	38

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_INV_ATTR	One or more attributes specified in the command either do not exist or do not support the setting specified.
E_INV_RANGE	One or more ranges specified in the command either do not exist or do not support the setting specified.
E_NO_MODULE	The addressed module does not exist.

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Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!f0001000110204??[cr]`

This command stores attribute 0 and range of channel 0 of the FieldPoint module at address 51 (0x33). The attribute is set to 0x02 and the range is set to 0x04. This would set an FP-AI-110 channel to a range of 0–10.4 V and a noise rejection of 500 Hz.

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Read 16-bit Data with Status [cmdchars] = !G

Description

The **Read 16-bit Data with Status** command reads data targeted input and output channels of the addressed module. Each data value is a 16-bit value. In addition, the status of the targeted channels is reported, to enable additional error checking.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Use the **Read Module Status** or **Read Channel Status** commands for details on the error condition of a bad channel.

Syntax

`!G[positions]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s data is to be read. A zero in any bit means that the corresponding channel is not targeted by this command.

Success Response

`A[status][data]`

`[status]` Four ASCII-hex characters, specifying the status of the channels targeted by this command. The Most Significant Bit represents channel 15, the Least Significant Bit represents channel 0. A “1” in any bit means that the corresponding channel’s status is bad. A zero in any bit means that the corresponding channel’s status is good.

Channels that are not targeted return a zero in the corresponding status bit.

The bits in the `[status]` field for channels that return “????” as their data should be ignored.

`[data]` Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant “1” in the `[positions]` field, and so on.

Each set of four characters represents an unsigned 16-bit number.

Targeted channels that are discrete channels return “????” as their data values. The corresponding bits in the `[status]` field for such channels should be ignored.

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Note Even if a channel has a bad status, a value is returned for that channel in [*data*].

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33!G000B??[*cr*]

This command tells the FieldPoint module at address 51 (0x33) to return the values of channels 1 and 0. The command also requests the status of channels 1 and 0.

A000201234567[*cs*][*cr*]

This response from the FieldPoint module indicates that the status of channel 1 is bad and the status of channel 0 is good. The data value of channel 1 is 0x0123 and that of channel 0 is 0x4567.

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Store 16-bit Data [cmdchars] = !g

Description

The **Store 16-bit Data** command prestores data for each targeted output channel of the addressed module into non-volatile memory for use as power-up settings. Each data value is a 16-bit value.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`!g[positions][data]`

`[positions]`	Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s data is to be stored. A zero in any bit means that the corresponding channel is not targeted by this command.
`[data]`	Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant “1” in the `[positions]` field, and so on. Each set of four characters represents an unsigned 16-bit number.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

```
>33!g000301234567??[cr]
```

This command tells the FieldPoint module at address 0x33 to store 0x0123 for channel 1 and 0x4567 for channel 0.

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Write 16-bit Data [cmdchars] = !H

Description

The **Write 16-bit Data** command writes data to targeted output channels of the addressed module. Each data value is a 16-bit value.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`!H[positions][data]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A "1" in any bit means that the corresponding channel's data is to be written. A zero in any bit means that the corresponding channel is not targeted by this command.

`[data]` Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant "1" in the `[positions]` field, and so on.

Each set of four characters represents an unsigned 16-bit number.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!H000301234567??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to write 0x0123 to channel 1 and 0x4567 to channel 0.

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Store Discrete [cmdchars] = !h

Description

The **Store Discrete** command stores data for each targeted output channel of the addressed module into non-volatile memory for use as power-up settings.

Syntax

`!h[positions][data]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s data is to be stored. A zero in any bit means that the corresponding channel is not targeted by this command.

Targeting channels that are inputs returns an error.

Targeting channels that do not exist returns an error.

`[data]` Four ASCII-hex characters, specifying the channel levels to be stored. A “1” in any bit means ON. A zero in any bit means OFF.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!h0001FFFF??[cr]`

This command tells the FieldPoint module at address 0x33 to store ON for channel 0. Notice that specifying data values for non-targeted channels is ignored by the module.

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Write 16-bit Data with Status [cmdchars] = !I

Description

The **Write 16-bit Data with Status** command writes data to targeted output channels of the addressed module. Each data value is a 16-bit value. In addition, the status of the targeted channels is reported, to enable additional error checking.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Use the **Read Module Status** or **Read Channel Status** commands for details on the error condition of a bad channel.

Syntax

`!I[positions][data]`

Note This command is an uppercase I, not a lowercase l.

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s data is to be written. A zero in any bit means that the corresponding channel is not targeted by this command.

`[data]` Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant “1” in the `[positions]` field, and so on.

Each set of four characters represents an unsigned 16-bit number.

Success Response

`A[status]`

`[status]` Four ASCII-hex characters, specifying the status of the channels targeted by this command. The most significant bit represents channel 15, the least significant bit represents channel 0. A “1” in any bit means that the corresponding channel’s status is bad. A zero in any bit means that the corresponding channel’s status is good.

Channels that are not targeted return a zero in the corresponding status bit.

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Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!I000301234567??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to write 0x0123 to channel 1 and 0x4567 to channel 0. This command also tells the module to return the status of the channels.

`A0003[cs][cr]`

This response indicates that both channels have bad status.

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Store Discrete Watchdog Data [cmdchars] = !i

Description

The **Store Discrete Watchdog Data** command stores the watchdog data for the targeted discrete output channels in the addressed FieldPoint module into non-volatile memory for use as power-up settings.

Syntax

`!i[positions][wdgData]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s watchdog data is to be set. A zero in any bit means that the corresponding channel is not targeted by this command.

`[wdgData]` Four ASCII-hex characters, specifying the levels which the discrete output channels must source if the bank’s watchdog timer expires. A “1” in any bit means ON. A zero in any bit means OFF.

Bits corresponding to non-targeted channels are ignored.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!i00FF00F0??[cr]`

This command tells the FieldPoint module at address 0x33 to set the watchdog data for channels 7, 6, 5, and 4 to ON and channels 3, 2, 1, and 0 to OFF.

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Read Discrete

[cmdchars] = !J

Description

The **Read Discrete** command reads discrete data from all discrete input and output channels of the addressed module.

Syntax

`!J`

Success Response

`A[data]`

`[data]` Four ASCII-hex characters, specifying the channel levels. A “1” in any bit means that the corresponding channel is ON. A zero in any bit means that the corresponding channel is OFF.

Channels that do not exist return a zero in the corresponding data bit.

Channels that are not discrete return a zero in the corresponding data bit.

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!J??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to return the levels of all its channels.

`A0030[cs][cr]`

This response from a 16-channel discrete FieldPoint module indicates that channels 5 and 4 are ON and the rest of the channels are OFF.

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Store 16-bit Watchdog Data [cmdchars] = !j

Description

The **Store 16-bit Watchdog Data** command prestores data for each targeted output channel of the addressed module into non-volatile memory for use as power-up settings. Each data value is a 16-bit value.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`!j[positions][wdgData]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A "1" in any bit means that a watchdog data value is to be stored for the corresponding channel. A zero in any bit means that the corresponding channel is not targeted by this command.

`[wdgData]` Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant "1" in the `[positions]` field, and so on.

Each set of four characters represents an unsigned 16-bit number.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

```
>33!j000C01234567??[cr]
```

This command tells the FieldPoint module at address 0x33 to store the watchdog data for channels 3 and 2 to be 0x1234 and 0x4567, respectively.

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Read Discrete with Status [cmdchars] = !K

Description

The **Read Discrete with Status** command reads discrete data from all discrete input and output channels of the addressed module. In addition, the status of the targeted channels is reported, to enable additional error checking.

Use the **Read Module Status** or **Read Channel Status** commands for details on the error condition of a bad channel.

Syntax

!K

Success Response

A[*status*][*data*]

[*status*] Four ASCII-hex characters, specifying the status of the channels targeted by this command. The most significant bit represents channel 15, the least significant bit represents channel 0. A “1” in any bit means that the corresponding channel’s status is bad. A zero in any bit means that the corresponding channel’s status is good.

Channels that do not exist return a zero in the corresponding status bit.

Channels that are not discrete return a zero in the corresponding status bit.

[*data*] Four ASCII-hex characters, specifying the channel levels. A “1” in any bit means that the corresponding channel is ON. A zero in any bit means that the corresponding channel is OFF.

Channels that do not exist return a zero in the corresponding data bit.

Channels that are not discrete return a zero in the corresponding data bit.

Note Even if a channel has a bad status, a value is returned for that channel in [*data*].

Error Responses

E_INVALID_CMD	Undefined command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

`>33!K??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to return the status of all its channels.

`A000000FF[cs][cr]`

This response from a 16-channel discrete FieldPoint module indicates that all channels have a good status, channels 15 through 8 are OFF, and channels 7 through 0 are ON.

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Store Watchdog Data Status [cmdchars] = !k

Description

The **Store Watchdog Data Status** command stores the enabled or disabled status of watchdog data for the targeted output channels in the addressed FieldPoint module into non-volatile memory for use as power-up settings. To disable an entire module, use the `!l` command.

Syntax

`!k[`*`positions`*`][`*`mask`*`]`

`[`*`positions`*`]`	Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s enabled/disabled state is to be stored. A zero in any bit means that the corresponding channel is not targeted by this command.
`[`*`mask`*`]`	Four ASCII-hex characters, specifying the enabled/disabled state targeted for the corresponding channel. Bit-15 is for the channel-15, and so on. A “1” in any bit means that the corresponding channel’s watchdog data status should be stored as enabled. A zero in any bit means that the corresponding channel’s watchdog data status should be stored as disabled.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!k001300FF??[`*`cr`*`]`

This command tells the FieldPoint module at address 0x33 to store the status as enabled for channels 4, 1, and 0, and to disable the use of watchdog data for all other channels.

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Write Discrete

[cmdchars] = !L

Description

The **Write Discrete** command drives outputs ON or OFF on targeted channels of the addressed FieldPoint module.

Syntax

`!L[positions][data]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s data is to be written. A zero in any bit means that the corresponding channel is not targeted by this command.

Targeting channels that are inputs returns an error.

Targeting channels that do not exist returns an error.

`[data]` Four ASCII-hex characters, specifying the channel levels. A “1” in any bit means that the corresponding channel is to be driven ON. A zero in any bit means that the corresponding channel is to be driven OFF.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!L0001FFFF??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to turn channel 0 to ON. Notice that specifying data values for non-target channels is ignored by the module.

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Store Watchdog Enable [cmdchars] = !l

Description

The **Store Watchdog Enable** command stores the specified status (enabled or disabled) of the watchdog timer for the addressed module in non-volatile memory for use as power-up setting. To store the watchdog timer value for a bank, use the `!V` command.

Syntax

`!l[wdgTmo]`

Note This command is a lowercase l, not an uppercase I.

`[wdgTmo]` Four ASCII-hex characters, specifying the watchdog timeout value. Timeout values of less than 200 ms (0 < `[wdgTmo]` < 20) result in an error. A `[wdgTmo]` of 0 disables the watchdog timer function for the bank. All other values enable the module.

Success Response

A

Error Responses

E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Error in command length, or time was less than 200 ms.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>00!l0021??[cr]`

This command stores the state of the watchdog timer as enabled for the FieldPoint module at address 0x33.

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Write Discrete with Status [cmdchars] = !M

Description

The **Write Discrete with Status** command drives outputs ON or OFF on targeted channels of the addressed FieldPoint module. In addition, the status of the targeted channels is reported, to enable additional error checking. Use the `!O` command for more information on a channel's status.

Use the **Read Module Status** or **Read Channel Status** commands for details on the error condition of a bad channel.

Syntax

`!M[`*`positions`*`][`*`data`*`]`

`[`*`positions`*`]`	Four ASCII-hex characters, specifying the channels targeted by this command. A "1" in any bit means that the corresponding channel's data is to be written. A zero in any bit means that the corresponding channel is not targeted by this command. Targeting channels that are inputs returns an error. Targeting channels that do not exist returns an error.
`[`*`data`*`]`	Four ASCII-hex characters, specifying the channel levels. A "1" in any bit means that the corresponding channel is to be driven ON. A zero in any bit means that the corresponding channel is to be driven OFF.

Success Response

`A[`*`status`*`]`

`[`*`status`*`]`	Four ASCII-hex characters, specifying the status of the channels targeted by this command. The most significant bit represents channel 15, the least significant bit represents channel 0. A "1" in any bit means that the corresponding channel's status is bad. A zero in any bit means that the corresponding channel's status is good. Channels that are not targeted return a zero in the corresponding status bit.

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.

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E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!M00010000??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to turn channel 0 to OFF. This command also tells the module to return the channel status.

`A0000[cs][cr]`

This response from the FieldPoint module indicates that the channel status is good.

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Read Module Status [cmdchars] = !N

Description

The **Read Module Status** command reads the current status of the addressed module.

Syntax

```
!N
```

Success Response

A[*mod_status*]

[*mod_status*] One ASCII-hex character, specifying the status of the addressed module as shown in the following table.

[mod_status] Value	Module Status
0	No Module (Base is empty)
1	Unconfigured Module (Module has not been written configuration information by the network module)
2	Module in Configuration (Module is processing configuration information)
3	Configured Module (Module has been configured by the network module and is available on the network)

Error Responses

E_INV_LIMS_GOT Specified limits invalid for the command.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33!N??[*cr*]

This command tells the FieldPoint module at address 51 (0x33) to return the module status.

A3[*cs*][*cr*]

This response from the FieldPoint module indicates that the module is configured.

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Execute Channel Command [cmdchars] = !n

Description

Execute Channel Command executes commands specific to individual channels on certain modules. Currently, only the FP-CTR-500 count input channels support channel specific commands.

Syntax

`!n[positions]{[command type][command] pairs}`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A "1" in any bit means that the corresponding channel's attributes and/or range are to be set. A zero in any bit means that the corresponding channel is not targeted by this command.

`{[command type][command] pairs}`

For each “1” bit in the [positions] field, there must be a `[command type][command]` pair. The first of these pairs corresponds to the most significant “1” in the `[positions]` field, and so on. There can be up to 16 pairs in this command, one for each channel that is targeted by the `[positions]` field.

`[command type]` Four ACSII-hex characters. This field is a 16-bit mask for the command types supported by the channel. A “1” in any bit means that a command of the corresponding command type is to be executed for the targeted channel. The only type of command supported by the FP-CTR-500 is control commands, for which this field should be set to 0001. Setting this field to 0000 would cause no command to be executed.

`[command]` Two ASCII-hex characters per entry. For each “1” bit in the preceding `[command type]` field, there is one entry in this field. Each entry indicates the command of the corresponding type to be executed for the targeted channel.

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The following table shows the valid [*command type*] and [*command*] values.

Module Name	Command Type	[command type] Entry	Commands	[command] Entry
FP-CTR-500 (Count Inputs)	Control Commands	0001	Reset Counter Increment Counter	01 02

Success Response

A

Error Responses

E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received.
E_INV_CHNL	One or more channels specified in the command does not exist.
E_INV_ATTR	One or more of the [*command type*][*command*] pairs are not valid for its targeted channel.

Refer to Chapter 2, *FieldPoint Responses*, for error numbers, other possible error responses, and error descriptions.

Example

`>01!n0008000102??[cr]`

This command tells the FieldPoint module at address 1 (0x01) (assume it is an FP-CTR-500) to have its counter channel 3 (0x0008) execute the control command (0x0001) "Increment Counter" (0x02).

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Read Channel Status [cmdchars] = !O

Description

The **Read Channel Status** command reads the current status of the targeted channels of the addressed module.

Syntax

!O[*positions*]

Note This command is an uppercase O, not a zero.

[*positions*] Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s status is to be read. A zero in any bit means that the corresponding channel is not targeted by this command.

Success Response

A[*chnl_status*]

[*chnl_status*] One ASCII-hex character per targeted channel, specifying the status of the channel as shown in the following table. The first character corresponds to the most significant “1” in the [*positions*] field, and so on.

[chnl_status] Value	Channel Status
0	Channel is configured, data status is good
1	Channel specific error 1 (refer to the next table)
2	Channel specific error 2 (refer to the next table)
3	Channel is unconfigured or is processing configuration information
?	Channel does not exist

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The following table lists channel-specific error messages for all FieldPoint I/O modules.

Module Name	[chnl_status] Value	Error Message
FP-AI-100 FP-AI-110 FP-AI-111	1	Out of Range
FP-AO-200	1	Open Current Loop
FP-AO-210	1	Overcurrent Protection
FP-DO-410	1	Current Limited
FP-TC-120	1	Out of Range
	2	Open Thermocouple
FP-RTD-122	1	Out of Range
	2	Open RTD
FP-CTR-500	1	Overflow since Last Read

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!OF000??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to provide the status of channels 15, 14, 13, and 12.

`A??10[cs][cr]`

This response from the FieldPoint module indicates that channels 15 and 14 do not exist, that channel 13 has an erroneous status and its description is available in the module's documentation, and that channel 12 has good status.

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Read Bank Status

[cmdchars] = !P

Description

The **Read Bank Status** command reads the configuration status of the entire bank connected to the addressed network module.

Syntax

`!P`

Success Response

`A[bank_status]`

`[bank_status]` One ASCII-hex character, specifying the status of the bank as shown in the following table.

[bank_status] Value	Bank Status
0	All I/O modules are configured
1	One or more I/O modules is not configured

Error Responses

E_BAD_ADDRESS The command is valid, but the addressed module does not support the command received.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>00!P??[cr]`

This command tells the FieldPoint module at address 0x00 to return the status of the bank.

`A1[cs][cr]`

This response indicates that one or more modules in the bank are not configured.

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Set Watchdog Delay [cmdchars] = !Q

Description

If a network module is addressed, the **Set Watchdog Delay** command sets up the timeout value for the FieldPoint bank's watchdog timer. If a module other than a network module is addressed, the addressed module is enabled or disabled for watchdog timer expiration, but the bank's watchdog timeout value is not affected. You should set the watchdog data before you issue this command.

Syntax

!Q[*wdgTmo*]

[*wdgTmo*] Four ASCII-hex characters, specifying the watchdog timeout value. The result of this command depends on the type of module that is addressed.

Success Response

A

Command Sent to Network Module

The watchdog timeout value is set equal to 10 times the number of milliseconds specified in this field. In addition, the watchdog timer is started. Timeout values of less than 200 ms (0 < [*wdgTmo*] < 20) result in an error. A [*wdgTmo*] of 0 disables the watchdog timer function for the bank.

Command Sent to I/O Module

The watchdog timeout value for the bank is not affected, and the running/stopped state of the watchdog timer is not altered. Non-zero delays of less than 200 ms ([*wdgTmo*] < 20) result in an error.

A [*wdgTmo*]≥ 20 enables the I/O module for watchdog timer expiration. A [*wdgTmo*] of 0 disables the addressed I/O module from being affected by a watchdog timer expiration.

Note The channel watchdog setups are not altered. Therefore, if you desire to re-enable the I/O module for watchdog timer expiration, you need to re-send this command to the I/O module with a valid [*wdgTmo*] value. All the channel setup you performed for setting watchdog data and enabling channels to source that pre-specified is re-enabled automatically.

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Error Responses

E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Error in command length, or time was less than 200 ms.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>00!Q0015??[cr]`

This command tells the FieldPoint module at address 0x00 to set its watchdog timeout value to 210 ms, and to start the watchdog timer.

`>33!Q0021??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to enable itself to react to watchdog timer expiration.

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Set Discrete Watchdog Data [cmdchars] = !R

Description

The **Set Discrete Watchdog Data** command sets up the levels that the targeted discrete output channels in the addressed FieldPoint module must be set to if the watchdog timer expires. This is a part of the channel setup for watchdog timer expiration.

Syntax

`!R[positions][wdgData]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the corresponding channel’s watchdog data is to be set. A zero in any bit means that the corresponding channel is not targeted by this command.

`[wdgData]` Four ASCII-hex characters, pre-specifying the levels which the discrete output channels must source if the bank’s watchdog timer expires. A “1” in any bit means that the corresponding channel must be turned ON if the network watchdog timer expires. A zero in any bit means that the corresponding channel must be turned OFF if the network watchdog timer expires.

Bits corresponding to non-targeted channels are ignored.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

```
>33!R00FF00F0??[cr]
```

This command tells the FieldPoint module at address 51 (0x33) to set the watchdog data such that when the timer expires, channels 7, 6, 5, and 4 are turned ON and channels 3, 2, 1, and 0 are turned OFF.

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Set 16-bit Watchdog Data [cmdchars] = !S

Description

The **Set 16-bit Watchdog Data** command pre-specifies the data values that the targeted output channels in the addressed module must go to if the watchdog timer expires. Usually this command is sent prior to enabling the module for watchdog timer expiration. This is a part of the channel set up for watchdog timer expiration.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

`!S[positions][wdgData]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A “1” in any bit means that the command is pre-specifying an output value for the corresponding channel. A zero in any bit means that the corresponding channel is not targeted by this command.

`[wdgData]` Four ASCII-hex characters per targeted channel. The first value (four characters) is for the channel corresponding to the most significant “1” in the `[positions]` field, and so on. The format of the four characters per channel is the same as that described in the **Write 16-bit Data** command.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_INV_CHNL	One or more channels specified in the command either do not exist or do not support the operation specified.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

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Example

```
>33!S000C01234567??[cr]
```

This command tells the FieldPoint module at address 51 (0x33) to set the watchdog data such that when the timer expires, channels 3 and 2 drive 0x1234 and 0x4567, respectively.

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Set Watchdog Data Status [cmdchars] = !T

Description

The **Set Watchdog Data Status** command enables or disables the targeted channels' ability to use the pre-specified watchdog data. This is a part of the channel set up for watchdog timer expiration. You should store the watchdog data before you send this command.

Syntax

`!T[positions][mask]`

`[positions]` Four ASCII-hex characters, specifying the channels targeted by this command. A "1" in any bit means that the corresponding channel's enabled/disabled state is to be stored. A zero in any bit means that the corresponding channel is not targeted by this command.

`[mask]` Four ASCII-hex characters, specifying the enabled/disabled state targeted for the corresponding channel. Bit-15 is for the channel-15, and so on. A "1" in any bit means that the channel should be enabled to source its pre-specified watchdog data if the watchdog timer expires. A zero in any bit means that the corresponding is disabled from sourcing its pre-specified watchdog data. Therefore, zero also implies that the channel's output remains unaffected by watchdog timer expiration.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_INSUFF_CHARS	Data field error. An insufficient or incorrect number of characters were received for the specified command.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!T001300FF??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to store the following: enable the use of the previously set watchdog data for channels 4, 1, and 0, and to disable the use of watchdog data for all other channels.

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Get Watchdog Info [cmdchars] = !U

Description

The **Get Watchdog Info** command provides all the information regarding the addressed module's watchdog configuration.

Each module can be enabled to respond to (or ignore) watchdog timeout. Further, each channel of a module can be configured to go to a pre-specified output value (watchdog data) upon a watchdog timer expiration. If a module is configured to ignore watchdog timeouts, then all its channels also ignore watchdog timeouts.

Refer to Appendix B, *How to Interpret Data*, for information about how to interpret and convert data.

Syntax

!U

Success Response

A[*moduleInfo*][*chnlEnable*][*chnlWdgData*]

[*moduleInfo*] 10 ASCII-hex characters. It contains the following information:

- [*wdgEnabled*] Two ASCII-hex characters representing an unsigned byte. A zero implies that the watchdog is not enabled for the module; a "1" implies that the module is enabled for watchdog timer expiration.
- [*wdgOccured*] Two ASCII-hex characters representing an unsigned byte. A zero implies that the watchdog timeout has not occurred; a "1" implies that a watchdog timer has expired.
- [*wdgTmo*] Four ASCII-hex characters (least significant byte first) representing an unsigned 16-bit number. The setting of the watchdog timeout value in tens of milliseconds.
- [*numChnls*] Two ASCII-hex characters. The number of channels in the module. One [*chnlWdgData*] is returned for each channel in the module.

[*chnlEnable*] Four ASCII-hex characters. Bit-15 corresponds to channel 15, and bit-0 corresponds to channel 0. A "1" in any bit position indicates that the corresponding channel has been configured to use its [*chnlWdgData*].

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A zero in a bit position indicates that the corresponding channel has been configured not to use the [*chnlWdgData*].

If a channel does not exist or a channel is not an output channel, the corresponding bit in this field is "0." The [*chnlEnable*] does not indicate whether the [*chnlWdgData*] has been explicitly set or not. It is assumed by the module that if a channel is enabled, that its watchdog data must have been pre-specified.

[*chnlWdgData*] Four ASCII-hex characters per channel of the module. This is the value that is sourced by the output channel if the corresponding [*chnlEnable*] bit is "1." The [*chnlWdgData*] is returned in the response even if it was not explicitly set previously. The [*chnlWdgData*] is returned in the response even if the channel is not an output channel.

Error Responses

E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33!U??[*cr*]

This command tells the FieldPoint module at address 51 (0x33) to return information about its watchdog configuration.

A0100020002000101234567[*cs*][*cr*]

This response from the module indicates that the watchdog timer is enabled with a timeout value of 5.12 s (0x200). The module has 2 channels, but only channel 0 is enabled to use its watchdog data (channel 1 is not affected by watchdog timer expiration). The response also indicates that the watchdog data for channels 1 and 0 is 0x0123 and 0x4567, respectively.

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Store Watchdog Delay [cmdchars] = !V

Description

The **Store Watchdog Delay** command sets the power-up value of the watchdog timeout value for the network module. This time is not related to the current setting of the watchdog timeout value that is set via the **Set Watchdog Delay** command. The power-up value specified in this command is used only if the SnapShot feature is enabled.

The timeout value specified in this command is stored with only the SnapShot information. This command does not change the current running/stopped state of the watchdog timer.

Syntax

`!V[wdgTmo]`

`[wdgTmo]`	Four ASCII-hex characters, specifying the power-up watchdog timeout value. The power-up watchdog timeout value is set equal to 10 times the number of milliseconds specified in this field and stored in non-volatile memory. The watchdog timer is not started. Timeout values of less than 200 ms (0 < `[wdgTmo]` < 20) result in an error. A `[wdgTmo]` of 0 disables the watchdog timer function for the bank upon future power-ups.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_BAD_ADDRESS	The command is valid, but the addressed module does not support the command received.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_ILLEGAL_DIGIT	One or more characters sent in the command could not be correctly converted to a digit (hex or decimal).
E_HW_FAILURE	An irrecoverable fault has occurred.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>00!V0200??[cr]`

This command tells the FieldPoint module at address 0x00 to use the watchdog timeout value of 5.12 s (0x200) upon future power-ups.

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Store SnapShot [cmdchars] = !W

Description

The **Store SnapShot** command instructs the network module to save the current ranges, attributes, output values, and watchdog settings of all the channels in the bank to non-volatile memory. In addition, the hot-swap reporting mode and the turn-around delays are also saved. These saved settings are used during future power-ups if the network module is enabled to do so via the **Use SnapShot** command.

This command does not save the watchdog timeout delay value for the communications module; use the **Store Watchdog Delay** command for that feature. This command can be sent to a FieldPoint network module only.

Syntax

```
!W
```

Success Response

```
A
```

Error Responses

E_INVALID_CMD	Undefined command.
E_BAD_ADDRESS	The command is valid, but the addressed module does not support the command received.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_HW_FAILURE	An irrecoverable fault has occurred.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

```
>00!W??[cr]
```

This command tells the FieldPoint module at address 0x00 to store the bank's current range settings, attribute settings, output levels, watchdog settings (except the timeout value), hot-swap reporting mode, and turn-around delays.

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Use SnapShot [cmdchars] = !X

Description

The **Use SnapShot** command instructs the network module to enable or disable the use of the power-up settings stored in non-volatile memory. The power-up settings are stored via the **Store SnapShot** command. This command can be sent to a FieldPoint network module only.

Syntax

`!X[flag]`

`[flag]` One ASCII-hex character as shown in the following table.

[flag] Value	Description
0	Disables the use of the stored power up settings. All I/O Modules in the bank are initialized to the factory default settings upon future power-ups.
1	Enables the use of the stored power up settings. All I/O Modules in the bank are initialized to the SnapShot settings.

Success Response

A

Error Responses

E_INVALID_CMD	Undefined command.
E_BAD_ADDRESS	The command is valid, but the addressed module does not support the command received.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_HW_FAILURE	An irrecoverable fault has occurred.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

`>33!X1??[cr]`

This command tells the FieldPoint module at address 51 (0x33) to use the currently stored SnapShot information during future power-ups.

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Read SnapShot Status [cmdchars] = !Y

Description

The **Read SnapShot Status** command reads the enabled/disabled status of the power-up settings.

Syntax

```
!Y
```

Success Response

```
A[status]
```

`[status]` One ASCII-hex character as shown in the following table.

[flag] Value	Description
0	Use of the stored power-up settings is disabled. All I/O modules in the bank are initialized to the factory default settings upon future power-ups.
1	Use of the stored power up settings is enabled. All I/O modules in the bank are initialized to the SnapShot settings.

Error Responses

E_INVALID_CMD	Undefined command.
E_BAD_ADDRESS	The command is valid, but the addressed module does not support the command received.
E_INV_LIMS_GOT	Specified limits invalid for the command.
E_HW_FAILURE	An irrecoverable fault has occurred.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

```
>00!Y??[cr]
```

This command tells the FieldPoint module at address 0x00 to return the status of the SnapShot feature.

```
A1[cs][cr]
```

This response from the module indicates that the SnapShot feature is enabled.

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Reset Module [cmdchars] = !Z

Description

If a network module is addressed, the **Reset Module** command resets all the I/O modules in the bank and resets the turn-around delay for all modules to zero. If a module other than a network module is addressed, the addressed module is reconfigured and the turn-around delay for the addressed module is set to zero. In both cases, the FieldPoint modules are configured to factory default settings (if the SnapShot feature is disabled) or to stored SnapShot information (if the SnapShot feature is enabled).

Syntax

!Z

Success Response

A

Error Responses

E_INV_LIMS_GOT	Specified limits invalid for the command.
E_NO_MODULE	The addressed module does not exist.

Refer to Chapter 2, *FieldPoint Responses*, for other possible error responses, error numbers, and error descriptions.

Example

>33!Z??[*cr*]

This command tells the FieldPoint module at address 51 (0x33) to return to its power-up state.

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A

ASCII Chart

Table A-1. ASCII Chart

Hex	Dec	ASCII
00	0	NUL
01	1	SOH
02	2	STX
03	3	ETX
04	4	EOT
05	5	ENQ
06	6	ACK
07	7	BEL
08	8	BS
09	9	HT
0A	10	LF
0B	11	VT
0C	12	FF
0D	13	CR
0E	14	SO
0F	15	SI
10	16	DLE
11	17	DC1
12	18	DC2
13	19	DC3
14	20	DC4
15	21	NAK
16	22	SYN
17	23	ETB
18	24	CAN
19	25	EM
1A	26	SUB
1B	27	ESC
1C	28	FS

Hex	Dec	ASCII
20	32	SP
21	33	!
22	34	"
23	35	#
24	36	$
25	37	%
26	38	&
27	39	'
28	40	(
29	41	)
2A	42	*
2B	43	+
2C	44	,
2D	45	-
2E	46	.
2F	47	/
30	48	0
31	49	1
32	50	2
33	51	3
34	52	4
35	53	5
36	54	6
37	55	7
38	56	8
39	57	9
3A	58	:
3B	59	;
3C	60	<

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Table A-1. ASCII Chart (Continued)

Hex	Dec	ASCII
1D	29	GS
1E	30	RS
1F	31	US
40	64	@
41	65	A
42	66	B
43	67	C
44	68	D
45	69	E
46	70	F
47	71	G
48	72	H
49	73	I
4A	74	J
4B	75	K
4C	76	L
4D	77	M
4E	78	N
4F	79	O
50	80	P
51	81	Q
52	82	R
53	83	S
54	84	T
55	85	U
56	86	V
57	87	W
58	88	X
59	89	Y
5A	90	Z
5B	91	[
5C	92	\
5D	93	]
5E	94	^
5F	95	_

Hex	Dec	ASCII
3D	61	=
3E	62	>
3F	63	?
60	96	`
61	97	a
62	98	b
63	99	c
64	100	d
65	101	e
66	102	f
67	103	g
68	104	h
69	105	i
6A	106	j
6B	107	k
6C	108	l
6D	109	m
6E	110	n
6F	111	o
70	112	p
71	113	q
72	114	r
73	115	s
74	116	t
75	117	u
76	118	v
77	119	w
78	120	x
79	121	y
7A	122	z
7B	123	{
7C	124	|
7D	125	}
7E	126	~
7F	127	DEL

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B

How to Interpret Data

This appendix explains how to interpret and convert data values.

Discrete Data

Discrete channels can take one of two values, which are generically known as asserted and negated states. Depending on how you view a discrete channel, you will refer to the asserted state as ON, TRUE, HIGH, HI, and so on, and to the corresponding negated state as OFF, FALSE, LOW, LO, and so on. Since the range setting for FieldPoint discrete channels is Boolean, the correlation between range setting and data value is trivial.

The FieldPoint commands described in this manual use 1 for the asserted state and 0 for the negated state.

Analog Data

Analog channels can take any value between a defined minimum and a defined maximum value. The minimum value (minScale) and maximum value (maxScale) are defined by the range setting. You must take the channel's range setting into account when correlating data values in your application and data values used in FieldPoint commands ([*data*]). The data values used in your application are also known as the engineering unit values (EUVs).

Table B-1 shows the possible range settings and the corresponding minScale and maxScale values for I/O modules that have analog channels. You can use this table to convert between engineering unit values (EUVs) and data values used in the FieldPoint commands ([*data*]).

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Table B-1. Range Settings for Analog Channels

Module Name	Range Setting	minScale	maxScale
FP-AI-100	0–24 mA 3.5–24 mA ± 24 mA ± 6 V 0–6 V ± 1.2 V 0–1.2 V 0–18 V ± 30 V 0–30 V ± 15 V	0 mA 3 mA –24 mA –6 V 0 V –1.2 V 0 V 0 V –30 V 0 V –15 V	24 mA 24 mA 24 mA 6 V 6 V 1.2 V 1.2 V 18 V 30 V 30 V 15 V
FP-AI-110	0–21 mA 3.5–21 mA ±21 mA ±10.4 V 0–10.4 V ±5.2 V 0–5.2 V ±1.04 V 0–1.04 V ±325 mV ±65 mV	0 mA 3.5 mA –21 mA –10.4 V 0 V –5.2 V 0 V –1.04 V 0 V –325 mV –65 mV	21 mA 21 mA +21 mA +10.4 V 10.4 V +5.2 V 5.2 V +1.04 V 1.04 V +325 mV +65 mV
FP-AI-111	0–21 mA 3.5–21 mA ± 21 mA	0 mA 3.5 mA –21 mA	21 mA 21 mA 21 mA
FP-TC-120 Input Channels Cold-Junction Channel	± 50 mV ± 25 mV –20, +80 mV ± 100 mV 0–2048 K –270, +1770 °C –454, +3218 °F 223–358 K –50, +85 °C –58, +185 °F	–50 mV – 25 mV –20 mV –100 mV 0 K –270 °C –454 °F 223 K –50 °C –58 °F	50 mV 25 mV 80 mV 100 mV 2048 K 1770 °C 3218 °F 358 K 85 °C 185 °F

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Table B-1. Range Settings for Analog Channels (Continued)

Module Name	Range Setting	minScale	maxScale
FP-RTD-122	73–1123 K –200, +850 °C –328, +1562 °F 0–400 Ω 0–4000 Ω	73 K –200 °C –328 °F 0 Ω 0 Ω	1123 K 850 °C 1562 °F 400 Ω 4000 Ω
FP-AO-200	0–21 mA 3.5–21 mA	0 mA 3.5 mA	21 mA 21 mA
FP-AO-210	0–10.2 V	0 V	10.2 V
FP-CTR-500 Count Inputs	0–65535 Counts	0 Counts	65535 Counts
FP-PWM-520	0–100%	0%	100%

Since the FieldPoint command set includes standard commands that use 12-bit values, as well as extended commands that use full 16-bit values, there are some differences that you must take into consideration when using the two types of commands. To better understand these differences, study the examples in this appendix.

When you write analog data (whether 12-bit or 16-bit), you need to know what data values to put into a command so that the FieldPoint channel correctly drives the level that you want. When you read analog data (whether 12-bit or 16-bit), you need to know what the value returned from the channel in response to your command means. In both of these situations, you must know what the range setting of the channel is, so that you can convert the values.

Examples of Conversions with Extended Commands

This section shows how to use Table B-1 to convert between engineering unit values and command data values when utilizing extended FieldPoint commands (16-bit resolution).

When you want to write a desired engineering unit value (Desired EUV), the formula to calculate the command data value ([*data*]) is as follows:

$$[data] = \frac{DesiredEUV - minScale}{maxScale - minScale} * 65535$$

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Remember that you must convert the [*data*] to hex before you use it in a FieldPoint command.

When you read a value from the FieldPoint command ([*data*]), the formula to calculate the engineering unit value (EUV) is as follows:

$$EUV = \frac{[data]}{65535} * (maxScale - minScale) + minScale$$

Remember that you must convert the [*data*] to decimal before you use it in the calculation.

Writing 4 mA to Channel with Range Setting 3.5–21 mA

This example illustrates how to calculate the value that you should include in the FieldPoint command for this channel.

[*data*] = (4 – 3.5) ÷ (21 – 3.5) * 65535
= 1872.43
= 1927 = 0x0750 hex (if rounding down)

Writing 10.5 mA to Channel with Range Setting 0–21 mA

This example illustrates how to calculate the value that you should include in the FieldPoint command for this channel.

[*data*] = (10.5 – 0) ÷ (21 – 0) * 65535
= 32767.5
= 32768 or 0x8000 hex (if rounding up)
= 32767 or 0x7FFF hex (if rounding down)

Reading 0x9000 from Channel with Range Setting ±21 mA

This example illustrates how to calculate the engineering unit value for this channel from data value returned in the response to the FieldPoint command.

0x9000 hex = 36864 decimal
EUV = (36864 ÷ 65535 * (21 – (–21))) + (–21)
= (0.56251 * 42) – 21
= 2.6254 mA

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Reading 0x0750 from Channel with Range Setting 3.5–21 mA

This example illustrates how to calculate the engineering unit value for this channel from data value returned in the response to the FieldPoint command.

0x0788 hex = 1928 decimal
EUV = (1872 ÷ 65535 * (21 – 3.5)) + 3.5
= (0.02856 * 17.5) + 3.5
= 3.9999 mA

Examples of Conversions with Standard Commands

This section shows how to use Table B-1 to convert between engineering unit values and command data values when utilizing standard FieldPoint commands (12-bit resolution).

When you want to write a desired engineering unit value (Desired EUV), the formula to calculate the command data value ([*data*]) is:

$$[data] = \frac{DesiredEUV - minScale}{maxScale - minScale} * 4095$$

Remember that you must convert the [*data*] to hex before you use it in a FieldPoint command.

When you read a value from the FieldPoint command ([data]), the formula to calculate the engineering unit value is as follows:

$$EUV = \frac{[data] - 4096}{4095} * (maxScale - minScale) + minScale$$

Remember that you must convert the [*data*] to decimal before you use it in the above calculation.

Writing 4 mA to Channel with Range Setting 3.5–21 mA

This example illustrates how to calculate the value that you should include in the FieldPoint command for this channel.

[*data*] = (4 – 3.5) ÷ (21 – 3.5) * 4095
= 117 or 0x75 hex

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Writing 10.5 mA to Channel with Range Setting 0–21 mA

This example illustrates how to calculate the value that you should include in the FieldPoint command for this channel.

[*data*] = (10.5 – 0) ÷ (21 – 0) * 4095
= 2047.5
= 2048 or 0x800 hex (if rounding up)
= 2047 or 0x7FF hex (if rounding down)

Reading 0x1000 from Channel with Range Setting ±21 mA

This example illustrates how to calculate the engineering unit value for this channel from data value returned in the response to the FieldPoint command.

0x1000 hex = 4096 decimal
EUV = ((4096 – 4096) ÷ 4095 * (21– (–21))) + (–21)
= (0 * 42) – 21
= –21.000 mA

Reading 0x1075 from Channel with Range Setting 3.5–21 mA

This example illustrates how to calculate the engineering unit value for this channel from data value returned in the response to the FieldPoint command.

0x1075 = 4213 decimal
EUV = ((4213 – 4096) ÷ 4095 * (21 – 3.5)) + 3.5
= (0.02857 * 17.5) + 3.5
= 4.000 mA

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C

Technical Support Resources

This appendix describes the comprehensive resources available to you in the Technical Support section of the National Instruments Web site and provides technical support telephone numbers for you to use if you have trouble connecting to our Web site or if you do not have internet access.

NI Web Support

To provide you with immediate answers and solutions 24 hours a day, 365 days a year, National Instruments maintains extensive online technical support resources. They are available to you at no cost, are updated daily, and can be found in the Technical Support section of our Web site at `www.natinst.com/support`.

Online Problem-Solving and Diagnostic Resources

- **KnowledgeBase**—A searchable database containing thousands of frequently asked questions (FAQs) and their corresponding answers or solutions, including special sections devoted to our newest products. The database is updated daily in response to new customer experiences and feedback.
- **Troubleshooting Wizards**—Step-by-step guides lead you through common problems and answer questions about our entire product line. Wizards include screen shots that illustrate the steps being described and provide detailed information ranging from simple getting started instructions to advanced topics.
- **Product Manuals**—A comprehensive, searchable library of the latest editions of National Instruments hardware and software product manuals.
- **Hardware Reference Database**—A searchable database containing brief hardware descriptions, mechanical drawings, and helpful images of jumper settings and connector pinouts.
- **Application Notes**—A library with more than 100 short papers addressing specific topics such as creating and calling DLLs, developing your own instrument driver software, and porting applications between platforms and operating systems.

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Software-Related Resources

- **Instrument Driver Network**—A library with hundreds of instrument drivers for control of standalone instruments via GPIB, VXI, or serial interfaces. You also can submit a request for a particular instrument driver if it does not already appear in the library.
- **Example Programs Database**—A database with numerous, non-shipping example programs for National Instruments programming environments. You can use them to complement the example programs that are already included with National Instruments products.
- **Software Library**—A library with updates and patches to application software, links to the latest versions of driver software for National Instruments hardware products, and utility routines.

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Glossary

Prefix	Meaning	Value
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
M-	mega-	10^{6}

%	percent
°	degrees
0x	precedes a hexadecimal number
Ω	ohms
B	bytes
bank	The combination of one FieldPoint network module and one or more terminal bases and I/O modules.
C	celsius
DSR	Data Set Ready
EDS	electronic data sheet
EMI	electromagnetic interference
FIFO	first-in-first-out
ft.	feet
g	grams
HotPnP	Hot Plug and Play
Hz	hertz
IEC	International Electrotechnical Commission
in.	inches
I/O	input/output

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LED	Light-emitting diode
POST	power-on self test
RAM	random-access memory
RTS	Request to Send
V	Volts
VDC	Volts direct current

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