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Allen-Bradley

FLEX Integra Analog Modules

(Cat. No. 1793-IE4, -IE4S, -OE2, -OE2S, -IE2XOE1 and -IE2XOE1S)

User Manual

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Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

Important: Identifies information that is critical for successful application and understanding of the product.

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ControlNet is a trademark of ControlNet International.

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Using This Manual

Purpose of this Manual

This manual shows you how to use your FLEX Integra Analog modules with Allen-Bradley programmable controllers. The manual helps you install, program and troubleshoot your modules.

Audience

You must be able to program and operate an Allen-Bradley programmable controller to make efficient use of your FLEX Integra modules. In particular, you must know how to program block transfers, and be familiar with DeviceNet or ControlNet software.

Vocabulary

We assume that you know how to do this in this manual. If you do not, refer to the appropriate programming and operations manual before you attempt to program your modules.

In this manual, we refer to:

- the analog input or analog output module as the “input module” or “output module”
- the Programmable Controller as the “controller”

Manual Organization

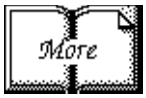
This manual is divided into five chapters. The following chart lists each chapter with its corresponding title and a brief overview of the topics covered in that chapter.

Chapter	Title	Contents
1	Overview of FLEX Integra and Analog modules	Describes FLEX Integra Analog modules, features, and how they function
2	How to Install Your Analog Module	How to install and wire the modules
3	Module Programming	Explains block transfer programming, sample programs
4	Writing Configuration to and Reading Status From with a Remote I/O Adapter	Explains how to configure your modules and read status information from your modules when using a remote I/O adapter
5	How Communication Takes Place and I/O Image Table Mapping with the DeviceNet Adapter	Explains how you communicate with your modules, and how the I/O image is mapped when using a DeviceNet adapter
6	Input, Status, Output and Configuration with ControlNet	Explains how you communicate with your modules, and how the I/O image is mapped when using ControlNet.
Appendix	**Title**	**Contents**
A	Specifications	Specifications for the analog modules

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Conventions

We use these conventions in this manual:

In this manual, we show:	Like this:
that there is more information about a topic in another chapter in this manual	
that there is more information about the topic in another manual	

For Additional Information

For additional information on FLEX Integra and FLEX I/O systems and modules, refer to the following documents:

Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1793 Series		FLEX Integra Product Data	1793-2.1	
1793-IB4		4 Input Module	1793-5.1	
1793-OB4P		4 Protected Output Module	1793-5.2	
1793-IB2XOB2P		2 In/2 Protected Output Module	1793-5.3	
1793-IE4	24V dc	4 Input Analog Module	1793-5.4	1791-6.5.1
1793-OE2	24V dc	2 Protected Output Analog Module	1793-5.5	
1793-IE2XOE1P	24V dc	2 In/1 Protected Output Analog Module	1793-5.6	
1793-OW4		4 Relay Output Module	1793-5.7	
1794		1794 FLEX I/O Product Data	1794-2.1	
1794-ACN	24V dc	ControlNet Adapter	1794-5.8	
1794-ACNR	24V dc	Redundant Media ControlNet Adapter	1794-5.18	
1794-ACN15	24V dc	ControlNet Adapter	1794-5.47	
1794-ACNR15	24V dc	Redundant Media ControlNet Adapter	1794-5.48	
1794-ADN	24V dc	DeviceNet Adapter	1794-5.14	1794-6.5.5
1794-ASB/C & D	24V dc	Remote I/O Adapter	1794-5.50	1794-6.5.9
1794-ASB2/B	24V dc	2-Slot Remote I/O Adapter	1794-5.44	1794-6.5.13
1794-APB	24V dc	Profibus Adapter	1794-5.40	1794-6.5.6
1794-IB8	24V dc	8 Sink Input Module	1794-5.30	
1794-OB8	24V dc	8 Source Output Module	1794-5.31	
1794-IB16	24V dc	16 Sink Input Module	1794-5.4	
1794-OB16	24V dc	16 Source Output Module	1794-5.3	
1794-IV16	24V dc	16 Source Input Module	1794-5.28	
1794-OV16	24V dc	16 Sink Output Module	1794-5.29	
1794-OB8EP	24V dc	8 Electronically Fused Output Module	1794-5.20	
1794-IB8S	24V dc	Sensor Input Module	1794-5.7	

Table continued on next page

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Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1794-IB10XOB6	24V dc	10 Input/6 Output Module	1794-5.24	
1794-IE8	24V dc	Selectable Analog 8 Input Module	1794-5.6	1794-6.5.2
1794-OE4	24V dc	Selectable Analog 4 Output Module	1794-5.5	
1794-IE4XOE2	24V dc	4 Input/2 Output Analog Module	1794-5.15	
1794-OF4	24V dc	4 Output Isolated Analog Module	1794-5.37	
1794-IF4	24V dc	4 Input Isolated Analog Module	1794-5.38	1794-6.5.8
1794-IF2XOF2	24V dc	2 Input/2 Output Isolated Analog Module	1794-5.39	
1794-IR8	24V dc	8 RTD Input Analog Module	1794-5.22	1794-6.5.4
1794-IT8	24V dc	8 Thermocouple Input Module	1794-5.21	1794-6.5.7
1794-IRT8	24V dc	8 Thermocouple/RTD Input Module	1794-5.50	1794-6.5.12
1794-IJ2	24V dc	2 Frequency Input Module	1794-5.49	1794-6.5.11
1794-ID2	24V dc	2 Input Incremental Encoder Module	1794-5.63	1794-6.5.15
1794-IP4	24V dc	4 Input Pulse Counter Module	1794-5.64	1794-6.5.16
1794-VHSC	24V dc	Very High Speed Counter Module	1794-5.67	1794-6.5.10
1794-IA8	120V ac	8 Input Module	1794-5.9	
1794-OA8	120V ac	Output Module	1794-5.10	
1794-TB2 1794-TB3		2-wire Terminal Base 3-wire Terminal Base	1794-5.2	
1794-TBN		Terminal Base Unit	1794-5.16	
1794-TBNF		Fused Terminal Base Unit	1794-5.17	
1794-TB3T		Temperature Terminal Base Unit	1794-5.41	
1794-TB3S		Spring Clamp Terminal Base Unit	1794-5.42	
1794-TB3TS		Spring Clamp Temperature Base Unit	1794-5.43	
1794-TB3G		Terminal Base Unit	1794-5.51	
1794-TB3GS		Spring Clamp Terminal Base Unit	1794-5.59	
1794-CE1, -CE3		Extender Cables	1794-5.12	
1794-NM1		Mounting Kit	1794-2.13	
1794-PS1	24V dc	Power Supply	1794-5.35	

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Overview of FLEX Integra and your Analog Modules

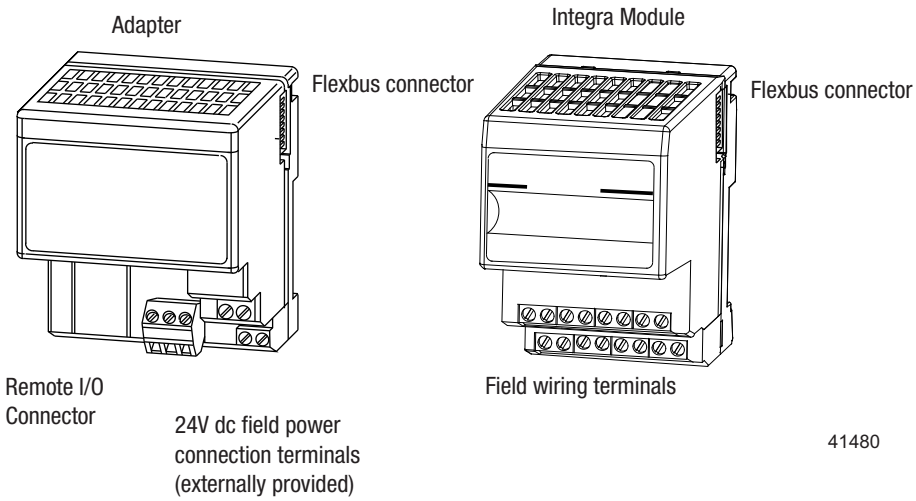
Chapter Objectives

In this chapter, we tell you about:

- what the FLEX Integra system is and what it contains
- types of FLEX Integra analog modules
- how FLEX Integra analog modules communicate with programmable controllers
- the features of your analog modules

The FLEX Integra System

FLEX Integra is a small, modular I/O system for distributed applications that performs all of the functions of rack-based I/O. The FLEX Integra system contains the following components shown below:



- adapter/power supply – powers the internal logic for as many as eight I/O modules
- I/O module with integral wiring terminals– contains the bus interface and circuitry needed to perform specific functions related to your application and connection terminals for connecting wiring.

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Types of FLEX Integra Modules

We describe the following FLEX Integra Analog modules in this user manual:

Catalog Number	Voltage	Inputs	Outputs	Description
1793-IE4	24V dc	4	–	analog – 4 input, single-ended, non-isolated; screw-cage connectors
1793-IE4S	24V dc	4	–	analog – 4 input, single-ended, non-isolated; spring-clamp connectors
1793-OE2	24V dc	–	2	analog – 2 output, single-ended, non-isolated; screw-cage connectors
1793-OE2S	24V dc	–	2	analog – 2 output, single-ended, non-isolated; spring-clamp connectors
1793-IE2XOE1	24V dc	2	1	analog – 2 input, single-ended, non-isolated and 1 output, single-ended, non-isolated; screw-cage connectiors
1793-IE2XOE1S	24V dc	2	1	analog – 2 input, single-ended, non-isolated and 1 output, single-ended, non-isolated; spring-clamp connectors

FLEX Integra analog input, output and combination modules are block transfer modules that interface analog signals with any Allen-Bradley programmable controllers that have block transfer capability. Block transfer programming moves input from the module's memory to a designated area in the processor data table, and output data words from a designated area in the processor data table to the module's memory. Block transfer programming also moves configuration words from the processor data table to module memory.

The analog modules have selectable ranges as shown in the table below:

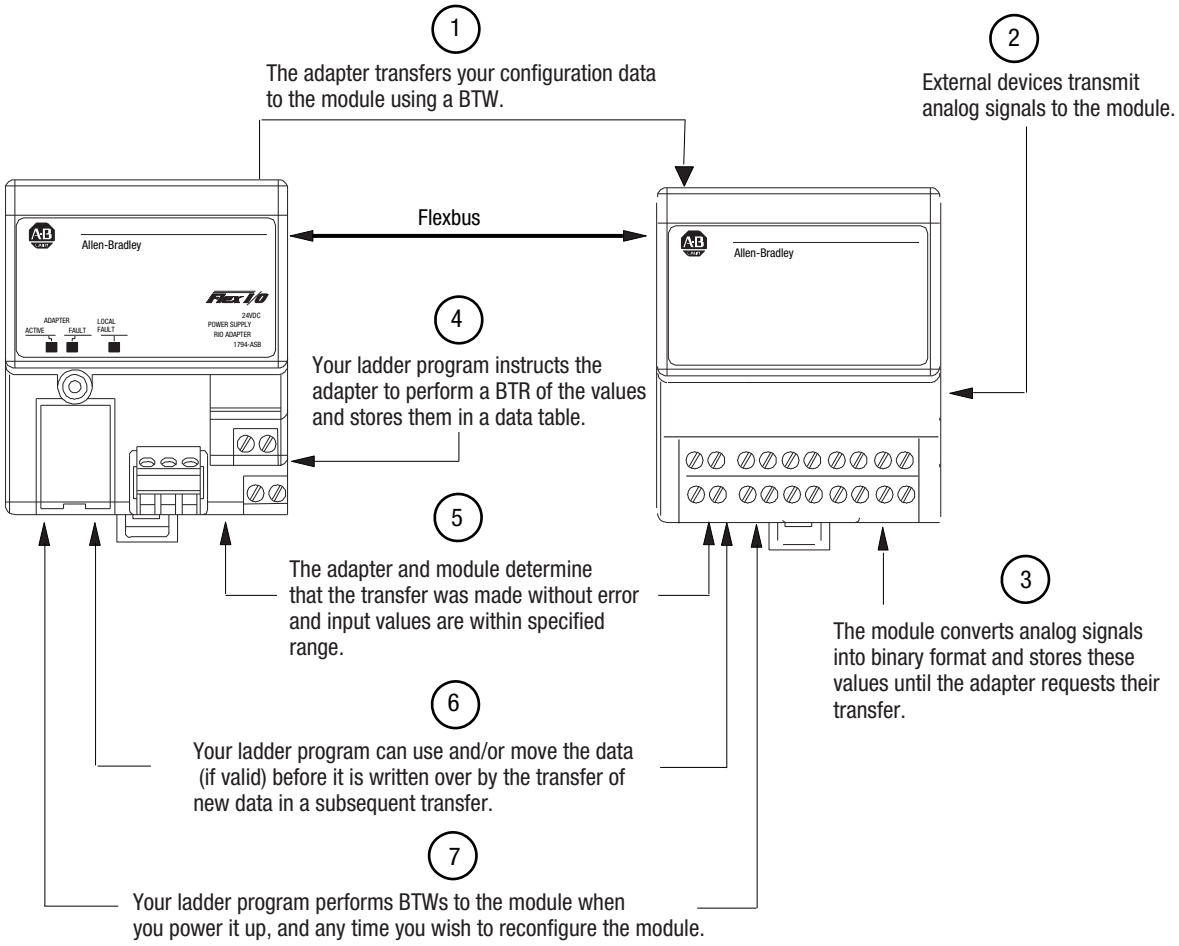
Voltage	Current
0 to 10V dc	0 to 20mA
±10V dc	4 to 20mA

How FLEX Integra Analog Modules Communicate with Programmable Controllers

The adapter/power supply transfers data to the module (block transfer write) and from the module (block transfer read) using BTW and BTR instructions in your ladder diagram program. These instructions let the adapter obtain input values and status from the module, and let you send output values and establish the module's mode of operation. Figure 1.1 describes the communication process.

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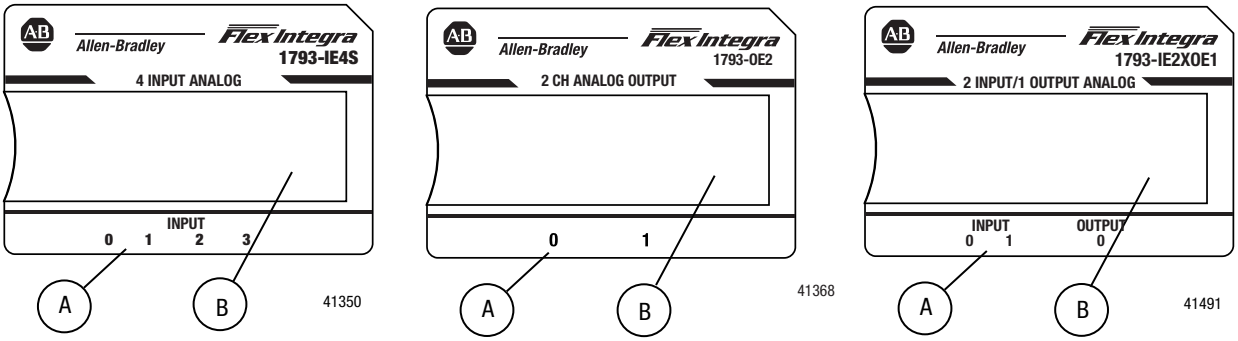
Figure 1.1
An Example of Communication Between an Adapter and an Analog Input Module



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Features of your Analog Modules

Each module has a unique label identifying its wiring and module type. A removable label provides space for writing individual designations per your application.



A = status indicator
B = insertable label

Chapter Summary

In this chapter you learned about the FLEX I/O system and the types of analog modules and how they communicate with programmable controllers.

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How to Install Your Analog Module

Chapter Objectives

In this chapter, we tell you about:

- how to install your module
- how to wire your module
- the indicators

Before You Install Your Analog Module

Before installing your analog module in the I/O chassis:

You need to:	As described under:
Calculate the power requirements of all modules in each chassis.	Power Requirements, page 2-2

ATTENTION: +24V dc power must be applied to your module before operation. If power is not applied, the module position will appear to the adapter as an empty slot in your chassis. If the adapter does not recognize your module after installation is completed, cycle power to the adapter.

Compliance to European Union Directives

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2EMC – Generic Emission Standard, Part 2 – Industrial Environment
- EN 50082-2EMC – Generic Immunity Standard, Part 2 – Industrial Environment

This product is intended for use in an industrial environment.

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Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 – Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, publication 1770-4.1
- Guidelines for Handling Lithium Batteries, publication AG-5.4
- Automation Systems Catalog, publication B111

This equipment is classified as open equipment and must be mounted in an enclosure during operation to provide safety protection.

Power Requirements

The wiring of the module is determined by the current draw through the terminals. Make certain that the current draw does not exceed 10A.



ATTENTION: Total current draw through the module wiring terminals is limited to 10A. Separate power connections may be necessary.



ATTENTION: Do not daisy chain power or ground from an analog module to any ac or dc discrete module.

Installing the Module

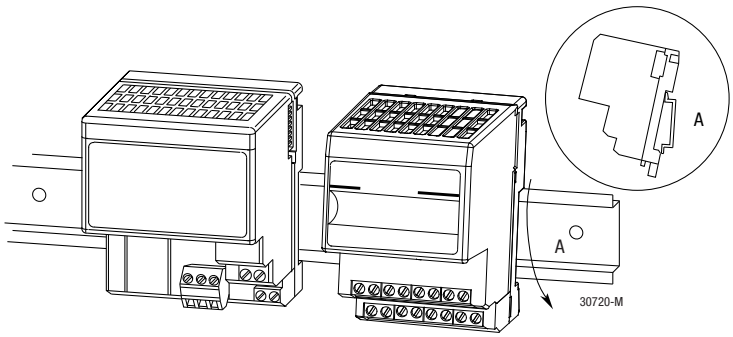
Installation of the analog module consists of:

This module mounts on a DIN rail. It connects to an adapter or another FLEX I/O or Integra module. Note: If using this module with FLEX I/O modules, do not mount between FLEX I/O modules. Mount Integra modules to the right of the FLEX I/O modules. To mount this module::

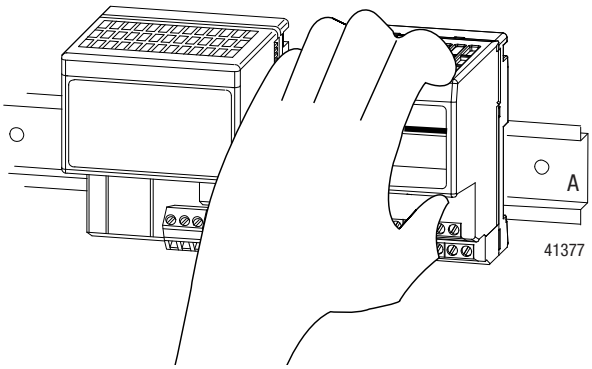
1. Remove the cover plug (if used) in the male connector of the unit to which you are connecting this module.

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2. Position the module on the 35 x 7.5mm DIN rail **A** (A-B pt. no. 199-DR1). Rotate the module onto the DIN rail with the top of the rail hooked under the lip on the rear of the module.

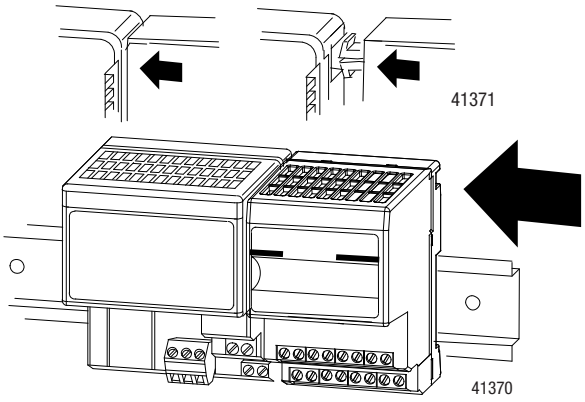


3. Press down to lock the module on the DIN rail.l



If the module does not lock in place, use a screwdriver of similar device to move the locking tab down, press the module flush with the DIN rail and release the locking tab to lock the module in place

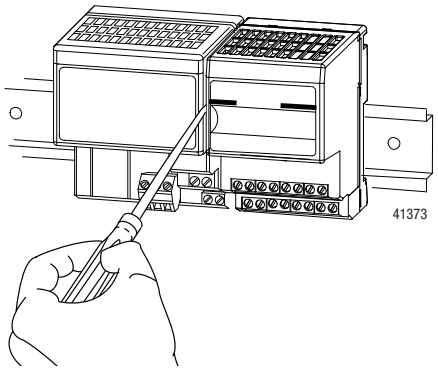
4. Firmly push the module into the adjacent module/terminal base until the units lock together.



5. Repeat the above steps to install the next Integra module.

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6. To remove an Integra module, you must work from the right side and remove one module at a time. To disengage a module from its neighbor, place a common flat-bladed screwdriver between the 2 modules and turn 1/4 turn to separate the modules.



7. Then slide the module away from its left neighbor, and release the locking lever to remove the module from the DIN rail.

ATTENTION: Do not remove this module under power. Removing this module under power will break the electrical backplane (flexbus) connections. This can cause personal injury or property damage by:

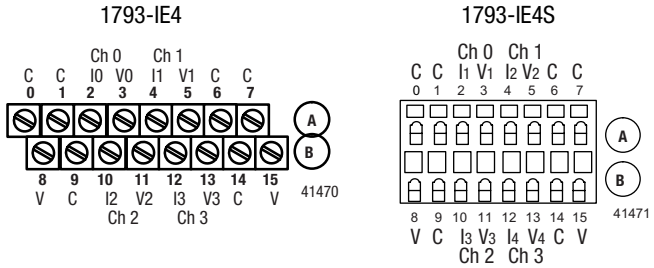
- sending an erroneous signal to your system's field devices causing unintended machine motion
- causing an explosion in a hazardous environment
- breaking communication to modules beyond this module

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Connecting Wiring for the Analog Modules

Connecting Wiring for the 1793-IE4 Input Module

This module is available with 2 styles of connectors; screw-cage and spring clamp. Refer to the wiring figure below.



Where: C = 24V dc common, V = 24V dc power, I_n = current in, V_n = voltage in.

1. Connect individual analog channel signal wiring to terminals on row **A** and row **C. Use Belden 8761 cable for signal wiring.**.

> **ATTENTION:** Connect only 1 current or 1 voltage signal per channel. Do not connect both current and voltage on 1 channel.

2. Connect the associated channel common to common terminals 1, 6, 9 or 14 according to the wiring table on the next page.

3. Connect +24V dc to terminal 8 on row **B.**

4. Connect 24V dc common to terminal 0 on row **A**.

5. If daisy-chaining +24V dc from this module to the next FLEX Integra module, connect a jumper from terminal 15 to terminal 8 on the next FLEX Integra module.

6. If daisy-chaining 24V dc common from this module to the next FLEX Integra module, connect a jumper from terminal 7 on this module to terminal 0 on the next Integra module.

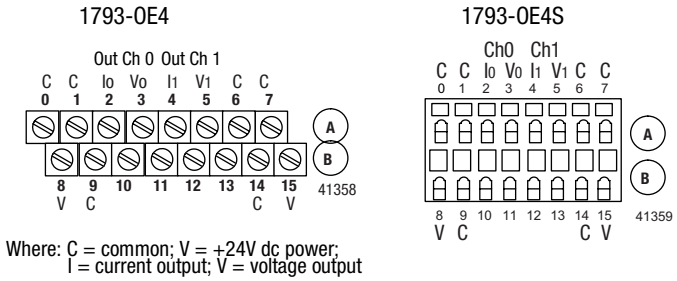
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Table 2.A Wiring connections for the 1793-IE4 Analog Module

Channel	Signal Type	Label Markings	Signal	Return
0	Current	I	2	1
	Voltage	V	3	1
1	Current	I	4	6
	Voltage	V	5	3
2	Current	I	10	9
	Voltage	V	11	9
3	Current	I	12	14
	Voltage	V	13	14
	24V dc Common	Terminals 0, 1, 6, 9, and 14 are connected together in the module.		
	+24V dc power	Terminals 8 and 15 are internally connected in the module.		

Connecting Wiring for the 1793-OE2 Output Module

. This module is available with 2 styles of connectors; 1793-OE2 - screw-cage and 1793-OE2S - spring clamp. Refer to the figure below.



Where: C = common; V = +24V dc power;
I = current output; V = voltage output

1. Connect individual analog output channel signal wiring as follows:

Channel 0 - Current output - connect output signal to terminal 2 (current output) on row A. Connect the associated channel common to terminal 1 on row A.

Channel 0 - voltage output - connect output signal to terminal 3 (current output) on row A. Connect the associated channel common to terminal 1 on row A.

Channel 1 - Current output - connect output signal to terminal 4 (current output) on row A. Connect the associated channel common to terminal 6 on row A.

Channel 0 - voltage output - connect output signal to terminal 5 (current output) on row A. Connect the associated channel common to terminal 6 on row A.

Note: Use Belden 8761 cable for signal wiring.

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ATTENTION: Connect only 1 voltage or current signal per channel. Do not connect both voltage and current on one channel.

2. Connect +24V dc to terminal 8 on row **B**

3. Connect 24V common to terminal 0 on row **A**.

4. If daisy-chaining +24V dc from this module to the next FLEX Integra module, connect a jumper from terminal 15 to terminal 8 on the next FLEX Integra module.

5. If daisy-chaining 24V dc common from this module to the next FLEX Integra module, connect a jumper from terminal 7 on this module to terminal 0 on the next Integra module.

.

ATTENTION: Total current draw through the module's 24V dc terminals is limited to 10A. Separate power connections to the module may be required.

ATTENTION:Do not remove this module under power. Removing this module under power will break the electrical backplane (flexbus) connections. This can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices causing unintended machine motion
- causing an explosion in a hazardous environment
- breaking communication to modules beyond this module

ATTENTION: Connect only one current or one voltage signal per channel. Do not connect both current and voltage on one channel.

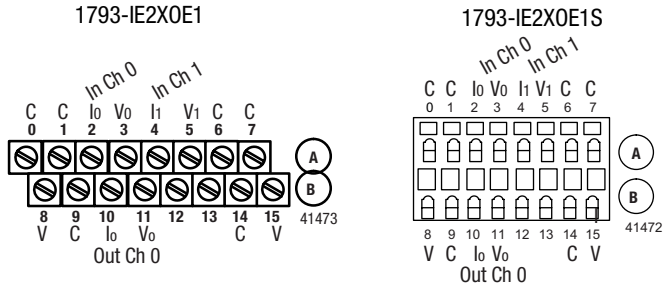
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Table 2.B
Wiring connections for the 1793-OE2 Analog Module

Channel	Type	Label Marking	Signal	Return
0	Current Signal	I	2	
	Current Common	RET		1
	Voltage Signal	V	3	
	Voltage Common	RET		1
1	Current Signal	I	4	
	Current Common	RET		6
	Voltage Signal	V	5	
	Voltage Common	RET		6
	24V dc Common	Terminals 0, 1, 6, 7, 9 and 14		
	+24V dc	Terminals 8 and 15 are internally connected to +V.		

Connecting Wiring for the 1793-IE2XOE1 Input/Output Module

This module is available with 2 styles of connectors; screw-cage and spring clamp. Refer to the wiring figure below.



Where: C = common; V = +24V dc power; $I_{0,1}$ = current in;
$V_{0,1}$ = voltage in; I_o = current out; V_o = voltage out

1. Connect individual analog input channel signal wiring to terminals on row **A.** Use terminals 2 (channel 0) and 4 (channel 1) for current and terminals 3 and 5 for current. **Use Belden 8761 cable for signal wiring.**.



ATTENTION: Connect only 1 current or 1 voltage signal per channel. Do not connect both current and voltage on 1 channel.

2. Connect the associated channel common to common terminals 1 and 6 according to the wiring table on the next page.

3. Connect individual analog output channel signal wiring to terminals 10 or 11 on row **B**. (Use terminal 10 for current, or terminal 11 for voltage - not both.)

4. Connect the associated channel common to common terminal 9 according to the wiring table on the next page.

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5. Connect +24V dc to terminal 8 on row **B**

6. Connect 24V dc common to terminal 0 on row **A**.

7. If daisy-chaining +24V dc from this module to the next FLEX Integra module, connect a jumper from terminal 15 to terminal 8 on the next FLEX Integra module.

8. If daisy-chaining 24V dc common from this module to the next FLEX Integra module, connect a jumper from terminal 7 on this module to terminal 0 on the next Integra module.



ATTENTION: Total current draw through the terminal base unit is limited to 10A. Separate power connections to the terminal base unit may be necessary.

Table 2.C
Wiring connections for the 1794-IE4XOE2 Analog Module

Channel	Signal Type	Label Markings	Signal	Return
Input				
0	Current	I	2	1
	Voltage	V	3	
1	Current	I	4	6
	Voltage	V	5	
Output				
0	Current	I	10	9
	Voltage	V	11	
+24V dc	Terminals 8 and 15 are internally connected to +V.			
24V dc common	Terminals 0, 1, 6, 7, 9, 14 are internally connected together in the module.			

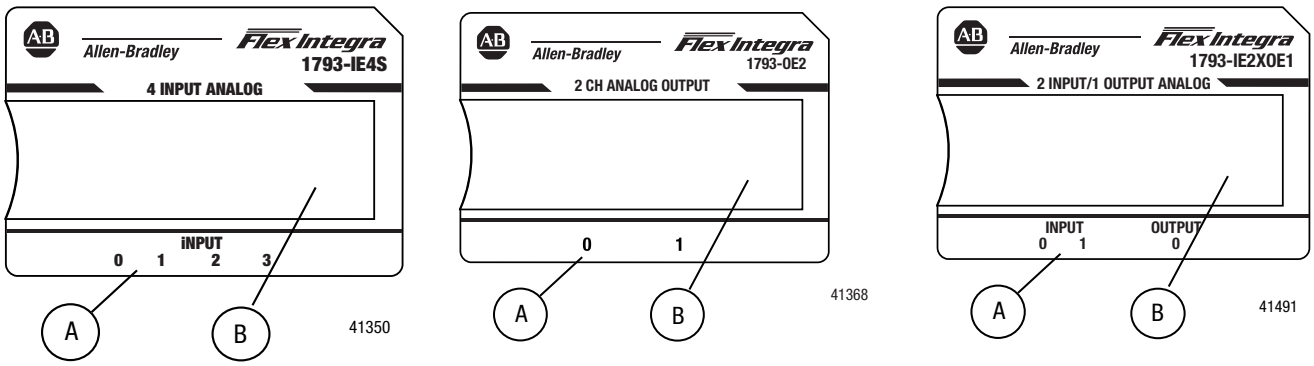


ATTENTION: Use a 100Ω, 25W or greater, resistor when connecting to a low-impedence device, i.e., panel meter. Failure to do so can result in damage to output circuitry.

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Module Indicators

The analog modules have status indicators that are on when power is applied to the module An insertable label is supplied to identify your inputs and outputs.



A = status indicator
B = insertable label

Chapter Summary

In this chapter you learned how to install and wire your analog module in an existing programmable controller system.

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Module Programming

Chapter Objectives

In this chapter, we tell you about:

- analog data format
- block transfer programming
- sample programs for the PLC-3 and PLC-5 processors

Block Transfer Programming

Your module communicates with the processor through bidirectional block transfers. This is the sequential operation of both read and write block transfer instructions.

A configuration block transfer write (BTW) is initiated when the analog module is first powered up, and subsequently only when the programmer wants to enable or disable features of the module. The configuration BTW sets the bits which enable the programmable features of the module, such as scaling, alarms, ranges, etc. Block transfer reads are performed to retrieve information from the module.

Block transfer read (BTR) programming moves status and data from the module to the processor's data table. The processor user program initiates the request to transfer data from the module to the processor. The transferred words contain module status, channel status and input data from the module.



ATTENTION: If the analog module is not powered up before the remote I/O adapter, the adapter will not recognize the module. Make certain that the analog module is installed and powered before or simultaneously with the remote I/O adapter. If the adapter does not establish communication with the module, cycle power to the adapter.

The following sample programs are minimum programs; all rungs and conditioning must be included in your application program. You can disable BTRs, or add interlocks to prevent writes if desired. Do not eliminate any storage bits or interlocks included in the sample programs. If interlocks are removed, the program may not work properly.

Your program should monitor status bits, block transfer read and block transfer write activity.

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Sample programs for FLEX Integra Analog Modules

The following sample programs show you how to use your analog module efficiently when operating with a programmable controller.

These programs show you how to:

- configure the module
- read data from the module
- update the module's output channels (if used)

These programs illustrate the minimum programming required for communication to take place.

PLC-3 Programming

Block transfer instructions with the PLC-3 processor use one binary file in a data table section for module location and other related data. This is the block transfer control file. The block transfer data file stores data that you want transferred to your module (when programming a block transfer write) or from your module (when programming a block transfer read). The address of the block transfer data files are stored in the block transfer control file.

The same block transfer control file is used for both the read and write instructions for your module. A different block transfer control file is required for every module.

A sample program segment with block transfer instructions is shown in Figure 3.1, and described below.

Figure 3.1
PLC-3 Family Sample Program Structure for a 1793-IE4 Module

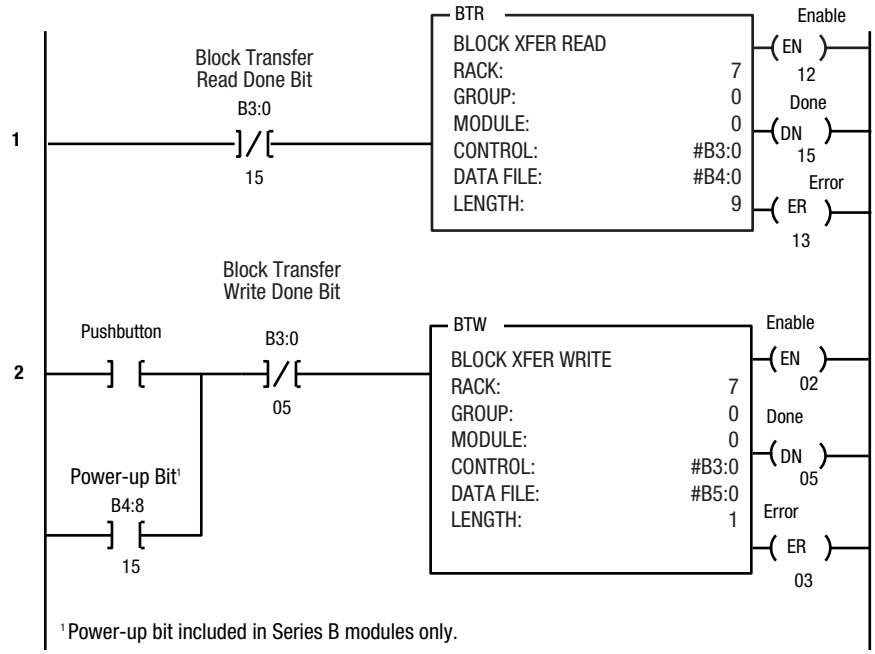
Program Action

At power-up in RUN mode, or when the processor is switched from PROG to RUN, the user program enables a block transfer read. Then it initiates a block transfer write to configure the module if the power - up bit is set.

Thereafter, the program continuously performs read block transfers.

Note: You must create the data file for the block transfers before you enter the block transfer instructions.

The pushbutton allows the user to manually request a block transfer write to configure the module.



[1] Power-up bit included in Series B modules only.

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Figure 3.2
PLC-3 Family Sample Program Structure for a 1793-OE2 Module

Program Action

At power-up in RUN mode, or when the processor is switched from PROG to RUN, the user program enables a block transfer read. Then it initiates a block transfer write to configure the module and send data values.

Thereafter, the program continuously performs read block transfers and write block transfers.

Note: You must create the data file for the block transfers before you enter the block transfer instructions.

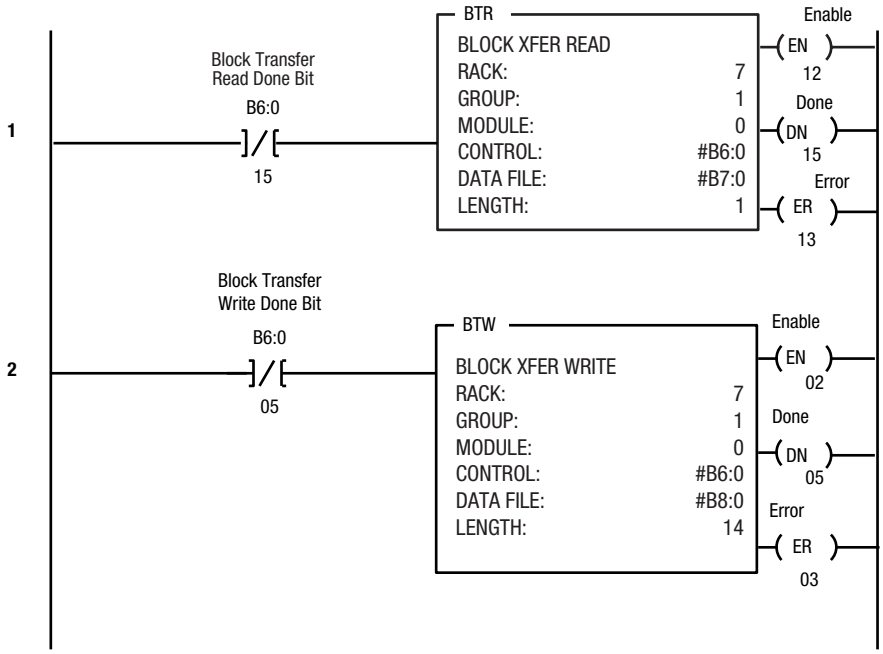
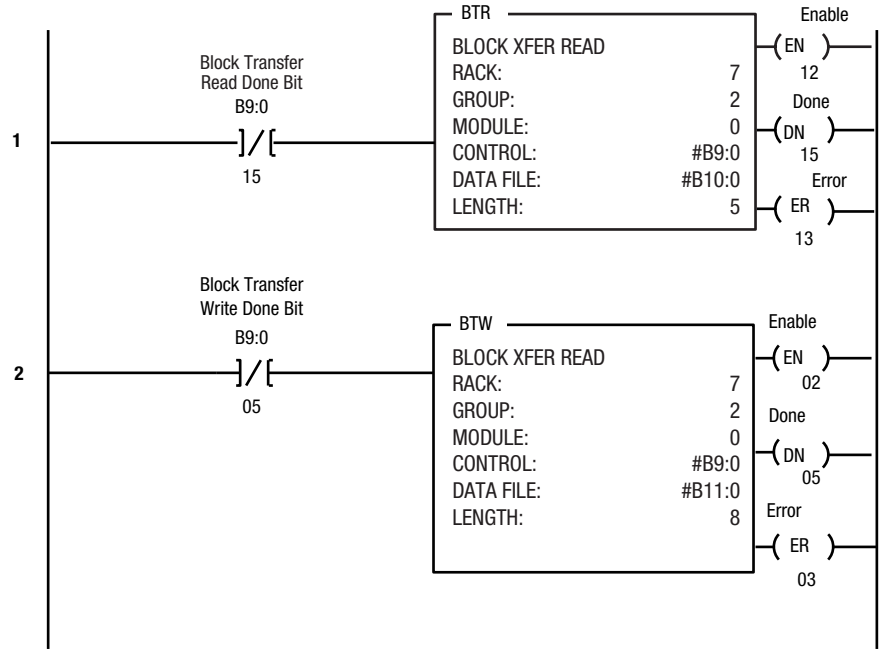


Figure 3.3
PLC-3 Family Sample Program Structure for a 1793-IE2XOE1 Module

Program Action

At power-up in RUN mode, or when the processor is switched from PROG to RUN, the user program enables a block transfer read. Then it initiates a block transfer write to configure the module and send data values

Thereafter, the program continuously performs read block transfers and write block transfers.
Note: You must create the data file for the block transfers before you enter the block transfer instructions.



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PLC-5 Programming

The PLC-5 program is very similar to the PLC-3 program with the following exceptions:

- block transfer enable bits are used instead of done bits as the conditions on each rung.
- separate block transfer control files are used for the block transfer instructions.

Figure 3.4
PLC-5 Family Sample Program Structure for the 1793-IE4

Program Action

At power-up in RUN mode, or when the processor is switched from PROG to RUN, the user program enables a block transfer read. Then it initiates a block transfer write to configure the module if the power-up bit is set.

Thereafter, the program continuously performs read block transfers to configure the module.

The pushbutton allows the user to manually request a block transfer write.

[1] Power-up bit included in Series B modules only.

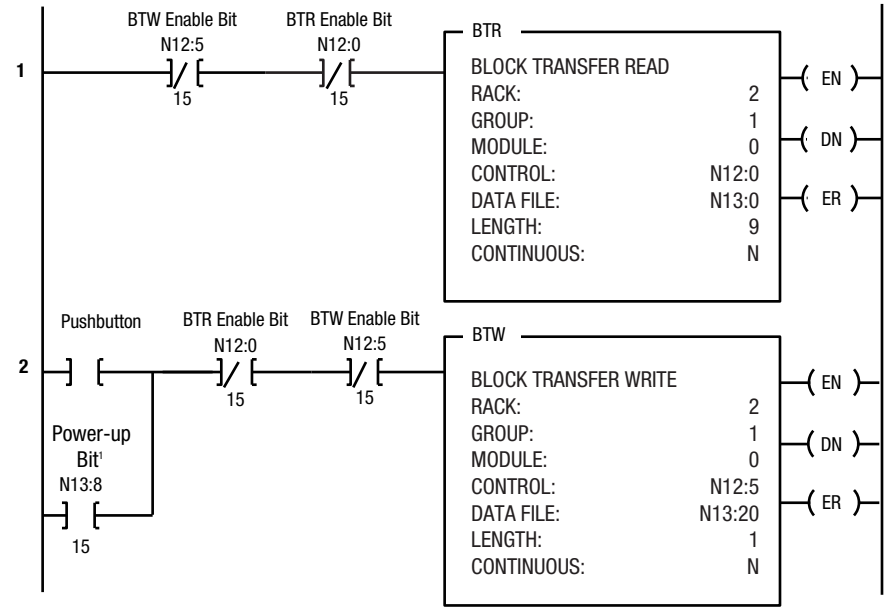
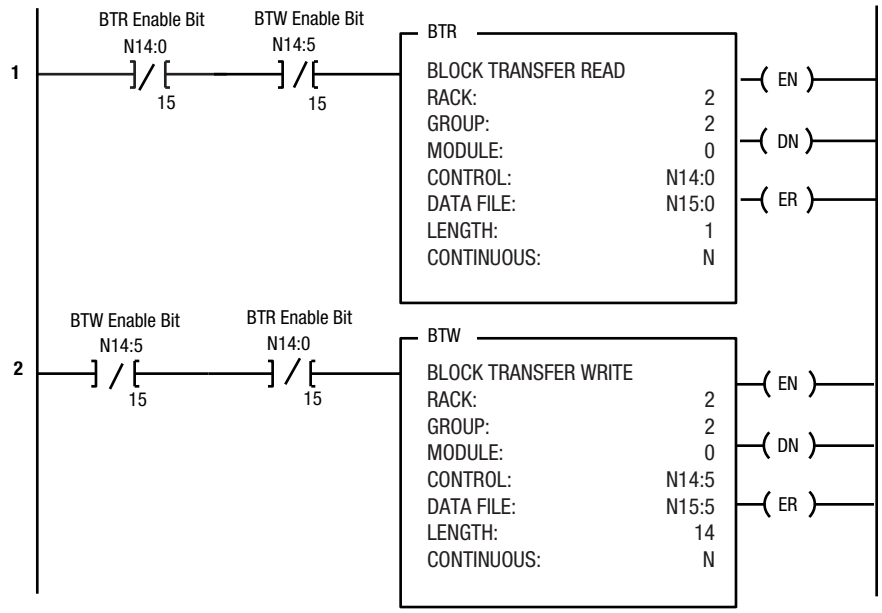


Figure 3.5
PLC-5 Family Sample Program Structure for the 1793-OE2

Program Action

At power-up in RUN mode, or when the processor is switched from PROG to RUN, the user program enables a block transfer read. Then it initiates a block transfer write to configure the module and send data values.

Thereafter, the program continuously performs read block transfers and write block transfers.



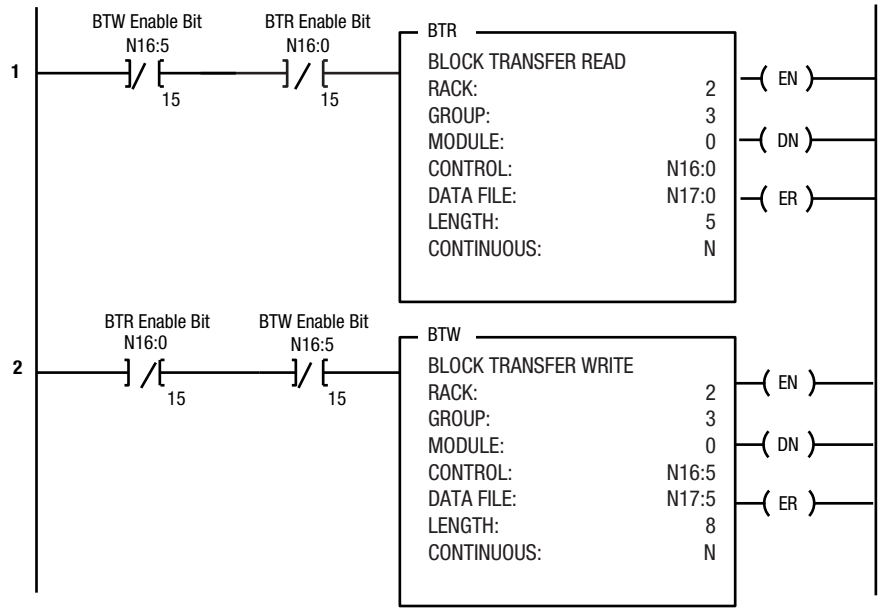
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Figure 3.6
PLC-5 Family Sample Program Structure for the 1793-IE2XOE1

Program Action

At power-up in RUN mode, or when the processor is switched from PROG to RUN, the user program enables a block transfer read. Then it initiates a block transfer write to configure the module and send data values.

Thereafter, the program continuously performs read block transfers and write block transfers.

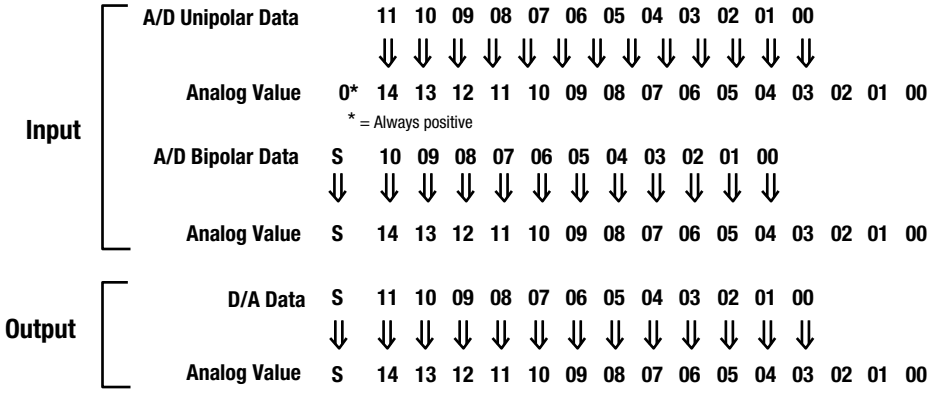


PLC-2 Programming

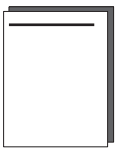
The 1793 analog I/O modules are not recommended for use with PLC-2 family programmable controllers due to the number of digits needed for high resolution. In addition, the data returned from the analog-to-digital converter in the module is 12-bit resolute. This value is left-justified into a 16-bit field, reserving the most significant bit for a sign bit. Refer to Appendix B for more information.

Analog Data Format

The data returned from the analog-to-digital converter in the module is 12-bit resolute. This value is left-justified into a 16-bit field, reserving the most significant bit for a sign bit.



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Refer to Appendix B for a table of values for various current and voltage modes.

Appendix B also includes an example of scaling.

Chapter Summary

In this chapter, you learned how to program your programmable controller. You were given sample programs for your PLC-3 and PLC-5 family processors.

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Writing Configuration to and Reading Status from Your Module with a Remote I/O Adapter

Chapter Objectives

In this chapter, we tell you about:

- configuring your module's features
- entering your data
- reading data from your module
- read block format

Configuring Your Analog Module

Note: You must use a 1794-ASB series D or later remote I/O adapter to communicate with the 1793 FLEX Integra analog modules.

Because of the many analog devices available and the wide variety of possible configurations, you must configure your module to conform to the analog device and specific application that you have chosen. The module is configured using a group of data table words that are transferred to the module using a block transfer write instruction.

The software configurable features available are:

- input/output range selection, including full range and bipolar
- safe state operating value (customer selected analog values the module will maintain in the event of a network communication error)

Note: PLC-5 family programmable controllers that use 6200 software programming tools can take advantage of the IOCONFIG utility to configure these modules. IOCONFIG uses menu-based screens for configuration without having to set individual bits in particular locations. Refer to your 6200 software literature for details.

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Range Selection

Individual input channels are configurable to operate with the following voltage or current ranges:

Ranges	Bit Settings	
	Configure Select	Full Range
0-10V dc/0-20mA	0	1
4-20mA	1	0
–10 to +10V dc	1	1
Off	0	0

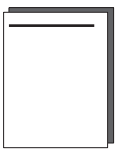
[1] When configured to Off, individual output channels will drive 0V/0mA.

You can select individual channel ranges using the designated words of the write block transfer instruction. Refer to the Bit/Word description for your particular module for word and bit numbers.

Safe State Value Selection

You can select the analog values that your output module will maintain in the event of a network communication error. When the multiplex control bits (M) are cleared simultaneously by a communication error, (or by the user), the analog outputs will automatically switch to the values set in the safe state analog words. This allows you to define a safe operating state for controlled devices which depend on the analog output from the module.

Data Format



The data returned from the analog-to-digital converter in the module is 12-bit resolute. This value is left-justified into a 16-bit field, reserving the most significant bit for a sign bit. The 4-20mA mode scales in the module and uses all 16 bits.

Refer to Appendix C for a table of values for various current and voltage modes, and an example of scaling to engineering terms.

Reading Data From Your Module

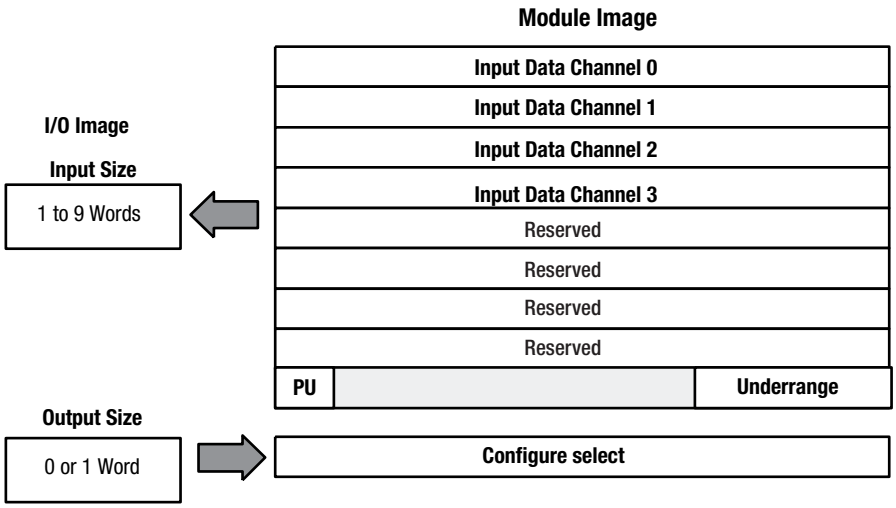
Read programming moves status and data from the module to the processor's data table. The processor's user program initiates the request to transfer data from the input module to the processor.

Mapping Data for the Analog Modules

The following read and write words and bit/word descriptions describe the information written to and read from the analog modules. Each word is composed of 16 bits.

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8 Input Analog Module (Cat. No. 1793-IE4 and -IE4S)



Analog Input Module (1793-IE4 and -IE4S) Read

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Read Word 0	S	Analog Value Channel 0														
Word 1	S	Analog Value Channel 1														
Word 2	S	Analog Value Channel 2														
Word 3	S	Analog Value Channel 3														
Word 4	S	Reserved														
Word 5	S	Reserved														
Word 6	S	Reserved														
Word 7	S	Reserved														
Word 8	PU	Not used – set to zero											U3	U2	U1	U0

Where: S = sign bit (in 2's complement)
U = Underrange bits for 4-20mA inputs
PU = Power up bit

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Word/Bit Descriptions for the 1793-IE4 and -IE4S Analog Input Module Read

Word	Decimal Bit (Octal Bit)	Definition
Read Word 0	Bits 00-14 (00-16)	**Channel 0 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 1	Bits 00-14 (00-16)	**Channel 1 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Word 2	Bits 00-14 (00-16)	**Channel 2 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 2 analog data sign bit.**
Word 3	Bits 00-14 (00-16)	**Channel 3 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 3 analog data sign bit.**
Words 4-7		**Reserved**
Word 8	Bits 00-03	**Underrange bits (U)** for individual channels **(4-20mA current input only)**- Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on. When set (1), indicates either a broken or open input wire, or input current at or below 4mA.
	Bits 04-14 (04-16)	Not used – set to 0.
	Bit 15 (17)	**Power Up bit .- This bit is set to 1 when all bits in the configuration register (write word 0) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

Analog Input Module (1793-IE4 and -IE4S) Write Configuration Block

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Write Word 0	Reserved				C3	C2	C1	C0	Reserved				F3	F2	F1	F0

Where: C = Configure select bit
F = Full range bit

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Range Selection Bits for the 1793-IE4 and -IE4S Analog Input Module

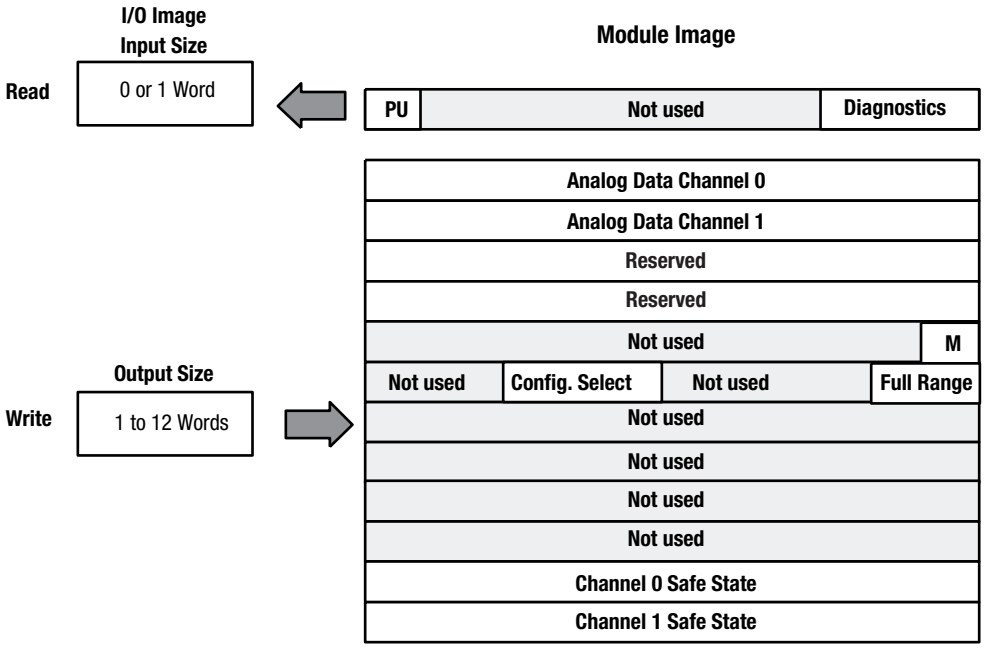
Channel No.	Channel 0		Channel 1		Channel 2		Channel 3	
	F0	C0	F1	C1	F2	C2	F3	C3
Decimal Bits (Octal Bits)	00	08 (10)	01	09 (11)	02	10 (12)	03	11 (13)
0-10V dc/0-20mA	1	0	1	0	1	0	1	0
4-20mA	0	1	0	1	0	1	0	1
–10 to +10V dc	1	1	1	1	1	1	1	1
Off[1]	0	0	0	0	0	0	0	0

C = Configure select bit
F = Full range bit
[1] When configured to off, individual channels will return 0000H on Series B modules, and 4 to 20mA on Series A modules.

Word/Bit Descriptions for the 1793-IE4 and -IE4S Analog Input Module Write

Word	Decimal Bit (Octal Bit)	Definition
Write Word 0	Bits 00-03	**Full range bits (F)** for individual channels – Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on.
	Bits 04-07	**Reserved**
	Bits 08-11 (10-13)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to input channel 0, bit 09 corresponds to input channel 1, and so on. Refer to Range Bit Selections.
	Bits 12-15 (14-17)	**Reserved**

2 Output Analog Module (Cat. No. 1793-OE2 and -OE2S)



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Analog Output Module (1793-OE2 and -OE2S) Read

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Read Word 0	PU	Not used – set to 0													W1	W0

Where: W = Diagnostic bits for current output wire broken or load resistance high. (Not used on voltage outputs.)
PU = Power up bit

Bit/Word Descriptions for the 1793-OE2 and -OE2S Analog Output Module Read

Word	Decimal Bit (Octal Bit)	Definition
Read Word 0	Bits 00-01	Current outputs only – When set (1), the wire on the output is broken or the load resistance is too high. Bit 00 corresponds to channel 0, bit 01 corresponds to channel 2, and so on.
	Bits 02-14 (02-16)	Not used – set to 0
	Bit 15 (17)	**Power Up bit. - This bit is set to 1 when all bits in the configuration register (write word 5) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

Analog Output Module (1793-OE2 and -OE2S) Write Configuration Block

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Write Word 0	S	Analog Data – Channel 0														
Word 1	S	Analog Data – Channel 1														
Word 2	S	Reserved														
Word 3	S	Reserved														
Word 4	0	Not used – set to 0													M1	M0
Word 5	0	Not used – set to 0					C1	C0	Not used – set to 0						F1	F0
Word 6 thru 9	Not used – set to 0															
Word 10	S	Safe State Value – Channel 0														
Word 11	S	Safe State Value – Channel 1														
Word 12	S	Reserved														
Word 13	S	Reserved														

Where: S = Sign bit (in 2's complement)
M = Multiplex control
C = Configure select bit
F = Full range bit

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Range Selection Bits for the 1793-OE2 and -OE2S Analog Output Module (Word 5)

Channel No.	Channel 0		Channel 1	
	F0	C0	F1	C1
Decimal Bits (Octal Bits)	00	08 (10)	01	09 (11)
4-20mA	0	1	0	1
0-10V dc/0-20mA	1	0	1	0
–10 to +10V dc	1	1	1	1
Off[1]	0	0	0	0

C = Configure select bit
F = Full range bit

[1] When configured to off, individual channels will send 0V or 0mV on Series B modules. On Series A modules, 2V or 4mA is output until the module is configured.

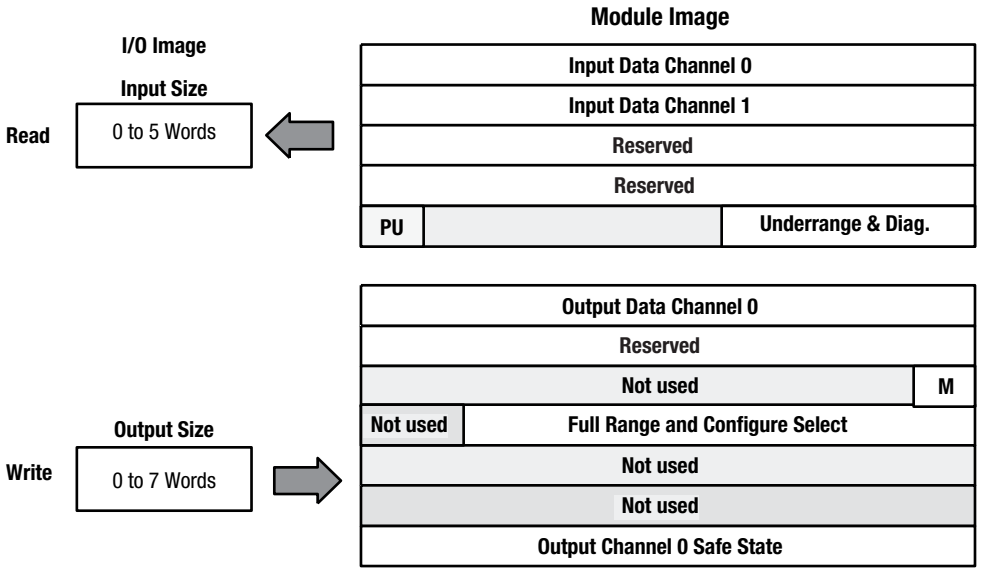
Word/Bit Descriptions for the 1793-OE2 and -OE2S Analog Output Module Write

Word	Decimal Bit (Octal Bit)	Definition
Write Word 0	Bits 00-14 (00-16)	**Channel 0 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 1	Bits 00-14 (00-16)	**Channel 1 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Word 2	Bits 00-14 (00-16)	**Channel 2 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 2 analog data sign bit.**
Word 3	Bits 00-14 (00-16)	**Channel 3 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 3 analog data sign bit.**
Word 4	Bits 00-03	**Multiplex control bits (M)** for individual channels. These bits control the safe state analog outputs. – Bit 00 corresponds to output channel 0, bit 01 corresponds to output channel 1, and so on. 1 = use words 0 or 1 as directed by channel number n 0 = use words 10 or 11 as directed by channel number n When bits 00-01 are all cleared (0) simultaneously by a communication error or user choice thru the programmable controller program, word 5 full range and configure select bits are preserved at their last setting.
	Bits 04-15 (04-17)	Not used – set to 0.
Word 5	Bits 00-01	**Full range bits (F)** for individual channels – Bit 00 corresponds to output channel 0, and bit 01 corresponds to output channel 1.
	Bits 02-07	Not used – set to 0.
	Bits 08-09 (10-11)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to output channel 0, and bit 09 corresponds to output channel 1.
	Bits 10-15 (12-17)	Not used – set to 0.
Words 6 thru 9	Bits 00-15 (00-17)	Not used – set to 0.
Word 10	Bits 00-14 (00-16)	**Channel 0 Safe State analog value** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 Safe State analog data sign bit.**
Word 11	Bits 00-14 (00-16)	**Channel 1 Safe State analog value** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 Safe State analog data sign bit.**

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Word	Decimal Bit (Octal Bit)	Definition
Words 12-13	Bits 00-15 (00-17)	**Reserved**

2 Input/1 Output Analog Combo Module (Cat. No. 1793-IE2XOE1 and -IE2XOE1S)



Analog Combo Module (1793-IE4XOE1) Read

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Read Word 0	S	Analog Value Input Channel 0														
Word 1	S	Analog Value Input Channel 1														
Word 2	S															
Word 3	S															
Word 4	PU	Not used – set to 0													W1	W0

Where: S = sign bit (in 2's complement)
W = Diagnostic bits for current output wire broken or load resistance high. (Not used on voltage outputs.)
PU = Power up bit

Word/Bit Descriptions for the 1794-IE4XOE1 and -IE2XOE1S Analog Combo Module Read

Word	Decimal Bit (Octal Bit)	Definition
Read Word 0	Bits 00-14 (00-16)	**Channel 0 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 1	Bits 00-14 (00-16)	**Channel 1 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Words 2 and 3		**Reserved**

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Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bits 00-01	**Underrange bits (U)** for individual channels **(4-20mA current input only)**- Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1. When set (1), indicates either a broken or open input wire, or input current at or below 4mA.
	Bits 02-03	**Reserved**
	Bits 04	**Wire Off bits (W)** – Current outputs only – When set (1), the wire on the current output is broken or the load resistance is too high. Bit 00 corresponds to channel 0.
	Bits 05-14 (05-16)	**Reserved**
	Bit 15 (17)	**Power Up bit - This bit is set to 1 when all bits in the configuration register (write word 3) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

Analog Combo Module (1793-IE2XOE1 and -IE2XOE1S) Write Configuration Block

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Write Word 0	S	Analog Data – Output Channel 0														
Word 1	S	Reserved														
Word 2	0	Not used – set to 0														M0
Word 3	Not used		C5	C4	C3	C2	C1	C0	0	0	0	F4	0	0	F1	F0
Words 4 and 5	Not used – set to 0															
Word 6	S	Safe State Value – Output Channel 0														
Word 7	S	Reserved														

Where: M = Multiplex control bits
S = Sign bit (in 2's complement)
C = Configure select bit
F = Full range bit

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Range Selection Bits for the 1793-IE2XOE1 and -IE2XOE1S Analog Combo Module

Channel No.	Input Channel 0		Input Channel 1		Output Channel 0	
	F0	C0	F1	C1	F4	C4
Decimal Bits (Octal Bits)	00	08 (10)	01	09 (11)	04	12 (14)
4-20mA	0	1	0	1	0	1
0-10V dc/0-20mA	1	0	1	0	1	0
–10 to +10V dc	1	1	1	1	1	1
Off[1]	0	0	0	0	0	0

C = Configure select bit
F = Full range bit
[1] When configured to off, individual channels will return 0000H.

Word/Bit Descriptions for the 1793-IE2XOE1 and -IE2XOE1S Analog Combo Module Write

Word	Decimal Bit (Octal Bit)	Definition
Write Word 0	Bits 00-14 (00-16)	**Channel 0 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 1	Bits 00-15 (00-17	**Reserved**
Word 2	Bit 00	**Multiplex control bits (M**) for individual channel. This bit controls the safe state analog outputs– Bit 00 corresponds to output channel 0. 1 = use words 0 (analog value) as directed by channel number n 0 = use words 6 (safe state analog value) as directed by channel number n When bit 00 is cleared (0) simultaneously by a communication error or user choice thru the programmable controller program, word 3 full range and configure select bits are preserved at their last setting.
	Bits 01-15 (01-17)	Not used – set to 0.
Word 3	Bits 00-01, 04	**Full range bits (F)** for individual channels – Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and bit 04 corresponds to output channel 1. Refer to Range Bit Selections.
	Bits 02, 03, 05-07	Not used – set to 0.
	Bits 08-09, 12 (10, 11, 13-15)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to input channel 0, bit 09 (11) corresponds to input channel 1, bit 12 (14) corresponds to output channel 0. Refer to Range Bit Selections.
	Bits 14-15 (16-17)	Not used – set to 0.

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Word	Decimal Bit (Octal Bit)	Definition
Words 4 and 5		Not used – set to 0.
Word 6	Bits 00-14 (00-16)	**Channel 0 Safe State analog value** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 Safe State analog data sign bit.**
Word 7	Bits 00-14 (00-16)	**Channel 1 Safe State analog value** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 Safe State analog data sign bit.**

Chapter Summary

In this chapter you learned how to configure your module's features and enter your data.

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How Communication Takes Place and I/O Image Table Mapping with the DeviceNet Adapter

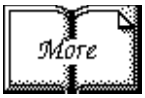
Chapter Objectives

In this chapter, we tell you about:

- DeviceNetManager software
- I/O structure
- image table mapping
- factory defaults

About DeviceNetManager Software

DeviceNetManager software is a tool used to configure your FLEX I/O DeviceNet adapter and its related modules, including any FLEX Integra modules. This software tool can be connected to the adapter via the DeviceNet network.

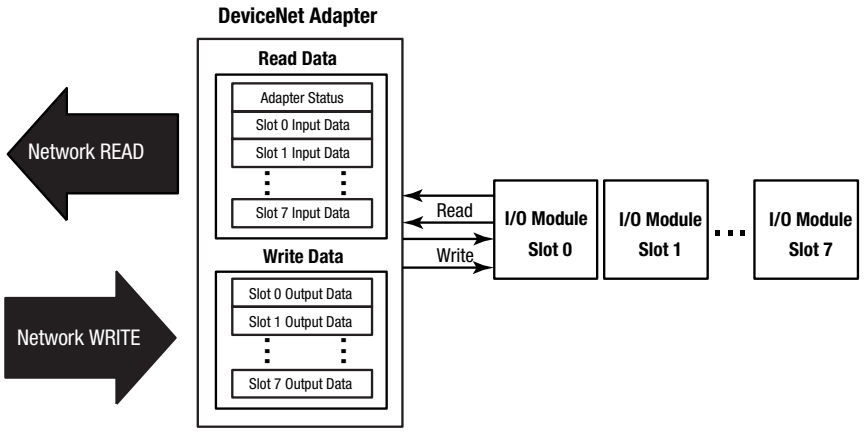


You must understand how DeviceNetManager software works in order to add a device to the network. Refer to the DeviceNetManager Software User Manual, publication 1787-6.5.3.

Polled I/O Structure

Output data is received by the adapter in the order of the installed I/O modules. The Output data for Slot 0 is received first, followed by the Output data for Slot 1, and so on up to slot 7.

The first word of input data sent by the adapter is the Adapter Status Word. This is followed by the input data from each slot, in the order of the installed I/O modules. The Input data from Slot 0 is first after the status word, followed by Input data from Slot 2, and so on up to slot 7.

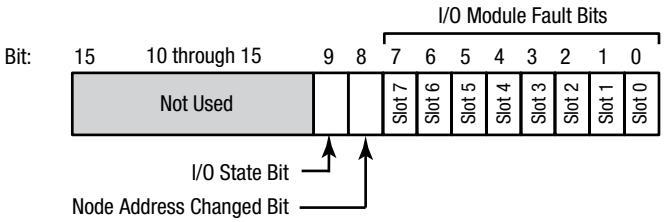


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Adapter Input Status Word

The input status word consists of:

- I/O module fault bits – 1 status bit for each slot
- node address changed – 1 bit
- I/O status – 1 bit



The adapter input status word bit descriptions are shown in the following table.

Bit Description	Bit	Explanation
I/O Module Fault	0	This bit is set (1) when an error is detected in slot position 0.
	1	This bit is set (1) when an error is detected in slot position 1.
	2	This bit is set (1) when an error is detected in slot position 2.
	3	This bit is set (1) when an error is detected in slot position 3.
	4	This bit is set (1) when an error is detected in slot position 4.
	5	This bit is set (1) when an error is detected in slot position 5.
	6	This bit is set (1) when an error is detected in slot position 6.
	7	This bit is set (1) when an error is detected in slot position 7.
Node Address Changed	8	This bit is set (1) when the node address switch setting has been changed since power up.
I/O State	9	Bit = 0 – idle Bit = 1 – run
	10 thru 15	Not used – sent as zeroes.

Possible causes for an **I/O Module Fault** are:

- transmission errors on the Flex I/O backplane
- a failed module
- a module removed from its terminal base
- incorrect module inserted in a slot position
- the slot is empty

The **node address changed** bit is set when the node address switch setting has been changed since power up. The new node address does not take affect until the adapter has been powered down and then powered back up.

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System Throughput

System throughput, from analog input to backplane, is a function of:

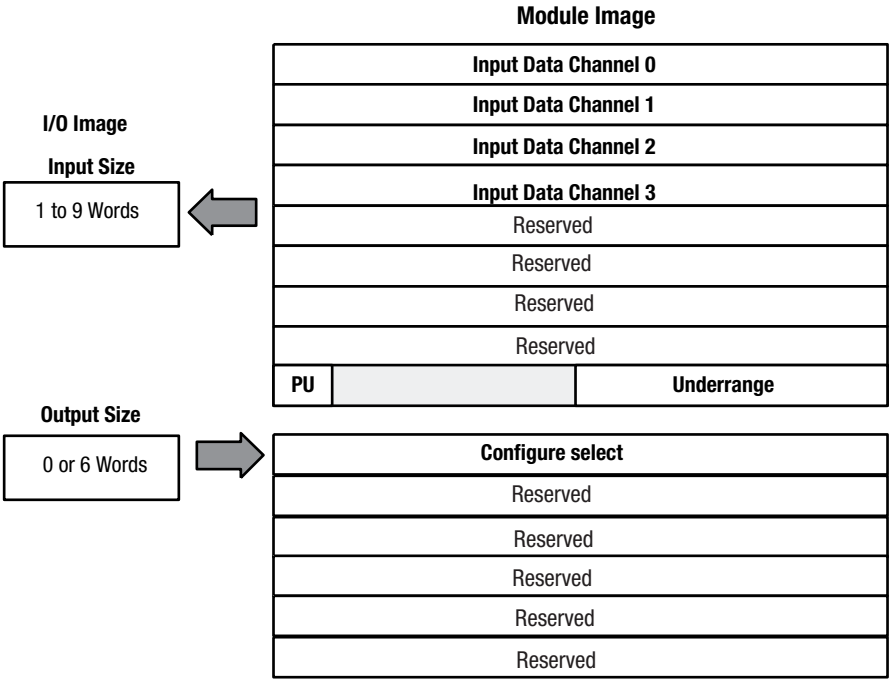
- the data format selected
- the type and mode of sensors selected
- whether filtering is selected

The A/D converter which converts channel 0 through 7 analog data to a digital word provides a programmable single low pass filter. You can set the frequency of this filter during module configuration. The selection influences the A/D output data rate, thus affecting system throughput.

Mapping Data into the Image Table

FLEX Integra analog input module data table mapping is shown below.

4 Input Analog Module (Cat. No. 1793-IE4 and -IE4S)



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Analog Input Module (1793-IE4 and -IE4S) Read

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Read Word 1	S	Analog Value Channel 0														
Word 2	S	Analog Value Channel 1														
Word 3	S	Analog Value Channel 2														
Word 4	S	Analog Value Channel 3														
Word 5	S	Reserved														
Word 6	S	Reserved														
Word 7	S	Reserved														
Word 8	S	Reserved														
Word 9	PU	Not used – set to zero											U3	U2	U1	U0

Where: S = sign bit (in 2's complement)
U = Underrange bits for 4-20mA inputs
PU = Power up bit

Word/Bit Descriptions for the 1793-IE4 and -IE4S Analog Input Module Read

Word	Decimal Bit (Octal Bit)	Definition
Read Word 1	Bits 00-14 (00-16)	**Channel 0 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 2	Bits 00-14 (00-16)	**Channel 1 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Word 3	Bits 00-14 (00-16)	**Channel 2 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 2 analog data sign bit.**
Word 4	Bits 00-14 (00-16)	**Channel 3 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 3 analog data sign bit.**
Words 5-8		**Reserved**
Word 9	Bits 00-03	**Underrange bits (U)** for individual channels **(4-20mA current input only)**- Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on. When set (1), indicates either a broken or open input wire, or input current at or below 4mA.
	Bits 04-14 (04-16)	Not used – set to 0.
	Bit 15 (17)	**Power Up bit .- This bit is set to 1 when all bits in the configuration register (write word 0) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

Analog Input Module (1793-IE4 and -IE4S) Write Configuration Block

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Write Word 1	Reserved				C3	C2	C1	C0	Reserved				F3	F2	F1	F0
2	Reserved															
3	Reserved															
4	Reserved															
5	Reserved															
6	Reserved															

Where: C = Configure select bit
F = Full range bit

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Range Selection Bits for the 1793-IE4 and -IE4S Analog Input Module

Channel No.	Channel 0		Channel 1		Channel 2		Channel 3	
	F0	C0	F1	C1	F2	C2	F3	C3
Decimal Bits (Octal Bits)	00	08 (10)	01	09 (11)	02	10 (12)	03	11 (13)
0-10V dc/0-20mA	1	0	1	0	1	0	1	0
4-20mA	0	1	0	1	0	1	0	1
–10 to +10V dc	1	1	1	1	1	1	1	1
Off[1]	0	0	0	0	0	0	0	0

C = Configure select bit
F = Full range bit

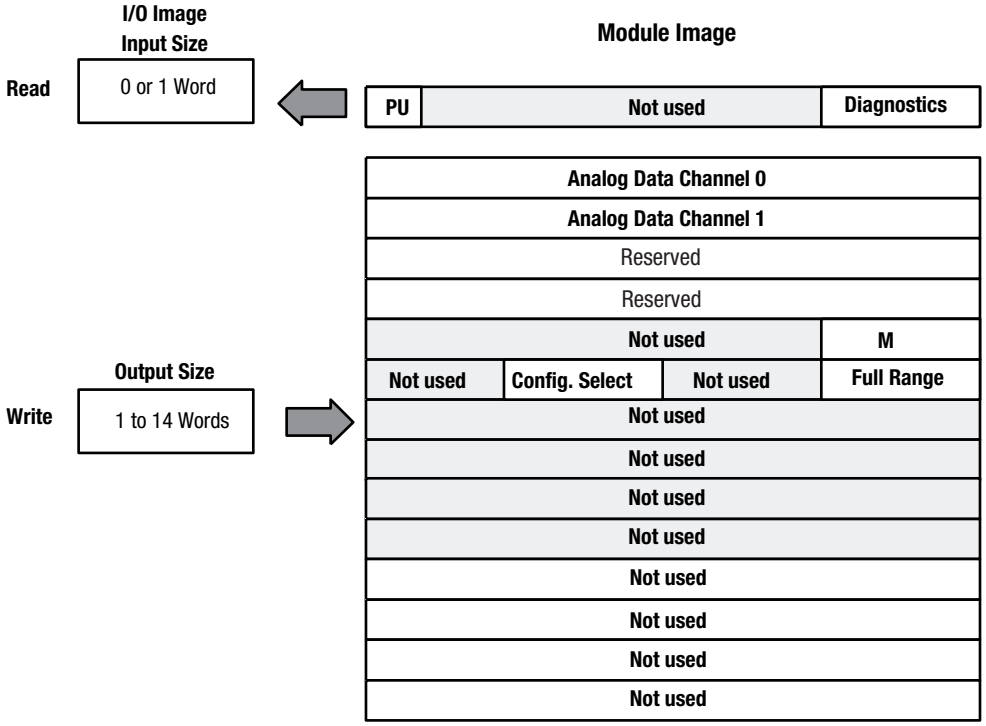
[1] When configured to off, individual channels will return 0000H on Series B modules, and 4 to 20mA on Series A modules.

Word/Bit Descriptions for the 1793-IE4 and -IE4S Analog Input Module Write

Word	Decimal Bit (Octal Bit)	Definition
Write Word 1	Bits 00-03	**Full range bits (F)** for individual channels – Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on.
	Bits 04-07	**Reserved**
	Bits 08-11 (10-13)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to input channel 0, bit 09 corresponds to input channel 1, and so on. Refer to Range Bit Selections.
	Bits 12-15 (14-17)	**Reserved**
2	Bits 01-15 (01-17)	**Reserved**
3	Bits 01-15 (01-17)	**Reserved**
4	Bits 01-15 (01-17)	**Reserved**
5	Bits 01-15 (01-17)	**Reserved**
6	Bits 01-15 (01-17)	**Reserved**

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2 Output Analog Module (Cat. No. 1793-OE2 and -OE2S)



Analog Output Module (1793-OE2 and -OE2S) Read

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Read Word 1	PU	Not used – set to 0													W1	W0

Where: W = Diagnostic bits for current output wire broken or load resistance high. (Not used on voltage outputs.)
PU = Power up bit

Bit/Word Descriptions for the 1793-OE2 and -OE2S Analog Output Module Read

Word	Decimal Bit (Octal Bit)	Definition
Read Word 1	Bits 00-01	Current outputs only – When set (1), the wire on the output is broken or the load resistance is too high. Bit 00 corresponds to channel 0, bit 01 corresponds to channel 2, and so on.
	Bits 02-14 (02-16)	Not used – set to 0
	Bit 15 (17)	**Power Up bit. - This bit is set to 1 when all bits in the configuration register (write word 5) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

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Analog Output Module (1793-OE2 and -OE2S) Write Configuration Block

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Write Word 1	S	Analog Data – Channel 0														
Word 2	S	Analog Data – Channel 1														
Word 3	S	Reserved														
Word 4	S	Reserved														
Word 5	0	Not used – set to 0													M1	M0
Word 6	0	Not used – set to 0					C1	C0	Not used – set to 0						F1	F0
Word 7 thru 10	Not used – set to 0															
Word 11	S	Reserved														
Word 12	S	Reserved														
Word 13	S	Reserved														
Word 14	S	Reserved														

Where: S = Sign bit (in 2's complement)
M = Multiplex control
C = Configure select bit
F = Full range bit

Range Selection Bits for the 1793-OE2 and -OE2S Analog Output Module (Word 5)

Channel No.	Channel 0		Channel 1	
	F0	**C0**	**F1**	**C1**
Decimal Bits (Octal Bits)	**00**	**08 (10)**	**01**	**09 (11)**
4-20mA	0	1	0	1
0-10V dc/0-20mA	1	0	1	0
–10 to +10V dc	1	1	1	1
Off[1]	0	0	0	0

C = Configure select bit
F = Full range bit

[1] When configured to off, individual channels will send 0V or 0mV on Series B modules. On Series A modules, 2V or 4mA is output until the module is configured.

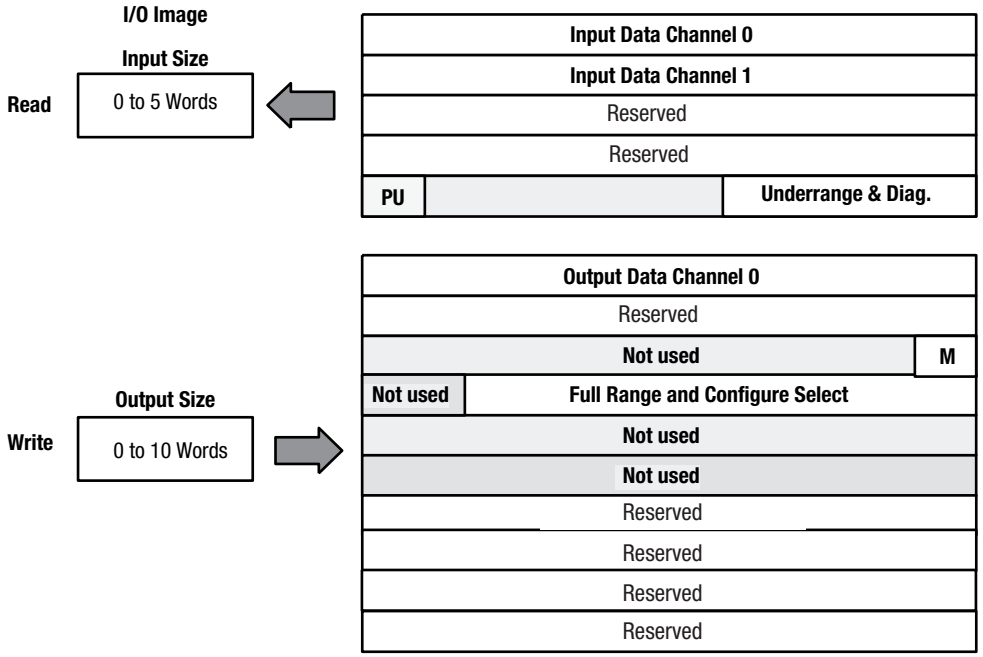
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Word/Bit Descriptions for the 1793-OE2 and -OE2S Analog Output Module Write

Word	Decimal Bit (Octal Bit)	Definition
Write Word 1	Bits 00-14 (00-16)	**Channel 0 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 2	Bits 00-14 (00-16)	**Channel 1 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Word 3	Bits 00-14 (00-16)	**Channel 2 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 2 analog data sign bit.**
Word 4	Bits 00-14 (00-16)	**Channel 3 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 3 analog data sign bit.**
Word 5	Bits 00-03	**Multiplex control bits (M**) for individual channels. These bits control the safe state analog outputs. – Bit 00 corresponds to output channel 0, bit 01 corresponds to output channel 1, and so on. 1 = use words 0 or 1 as directed by channel number n 0 = use words 10 or 11 as directed by channel number n When bits 00-01 are all cleared (0) simultaneously by a communication error or user choice thru the programmable controller program, word 6 full range and configure select bits are preserved at their last setting.
	Bits 04-15 (04-17)	Not used – set to 0.
Word 6	Bits 00-01	**Full range bits (F)** for individual channels – Bit 00 corresponds to output channel 0, and bit 01 corresponds to output channel 1.
	Bits 02-07	Not used – set to 0.
	Bits 08-09 (10-11)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to output channel 0, and bit 09 corresponds to output channel 1.
	Bits 10-15 (12-17)	Not used – set to 0.
Words 7 thru 10	Bits 00-15 (00-17)	Not used – set to 0.
Words 11-14	Bits 00-15 (00-17)	**Reserved**

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2 Input/1 Output Analog Combo Module (Cat. No. 1793-IE2XOE1 and -IE2XOE1S)



Analog Combo Module (1793-IE2XOE1 and -IE2XOE1S) Read

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Read Word 1	S	Analog Value Input Channel 0														
Word 2	S	Analog Value Input Channel 1														
Word 3	S	Reserved														
Word 4	S	Reserved														
Word 5	PU	Not used – set to 0													W1	W0

Where: S = sign bit (in 2's complement)
W = Diagnostic bits for current output wire broken or load resistance high. (Not used on voltage outputs.)
PU = Power up bit

Word/Bit Descriptions for the 1793-IE2XOE1 and -IE2XOE1S Analog Combo Module Read

Word	Decimal Bit (Octal Bit)	Definition
Read Word 1	Bits 00-14 (00-16)	**Channel 0 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 2	Bits 00-14 (00-16)	**Channel 1 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Words 3 and 4		**Reserved**

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Word	Decimal Bit (Octal Bit)	Definition
Word 5	Bits 00-01	**Underrange bits (U)** for individual channels **(4-20mA current input only)**- Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1. When set (1), indicates either a broken or open input wire, or input current at or below 4mA.
	Bits 02-03	**Reserved**
	Bits 04	**Wire Off bits (W)** – Current outputs only – When set (1), the wire on the current output is broken or the load resistance is too high. Bit 00 corresponds to channel 0.
	Bits 05-14 (05-16)	**Reserved**
	Bit 15 (17)	**Power Up bit - This bit is set to 1 when all bits in the configuration register (write word 3) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

Analog Combo Module (1793-IE2XOE1 and -IE2XOE1S) Write Configuration Block

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Write Word 1	S	Analog Data – Output Channel 0														
Word 2	S	Reserved														
Word 3	0	Not used – set to 0														M0
Word 4	Not used		C5	C4	C3	C2	C1	C0	0	0	0	F4	0	0	F1	F0
Words 5 and 6	Not used – set to 0															
Word 7	Reserved															
Word 8	Reserved															
Word 9	Reserved															
Word 10	Reserved															

Where: M = Multiplex control bits
S = Sign bit (in 2's complement)
C = Configure select bit
F = Full range bit

Range Selection Bits for the 1793-IE2XOE1 and -IE2XOE1S Analog Combo Module

Channel No.	Input Channel 0		Input Channel 1		Output Channel 0	
	F0	**C0**	**F1**	**C1**	**F4**	**C4**
Decimal Bits (Octal Bits)	**00**	**08 (10)**	**01**	**09 (11)**	**04**	**12 (14)**
4-20mA	0	1	0	1	0	1
0-10V dc/0-20mA	1	0	1	0	1	0
–10 to +10V dc	1	1	1	1	1	1
Off[1]	0	0	0	0	0	0

C = Configure select bit
F = Full range bit
[1] When configured to off, individual channels will return 0000H.

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Word/Bit Descriptions for the 1793-IE2XOE1 and -IE2XOE1S Analog Combo Module Write

Word	Decimal Bit (Octal Bit)	Definition
Write Word 1	Bits 00-14 (00-16)	**Channel 0 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 2	Bits 00-15 (00-17	**Reserved**
Word 3	Bit 00	**Multiplex control bits (M)** for individual channel. This bit controls the safe state analog outputs– Bit 00 corresponds to output channel 0. 1 = use words 0 (analog value) as directed by channel number n 0 = use words 6 (safe state analog value) as directed by channel number n When bit 00 is cleared (0) simultaneously by a communication error or user choice thru the programmable controller program, word 4 full range and configure select bits are preserved at their last setting.
	Bits 01-15 (01-17)	Not used – set to 0.
Word 4	Bits 00-01, 04	**Full range bits (F)** for individual channels – Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and bit 04 corresponds to output channel 1. Refer to Range Bit Selections.
	Bits 02, 03, 05-07	Not used – set to 0.
	Bits 08-09, 12 (10, 11, 13-15)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to input channel 0, bit 09 (11) corresponds to input channel 1, bit 12 (14) corresponds to output channel 0. Refer to Range Bit Selections.
	Bits 14-15 (16-17)	Not used – set to 0.
Words 5 and 6	Bits 01-15 (01-17)	Not used – set to 0.
Words 7 thru 10	Bits 01-15 (01-17)	**Reserved**

Defaults

Each I/O module has default values associated with it. At default, each module will generate inputs/status and expect outputs/configuration.

Module Defaults for:		Factory Defaults		Real Time Size	
Catalog Number	Description	Input Default	Output Default	Input Default	Output Default
1793-IE4	4-Input Module	11	4	8	0
1793-OE2	2-Output Module	11	4	8	0
1793-IE2XOE1	2-Input/1 Output Module	11	4	8	0

Factory defaults are the values assigned by the adapter when you:

- first power up the system, and
- no previous stored settings have been applied.

For analog modules, the defaults reflect the actual number of input words/ output words. For example, for the 4-input module, you have 11 input words, and 4 output words.

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You can change the I/O data size for a module by reducing the number of words mapped into the adapter module, as shown in “real time sizes.”

Real time sizes are the settings that provide optimal real time data to the adapter module.

Analog modules have 15 words assigned to them. This is divided into input words/output words. You can reduce the I/O data size to fewer words to increase data transfer over the backplane.

For information on using DeviceNetManager software to configure your adapter, refer to the DeviceNetManager Software User Manual, publication 1787-6.5.3.

Chapter Summary

In this chapter, you learned how this module communicates over the DeviceNet network, and the image table mapping for the module.

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Input, Status, Output and Configuration Files using ControlNet

What this Chapter Contains

Read this chapter to familiarize yourself with input, output and configuration files for analog I/O modules on ControlNet.This chapter talks about:

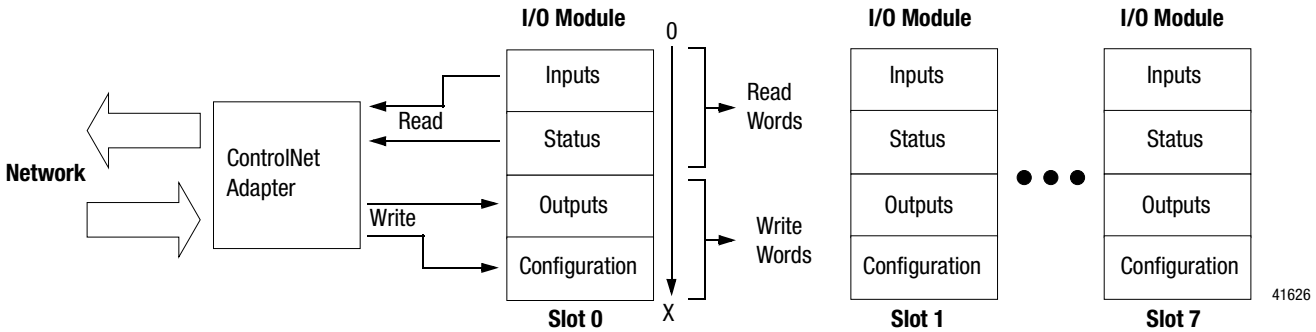
- the ControlNet Adapter
- I/O structure
- fault state data
- communication fault data
- idle state behavior
- input data behavior upon module removal

About the ControlNet Adapter

The FLEX I/O ControlNet adapter (cat. no. 1794-ACN15 or -ACNR15) interfaces up to 8 FLEX I/O and/or FLEX Integra modules and a ControlNet processor or scanner. The adapter can support ControlNet real-time data connections to individual modules or module groups. Each connection is independent of the others and can be from different processors or scanners.

Communication Over the FLEX I/O Backplane

One ControlNet adapter can interface up to eight terminal base units with installed FLEX I/O and/or FLEX Integra modules, forming a FLEX I/O system of up to eight slots. The adapter communicates to other network system components (typically one or more controllers or scanners, and/or programming terminals) over the ControlNet network. The adapter communicates with its I/O modules over the flexbus backplane.



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Scheduled Data-Transfer

Scheduled data transfer:

- is continuous.
- is asynchronous to the controller program scan.
- occurs at the actual rate displayed in the Actual Packet Interval field on the programming software ControlNet I/O mapping (monitor) screen

Unscheduled Data-Transfer

Unscheduled operations include:

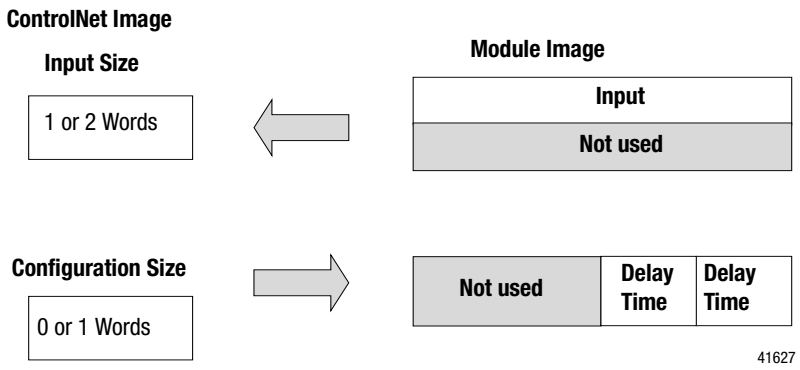
- unscheduled non-discrete I/O data transfers–through ControlNet I/O Transfer (CIO) instructions
- peer-to-peer messaging–through Message (MSG) instructions
- messaging from programming devices

Unscheduled messaging on a ControlNet network is non-deterministic. Your application and your configuration – number of nodes, application program, network update time (NUT), amount of scheduled bandwidth used, etc.– determine how much time there is for unscheduled messaging.

Module I/O Mapping

The I/O map for a module is divided into read words and write words. Read words consist of **input and status words**, and write words consist of **output and configuration words**. The number of read words or write words can be 0 or more. The length of each I/O module's read words and write words vary in size depending on module complexity. Each I/O module will support at least 1 input word or 1 output word. Status and configuration are optional, depending on the module.

For example, a 16 point discrete input module will have up to 2 read words and 1 write word.



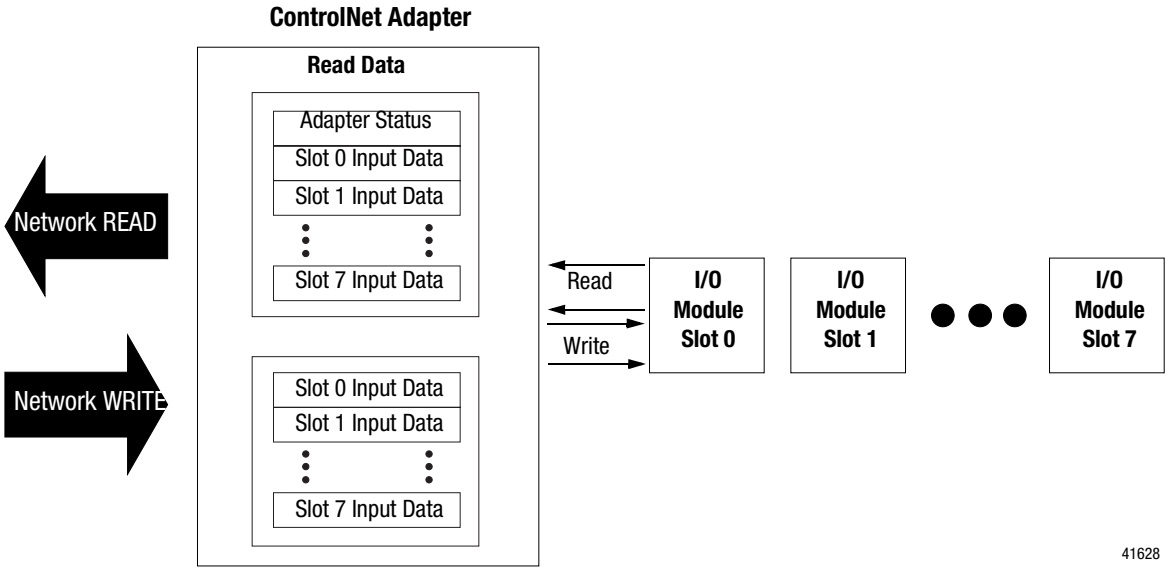
Check the I/O map for each module for the exact mapping.

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I/O Structure

Output data is received by the adapter in the order of the installed I/O modules. The output data for slot 0 is received first, followed by the output data for slot 1, and so on up to slot 7.

The first word of input data sent by the adapter is the Adapter status word. This is followed by the input data from each slot, in the order of the installed I/O modules. The input data from slot 0 is first after the status word, followed by input data from slot 2, and so on up to slot 7.



Adapter Input Status Word

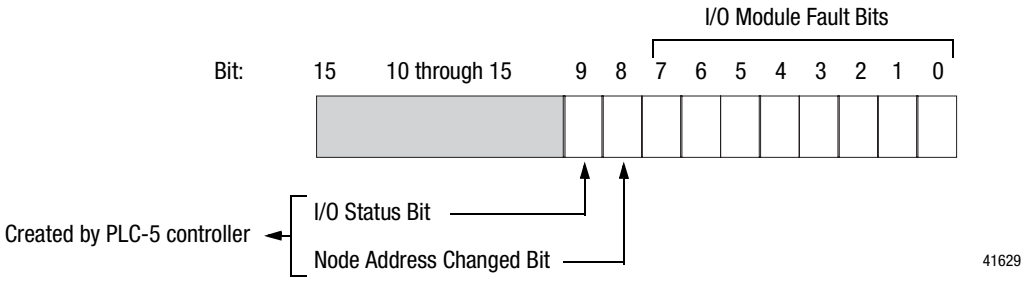
The input status word consists of:

- I/O module fault bits – 1 status bit for each slot

Additionally, in the case of a PLC-5 controller, it adds:

- node address changed – 1 bit (created by PLC-5 controller)
- I/O status – 1 bit (created by PLC-5 controller)

Resulting in the following ControlNet adapter status word for a PLC-5 controller.



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As an example, in a PLC-5 system, the adapter input status word bit descriptions are shown in the following table.

Bit Description:	Bit:	Explanation:
I/O Module Fault	0	This bit is set (1) when an error is detected in slot position 0.
	1	This bit is set (1) when an error is detected in slot position 1.
	2	This bit is set (1) when an error is detected in slot position 2.
	3	This bit is set (1) when an error is detected in slot position 3.
	4	This bit is set (1) when an error is detected in slot position 4.
	5	This bit is set (1) when an error is detected in slot position 5.
	6	This bit is set (1) when an error is detected in slot position 6.
	7	This bit is set (1) when an error is detected in slot position 7.
Node Address Changed (Created by PLC-5 controller.)	8	This bit is set (1) when the node address switch setting has been changed since power-up.
I/O State (Created by PLC-5 controller.)	9	Bit = 0 -idle bit = 1 - run
	10 though 15	Not used – set to 0

Possible causes for an **I/O Module Fault** are:

- transmission errors on the flexbus backplane
- a failed module
- a module removed from its terminal base
- incorrect module inserted in a slot position
- the slot is empty
- the slot contains a non-discrete module

Safe State Data

The ControlNet adapter provides storage for alternate module output data during communication faults or processor idle state. This “safe state data” assures that a known output will be applied to the output devices during the previously mentioned failure modes. The processor or scanner software must include the means to specify this safe state data for each module. If applicable, this data is sent in the configuration block (see Image Table Mapping later in this chapter).

Device Actions

Device actions include:

- communication fault behavior
- idle state behavior
- input data behavior upon module removal

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Communication Fault Behavior

You can configure the adapter response to a communication fault for each I/O module in its system. Upon detection of a communication fault, the adapter can:

- leave the module output data in its last state (hold last state)
- reset the module output data to zero (reset)
- apply fault state data to the module output

Idle State Behavior

The ControlNet adapter can detect the state of the controlling processor or scanner. Only 2 states can be detected: run mode, or program mode (idle).

When run mode is detected, the adapter copies the output data received from the processor to the corresponding module output. When program mode is detected, the adapter can be configured to:

- leave the module output data in its last state (hold last state)
- reset the module output data to zero (reset)
- apply fault state data to the module output

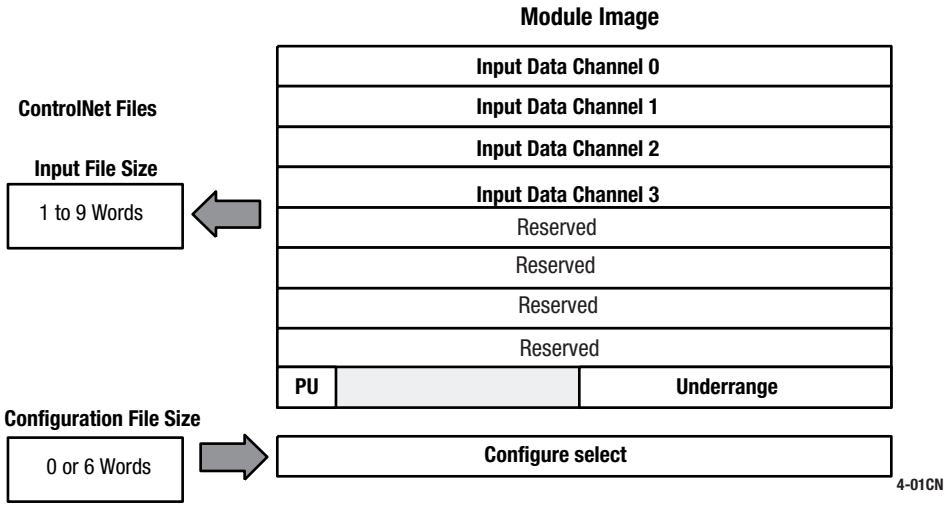
Input Data Behavior upon Module Removal

I/O module input data sent by the adapter upon module removal is configurable. The adapter can:

- reset the module input data sent by the adapter to zero (reset)
- leave the module input data sent by the adapter in the last state before module removal (hold last state)

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4 Input Analog Module (Cat. No. 1793-IE4 and -IE4S)



Input Word/Bit Descriptions for the 1793-IE4 and -IE4S Analog Input Module

Input Word	Decimal Bit (Octal Bit)	Definition
Input Word 0	Bits 00-14 (00-16)	**Channel 0 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 1	Bits 00-14 (00-16)	**Channel 1 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Word 2	Bits 00-14 (00-16)	**Channel 2 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 2 analog data sign bit.**
Word 3	Bits 00-14 (00-16)	**Channel 3 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 3 analog data sign bit.**
Words 4-7		**Reserved**
Word 8	Bits 00-03	**Underrange bits (U)** for individual channels **(4-20mA current input only)**- Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on. When set (1), indicates either a broken or open input wire, or input current at or below 4mA.
	Bits 04-14 (04-16)	Not used – set to 0.
	Bit 15 (17)	**Power Up bit .- This bit is set to 1 when all bits in the configuration register (write word 0) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

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Range Selection Bits for the 1793-IE4 and -IE4S Analog Input Module

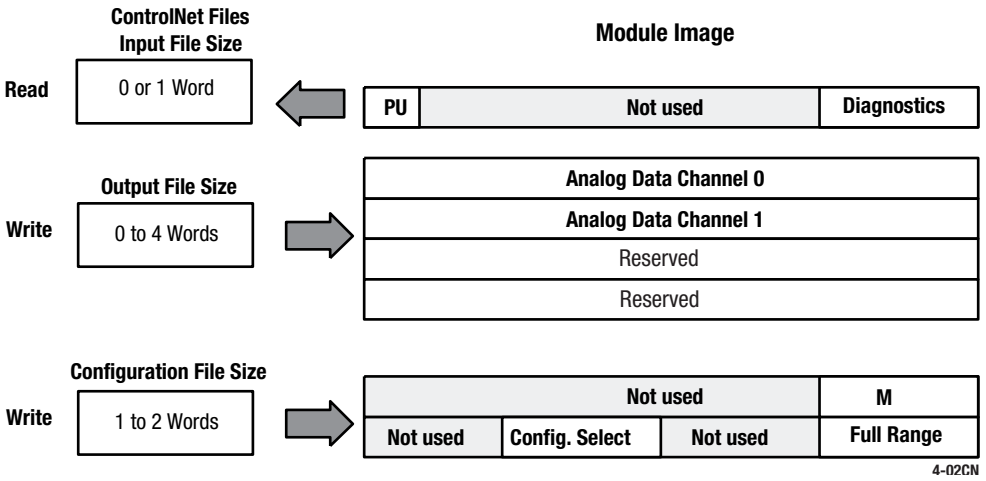
Channel No.	Channel 0		Channel 1		Channel 2		Channel 3	
	F0	C0	F1	C1	F2	C2	F3	C3
Decimal Bits (Octal Bits)	00	08 (10)	01	09 (11)	02	10 (12)	03	11 (13)
0-10V dc/0-20mA	1	0	1	0	1	0	1	0
4-20mA	0	1	0	1	0	1	0	1
–10 to +10V dc	1	1	1	1	1	1	1	1
Off[1]	0	0	0	0	0	0	0	0

C = Configure select bit
F = Full range bit
[1] When configured to off, individual channels will return 0000H .

Configuration Word/Bit Descriptions for the 1793-IE4 and -IE4S Analog Input Module

Configuration Word	Decimal Bit (Octal Bit)	Definition
Write Word 0	Bits 00-03	**Full range bits (F)** for individual channels – Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and so on.
	Bits 04-07	**Reserved**
	Bits 08-11 (10-13)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to input channel 0, bit 09 corresponds to input channel 1, and so on. Refer to Range Bit Selections.
	Bits 12-15 (14-17)	**Reserved**

2 Output Analog Module (Cat. No. 1793-OE2 and -OE2S)



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ABit/Word Descriptions for the 1793-OE2 and -OE2S Analog Output Module Read

Input Words	Decimal Bit (Octal Bit)	Definition
Read Word 0	Bits 00-01	Current outputs only – When set (1), the wire on the output is broken or the load resistance is too high. Bit 00 corresponds to channel 0, bit 01 corresponds to channel 2, and so on.
	Bits 02-14 (02-16)	Not used – set to 0
	Bit 15 (17)	**Power Up bit. - This bit is set to 1 when all bits in the configuration register (write word 5) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

Range Selection Bits for the 1793-OE2 and -OE2S Analog Output Module (Word 5)

Channel No.	Channel 0		Channel 1	
	F0	C0	F1	C1
Decimal Bits (Octal Bits)	00	08 (10)	01	09 (11)
4-20mA	0	1	0	1
0-10V dc/0-20mA	1	0	1	0
–10 to +10V dc	1	1	1	1
Off[1]	0	0	0	0

C = Configure select bit
F = Full range bit
[1] When configured to off, individual channels will send 0V or 0mV.

Output Word/Bit Descriptions for the 1793-OE2 and -OE2S Analog Output Module Write

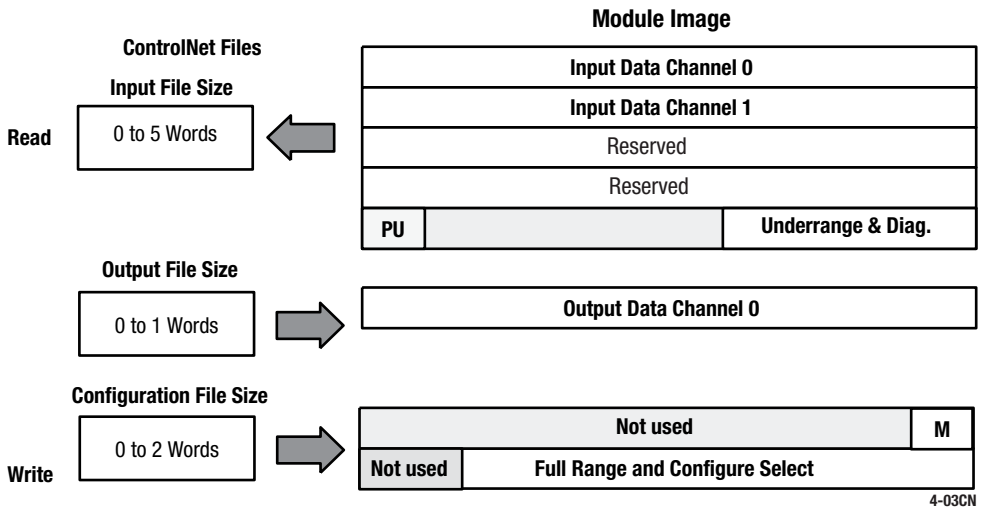
Output Word	Decimal Bit (Octal Bit)	Definition
Configuration Word 0	Bits 00-14 (00-16)	**Channel 0 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 1	Bits 00-14 (00-16)	**Channel 1 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**
Word 2	Bits 00-14 (00-16)	**Channel 2 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 2 analog data sign bit.**
Word 3	Bits 00-14 (00-16)	**Channel 3 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 3 analog data sign bit.**

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Configuration Word/Bit Descriptions for the 1793-OE2 and -OE2S Analog Output Module Write

Configuration Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bits 00-03	**Multiplex control bits (M)** for individual channels. These bits control the safe state analog outputs. – Bit 00 corresponds to output channel 0, bit 01 corresponds to output channel 1, and so on. 1 = use words 0 or 1 as directed by channel number n 0 = use words 10 or 11 as directed by channel number n When bits 00-01 are all cleared (0) simultaneously by a communication error or user choice thru the programmable controller program, word 5 full range and configure select bits are preserved at their last setting.
	Bits 04-15 (04-17)	Not used – set to 0.
Word 5	Bits 00-01	**Full range bits (F)** for individual channels – Bit 00 corresponds to output channel 0, and bit 01 corresponds to output channel 1.
	Bits 02-07	Not used – set to 0.
	Bits 08-09 (10-11)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to output channel 0, and bit 09 corresponds to output channel 1.
	Bits 10-15 (12-17)	Not used – set to 0.

2 Input/1 Output Analog Combo Module (Cat. No. 1793-IE2XOE1 and -IE2XOE1S)



Input Word/Bit Descriptions for the 1793-IE2XOE1and -IE2XOE1S Analog Combo Module

Input Word	Decimal Bit (Octal Bit)	Definition
Input Word 0	Bits 00-14 (00-16)	**Channel 0 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**
Word 1	Bits 00-14 (00-16)	**Channel 1 analog data** – 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 1 analog data sign bit.**

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Input Word	Decimal Bit (Octal Bit)	Definition
Words 2 and 3		**Reserved**
Word 4	Bits 00-01	**Underrange bits (U)** for individual channels **(4-20mA current input only)**- Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1. When set (1), indicates either a broken or open input wire, or input current at or below 4mA.
	Bits 02-03	**Reserved**
	Bits 04	**Wire Off bits (W)** – Current outputs only – When set (1), the wire on the current output is broken or the load resistance is too high. Bit 00 corresponds to channel 0.
	Bits 05-14 (05-16)	**Reserved**
	Bit 15 (17)	**Power Up bit - This bit is set to 1 when all bits in the configuration register (write word 3) are 0 (unconfigured state).** The configuration register can be cleared by either a reset, or by the user writing all zeroes to it.

Range Selection Bits for the 1793-IE2XOE1and -IE2XOE1S Analog Combo Module

Channel No.	Input Channel 0		Input Channel 1		Output Channel 0	
	F0	C0	F1	C1	F4	C4
Decimal Bits (Octal Bits)	**00**	**08 (10)**	**01**	**09 (11)**	**04**	**12 (14)**
4-20mA	0	1	0	1	0	1
0-10V dc/0-20mA	1	0	1	0	1	0
–10 to +10V dc	1	1	1	1	1	1
Off[1]	0	0	0	0	0	0

C = Configure select bit
F = Full range bit
[1] When configured to off, individual channels will return 0000H.

Output Word/Bit Descriptions for the 1793-IE2XOE1and -IE2XOE1S Analog Combo Module

Output Word	Decimal Bit (Octal Bit)	Definition
Write Word 0	Bits 00-14 (00-16)	**Channel 0 analog data –** 12-bit left justified two's complement number; unused lower bits are zero; 4-20mA uses all 16 bits.
	Bits 15 (17)	**Channel 0 analog data sign bit.**

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Configuration Word/Bit Descriptions for the 1793-IE2XOE1 and -IE2XOE1S Analog Combo Module

Configuration Word	Decimal Bit (Octal Bit)	Definition
Word 2	Bit 00	**Multiplex control bits (M)** for individual channel. This bit controls the safe state analog outputs– Bit 00 corresponds to output channel 0. 1 = use words 0 (analog value) as directed by channel number n 0 = use words 6 (safe state analog value) as directed by channel number n When bit 00 is cleared (0) simultaneously by a communication error or user choice thru the programmable controller program, word 3 full range and configure select bits are preserved at their last setting.
	Bits 01-15 (01-17)	Not used – set to 0.
Word 3	Bits 00-01, 04	**Full range bits (F)** for individual channels – Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1, and bit 04 corresponds to output channel 1. Refer to Range Bit Selections.
	Bits 02, 03, 05-07	Not used – set to 0.
	Bits 08-09, 12 (10, 11, 13)	**Configure select bits (C)** for individual channels – Bit 08 corresponds to input channel 0, bit 09 (11) corresponds to input channel 1, bit 12 (14) corresponds to output channel 0. Refer to Range Bit Selections.
	Bits 14-15 (16-17)	Not used – set to 0.

Chapter Summary

In this chapter, you learned how this module communicates over the ControlNet network, and the image table mapping for the module.

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Specifications

Specifications - 4 Input Analog Module, Cat. No. 1793-IE4 and -IE4S	
Module Type	4 analog inputs 1793-IE4 - 16 screw-cage terminals 1793-IE4S - 16 spring-clamp terminals
Module Location	DIN rail mounting
Number of Channels	4
Data Format	16-bit 2's complement, left-justified
Conversion Type	Successive approximation
Conversion Rate	256µs all channels
Resolution Voltage Current	12-bits - unipolar; 11-bit plus sign - bipolar 2.56mV/cnt unipolar; 5.13mV/cnt bipolar 5.13µA/cnt
Input Current Terminal	4-20mA (user configurable) 0-20mA (user configurable)
Input Voltage Terminal	±10V (user configurable) 0-10V (user configurable)
Normal Mode Rejection Ratio Voltage Terminal Current Terminal	 -3db @ 17Hz; -20db/decade -10db @ 50Hz; -11.4db @ 60Hz -3db @ 17Hz; -20db/decade -15.3db @ 50Hz; -16.8db @ 60Hz
Step Response to 63% Voltage Terminal Current Terminal	 9.4ms 18.2ms
Impedance Voltage Terminal Current Terminal	 100K Ω; 200K Ω @ dc 238Ω
Absolute Accuracy Voltage Terminal Current Terminal	 0.20% FS @ 25°C 0.20% FS @ 25°C
Accuracy Drift Voltage Terminal Current Terminal	 0.00428% FS per °C 0.00407% FS per °C
Maximum Overload Voltage Terminal Current Terminal	Single channel, continuous 30V 32mA
Isolation Voltage	Channel to system - 850V dc for 1s Channel to channel - None
Flexbus Current	20mA maximum
Power Dissipation	1.0W @ 31.2V dc

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Specifications - 4 Input Analog Module, Cat. No. 1793-IE4 and -IE4S	
Thermal Dissipation	3.4 BTU/hr @ 31.2V dc
Indicators	1 green power indicators
External dc Power Voltage Current	19.2-31.2V dc (5% ac ripple) 60mA maximum
Dimensions in (mm)	2.72H x 3.15D x 2.17W (69H x 80D x 55W)
Environmental Conditions Operational Temperature Storage Temperature Relative Humidity Shock Operating Nonoperating Vibration	 0 to +55°C (32 to +131°F) -40 to +85°C (-40 to +185°F) 5 to 95% noncondensing Tested to 30g peak acceleration, 11(±1)ms pulse width Tested to 50g peak acceleration, 11(±1)ms pulse width Tested 5g @ 10-500Hz per IEC68-2-6
Conductors Wire Size Category	12 gauge (4mm^2) stranded wire 3/64 in (1.2mm) maximum insulation 2
Agency Certification (when product is marked)	• CSA certified • CSA Class 1, Division 2 Groups A, B, C and D certified • UL listed • CE marked for all applicable directives
User Manual	• Publication 1793-6.5.1

1 Use this category information for planning conductor routing as described in publication 1770-4.1, "Wiring and Grounding Guidelines for Noise Immunity."

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Specifications - 2 Output Analog Module, Cat. No. 1793-OE2 and -OE2S	
Module Type	2 analog output 1793-OE2 - 16 screw-cage terminals 1793-OE2S - 16 spring-clamp terminals
Module Location	DIN rail mounting
Number of Channels	2 out - nonisolated
Output	
Resolution Voltage Current	12-bits plus sign 2.56mV/cnt 5.13µA/cnt
Data Format	left justified 16-bit 2's complement
Conversion Type	Pulse width modulation
Conversion Rate	1.024ms all channels
Current Terminal	4-20mA (user configurable) 0-20mA (user configurable)
Voltage Terminal	±10V (user configurable) 0-10V (user configurable) 3A maximum
Step Response to 63% Voltage Terminal Current Terminal	 24ms 24ms
Impedance Voltage Terminal Current Terminal	 15-750 Ω resistive 15-750 Ω resistive
Absolute Accuracy Voltage Terminal Current Terminal	 0.133% FS @ 25°C 0.425% FS @ 25°C
Accuracy Drift Voltage Terminal Current Terminal	 0.0045% FS per °C 0.0069% FS per °C
Isolation Voltage	Channel to system - 850V dc for 1s Channel to channel - None
General	
Flexbus Current	20mA maximum
Power Dissipation	2.5W @ 31.2V dc
Thermal Dissipation	8.5 BTU/hr @ 31.2V dc
Indicators	1 green power indicators
External dc Power Voltage Current	19.2-31.2V dc (5% ac ripple) 70mA maximum
Dimensions in (mm)	2.72H x 3.15D x 2.17W (69H x 80D x 55W)
Environmental Conditions Operational Temperature Storage Temperature Relative Humidity Shock Operating Nonoperating Vibration	 0 to +55°C (32 to +131°F) -40 to +85°C (-40 to +185°F) 5 to 95% noncondensing Tested to 30g peak acceleration, 11(±1)ms pulse width Tested to 50g peak acceleration, 11(±1)ms pulse width Tested 5g @ 10-500Hz per IEC68-2-6
Conductors Wire Size Category	12 gauge (4mm^2) stranded wire 3/64 in (1.2mm) maximum insulation 2
Agency Certification (when product is marked)	• CSA certified • CSA Class 1, Division 2 Groups A, B, C and D certified • UL listed • CE marked for all applicable directives
Publications	• Installation Instructions - 1793-5.6 • User Manual - 1793-6.5.1

1 Use this category information for planning conductor routing as described in publication 1770-4.1, "Wiring and Grounding Guidelines for Noise Immunity."

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Specifications - 2 Input/1 Output Analog Module, Cat. No. 1793-IE2X0E1 and -IE2X0E1S	
Module Type	2 analog inputs, 1 analog output 1793-IE2X0E1 - 16 screw-cage terminals 1793-IE2X0E1S - 16 spring-clamp terminals
Module Location	DIN rail mounting
Number of Channels	3 - 2 in, 1 out - nonisolated
Input	
Resolution Voltage Current	12-bits - unipolar; 11-bit plus sign - bipolar 2.56mV/cnt unipolar; 5.13mV/cnt bipolar 5.13µA/cnt
Data Type	left justified 16-bit 2's complement
Conversion Type	Successive approximation
Conversion Rate	256µs all channels
Input Current Terminal	4-20mA (user configurable) 0-20mA (user configurable)
Input Voltage Terminal	±10V (user configurable) 0-10V (user configurable)
Normal Mode Rejection Ratio Voltage Terminal Current Terminal	 -3db @ 17Hz; -20db/decade -10db @ 50Hz; -11.4db @ 60Hz -3db @ 17Hz; -20db/decade -15.3db @ 50Hz; -16.8db @ 60Hz
Step Response to 63% Voltage Terminal Current Terminal	 9.4ms 18.2ms
Impedance Voltage Terminal Current Terminal	 9.4ms100K Ω; 200K Ω @ dc 238Ω
Absolute Accuracy Voltage Terminal Current Terminal	 0.20% FS @ 25°C 0.20% FS @ 25°C
Accuracy Drift Voltage Terminal Current Terminal	 0.00428% FS per °C 0.00407% FS per °C
Maximum Overload Voltage Terminal Current Terminal	Single channel, continuous 30V 32mA
Output	
Resolution Voltage Current	12-bits plus sign 2.56mV/cnt 5.13µA/cnt
Data Type	left justified 16-bit 2's complement
Conversion Type	Pulse width modulation
Conversion Rate	1.024ms all channels
Current Terminal	4-20mA (user configurable) 0-20mA (user configurable)
Voltage Terminal	±10V (user configurable) 0-10V (user configurable) 3A maximum
Step Response to 63% Voltage Terminal Current Terminal	 24ms 24ms
Impedance Voltage Terminal Current Terminal	 15-750 Ω resistive 15-750 Ω resistive
Absolute Accuracy Voltage Terminal Current Terminal	 0.133% FS @ 25°C 0.425% FS @ 25°C

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Specifications - 2 Input/1 Output Analog Module, Cat. No. 1793-IE2X0E1 and -IE2X0E1S	
Accuracy Drift Voltage Terminal Current Terminal	 0.0045% FS per ^{o}C 0.0069% FS per ^{o}C
Isolation Voltage	Channel to system - 850V dc for 1s Channel to channel - None
General	
Flexbus Current	20mA maximum
Power Dissipation	2.5W @ 31.2V dc
Thermal Dissipation	8.5 BTU/hr @ 31.2V dc
Indicators	1 green power indicators
External dc Power Voltage Current	19.2-31.2V dc (5% ac ripple) 100mA maximum
Dimensions in (mm)	2.72H x 3.15D x 2.17W (69H x 80D x 55W)
Environmental Conditions Operational Temperature Storage Temperature Relative Humidity Shock Operating Nonoperating Vibration	 0 to +55^{o}C (32 to +131^{o}F) -40 to +85^{o}C (-40 to +185^{o}F) 5 to 95% noncondensing Tested to 30g peak acceleration, 11(+1)ms pulse width Tested to 50g peak acceleration, 11(+1)ms pulse width Tested 5g @ 10-500Hz per IEC68-2-6
Conductors Wire Size Category	12 gauge (4mm^{2}) stranded wire 3/64 in (1.2mm) maximum insulation 2
Agency Certification (when product is marked)	• CSA certified • CSA Class 1, Division 2 Groups A, B, C and D certified • UL listed • CE marked for all applicable directives
Publications	• Installation Instructions - 1793-5.7 • User Manual - 1793-6.5.1

1 Use this category information for planning conductor routing as described in publication 1770-4.1, "Wiring and Grounding Guidelines for Noise Immunity."

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Data Table Formats

Two's Complement Binary

Two's complement binary is used when performing mathematical calculations internal to the processor. To complement a number means to change it to a negative number. For example, the following binary number is equal to decimal 22.

$$10110_2 = 22_{10}$$

First, the two's complement method places an extra bit (sign bit) in the left-most position, and lets this bit determine whether the number is positive or negative. The number is positive if the sign bit is 0 and negative if the sign bit is 1. Using the complement method:

0 10110 = 22

To get the negative using the two's complement method, you must invert each bit from right to left after the first "1" is detected.

In the above example:

0 10110 = +22

Its two's complement would be:

1 01010 = –22

Note that in the above representation for +22, starting from the right, the first digit is a 0 so it is not inverted; the second digit is a 1 so it is not inverted. All digits after this one are inverted.

If a negative number is given in two's complement, its complement (a positive number) is found in the same way:

1 10010 = –14
0 01110 = +14

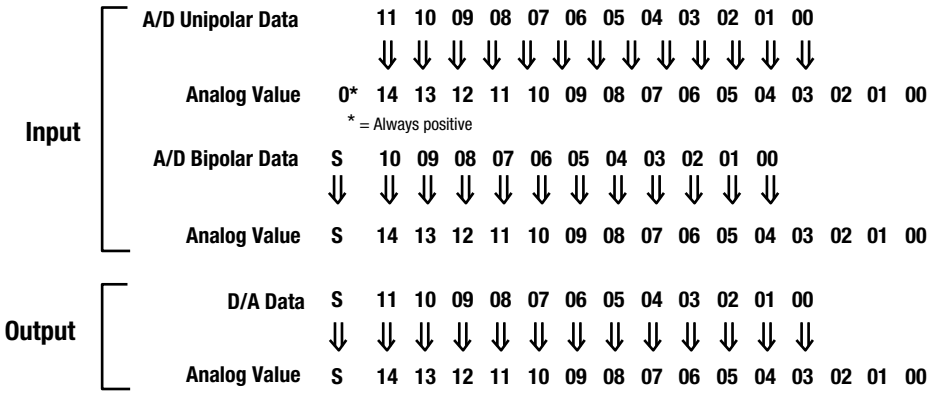
All bits from right to left are inverted after the first "1" is detected.

The two's complement of 0 is not found, since no first "1" is ever encountered in the number. The two's complement of 0 then is still 0.

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Analog Data Format

The data returned from the analog-to-digital converter in the module is 12-bit resolute. This value is left-justified into a 16-bit field, reserving the most significant bit for a sign bit.



Current (mA)	4-20mA Mode	0-20mA Mode	Voltage (V)	±10 Volt Mode		0-10 Volt Mode
				Input	Output	
			–10.50	8000	8000	
0.00		0000	–10.00	8620	8618	
1.00		0618	–9.00	9250	9248	
2.00		0C30	–8.00	9E80	9E78	
3.00		1248	–7.00	AAB0	AAA8	
4.00	0000	1860	–6.00	B6E0	B6D8	
5.00	0787	1E78	–5.00	C310	C310	
6.00	0F0F	2490	–4.00	CF40	CF40	
7.00	1696	2AA8	–3.00	DB70	DB70	
8.00	1E1E	30C0	–2.00	E7A0	E7A0	
9.00	25A5	36D8	–1.00	F3D0	F3D0	
10.00	2D2D	3CF0	0.00	0000	0000	0000
11.00	34B4	4310	1.00	0C30	0C30	0C30
12.00	3C3C	4928	2.00	1860	1860	1860
13.00	43C3	4F40	3.00	2490	2490	2490
14.00	4B4B	5558	4.00	30C0	30C0	30C0
15.00	52D2	5B70	5.00	3CF0	3CF0	3CF0
16.00	5A5A	6188	6.00	4920	4928	4928
17.00	61E1	67A0	7.00	5550	5558	5558
18.00	6969	6DB8	8.00	6180	6188	6188
19.00	70F0	73D0	9.00	6DB0	6DB8	6DB8
20.00	7878	79E8	10.00	79E0	79E8	79E8
21.00	7FFF	7FF8	10.50	7FF0	7FF8	7FF8

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Scaling Example

To scale your data to a different range:

- SLC 500 - use the scaling instruction.
- PLC-5 - determine a constant (slope) by dividing the desired range by the actual range. Multiply the result by your data, and add or subtract any offset.

Example:
A 4-20mA input places data at N13:0 (Figure 3.4 on page 3-4), with a range of 0 to 30,840. (30,840 = 7878 hex - see data format on page C-2).

You want the 4-20mA (0 to 30,840) to be 32 to 1000 degrees in the PLC-5.
Use the following formula:

Scaled Data (degrees) @ N30:0 = {[(Desired Range)/Actual Range] X Analog Input Data} + Offset

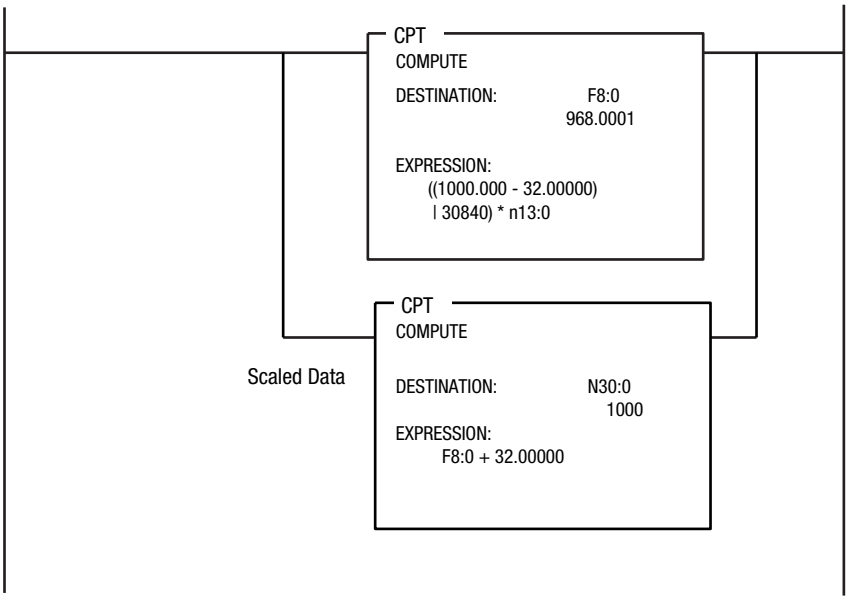
= {[(1000 - 32)/30,840] X N13:0} + 32
F8:0

= F8:0 + 32

Scaled Data (degrees) @ N30:0 = F8:0 + 32 (See ladder logic below)

Example using Compute Instructions

This rung will scale FLEX I/O analog data to a different range. In this example, we want the 4-20mA input data to represent 32 to 1000 degrees in the PLC-5. For this example, N13:0 = 30,840 (7878 in hex). Two compute instructions are needed because of the way the destination value will be rounded if we use an integer location instead of floating point in the first compute instruction. The second compute instruction has a final destination of an integer location.



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Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
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Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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