Allen-Bradley

Compact™ 8-Bit Low Resolution Analog I/O Combination Module

(Catalog Number 1769-IF4XOF2)

User Manual

Rockwell Automation

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.

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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Glossary

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Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- Who Should Use This Manual on page P-1
- How to Use This Manual on page P-1
- Related Documentation on page P-2
- Conventions Used in This Manual on page P-2
- Rockwell Automation Support on page P-3

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Allen-Bradley Compact™ I/O.

How to Use This Manual

As much as possible, we organized this manual to explain, in a task-by-task manner, how to install, configure, program, operate and troubleshoot a control system using the analog I/O modules.

Manual Contents

If you want...	See
An overview of the analog combination module	Chapter 1
A quick start guide for experienced users	Chapter 2
Installation and wiring guidelines	Chapter 3
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Definitions of terms used in this manual	Glossary

Related Documentation

The table below provides a listing of publications that contain important information about MicroLogix 1500 systems.

For	Read this document	Document number
A user manual containing information on how to install, use and program your MicroLogix 1500 controller.	MicroLogix™ 1500 User Manual	1764-UM001A-US-P
A user manual containing information on how to install, and use your 1769-ADN DeviceNet Adapter.	DeviceNet Adapter User Manual	1769-UM001A-US-P
A user manual containing information on how to install, use and program your CompactLogix controller.	CompactLogix User Manual	1769-UM007C-EN-P
An overview of 1769 Compact Discrete I/O modules	1769 Compact Discrete Input/Output Modules Product Data	1769-2.1
An overview of the MicroLogix 1500 System, including 1769 Compact I/O.	MicroLogix™ 1500 System Overview	1764-SO001B-EN-P
In-depth information on grounding and wiring Allen-Bradley programmable controllers.	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1

If you would like a manual, you can:

- download a free electronic version from the internet at **www.theautomationbookstore.com**
- purchase a printed manual by:
  - contacting your local distributor or Rockwell Automation representative
  - visiting **www.theautomationbookstore.com** and placing your order
  - calling 1.800.963.9548 (USA/Canada) or 001.330.725.1574 (Outside USA/Canada)

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists (like this one) provide information not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- Italic type is used for emphasis.
- Text in this font indicates words or phrases you should type.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with over 75 Sales/Support Offices, 512 authorized distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Rockwell Automation representatives in every major country in the world.

Local Product Support

Contact your local Rockwell Automation representative for:

- sales and order support
- product technical training
- warranty support
- support service agreement

Technical Product Assistance

If you need to contact Rockwell Automation for technical assistance, please review the information in Chapter 5, *Module Diagnostics and Troubleshooting* first. Then call your local Rockwell Automation representative.

Your Questions or Comments on the Manual

If you find a problem with this manual, please notify us. If you have any suggestions for how this manual could be made more useful to you, please contact us at the address below:

Rockwell Automation
Automation Control and Information Group
Technical Communication, Dept. A602V
P.O. Box 2086
Milwaukee, WI 53201-2086

Overview

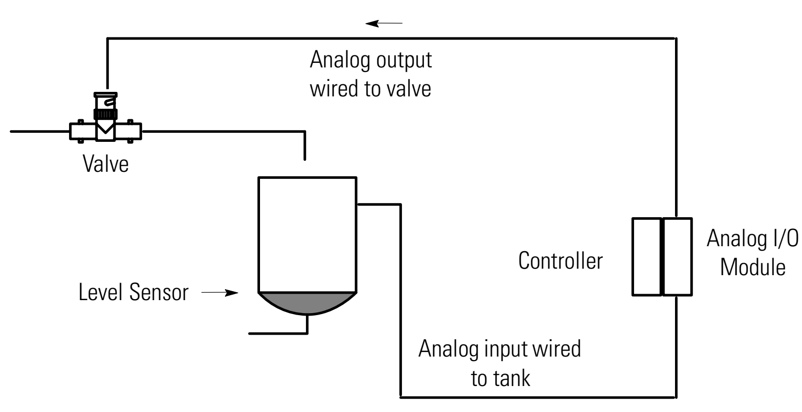
This chapter explains how analog data is used and describes the 1769-IF4XOF2 combination analog I/O module. Included is information about:

- How to Use Analog I/O on page 1-1
- General Description of the Module's Hardware and Diagnostic Features on page 1-2
- Overview of the Analog System on page 1-4

How to Use Analog I/O

Analog refers to the representation of numerical quantities by the measurement of continuous physical variables. Analog applications are present in many forms. The following application shows a typical use of analog data.

In this application, the processor controls the amount of fluid in a holding tank by adjusting the valve opening. The valve is initially open 100%. As the fluid level in the tank approaches the preset point, the processor modifies the output to close the valve 90%, 80%, and so on, continuously adjusting the valve to maintain the fluid level.



General Description of the Module's Hardware and Diagnostic Features

The analog input channels convert and digitally store analog data for retrieval by controllers, such as the MicroLogix™ 1500 and CompactLogix, and from network adapters like the 1769-ADN (Series B) DeviceNet Adapter. The module supports connections from any combination of up to four voltage or current analog sensors. The four high-impedance input channels can be wired as either single-ended or differential inputs.

The output channels provide two single-ended analog outputs, each individually configurable for voltage or current.

The module provides the following input/output types/ranges:

Table 1.1 Normal and Full Input and Output Ranges

Normal Operating Range	Full Module Range(1)
0 to +10V dc	0.0 to +10.5V dc
0 to 20 mA	0 to 21 mA

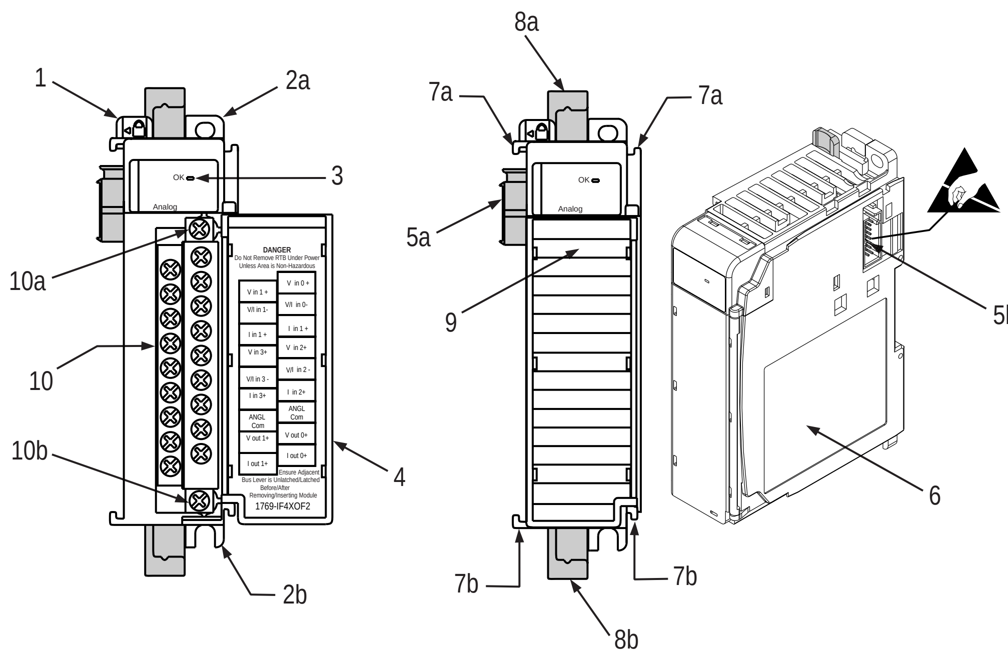
(1) The module provides an overrange band of 0.5V for the 0 to 10V range and 1 mA for the 0 to 20 mA range.

The modules provide the data as raw/proportional data. If scaling to engineering units is required, it must be done in your control program.

Hardware Features

The module has a removable terminal block. The module's four input channels can be wired as either single-ended or differential inputs. The module's two output channels are single-ended only. Module configuration is done via proper wiring of the I/O and the controller's programming software. In addition, some controllers support configuration via the user program. In either case, the module configuration is stored in the memory of the controller. Refer to your controller's user manual for more information.

The following illustration shows the hardware features of the Compact combination analog I/O module.



Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tab
2b	lower panel mounting tab
3	green module status OK LED
4	module door with terminal identification label
5a	movable bus connector (bus interface) with female pins
5b	stationary bus connector (bus interface) with male pins
6	nameplate label
7a	upper tongue-and-groove slots
7b	lower tongue-and-groove slots
8a	upper DIN rail latch
8b	lower DIN rail latch
9	write-on label for user identification tags
10	removable terminal block (RTB) with finger-safe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw

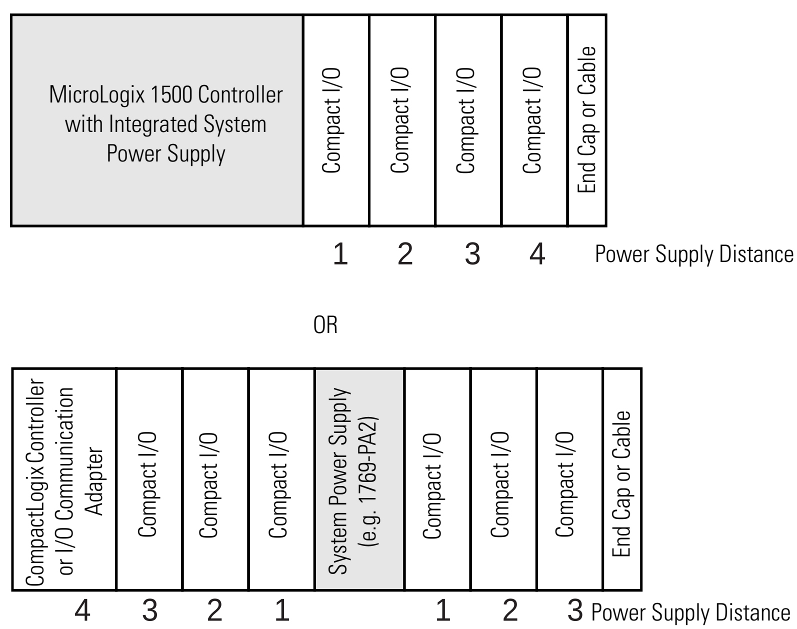
General Diagnostic Features

The module contains diagnostic features that can help you identify the source of problems that may occur during power-up or during normal channel operation. These power-up and channel diagnostics are explained in Chapter 5, *Module Diagnostics and Troubleshooting*.

Overview of the Analog System

The module communicates to the controller through the bus interface. The module also receives 5 and 24V dc power through the bus interface.

You can install as many analog modules as your power supply can support. However, the 1769-IF4XOF2 module has a power supply distance rating of 8, which means that it may not be located more than 8 modules away from the system power supply. The illustration below shows how power supply distance is determined.



System Operation

At power-up, the module performs a check of its internal circuits, memory, and basic functions. During this time, the module status LED remains off. If no faults are found during power-up diagnostics, the module status LED is turned on.

After power-up checks are complete, the module waits for valid channel configuration data. If an invalid configuration is detected, the module generates a configuration error. Once a channel is properly configured and enabled, it begins the analog-to-digital or digital-to-analog conversion process.

Input Channels

Each time an input channel is read by the module, that analog data value is tested by the module for an over-range condition (e.g. input voltage greater than 10V dc). If such a condition is detected, a unique bit is set in the channel status word. The channel status word is described in Input Data File on page 4-3.

The controller reads the analog data from the module. This typically occurs at the end of the program scan or when commanded by the control program. If the controller and the module determine that the bus data transfer was made without error, the data is used in your control program.

Output Channels

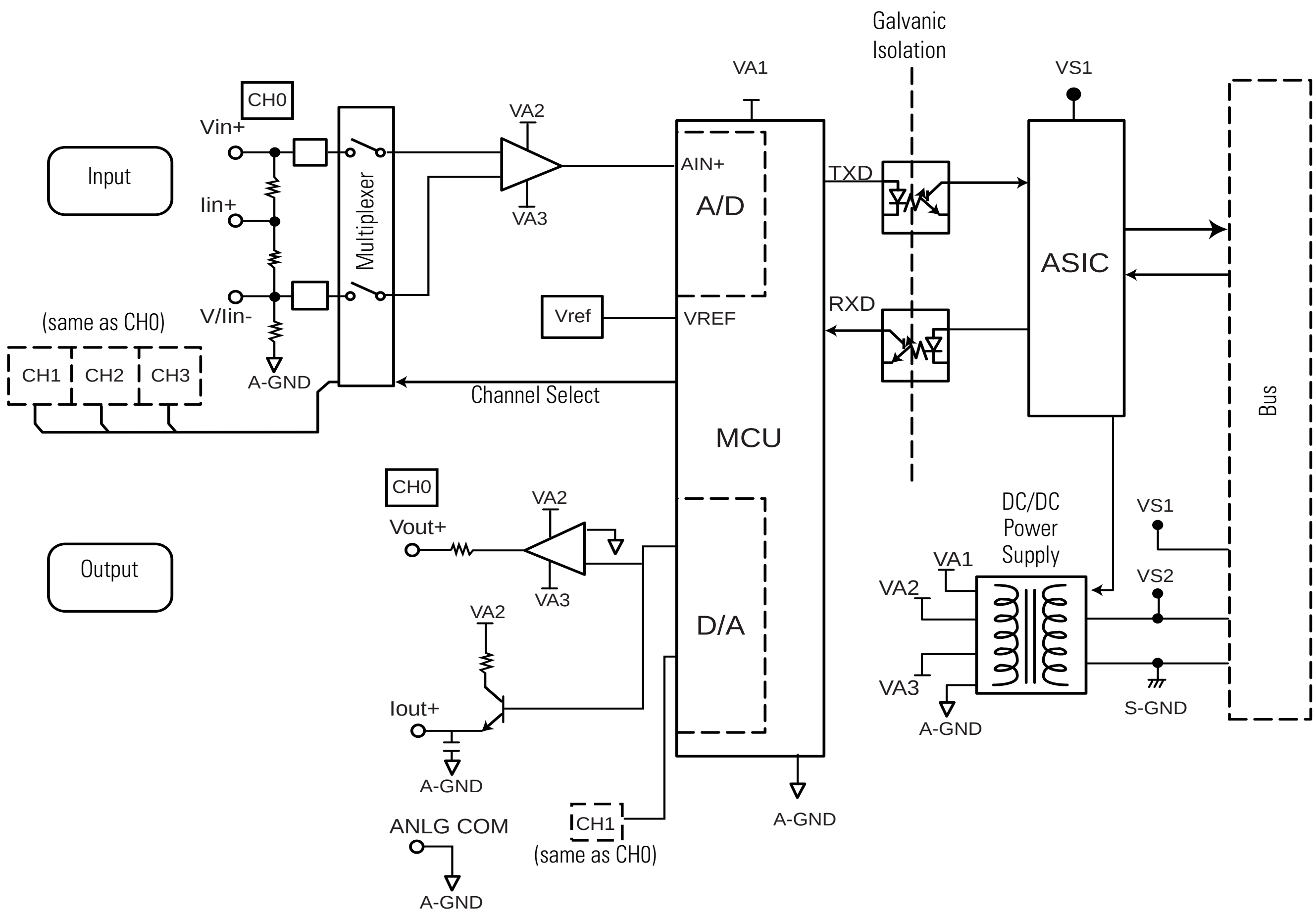
The module monitors output channels for over-range conditions. If such a condition is detected, a unique bit is set in the channel status word. The channel status word is described in Output Data File on page 4-7.

The module receives proportional binary values from the bus master (e.g. controller). This typically occurs at the end of the program scan or when commanded by the control program. If the controller and the module determine that the bus transfer was completed without error, the module converts the data to an analog output signal.

Module Operation

Module Block Diagram

The module's input channel circuitry consists of four differential analog inputs multiplexed into a single analog-to-digital (A/D) converter. The A/D converter reads the selected input signal and converts it to a digital value which is presented to the controller. The multiplexer sequentially switches each input channel to the module's A/D converter. The module's output channel uses a digital-to-analog (D/A) converter to read the digital output data from the controller and convert it to an analog output signal. See the block diagram below.



Module Calibration

The module's input/output channel calibration is guaranteed by its design. No field calibration is required.

Quick Start for Experienced Users

Before You Begin

This chapter can help you to get started using the analog module. We base the procedures here on the assumption that you have an understanding of Allen-Bradley controllers. You should understand electronic process control and be able to interpret the ladder logic instructions required to generate the electronic signals that control your application.

Because it is a start-up guide for experienced users, this chapter *does not* contain detailed explanations about the procedures listed. It does, however, reference other chapters in this book where you can get more information about applying the procedures described in each step.

If you have any questions or are unfamiliar with the terms used or concepts presented in the procedural steps, *always read the referenced chapters* and other recommended documentation before trying to apply the information.

Required Tools and Equipment

Have the following tools and equipment ready:

- medium blade or cross-head screwdriver
- analog input or output device
- shielded, twisted-pair cable for wiring (Belden™ 8761 or equivalent)
- controller (for example, a MicroLogix™ 1500 controller)
- analog combination (1769-IF4XOF2) module
- programming device and software (for example, RSLogix 500™)

What You Need To Do

This chapter covers:

- Verify power supply is adequate on page 2-2
- Attach and lock the module. on page 2-2
- Mount the I/O bank. on page 2-3
- Wire the module. on page 2-4
- Configure the module on page 2-5
- Start the system. on page 2-6
- Monitor the module status. on page 2-6

Step 1: Verify power supply is adequate

Reference

Chapter 3
(Installation and Wiring)

Ensure that your power supply has sufficient current output to support your system configuration. The modules maximum current draw is shown below.

Module	5V dc	24V dc
1769-IF4XOF2	120 mA	160 mA

TIP The module cannot be located more than 8 modules away from the system power supply.

Step 2: Attach and lock the module.

Reference

Chapter 3
(Installation and Wiring)

a. Check that the bus lever of the module to be installed is in the unlocked (fully right) position.
b. Use the upper and lower tongue-and-groove slots to secure the modules together (or to a controller).
c. Move the module back along the tongue-and-groove slots until the bus connectors line up with each other.
d. Push the bus lever back slightly to clear the positioning tab. Use your fingers or a small screwdriver.

e. To allow communication between the controller and module, move the bus lever fully to the left until it clicks. Ensure it is locked firmly in place.

ATTENTION

When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

f. Attach an end cap terminator to the last module in the system by using the tongue-and-groove slots as before.

g. Lock the end cap bus terminator.

ATTENTION

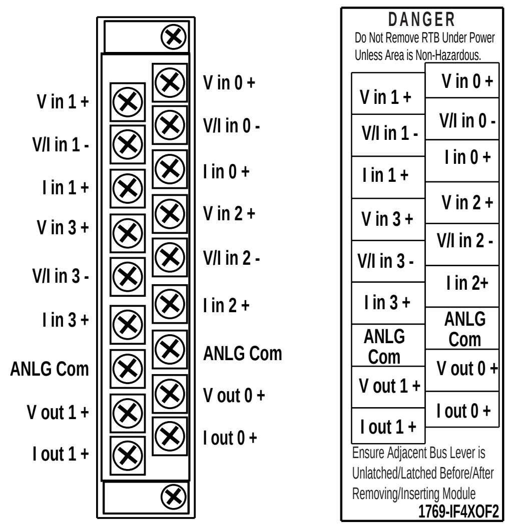
Remove power before removing or inserting this module. When you remove or insert a module with power applied, an electrical arc may occur.

Step 3:	**Mount the I/O bank.**	**Reference** Chapter 3 (Installation and Wiring)

Be sure to observe minimum spacing guidelines on page 3-7 for adequate ventilation.

Step 4:	Wire the module.	Reference
		Chapter 3 (Installation and Wiring)

The terminal connections are shown below:



Be sure to follow the system wiring guidelines on page 3-10. See the 1769-IF4XOF2 Wiring Diagram Showing Differential Inputs on page 3-18 and the Wiring Single-ended Sensor/Transmitter Input Types on page 3-19 for examples of wiring using differential and single-ended inputs.

Step 5:	**Configure the module**	**Reference**
		Chapter 4 (Module Data, Status, and Configuration Channel for 1769-IF4XOF2)

The 1769-IF4XOF2 module is configured for current or voltage operation by proper wiring of the analog I/O device to the module. However, a channel is enabled using its configuration file.

Table 2.1 Configuration Data File

Word	**Bit Position**															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Not Used[1]								EI3	EI2	EI1	EI0	FM0[2]	PM0[2]	Not Used[1]	PFE0[2]
1	Not Used[1]										EO1	EO0	FM1[2]	PM1[2]	Not Used[1]	PFE1[2]
2	SGN	Channel 0 Fault Value[2]								0	0	0	0	0	0	0
3	SGN	Channel 0 Program (Idle) Value[2]								0	0	0	0	0	0	0
4	SGN	Channel 1 Fault Value[2]								0	0	0	0	0	0	0
5	SGN	Channel 1 Program (Idle) Value[2]								0	0	0	0	0	0	0

(1) Any attempt to write a non-valid (1's) bit configurations into any not used selection field results in a module configuration er ror.
(2) Not all controllers support these functions. Refer to your controller's user manual for details.

The configuration file is typically modified using the programming software configuration screen. It can also be modified through the control program, if supported by the controller. See the configuration file chart on page 4-8.

For an example of module configuration using MicroLogix 1500 and RSLogix 500, see Appendix B. For an example of module configuration using CompactLogix and RSLogix 5000, see Appendix C.

Step 6: Start the system.

Reference

Chapter 5
(Module Diagnostics and Troubleshooting)

a. Apply power.
b. Download your program, which contains the analog module configuration settings, to the controller and put the controller into Run mode.
c. During a normal start-up, the module status LED turns on.
d. If the module status LED does not turn on, cycle power. If the condition persists, replace the module.

Step 7: Monitor the module status.

Reference

Chapter 6
(Module Diagnostics and Troubleshooting)

Module and channel configuration errors are reported to the controller. These errors are typically reported in the controller's I/O status file. Check the controller's I/O file.

Channel status data is also reported in the module's input data table, so these bits can be used in your control program to flag a channel error. See Input Data File on page 4-3.

Installation and Wiring

This chapter tells you about:

- Compliance to European Union Directives on page 3-1
- Power Requirements on page 3-2
- General Considerations to Avoid Electrostatic Damage on page 3-2
- System Assembly on page 3-5
- Mounting the Module on page 3-6
- Field Wiring Connections on page 3-10
- Analog Input Wiring on page 3-16
- Analog Output Wiring on page 3-21

Compliance to European Union Directives

This product is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

The analog modules are 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 50081-2
  EMC – Generic Emission Standard, Part 2 - Industrial Environment

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

This product is intended for use in an industrial environment.

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 EN61131-2, 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
- *Automation Systems Catalog*, publication B113

Power Requirements

The module receives its power through the bus interface from the +5V dc/+24V dc system power supply.

The maximum current drawn by the module is shown in the table below.

Module	5V dc	24V dc
1769-IF4XOF2	120 mA	160 mA

General Considerations to Avoid Electrostatic Damage

Compact I/O is suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[(1)]) and to circuits not exceeding Over Voltage Category II[(2)] (IEC 60664-1).[(3)]

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.
- This product must be installed in an enclosure.
- All wiring must comply with N.E.C. article 501-4(b)

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors if you touch bus connector pins or the terminal block. Follow these guidelines when you handle the module:

- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When not in use, keep the module in its static-shield box.

Remove Power

ATTENTION

Remove power before removing or inserting this module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc 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

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

Reducing Electrical Noise Interference

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference. Analog inputs and outputs are highly susceptible to electrical noise. Electrical noise coupled to the analog inputs will reduce the performance (accuracy) of the module.

Group your modules to minimize adverse effects from radiated electrical noise and heat. Consider the following conditions when selecting a location for the analog module. Position the module:

- away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives
- away from modules which generate significant radiated heat, such as the 1769-IA16. Refer to the module’s heat dissipation specification.

In addition, route shielded, twisted-pair analog input and output wiring away from any high voltage I/O wiring.

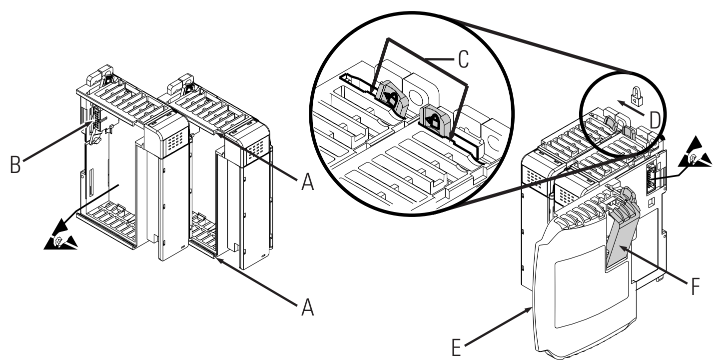
Protecting the Circuit Board from Contamination

The printed circuit boards of the analog modules must be protected from dirt, oil, moisture, and other airborne contaminants. To protect these boards, the system must be installed in an enclosure suitable for the environment. The interior of the enclosure should be kept clean and the enclosure door should be kept closed whenever possible.

System Assembly

The module can be attached to the controller or an adjacent I/O module or power supply *before* or *after* mounting. For mounting instructions, see Panel Mounting Using the Dimensional Template on page 3-7, or DIN Rail Mounting on page 3-8. To work with a system that is already mounted, see Replacing a Single Module within a System on page 3-9.

The following procedure shows you how to assemble the Compact I/O system.



1. Disconnect power.

2. Check that the bus lever of the module to be installed is in the unlocked (fully right) position.

3. Use the upper and lower tongue-and-groove slots (A) to secure the modules together (or to a controller or power supply).

4. Move the module back along the tongue-and-groove slots until the bus connectors (B) line up with each other.

5. Push the bus lever back slightly to clear the positioning tab (C). Use your fingers or a small screwdriver.

6. To allow communication between the controller and module, move the bus lever fully to the left (D) until it clicks. Ensure it is locked firmly in place.

ATTENTION

When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

7. Attach an end cap terminator (E) to the last module in the system by using the tongue-and-groove slots as before.

8. Lock the end cap bus terminator (F).

IMPORTANT

A 1769-ECR or 1769-ECL right or left end cap must be used to terminate the end of the communication bus.

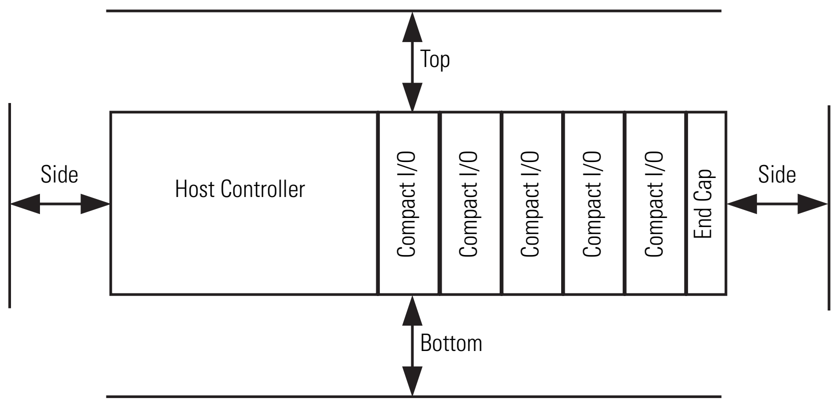
Mounting the Module

ATTENTION

During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage on power up.

Minimum Spacing

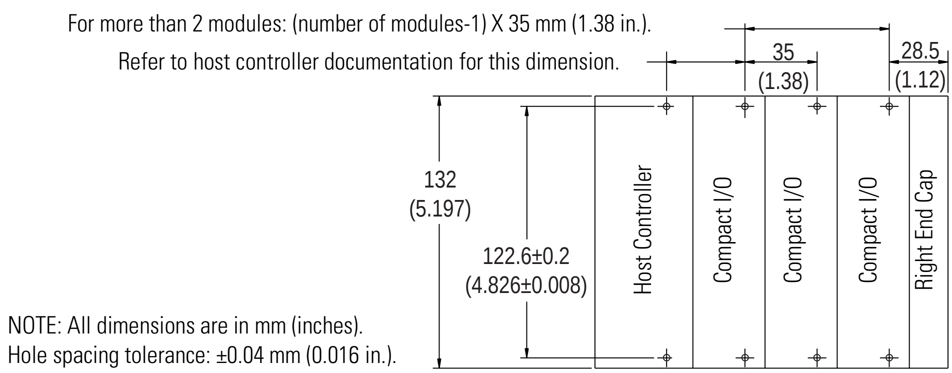
Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50 mm (2 in.) of space on all sides for adequate ventilation, as shown below:



Panel Mounting

Mount the module to a panel using two screws per module. Use M4 or #8 panhead screws. Mounting screws are required on every module.

Panel Mounting Using the Dimensional Template



Panel Mounting Procedure Using Modules as a Template

The following procedure allows you to use the assembled modules as a template for drilling holes in the panel. Due to module mounting hole tolerance, it is important to follow these procedures:

1. On a clean work surface, assemble no more than three modules.
2. Using the assembled modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the assembled modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the recommended M4 or #8 screw.
5. Place the modules back on the panel, and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

TIP If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.

7. Repeat steps 1 to 6 for any remaining modules.

DIN Rail Mounting

The module can be mounted using the following DIN rails:
35 x 7.5 mm (EN 50 022 - 35 x 7.5) or 35 x 15 mm (EN 50 022 - 35 x 15).

Before mounting the module on a DIN rail, close the DIN rail latches. Press the DIN rail mounting area of the module against the DIN rail. The latches will momentarily open and lock into place.

Replacing a Single Module within a System

The module can be replaced while the system is mounted to a panel (or DIN rail). Follow these steps in order:

1. Remove power. See attention note on 3-4.
2. On the module to be removed, remove the upper and lower mounting screws from the module (or open the DIN latches using a flat-blade or phillips-style screwdriver).
3. Move the bus lever to the right to disconnect (unlock) the bus.
4. On the right-side adjacent module, move its bus lever to the right (unlock) to disconnect it from the module to be removed.
5. Gently slide the disconnected module forward. If you feel excessive resistance, check that the module has been disconnected from the bus, and that both mounting screws have been removed (or DIN latches opened).

   TIP It may be necessary to rock the module slightly from front to back to remove it, or, in a panel-mounted system, to loosen the screws of adjacent modules.

6. Before installing the replacement module, be sure that the bus lever on the module to be installed and on the right-side adjacent module are in the unlocked (fully right) position.
7. Slide the replacement module into the open slot.
8. Connect the modules together by locking (fully left) the bus levers on the replacement module and the right-side adjacent module.
9. Replace the mounting screws (or snap the module onto the DIN rail).

Field Wiring Connections

Grounding

This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded. Refer to *Industrial Automation Wiring and Grounding Guidelines*, Allen-Bradley publication 1770-4.1, for additional information.

System Wiring Guidelines

Consider the following when wiring your system:

General

- All module commons (ANLG COM) are connected in the analog module. The analog common (ANLG COM) is not connected to earth ground inside the module.
- Channels are not isolated from each other.
- Use Belden™ 8761, or equivalent, shielded wire.
- Under normal conditions, the drain wire and shield junction must be connected to earth ground via a panel or DIN rail mounting screw at the analog I/O module end. Keep the shield connection to ground as short as possible.[1]
- To ensure optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.[2]

Inputs

- If multiple power supplies are used with analog inputs, the power supply commons must be connected.
- The module does not provide loop power for analog inputs. Use a power supply that matches the input transmitter specifications.
- Differential analog inputs are more immune to noise than single-ended analog inputs.
- Voltages on Vin+, V/Iin-, and Iin+ of the module must be within 0 to +10V dc of analog common.

(1) In environments where high-frequency noise may be present, it may be necessary to directly ground cable shields to earth at the module end and via a 0.1μF capacitor at the sensor end.
(2) Cable length over 50 meters may impact accuracy., For details, refer to the *Compact Combination Analog I/O Module*, publication 1769-UM008A-EN-P.

Outputs

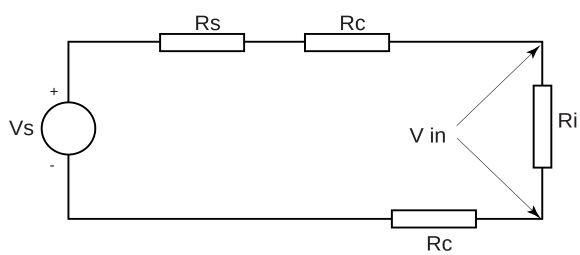
- Voltage outputs (Vout 0+ and Vout 1+) of the module are referenced to ANLG COM. Load resistance for a voltage output channel must be equal to or greater than 1K Ω.
- Current outputs (Iout 0+ and Iout 1+) of the module source current that returns to ANLG COM. Load resistance for a current output channel must remain between 0 and 300 Ω.

ATTENTION

Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up. Once wiring is complete, ensure the module is free of all metal fragments.

Effect of Transducer/Sensor and Cable Length Impedance on Voltage Input Accuracy

For voltage inputs, the length of the cable used between the transducer/sensor and the module can affect the accuracy of the data provided by the module.



Where:

Rc = DC resistance of the cable (each conductor) depending on cable length

Rs = Source impedance of analog transducer/sensor input

Ri = Impedance of the voltage input (150 KΩ)

Vs = Voltage source (voltage at the transducer/sensor input device)

Vin = Measured potential at the module input

%Ai = Percent added inaccuracy in a voltage-based system due to source and cable impedance.

$$Vin = \frac{[Ri \times Vs]}{[Rs + (2 \times Rc) + Ri]}$$

For example, for Belden 8761 two conductor, shielded cable:

Rc = 16 Ω/1000 ft
Rs = 0 (ideal source)

Table 3.1 Effect of Cable Length on Input Accuracy

Length of Cable (m)	dc resistance of the cable, Rc (Ω)	Accuracy impact at the input module
50	2.625	0.00350%
100	5.25	0.00700%
200	10.50	0.01400%
300	15.75	0.02100%

$$\%Ai = \left(1 - \frac{Vin}{Vs}\right) \times 100$$

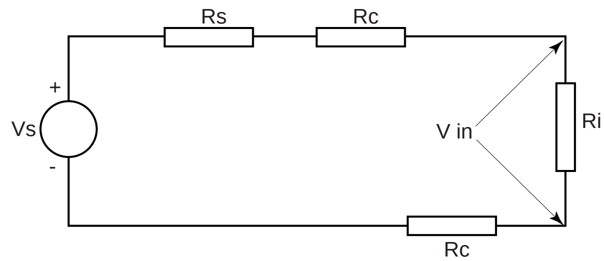
As input source impedance (Rs) and/or resistance (dc) of the cable (Rc) get larger, system accuracy decreases. If you determine that the inaccuracy error is significant, implementing the following equation in the control program can compensate for the added inaccuracy error due to the impedance of the source and cable.

$$Vs = Vin \times \frac{[Rs + (2 \times Rc) + Ri]}{Ri}$$

TIP In a current loop system, source and cable impedance do not impact system accuracy.

Effect of Device and Cable Output Impedance on Output Accuracy

The maximum value of the output impedance is shown in the example below, because it creates the largest deviation from an ideal voltage source.



Where:

Rc = DC resistance of the cable (each conductor) depending on cable length

Rs = Source impedance of the 1769-IF4XOF2 output (10 Ω)

Ri = Impedance of the voltage input (150 KΩ for the voltage input channel of the 1769-IF4XOF2)

Vs = Voltage at the output

Vin = Measured potential at the module input

%Ai = Percent added inaccuracy in a voltage-based system due to source and cable impedance.

$$Vin = \frac{[Ri \times Vs]}{[Rs + (2 \times Rc) + Ri]}$$

For example, for Belden 8761 two conductor, shielded cable and an input channel:

Rc = 16 Ω/1000 ft
Rs = 10 Ω
Ri = 150 KΩ

$$\%Ai = \left(1 - \frac{Vin}{Vs}\right) \times 100$$

Table 3.2 Effect of Output Impedance and Cable Length on Accuracy

Length of Cable (m)	dc resistance of the cable Rc (Ω)	Accuracy impact at the input module
50	2.625	0.01017%
100	5.25	0.01366%
200	10.50	0.02066%
300	15.75	0.02766%

As output impedance (Rs) and/or resistance (dc) of the cable (Rc) get larger, system accuracy decreases. If you determine that the inaccuracy error is significant, implementing the following equation in the control program can compensate for the added inaccuracy error due to the impedance of the output module and cable.

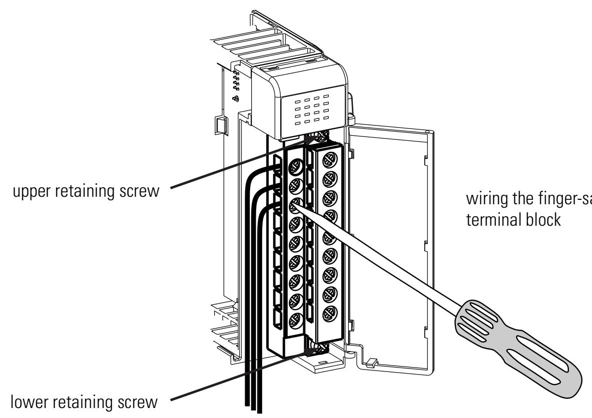
$$Vs = Vin \times \frac{[Rs + (2 \times Rc) + Ri]}{Ri}$$

TIP In a current loop system, source and cable impedance do not impact system accuracy.

Removing the Finger-Safe Terminal Block

When wiring field devices to the module, it is not necessary to remove the terminal block. If you remove the terminal block, use the write-on label on the side of the terminal block to identify the module slot location and type.

To remove the terminal block, loosen the upper and lower retaining screws. The terminal block will back away from the module as you remove the screws. When replacing the terminal block, torque the retaining screws to 0.46 Nm (4.1 in-lbs).



Wiring the Finger-Safe Terminal Block

When wiring the terminal block, keep the finger-safe cover in place.

1. Loosen the terminal screws to be wired.

2. Route the wire under the terminal pressure plate. You can use the bare wire or a spade lug. The terminals will accept a 6.35 mm (0.25 in.) spade lug.

TIP The terminal screws are non-captive. Therefore, it is possible to use a ring lug [maximum 1/4 inch o.d. with a 0.139 inch minimum i.d. (M3.5)] with the module.

3. Tighten the terminal screw making sure the pressure plate secures the wire. Recommended torque when tightening terminal screws is 0.68 Nm (6 in-lbs).

TIP If you need to remove the finger-safe cover, insert a screw driver into one of the square wiring holes and gently pry the cover off. If you wire the terminal block with the finger-safe cover removed, you will not be able to put it back on the terminal block because the wires will be in the way.

Wire Size and Terminal Screw Torque

Each terminal accepts up to two wires with the following restrictions:

Wire Type		Wire Size	Terminal Screw Torque	Retaining Screw Torque
Solid	Cu-90°C (194°F)	#14 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)
Stranded	Cu-90°C (194°F)	#16 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)

Analog Input Wiring

ATTENTION

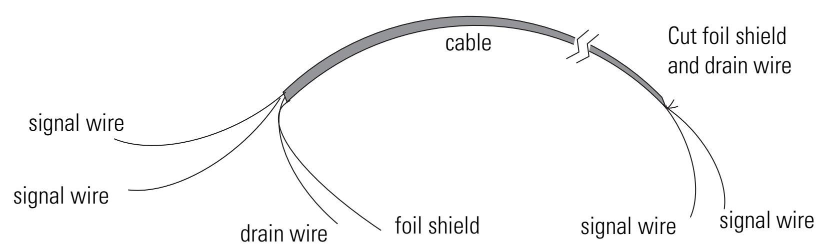
To prevent shock hazard, care should be taken when wiring the module to analog signal sources. Before wiring any analog module, disconnect power from the system power supply and from any other source to the analog module.

After the analog module is properly installed, follow the wiring procedure below. To ensure proper operation and high immunity to electrical noise, always use Belden™ 8761 (shielded, twisted-pair) or equivalent wire.

ATTENTION

When wiring an analog input, take care to avoid connecting a voltage source to a channel configured for current input. Improper module operation or damage to the voltage source can occur.

Never connect a voltage or current source to an analog output channel.



To wire your module follow these steps.

1. At each end of the cable, strip some casing to expose the individual wires.

2. Trim the signal wires to 2-inch lengths. Strip about 3/16 inch (5 mm) of insulation away to expose the end of the wire.

ATTENTION

Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up.

3. At one end of the cable, twist the drain wire and foil shield together.

   Under normal conditions, this drain wire and shield junction must be connected to earth ground, via a panel or DIN rail mounting screw at the analog I/O module end. Keep the length of the drain wire as short as possible.

   In environments where high frequency noise may be present, the cable shields should be grounded via a 0.1 μF capacitor at the end using the data. In other words, for analog inputs, the cable shield should be grounded via the 0.1 μF capacitor at the analog module end. For analog outputs, the cable shield should be grounded via a 0.1 μF capacitor at the load end.

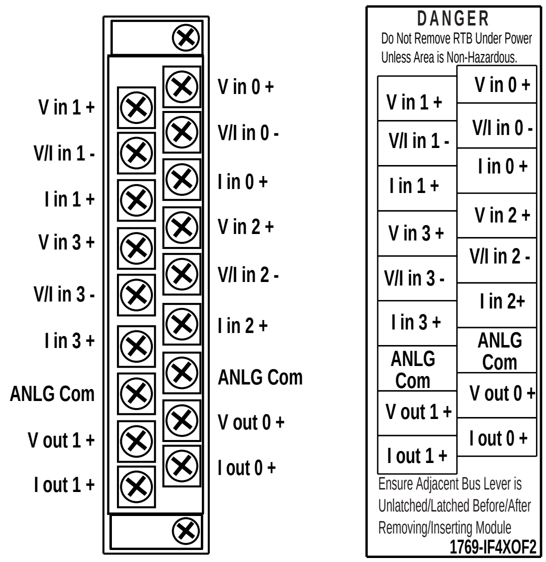
4. At the other end of the cable, cut the drain wire and foil shield back to the cable.

5. Connect the signal wires to the terminal block as shown in Analog Input Wiring on page 3-16 and Analog Output Wiring on page 3-21. Connect the other end of the cable to the analog input or output device.

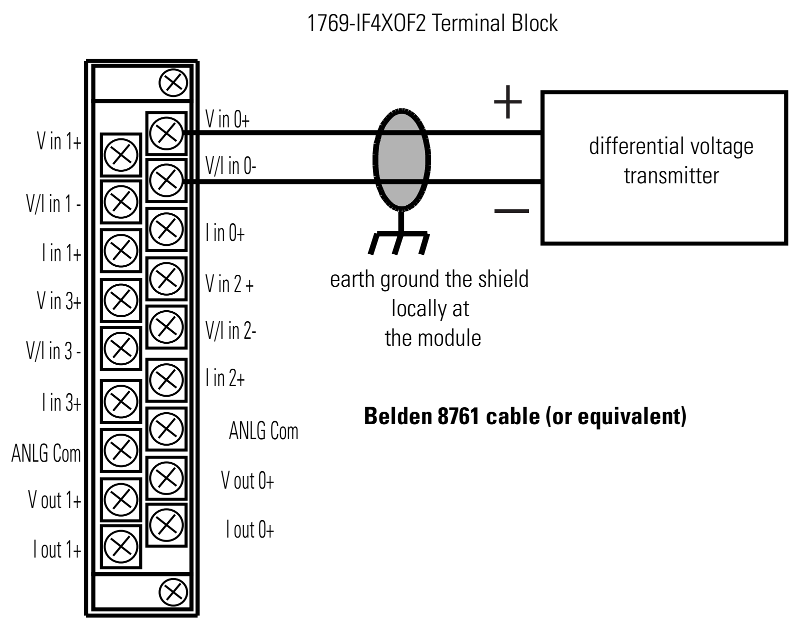
6. Repeat steps 1 through 5 for each channel on the module.

Terminal Door Label

A removable, write-on label is provided with the module. Remove the label from the door, mark the identification of each terminal with permanent ink, and slide the label back into the door. Your markings (ID tag) will be visible when the module door is closed.

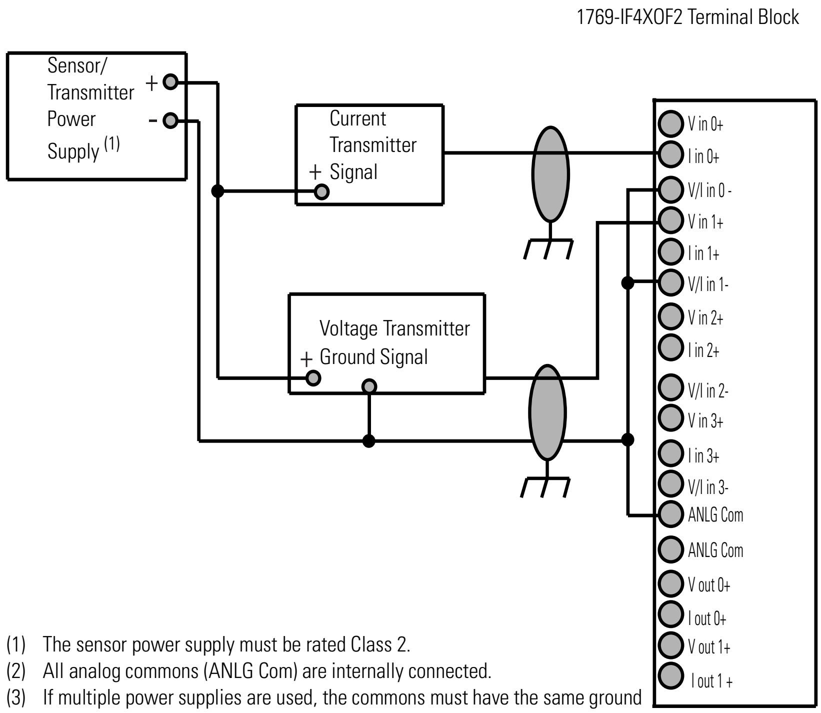


Wiring Diagram Showing Differential Inputs



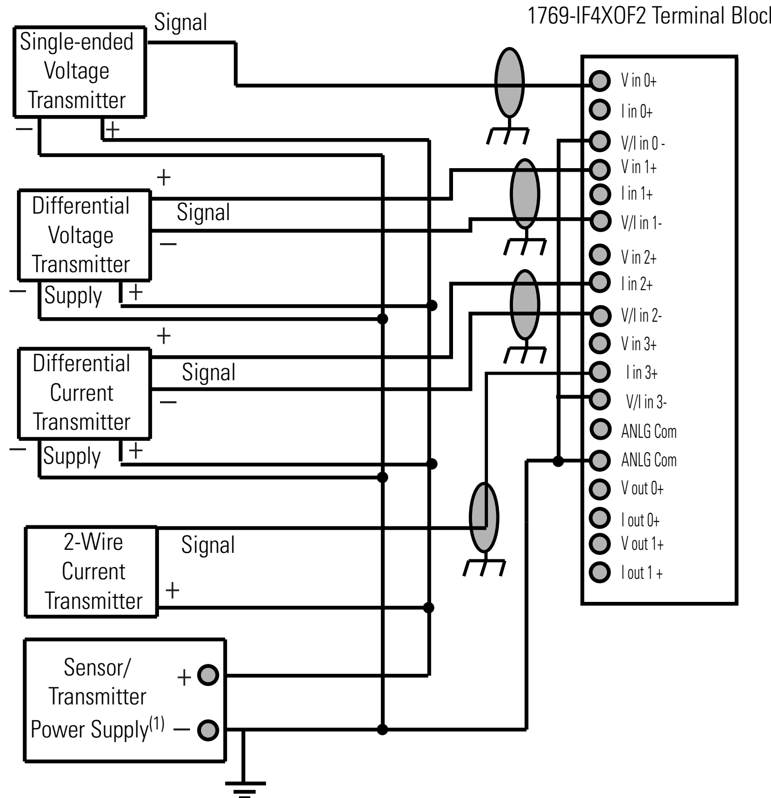
(1) All analog commons (ANLG Com) are internally connected.
(2) If multiple power supplies are used, the commons must have the same ground reference.
(3) User Belden 8761 cable (or equivalent) for wiring analog I/O.

Wiring Single-ended Sensor/Transmitter Input Types



(1) The sensor power supply must be rated Class 2.
(2) All analog commons (ANLG Com) are internally connected.
(3) If multiple power supplies are used, the commons must have the same ground reference.
(4) User Belden 8761 cable (or equivalent) for wiring analog I/O.

Wiring Mixed Transmitter Input Types



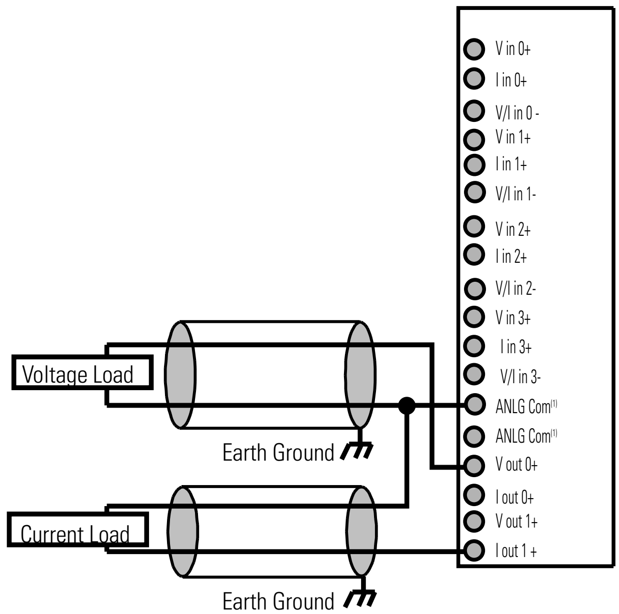
(1) The sensor power supply must be rated Class 2.
(2) All analog commons (ANLG Com) are internally connected.
(3) If multiple power supplies are used, the commons must have the same ground reference.

(4) User Belden 8761 cable (or equivalent) for wiring analog I/O.

Analog Output Wiring

ATTENTION

To prevent shock hazard, care should be taken when wiring the module to analog signal sources. Before wiring any analog module, disconnect power from the system power supply and from any other source to the analog module.



(1) All analog common terminals (ANLG Com) are internally connected in the module.

1769-IF4XOF2 Module Data, Status, and Configuration Channels

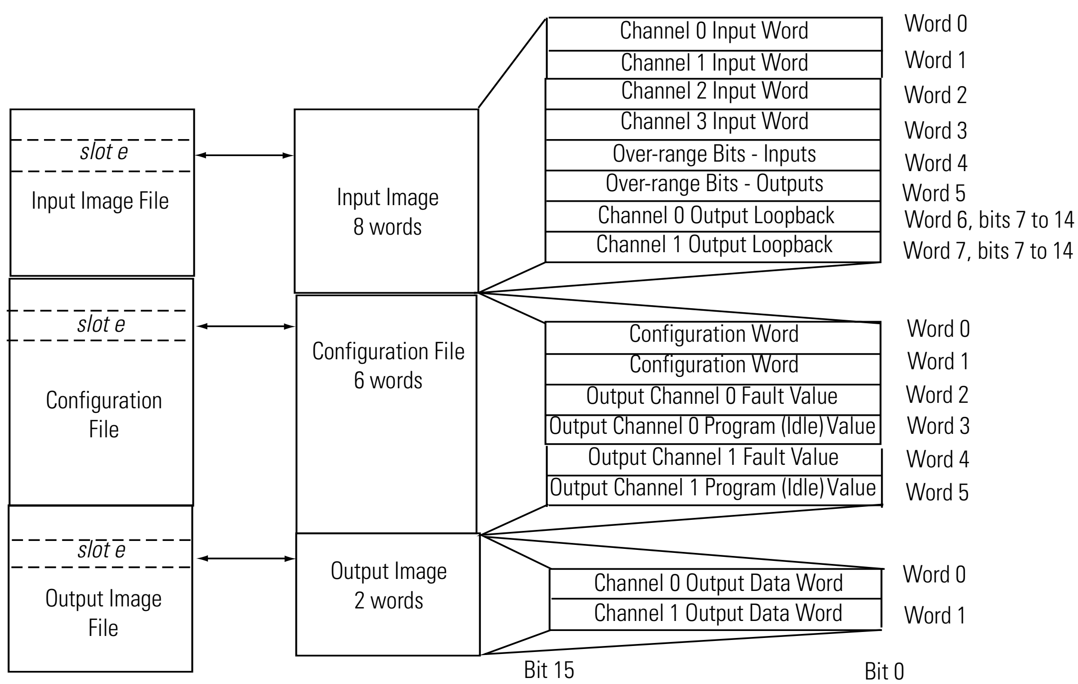
This chapter examines the 1769-IF4XOF2 module's data table, channel status, and channel configuration word:

- Module Addressing on page 4-1
- Input Data File on page 4-3
- Output Data File on page 4-7
- Configuration Data File on page 4-8

Module Addressing

The following memory map shows the input, output, and configuration image tables. Detailed information on the input image table can be found in Input Image on page 4-3.

Memory Map



Input/Output/Configuration Data Registers

Data registers are available for input, output, and configuration. There are eight input data registers, six configuration registers, and two output data registers. The module and programming software applies the following default values to the registers:

Table 4.1 Data Registers

Register	Function	Default at Power-Up	Programming Software Default Down Load
C:0	Configuration Word 1	0000h	0000h
C:1	Configuration Word 2	0000h	0000h
C:2	Configuration - Channel 0 Fault Value	0000h	0000h
C:3	Configuration - Channel 0 Program Value	0000h	0000h
C:4	Configuration - Channel 1 Fault Value	0000h	0000h
C:5	Configuration - Channel 1 Program Value	0000h	0000h
I:0	Channel 0 Input Word	0000h	
I:1	Channel 1 Input Word	0000h	
I:2	Channel 2 Input Word	0000h	
I:3	Channel 3 Input Word	0000h	
I:4	Input Channel Over-range	0000h	
I:5	Output Channel Over-range	0000h	
I:6	Channel 0 Output Data Echo	0000h	
I:7	Channel 1 Output Data Echo	0000h	
O:0	Channel 0 Output Word	0000h	0000h
O:1	Channel 1 Output Word	0000h	0000h

Input Data File

The input data file provides access to analog input data for use in the control program. Input data resolution is 8 bits with the least significant 7 bits (0 to 6) permanently set to zero (0) by the module. In addition, over-range indication for the input and output channels, and output data feedback is provided as described below.

Table 4.2 Input Data File

Word	Bit Position															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	SGN	Analog Input Data Value Channel 0								0	0	0	0	0	0	0
1	SGN	Analog Input Data Value Channel 1								0	0	0	0	0	0	0
2	SGN	Analog Input Data Value Channel 2								0	0	0	0	0	0	0
3	SGN	Analog Input Data Value Channel 3								0	0	0	0	0	0	0
4	Not Used(1)												I3	I2	I1	I0
5	Not Used(1)	H0	Not Used(1)	H1	Not Used(1)								E1	E0	O1	O0
6	SGN	Output Data Echo/Loopback for Output Channel 0								0	0	0	0	0	0	0
7	SGN	Output Data Echo/Loopback for Output Channel 1								0	0	0	0	0	0	0

(1) All unused bits are set to 0 by the module.

Input Image

The input image file represents input channel data words I/O, and I/O channel status bits. Input words 0 through 3 contain the converted analog input data from the field device. Word 4, bit 1,2 and 3 are the over-range flag bits for input channels 0 to 3. Word 5, bit 0 and 1 are the over-range flag bits for output channels 0 and 1. Words 6 and 7, bits 7 through 14 are the data echo. These words provide output channel loopback/data echo from output channels 0 and 1 through the input array. See Input Data File on page 4-3 for more information.

TIP

You can access information in the input image file using the programming software configuration screen.

Input Data Words 0 through 3

All bits shown as 0 (bits 0 through 6) are always set to 0. Bits 7 through 14 contain the 8 input data bits. The table below illustrates the format of the input data, words 0 to 3.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SGN	A7	A6	A5	A4	A3	A2	A1	A0	0	0	0	0	0	0	0

Input Data Words 4 through 7

These words contain diagnostic and control information. For details see Bit Definitions for Input Data below.

Bit Definitions for Input Data

Sign Bit (SGN)

The sign bit is always positive (equal to zero).

Over Input Range Flag Bits (I0 to I3)

Word 4, bits 0 to 3 (i0 to I3) contain over-range flag bits for input channels 0 through 3 respectively. These bits can be used in the control program for error detection. When set to 1, the bits signal that the input signal is outside the normal operating range. However, the module continues to convert analog data to the maximum full-range value. When the over-range condition is cleared, the bits automatically reset to (0).

Over Output Range Flag Bits (O0 and O1)

Word 5, bits 0 and 1 (O0 and O1) provide over-range indication for output channels 0 and 1. These bits can be used in the control program for error detection. When set to 1, the bits signal that the output signal is outside the normal operating range. However, the module continues to convert analog data to the maximum full-range value. When the over-range condition is cleared, the bits automatically reset to 0.

TIP

Under-range indication is not provided for the 1769-IF4OXF2 because zero is a valid number.

Refer to Table 4.9 Valid Input Data on page 4-14 to view the normal operating and over-range areas.

Invalid Data Set (Ex)

Word 5, bits 2 and 3 provide invalid output data indication for output channels 0 and 1, respectively. When either invalid output data bit is set to 1, it indicates that invalid output data has been sent by the controller to that channel of the module. When this occurs, the module sets the appropriate (Ex) flag and continues to operate with the previously accepted data.

NOTE: Invalid data is a value outside the standard range or increment. For example, 128, 256, etc. or by writing to bits 0 though 6 and bit 15.

Hold Last State (Hx)

Word 5, bits 12 and 14, indicates that the channel is in a hold last state condition when set to 1.

IMPORTANT	Not all controllers support Hold Last State functionality. Refer to your controller's user manual.

Analog Output Loopback/Data Echo

Input words 6 and 7, bits 7-14, reflect the analog output data echo of the analog value being converted by the digital/analog converter, not necessarily the electrical state of the output terminals. They do not reflect shorted or open outputs.

IMPORTANT	Input words 6 and 7 contain the Output Data Echo/Loopback information for output channels 0 and 1 respectively. Bits 0 through 6 and Bit 15 of words 6 and 7 should always be set to zero in your control program, or the module will set the Invalid Data Set (Ex) flag.

IMPORTANT	It is only important to use the loopback function of input words 6 and 7 if the controller supports the Program Mode or Fault Mode functions, and if it is configured to use them.

Input Data Resolution and Format

The following table identifies the current and voltage input ranges for the 1769-IF4XOF2 module, and the number of significant bits provided by the module with its single (non-programmable) filter. The number of significant bits indicated in the table has little or no jitter due to noise. The module's RAW/Proportional data format presents the value to the controller via a left justified 16-bit field, with the most significant bit for the sign bit (which is always zero).

Table 4.3 Input Data Resolution and Format

Full Input Range	RAW/Proportional Data			
	Significant Bits	**Resolution per LSB**	**Decimal Representation of Input**	**Count Value**
0V to 10.5V dc	Sign + 8 bits	41.18mV	0 to 32640	128 (1LSB)
0 mA to 21 mA	Sign + 8 bits	82.35mA	0 to 32640	128 (1LSB)

Input Scaling

Example 1: Find voltage by converting raw/proportional data values

To convert a raw/proportional data value to find the voltage being measured:

Voltage = (Input Data Value X volts/significant bit) / (counts/significant bit)

If input data value is 32,640

Voltage = (32640 X 0.04118V) / 128

= 10.50 Volts

Example 2: Find current by converting raw/proportional data values

To convert a raw/proportional data value to find the current being measured:

Current = (Input Data Value X amps/significant bit) / (counts/significant bit)

If the input data value is 31,104

Current = (31,104 X 0.08235A) /128

= 20 mA

Output Data File

The output file contains the module's analog output data information. Word 0 and 1, bits 7 through 14 contain the output data bits for channels 0 and 1.

The output data file applies only to output data from the module as shown in the table below.

Table 4.4 Output Data File

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	SGN	Analog Output Data Channel 0								0	0	0	0	0	0	0
1	SGN	Analog Output Data Channel 1								0	0	0	0	0	0	0

Output Data Words 0 and 1

The SGN bit of Words 0 and 1 is always zero (0). The following table illustrates the format of the output data.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SGN	A7	A6	A5	A4	A3	A2	A1	A0	0	0	0	0	0	0	0

IMPORTANT Bits 0 through 6 and Bit 15 of output data words 0 and 1 should always be set to zero in your control program. If they are not set to 0, the invalid data flag (Ex) will be set for that channel. However the channel will continue to operate with the previously converted value. If a MVM (Move with Mask) instruction is used with a mask of 7F80 (hexidecimal) to move data to the output words, writing to bits 0 through 6 and bit 15 can be avoided.

Output Data Resolution and Format

The resolution of an analog output channel depends on the output type/range and data format selected. The following table provides detailed resolution information for the module.

Table 4.5 Output Resolution

Full Output Range	RAW/Proportional Data			
	Significant Bits	Resolution per LSB	Decimal Representation of Output	Count Value
0V to 10.5 V dc	Sign + 8 bits	41.18mV	0 to 32640	128 (1LSB)
0 mA to 21 mA	Sign + 8 bits	82.35mA	0 to 32640	128 (1LSB)

Configuration Data File

The configuration file allows you to enable or disable an input or output channel. It also allows you to configure the operation of the outputs during a mode change to Program or a Fault condition. Word 0 bits 4, 5, 6 and 7 allow the individual input channels to be enabled or disabled. Word 1 bits 4 and 5 allow the individual output channels to be enabled or disabled.

TIP

Not all controllers support program access to the configuration file. Refer to your controller’s user manual.

The manipulation of the bits from this file is normally done with programming software (e.g. RSLogix 500, RSLogix 5000, RSNetworx for DeviceNet, etc.) during initial configuration of the system. In that case, graphical screens are typically provided by the programmer to simplify configuration. However, some systems, like the 1769-ADN DeviceNet Adapter, also allow the bits to be altered as part of the control program, using communication rungs. In that case, it may be beneficial to understand the bit arrangement.

Table 4.6 Configuration Data File

Word	Bit Position															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Not Used[1]								EI3	EI2	EI1	EI0	FM0[2]	PM0[2]	Not Used[1]	PFE0[2]
1	Not Used[1]										EO1	EO0	FM1[2]	PM1[2]	Not Used[1]	PFE1[2]
2	SGN	Channel 0 Fault Value[2]								0	0	0	0	0	0	0
3	SGN	Channel 0 Program (Idle) Value[2]								0	0	0	0	0	0	0
4	SGN	Channel 1 Fault Value[2]								0	0	0	0	0	0	0
5	SGN	Channel 1 Program (Idle) Value[2]								0	0	0	0	0	0	0

(1) Any attempt to write a non-valid (1's) bit configurations into any not used selection field results in a module configuration er ror.

(2) Not all controllers support these functions. Refer to your controller's user manual for details.

Bit Definitions for Configuration Data

Sign Bit (SGN)

The sign bit is always positive (Bit 15 = zero).

Enable/Disable Input Channel (EIx)

Word 0 bits 4 to 7 (EI0 to EI3) are defined as the input channel enable/disable bits. These bits allow individual input channels 0 through 3 to be enabled (on) or disabled (off). When a channel is not enabled, the module provides no current or voltage input to the host controller.

Enable/Disable Output Channel (EOx)

Word 1 bits 4 and 5 (EO0 and EO1) are defined as the output channel enable/disable bits. EOx bits allow individual output channels 0 and 1 to be enabled or disabled. When a channel is not enabled, the module does not produce current or voltage.

TIP To improve performance and speed, disable unused channels.

Program/Idle Mode Selection Channel 0 and 1 (PM0 and PM1)

These bits provide Program (Idle) Mode selection for analog output channels 0 (Word 0 Bit 2) and 1 (Word 1 Bit 2).

- *Hold Last State (0)* – When reset (to 0), this bit directs the module to hold the analog output at the last converted value when the module transitions from Run to Program Mode. This is the default channel condition.

IMPORTANT Hold last state is the default condition for the module during a control system run-to-program mode change.

TIP MicroLogix 1500™ does not support the analog output module's default hold last state function and resets analog outputs to zero when the system enters the program mode.

- *User-Defined Safe State (1)* – When this bit is set (to 1) and the module transitions to Program mode, the module converts the user-specified integer value from the Channel x Program Value Word (3 or 5) to the appropriate analog output.

Fault Mode Selection Channel 0 and 1 (FM0 and FM1)

FM0 and FM1 bits provide Fault Mode selection for analog output channels 0 (Word 0 Bit 3) and 1 (Word 1 Bit 3). When this selection is disabled [the bit is reset (0)] and the system transitions from Run to Fault mode, the module *holds* the *last* output *state* value. This means that the analog output remains at the last converted value prior to the condition that caused the system to enter the fault mode.

IMPORTANT Hold last state is the default condition for the module during a control system run-to-fault mode change.

TIP MicroLogix 1500 does not support the analog output module's default hold last state function and resets analog outputs to zero when the system enters the fault mode.

- *Hold Last State (0)* – When reset, this bit directs the module to hold the analog output at the last converted value when the module transitions to Fault Mode. This is the default condition.
- *User-Defined Safe State (1)* – When this bit is set and the module transitions to Fault mode, the module converts the user-specified integer value from the Channel x Fault Value Word (2 or 4) to the appropriate analog output for the configured range as wired. If the default value, 0000, is entered, the output converts to the minimum value for the range selected.

TIP Not all controllers support this function. Refer to your controller's user manual for details.

Program to Fault Enable Selection (PFE0 and PFE1)

The Program to Fault Enable bit determines which data value, Program (PFEx = 0) or Fault (PFEx = 1), is applied to the output if the module undergoes a fault condition while in the Program Mode, resulting in a change to Fault Mode. Word 0 Bit 0 applies to channel 0, while Word 1 Bit 0 applies to channel 1.

- *Program Value (Channel 0 and 1)* – Words 3 and 5 allow you to enter the integer values that output Channel 0 (Word 3) and output Channel 1 (Word 5) should assume when the system transitions to the Program mode. The value must be in increments of 128 (0, 128, 256, etc.) for proper operation. If the value entered is outside the acceptable increment or range, the module generates a configuration error for that channel. The module default value is zero.

- *Fault Value (Channel 0 and 1)* – Words 2 and 4 allow you to enter the integer values that output Channel 0 (Word 2) and output Channel 1 (Word 4) should assume when the system transitions to the Fault mode. The value must be in increments of 128 (0, 128, 256, etc.) for proper operation. If the value entered is outside the acceptable increment or range, the module generates a configuration error for that channel. The module default value is zero.

IMPORTANT PMx, FMx, PFEx, Channel x Program (Idle) Value, and Channel x Fault Value functions are not supported by all controllers. Refer to your controller's user manual for details.

Input Filter Selection

The 1769-IF4XOF2 has a fixed input filter. No configuration is required.

Channel Step Response

The module's fixed filter frequency determines the channel's step response. The step response is the time required for the analog input signal to reach 63% or 90% of its expected final value. This means that if an input signal changes faster than the channel step response, a portion of that signal will be attenuated by the channel filter.

Table 4.7 Filter Frequency and Step Response

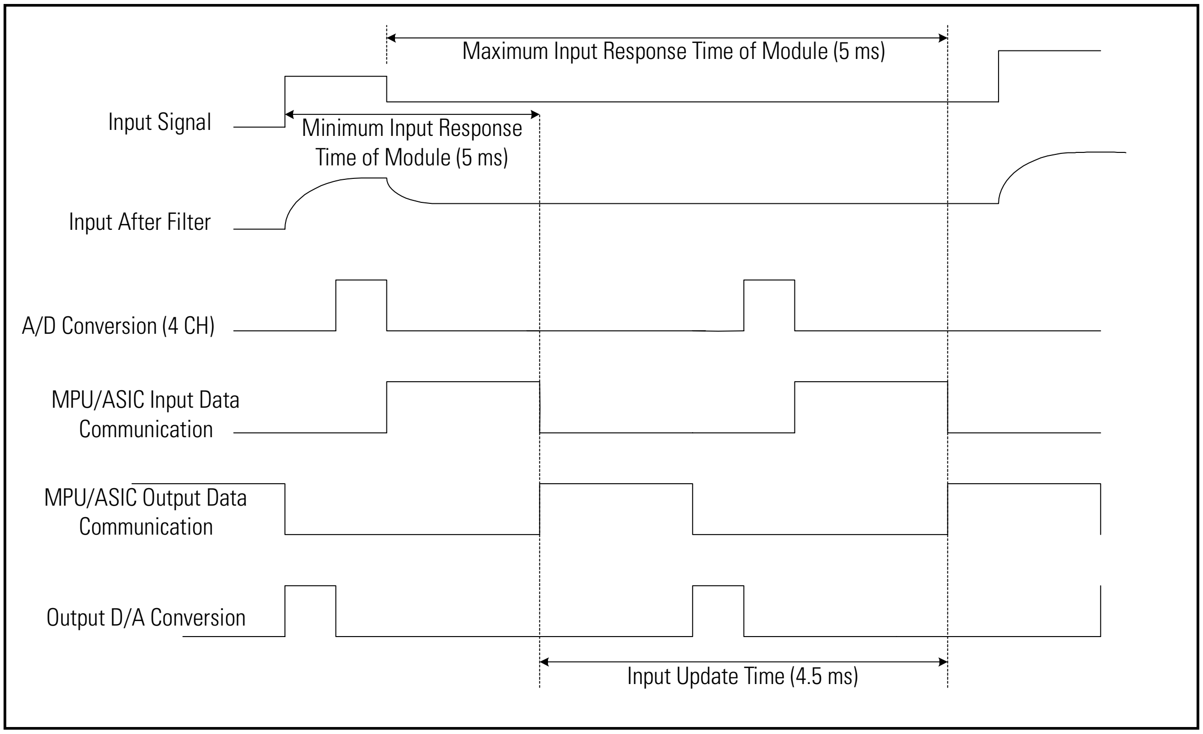
Fixed Filter Frequency	Filter Cut-Off Frequency	Step Response % Complete	Step Response Time
2.7 kHz	2.7 kHz	63%	59 us
2.7 kHz	2.7 kHz	90%	136 us (Nominal)

Channel Cut-Off Frequency

The -3 dB frequency is the filter cut-off frequency. The cut-off frequency is defined as the point on the input channel frequency response curve where the frequency components of the input signal are passed with 3 dB of attenuation. All input frequency components at or below the cut-off frequency are passed by the digital filter with less than 3 dB of attenuation. All frequency components above the cut-off frequency are increasingly attenuated.

Module Input Update Time and Scanning Process

The module input update time is defined as the time required for the module to sample and convert the input signals of all 4 enabled input channels and provide the resulting data values to the processor.



Module update time can be calculated by adding the sum of all enabled channel times. Channel times include channel scan time, channel switching time, and reconfiguration time. The module sequentially samples the channels in a continuous loop. The table below shows module update times, based on the number of input channels enabled.

Table 4.8 Module Update Time

Number of Enabled Input Channels	Typical Update Time(1)
0	1.3 ms
1	2.1 ms
2	2.9 ms
3	3.7 ms
4	4.5 ms

(1) Each enabled output channel adds 0.02 ms to the typical module update time.

Analog Range Selection

The analog input range selection is accomplished by proper wiring of the input channels.

Valid Input Data Word Formats/Ranges

The analog input data received at the module is converted to RAW/proportional data format. Unlike the 1769-IF4 and 1769OF2. on-board scaling is not provided by the module. You must do this via your control program.

The following table shows the valid input data format for the data range provided by the module.

Table 4.9 Valid Input Data

Input Range	Input Value	Example Data	Input Range Condition	Raw/Proportional Data Decimal Range
0 to +10V dc	Over 10.5V dc	+11.0V dc	Over-range(1)	32640
	+10.5V dc	+ 10.5V dc	Over-range(1)	32640
	0.0V dc to +10.0V dc	+10.0V dc	Normal	31104
		5.0V dc	Normal	15488
		0.0V dc	Normal	0
0 to 20 mA	Over 21.0 mA	+22.0 mA	Over-range(1)	32640
	21.0 mA	+21.0 mA	Over-range(1)	32640
	0.0 mA to 20.0 mA	+20.0 mA	Normal	31104
		+10.0 mA	Normal	15488
		0.0 mA	Normal	0

(1) The module's maximum range is 10.5V or 21 mA. An over-range flag is set at either value. This flag automatically resets when the input data is below the over-range value.

Valid Output Data Word Formats/Ranges

The analog output data received at the module is converted to RAW/proportional data format. Unlike the 1769-IF4 and 1769OF2. on-board scaling is not provided by the module. You must do this via your control program.

The following table shows the valid output data format for the data range provided by the module.

Table 4.10 Valid Output Data

Output Range	Output Value	Example Data	Output Range Condition	Raw/Proportional Data Decimal Range
0 to 10V dc	Over +10.5V dc	N/A	N/A(1)	N/A
	+10.5V dc	+ 10.5V dc	Over-range(1)	32640
	0.0V dc to +10.0V dc	+10.0V dc	Normal	31104
		+5.0V dc	Normal	15488
		0.0V dc	Normal	0
0 to 20mA	Over 21.0 mA	N/A	N/A(1)	N/A
	21.0 mA	21.0 mA	Over-range(1)	32640
	0.0 mA to 20.0 mA	20.0 mA	Normal	31104
		10.0 mA	Normal	15488
		0.0 mA	Normal	0

(1) The module's maximum range is 10.5V or 21 mA. An over-range flag is set at either value. This flag automatically resets when the output data is below the over-range value.

Module Diagnostics and Troubleshooting

This chapter describes troubleshooting the analog input and output channels. This chapter contains information on:

- Safety Considerations When Troubleshooting on page 5-1
- Module Operation vs. Channel Operation on page 5-2
- Module Diagnostic Features on page 5-3
- Critical vs. Non-Critical Errors on page 5-4
- Module Condition Errors on page 5-6

Safety Considerations When Troubleshooting

Safety considerations are an important element of proper troubleshooting procedures. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance.

The following sections describe several safety concerns you should be aware of when troubleshooting your control system.

ATTENTION

Never reach into a machine to actuate a switch because unexpected motion can occur and cause injury.

Remove all electrical power at the main power disconnect switches before checking electrical connections or inputs/outputs causing machine motion.

Indicator Lights

When the green LED on the analog module is illuminated, it indicates that power is applied to the module.

Activating Devices When Troubleshooting

When troubleshooting, never reach into the machine to actuate a device. Unexpected machine motion could occur.

Stand Clear of the Machine

When troubleshooting any system problem, have all personnel remain clear of the machine. The problem could be intermittent, and sudden unexpected machine motion could occur. Have someone ready to operate an emergency stop switch in case it becomes necessary to shut off power to the machine.

Program Alteration

There are several possible causes of alteration to the user program, including extreme environmental conditions, Electromagnetic Interference (EMI), improper grounding, improper wiring connections, and unauthorized tampering. If you suspect a program has been altered, check it against a previously saved program on an EEPROM or UVPROM memory module.

Safety Circuits

Circuits installed on the machine for safety reasons, like over-travel limit switches, stop push buttons, and interlocks, should always be hard-wired to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Module Operation vs. Channel Operation

The module performs operations at two levels:

- module level
- channel level

Module-level operations include functions such as power-up, configuration, and communication with a bus master, such as a MicroLogix 1500 or Compact Logix controller.

Channel-level operations describe channel related functions, such as data conversion and over-range detection.

Internal diagnostics are performed at both levels of operation. When detected, module error conditions are immediately indicated by the module status LED. Both module hardware and channel configuration error conditions are reported to the controller. Channel over-range conditions are reported in the module's input data table. Module hardware errors are typically reported in the controller's I/O status file. Refer to your controller manual for details.

Power-up Diagnostics

At module power-up, a series of internal diagnostic tests are performed. These diagnostic tests must be successfully completed or the module status LED remains off and a module error results and is reported to the controller.

If module status LED is:	Indicated condition:	Corrective action:
On	Proper Operation	No action required.
Off	Module Fault	Cycle power. If condition persists, replace the module.

Channel Diagnostics

When an input or output channel is enabled, the module performs a diagnostic check to see that the channel has been properly configured. In addition, the module checks each channel on every scan for configuration errors and over-range conditions.

Out-of-Range Detection

For input channels, whenever the data received at the channel word is out of the defined operating range, an over-range error is indicated in input data word 4, bits 0 to 3 for input channels 0 through 3, respectively.

For output channels, whenever the controller is driving data over the defined operating range, an over-range error is indicated in the input data word 5, bits 0 and 1 for output channels 0 and 1, respectively.

Critical vs. Non-Critical Errors

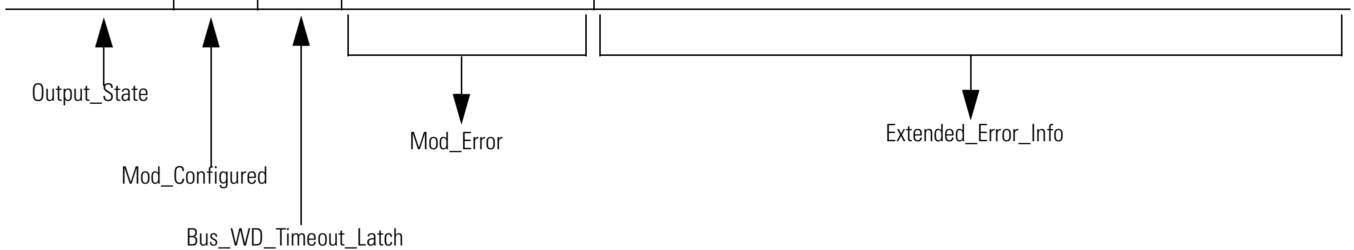
Critical errors signal conditions that prevent normal or recoverable operation of the system. When these types of errors occur, the system leaves the run or program mode of operation until the error is remedied. See Table 5.2 Extended Error Codes on page 5-5 for more information on critical module errors.

Non-critical errors are recoverable and can be dealt with by running the Fault routine. For example, a channel over-range condition is a non-critical error. See Table 5.2 Extended Error Codes on page 5-5 for more information.

I/O Module Errors

The analog I/O modules notify the host of critical and non-critical module errors. Word 0 contains the error codes generated by the module. The module errors are expressed as two fields: Mod_Error (bits 9, 10, and 11) and Extended_Error_Info (bits 0 to 8). The following table shows the error fields:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1



r = read only

Mod_Error Field

The Mod_Error field classifies module errors into three groups:

- No Errors (Mod_Error = 0): The module has no errors. There is no need to check the Extended_Error_Info field.
- Hardware Errors (Mod_Error = 1): Check the Extended_Error_Info field for general and specific error codes.
- Configuration Errors (Mod_Error = 2): Check the Extended_Error_Info field for module-specific error codes.

Extended_Error_Info Field

Check the Extended_Error_Info field when a non-zero value is in the Mod_Error field. The following are some Extended_Error_Info error codes:

Table 5.1 Extended Error Information Field

Error Type	Mod_Error (11:9)	Extended_Error_Info (8:0)
No Error	0	always 000
Hardware Error	1	000 = no additional information 001 = Power-up Reset 002 to 0FF = general common errors 100 to 1FF = module specific errors
Configuration Error	2	000 = no additional information 001 to 1FF = module specific errors

Extended Error Codes

When invalid values are entered in the configuration file, the module ignores the invalid configuration, generates a non-critical error, and keeps operating with the previous configuration. The following table explains the extended error codes for the 1769-IF4XOF2 analog combination module:

Table 5.2 Extended Error Codes

Error Type	Hex Equivalent[1]	Module Error Code Bits (11:9)	Extended Error Information Code Bits 8:0	Error Description
		Binary	Binary	
No Error	X000	000	0 0000 0000	No Error
General Common Hardware Error	X200	001	0 0000 0000	General Hardware Error; no additional information
	X201	001	0 0000 0001	Power-up reset state
Hardware-Specific Error	X300	001	1 0000 0000	General hardware error (ASIC)
	X301	001	1 0000 0001	Microprocessor hardware error
1769-IF4XOF2 Specific Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	invalid Fault Value Entered for (channel 0)
	X402	010	0 0000 0010	invalid Fault Value Entered for (channel 1)
	X403	010	0 0000 0011	invalid Program Value Entered for (channel 0)
	X404	010	0 0000 0100	invalid Program Value Entered for (channel 1)

(1) X represents the "Don't Care" digit.

Module Condition Errors

Common Hardware Errors

There are several general common hardware errors. The following table lists these errors.

Table 5.3 Common Hardware Errors

Mod_Error (11:9)	Extended_Error _Info (8:0)	Error Description
0	000	No Errors
1	000	General hardware error; no additional information
1	001	Power-up reset state

Hardware Specific Errors

If the module detects that any of the analog to digital converters are not functioning properly, one of the following hardware errors is set:

Table 5.4 Specific Hardware Errors

Mod_Error (11:9)	Extended_Error _Info (8:0)	Error Description
1	100	General H/W error (ASIC)
1	101	Microprocessor H/W error
1	102	SPARE (not part of 1769-IF4XOF2 design)
1	103	SPARE (not part of 1769-IF4XOF2 design)

Module Inhibit Function

Some controllers support the module inhibit function. See your controller manual for details.

Whenever the combination module is inhibited, it enters the program mode and the output channels are changed to the state configured for the program mode. The input channels of the module continue to provide information about changes at its inputs to the 1769 Compact Bus Master (for example, a CompactLogix controller).

Contacting Rockwell Automation

If you need to contact Rockwell Automation for assistance, please have the following information available when you call:

- a clear statement of the problem, including a description of what the system is actually doing. Note the LED state; also note input and output image words for the module.
- a list of remedies you have already tried
- processor type and firmware number (See the label on the processor.)
- hardware types in the system, including all I/O modules
- fault code if the processor is faulted

Specifications

General Specifications

Specification	1769-IF4XOF2
Dimensions	118 mm (height) x 87 mm (depth) x 35 mm (width) height including mounting tabs is 138 mm 4.65 in. (height) x 3.43 in (depth) x 1.38 in (width) height including mounting tabs is 5.43 in.
Approximate Shipping Weight (with carton)	290g (0.64 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +60°C (32°F to +140°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. peak-to-peak Relay Operation: 2G[1]
Shock	Operating: 30G, 11 ms panel mounted (20G, 11 ms DIN rail mounted) Relay Operation: 7.5G panel (5G DIN rail mounted) Non-Operating: 40G panel mounted (30G DIN rail mounted)
Bus Current Draw (max.)	120 mA at 5V dc 160 mA at 24V dc
Heat Dissipation	3.03 Total Watts (The Watts per point, plus the minimum Watts, with all points energized.)
System Power Supply Distance Rating	8 (The module may not be more than 8 modules away from a system power supply.)
Recommended I/O Cable	Belden™ 8761 (shielded)
Maximum I/O Cable Length	200m (656 feet) Exceeding cable length reduces accuracy. For more information, see “Effect of Transducer/Sensor Cable Length Impedance on Voltage Input Accuracy” on page 3-11 and “Effect of Device and Cable Output Impedance on Output Module Accuracy” on page 3-13.
Module OK LED	On: module has power, has passed internal diagnostics, and is communicating over the bus. Off: Any of the above is not true.
Agency Certification	C-UL certified (under CSA C22.2 No. 142) UL 508 listed CE and C-Tick compliant for all applicable directives
Vendor I.D. Code	1
Product Type Code	10
Product Code	33

Specification	1769-IF4XOF2
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)
Radiated and Conducted Emissions	EN50081-2 Class A
Electrical /EMC:	*The module has passed testing at the following levels:*
ESD Immunity (IEC61000-4-2)	• 4 kV contact, 8 kV air, 4 kV indirect
Radiated Immunity (IEC61000-4-3)	• 10 V/m , 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
Fast Transient Burst (IEC61000-4-4)	• 2 kV, 5kHz
Surge Immunity (IEC61000-4-5)	• 1kV galvanic gun
Conducted Immunity (IEC61000-4-6)	• 10V, 0.15 to 80MHz(2)

(1) When a relay module, such as the 1769-OW8, is used.

(2) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Input Specifications

Specification	1769-IF4XOF2
Number of Inputs	4 differential or single-ended
Analog Normal Operating Ranges	Voltage: 0 to 10V dc Current: 0 to 20 mA
Full Scale(1) Analog Ranges	Voltage: 0 to 10.5V dc Current: 0 to 21 mA
Converter Type	Successive Approximation
Resolution (max.)	8 bits plus sign (Sign is always positive)
Response Speed per Channel	5 ms
Rated Working Voltage(2)	30V ac/30V dc
Common Mode Voltage(3)	10V dc maximum per channel
Common Mode Rejection	greater than 60 dB at 60 Hz at 1V between inputs and analog common
Normal Mode Rejection	none
Input Impedance	Voltage Terminal: 150K Ω (nominal) Current Terminal: 150 Ω (nominal)
Overall Accuracy(4) at 25°C	Voltage Terminal: ±0.7% full scale Current Terminal: ±0.6% full scale
Overall Accuracy at 0 to 60°C	Voltage Terminal: ±0.9% full scale Current Terminal: ±0.8% full scale
Accuracy Drift with Temperature	Voltage Terminal: ±0.006% per °C Current Terminal: ±0.006% per °C

Specification	**1769-IF4XOF2**
Calibration	Not required. Accuracy is guaranteed by components.
Non-linearity (in percent full scale)	±0.4%
Repeatability(5)	±0.4%
Input Channel Configuration	via wiring of devices, configuration software screen, or the user program (by writing a unique bit pattern into the module's configuration file). Refer to your controller's user manual to determine if user program configuration is supported.
Channel Diagnostics	Over range by bit reporting
Maximum Overload at Input Terminals(6)	Voltage Terminal: 20V continuous, 0.1 mA Current Terminal: 32 mA continuous, 5V dc
Input Group to Bus Isolation	500V ac or 710V dc for 1 minute (qualification test) 30V ac/30V dc working voltage (IEC Class 2 reinforced insulation)

(1) The over-range flag will come on when the normal operating range is exceeded. The module will continue to convert the analog input up to the maximum full scale range. The flag automatically resets when within the normal operating range.
(2) Rated working voltage is the maximum continuous voltage that can be applied at the input terminal, including the input signal and the value that floats above ground potential (for example, 10V dc input sig nal and 20V dc potential above ground).
(3) For proper operation, both the plus and minus input terminals must be within 0 to +10V dc of analog common.
(4) Includes offset, gain, non-linearity and repeatability error terms.
(5) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.
(6) Damage to the input circuit may occur if this value is exceeded.

Output Specifications

Specification	**1769-IF4XOF2**
Number of Outputs	2 single-ended
Analog Normal Operating Ranges(1)	Voltage: 0 to 10V dc Current: 0 to 20 mA
Full Scale Analog Ranges	Voltage: 0 to 10.5V dc Current: 0 to 21 mA
Converter Type	Resistor String
Resolution (max.)	8 bits plus sign (Sign is always positive, Bit 15 = 0)
Response Speed per Channel	0.3 ms for rated resistance and rated inductors 3.0 ms for rated capacitance
Current Load on Voltage Output	10 mA max.
Resistive Load on Current Output	0 to 300 Ω (includes wire resistance)
Load Range on Voltage Output	>1 kΩ at 10V dc
Max. Inductive Load (Current Outputs)	0.1 mH

Specification	1769-IF4XOF2
Max. Capacitive Load (Voltage Outputs)	1 µF
Overall Accuracy(2) at 25°C	Voltage Terminal: ±0.5% full scale Current Terminal: ±0.5% full scale
Overall Accuracy at 0 to 60°C	Voltage Terminal: ±0.6% full scale Current Terminal: ±1.0% full scale
Accuracy Drift with Temperature	Voltage Terminal: ±0.01% full scale per °C Current Terminal: ±0.01% full scale per °C
Output Ripple;(3) range 0 - 50 kHz (referred to output range)	±0.05%
Non-linearity (in percent full scale)	±0.4%
Repeatability(4) (in percent full scale)	±0.05%
Output Impedance	10 Ω (nominal)
Open and Short-Circuit Protection	Yes
Maximum Short-Circuit	Current: 40 mA
Maximum Open Circuit	Voltage: 15V
Output Response at System Power Up and Power Down	+2.0V dc to -1.0V dc spike for less than 6 ms
Rated Working Voltage	30V ac/30V dc
Channel Diagnostics	Over range by bit reporting
Output Group to Backplane Isolation	500V ac or 710V dc for 1 minute (qualification test) 30V ac/30V dc working voltage (IEC Class 2 reinforced insulation)

(1) The over-range flag will come on when the normal operating range is exceeded. The module will continue to convert the analog output up to the maximum full scale range. The flag automatically resets when within the normal operating range.

(2) Includes offset, gain, drift, non-linearity and repeatability error terms.

(3) Output ripple is the amount a fixed output varies with time, assuming a constant load and temperature.

(4) Repeatability is the ability of the output module to reproduce output readings when the same controller value is applied to it consecutively, under the same conditions and in the same direction.

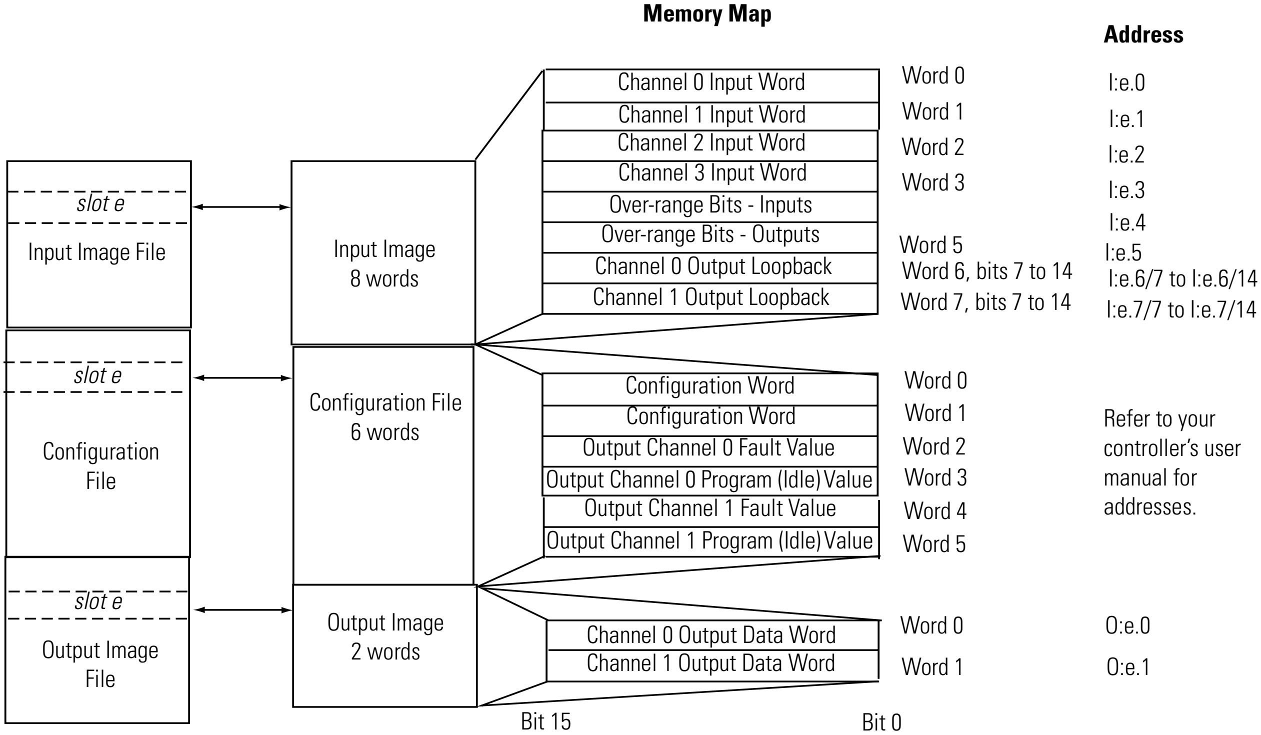
Module Addressing and Configuration with MicroLogix 1500

This chapter examines the analog module's addressing scheme and describes module configuration using RSLogix 500 and MicroLogix 1500.

Module Addressing

The following memory map shows the input, output, and configuration image tables for the 1769-IF4XOF2. Detailed information for these image tables can be found on page 4-3.

Memory Map

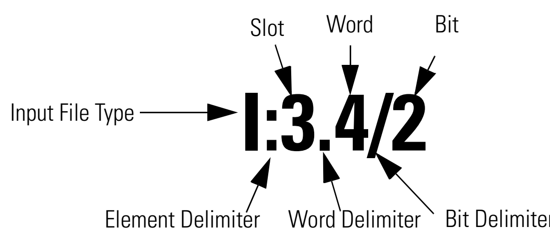


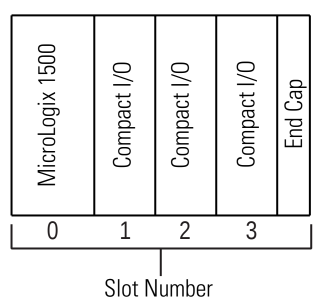
1769-IF4XOF2 Input Image

The input image file represents input channel data words I/O, channel status bits. Input words 0 through 3 contain the converted analog input data from the field device. Word 4, bits 0 to 3 are the over-range flag bits for input channels 0 to 3. Word 5, bit 0 and 1 are the over-range flag bits for channels 0 and 1. Words 6 and 7, bits 7 through 14 are the data echo. These words provide output loopback/data echo through the input array. The Input Data File is explained in more detail on page 4-3. To receive valid status information, the channel must be enabled.

TIP You can access information in the input image file using the programming software configuration screen.

For example, to obtain the over-range status of input channel 2 of the 1769-IF4XOF2 analog module located in slot 3, use address I:3.4/2.





TIP The end cap does not use a slot address.

1769-IF4XOF2 Configuration File

The configuration file allows you to enable or disable the modules input and/or output channels. It also allows you to select how the Program or Fault mode condition and what the output value will be if the User-defined Safe State is selected. The configuration file is explained in more detail in Configuration Data File on page 4-8.

The configuration file is modified using the programming software configuration screen. For an example of module configuration using RSLogix 500.

TIP

The RSLogix 500 configuration default is to enable each analog input channel. For improved analog input module performance, disable any *unused* channels.

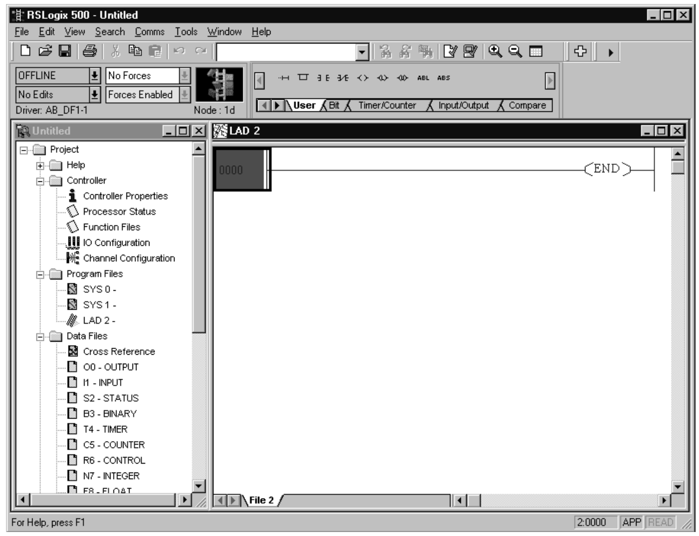
Table B.1 Software Configuration Channel Defaults

1769-IF4XOF2	
Parameter	**Default Setting**
Enable/Disable Input/Output Channel	Disabled
Program Mode (Outputs)	Hold Last State
Fault Mode (Outputs)	Hold Last State

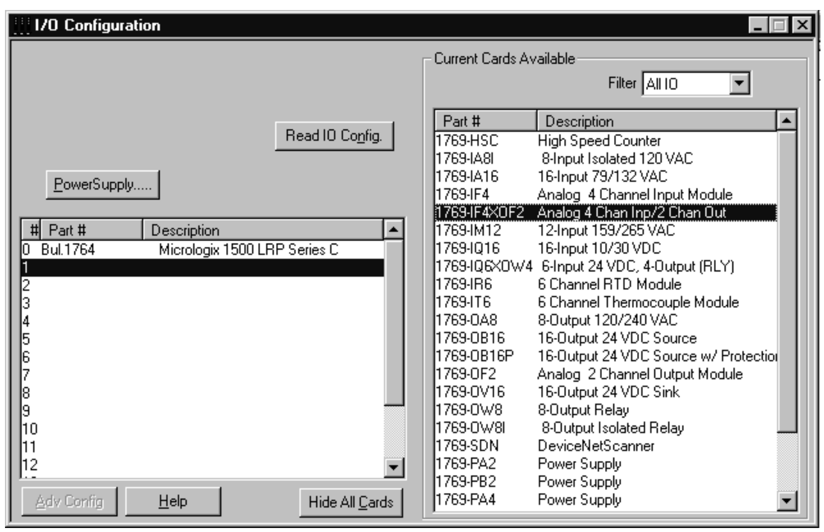
Configuring 1769-IF4XOF2 in a MicroLogix 1500 System

This example takes you through configuring your 1769-IF4XOF2 analog module with RSLogix 500 programming software. This application example assumes your module is installed as expansion I/O in a MicroLogix 1500 system, and that RSLinx™ is properly configured and a communications link has been established between the MicroLogix processor and RSLogix 500.

Start RSLogix and create a MicroLogix 1500 application. The following screen appears:

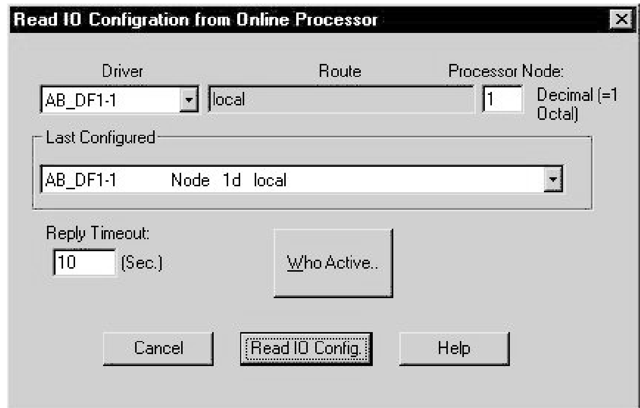


While offline, double-click on the IO Configuration icon under the controller folder and the following IO Configuration screen appears.

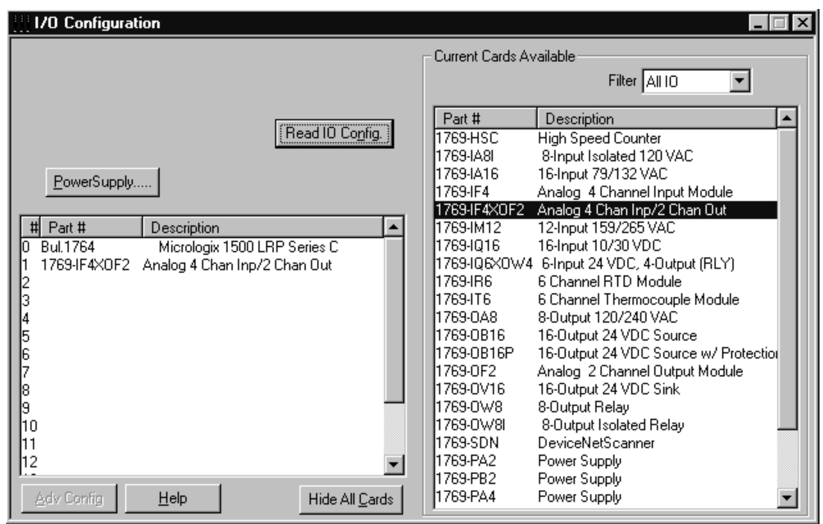


This screen allows you to manually enter expansion modules into expansion slots, or to automatically read the configuration of the controller. To read the existing controller configuration, click on the Read IO Config button.

A communications dialog appears, identifying the current communications configuration so that you can verify the target controller. If the communication settings are correct, click on Read IO Config.

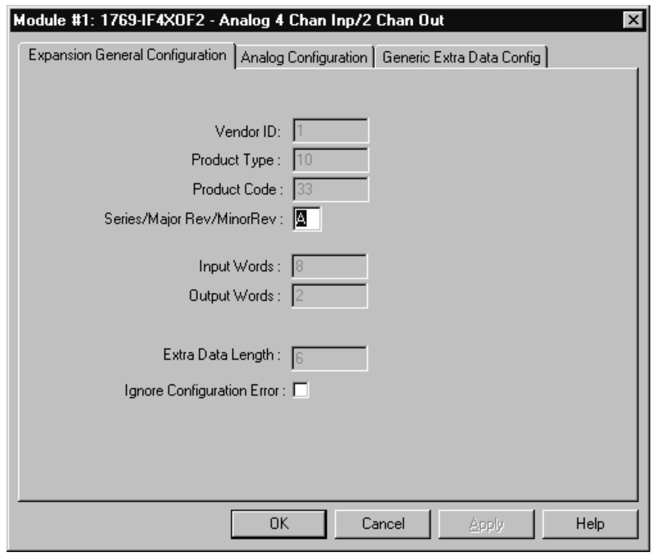


The actual I/O configuration is displayed. In this example, the 1769-IF4XOF2 is attached to the MicroLogix 1500 processor.



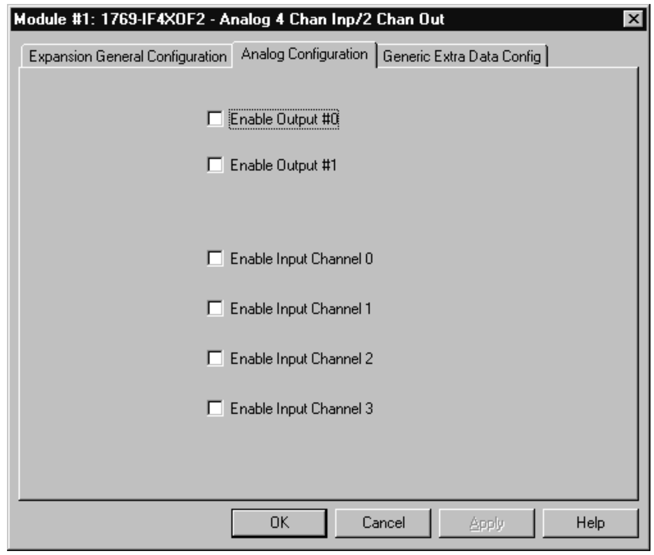
Configuring the 1769-IF4XOF2

The 1769-IF4XOF2 analog module is installed in slot 1. To configure the module, double-click on the module/slot. The 1769-IF4XOF2 general configuration screen appears.

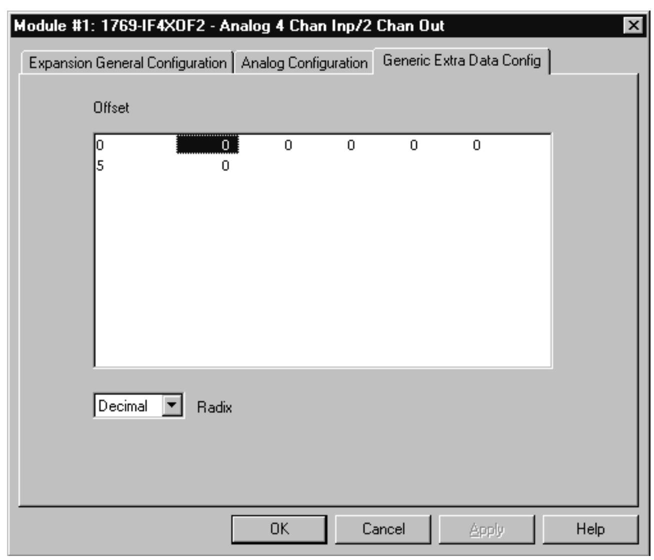


Analog Input/Output Configuration

Each of the four analog input words (channels) and two output words (channels) are disabled by default. To enable a channel, click its Enable box so that a check mark appears in it. For optimum module performance, disable any channel that is not hardwired to a real input.



Generic Extra Data Configuration



This tab redisplays the configuration information entered on the Analog Input Configuration screen in a raw data format. You have the option of entering the configuration using this tab instead of the Analog Input Configuration tab. You do not have to enter data in both places.

Configuration Using the 1769-IF4XOF2 Combination Analog Module with a CompactLogix System

The following is used to generate a Generic or Thin Profile and configure the 1769-IF4XOF2 analog combination module in RSLogix5000.

Version 8.02 of RSLogix5000 and the CompactLogix controllers support only the Generic 1769 Module Profile for 1769-IF4XOF2.

Version 10 of RSLogix 5000 and the CompactLogix controllers provides a “Thin” Profile for the 1769-IF4XOF2 module.

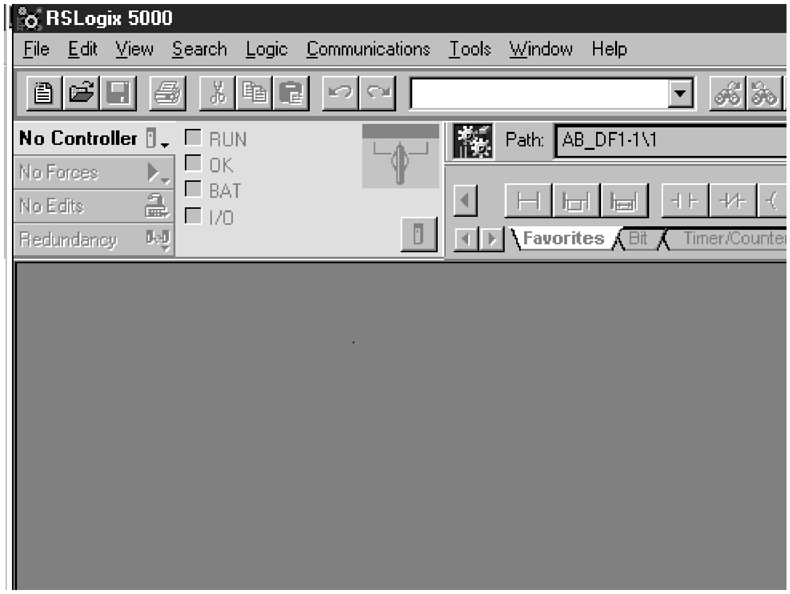
TIP

A Thin profile for an I/O module provides an extra layer of support when entering and configuring an I/O module in your project. You do not enter I/O and Configuration file lengths for a Thin profile as you must when using the Generic profile. In addition, the I/O and Configuration tags that are created for each I/O module contain descriptive tag elements, making it easier to identify each I/O and Configuration parameter.

Adding a 1769-IF4XOF2 Module to Your System

Refer to Chapter 3 of this manual for detailed information on wiring your 1769-IF4XOF2 analog combination module.

Start RSLogix 5000 programming software by double-clicking its icon on your desktop. The following screen displays:

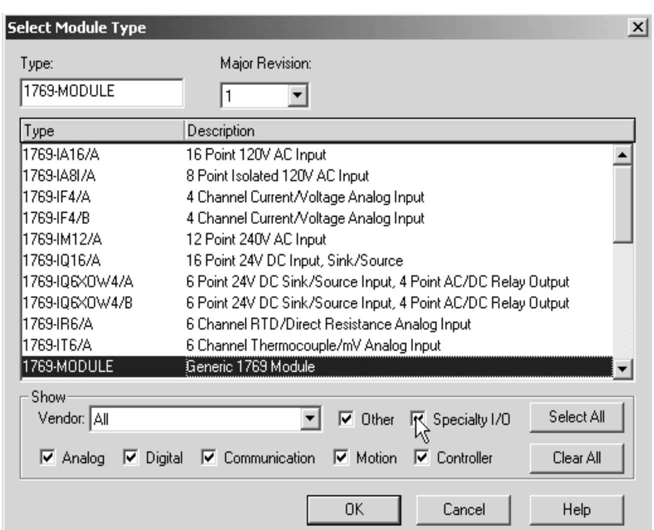


Click the File pull down menu and select New or click the New icon. Choose your controller type, name your project, then click OK. A new project screen displays.

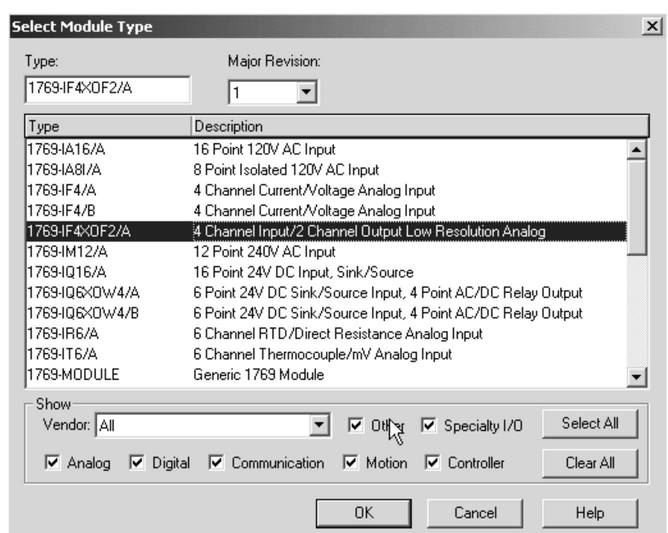
The area on the left of this screen is called the Controller Organizer. This is where controller properties, tasks, tags and I/O are found.

The last entry is called “[0] CompactBus Local”. This is where the local I/O is entered into your project. Right click on it and select “New Module.” One of the following screens displays, depending upon your version of RSLogix 5000:

RSLogix 5000 Version 8 - Generic Profile



RSLogix 5000 Version 10 - Thin Profile



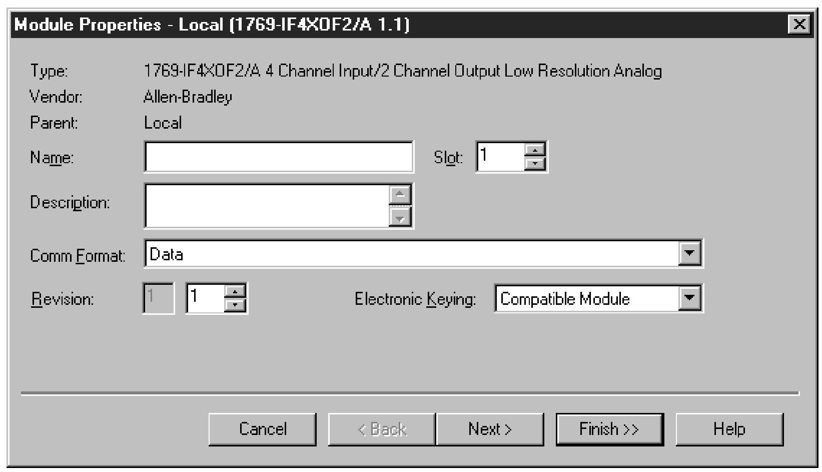
Select either the generic 1769-MODULE or the 1769-IF4XOF2/A and click OK.

For RSLogix 5000 version 10, see Thin Profile below.

For RSLogix 5000 version 8, see Generic Profile on page C-4.

Thin Profile

Once you have selected the 1769-IF4XOF2 module and clicked OK, the following screen appears:

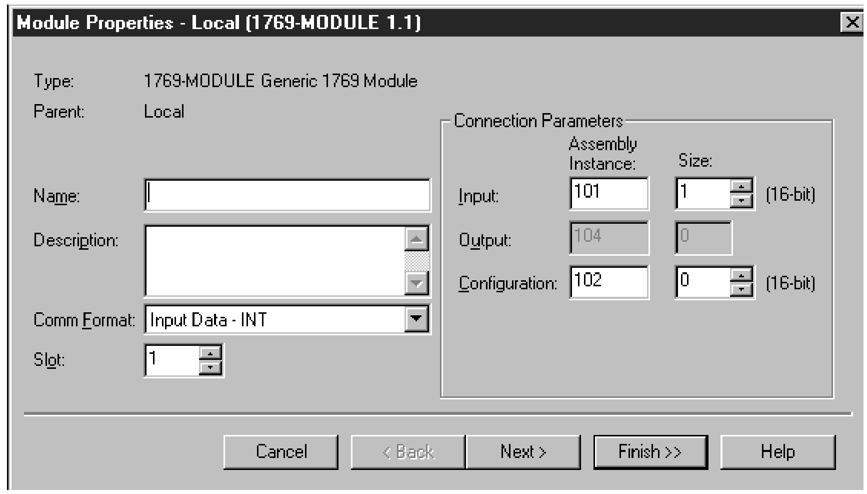


Enter a name for your module and a description, if desired. You may Click Finish. The appropriate I/O and Configuration tags are created, and the module appears in the Controller Organize below the “[0] CompactBus Local”.

See Configuring the 1769-IF4XOF2 Analog Combination Module on page C-5 to continue.

Generic Profile

Once you have selected the Generic 1769 Module and clicked OK, the following screen appears:



IMPORTANT Do not modify the “Assembly Instance” values.

Enter a name and choose “Data-INT” for the “Comm Format”. Enter the Input, Output and Configuration data lengths for the following:

- Input Size: 8
- Output Size: 2
- Configuration Size: 6

When you have entered all necessary parameters, click Finish. The module with the name you entered appears below “[0] CompactBus Local” in the Controller Organizer.

See Configuring the 1769-IF4XOF2 Analog Combination Module on page C-5 to continue.

Configuring the 1769-IF4XOF2 Analog Combination Module

When you add an I/O module into a CompactLogix system, the Input, Output and Configuration tags are automatically created in the Controller Tag base for that module.

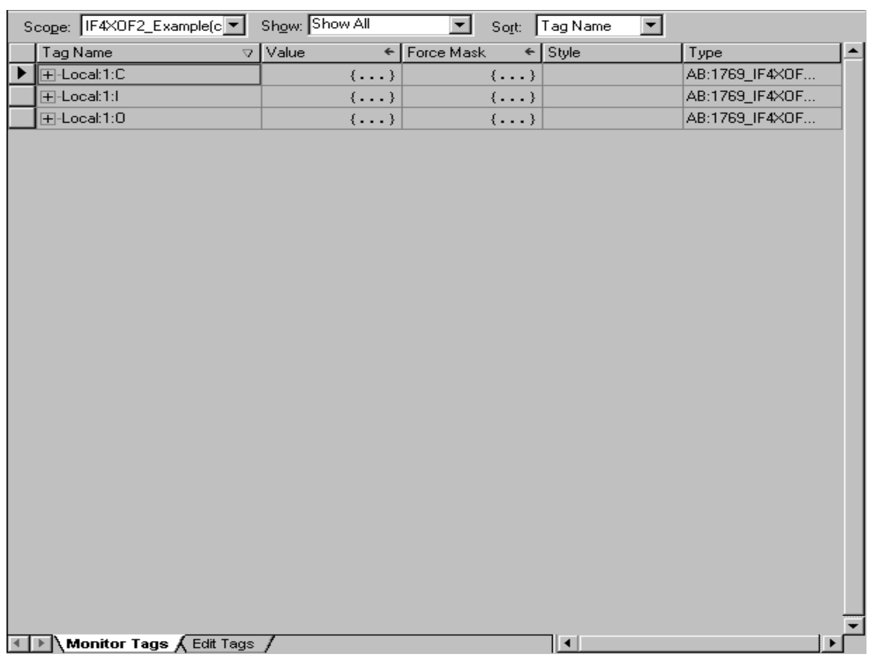
TIP

When a Thin Profile is used, each of these tags and their sub elements contain descriptive names, which match the documentation for that module.

For the case of the 1769-IF4XOF2, the following tags are created:

Local:s:I Input tag
Local:s:O Output tag
Local:s:C Configuration tag
where "s" is the slot number of the I/O module

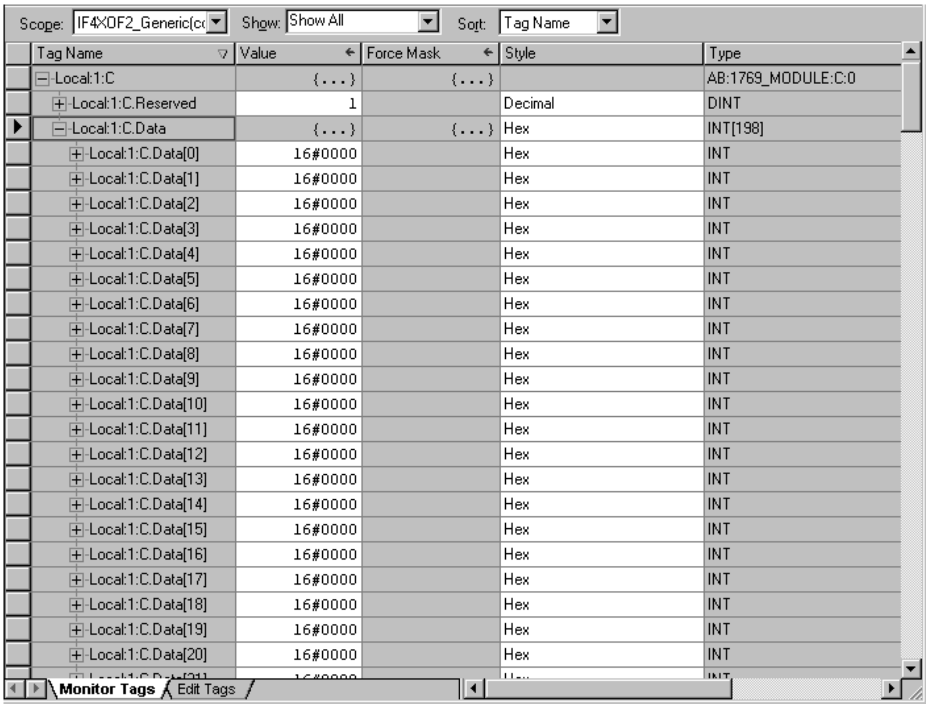
The screen below shows the 1769-IF4XOF2 in slot 1.



Each of these tags is expanded by clicking on the plus sign to its left. Click the plus sign to the left of the Configuration tag, then also click the plus sign to the left of "Local:1:C.Data."

One of the following screens displays, depending upon whether you are using a Generic or Thin Profile:

RSLogix 5000 Version 8 - Generic Profile

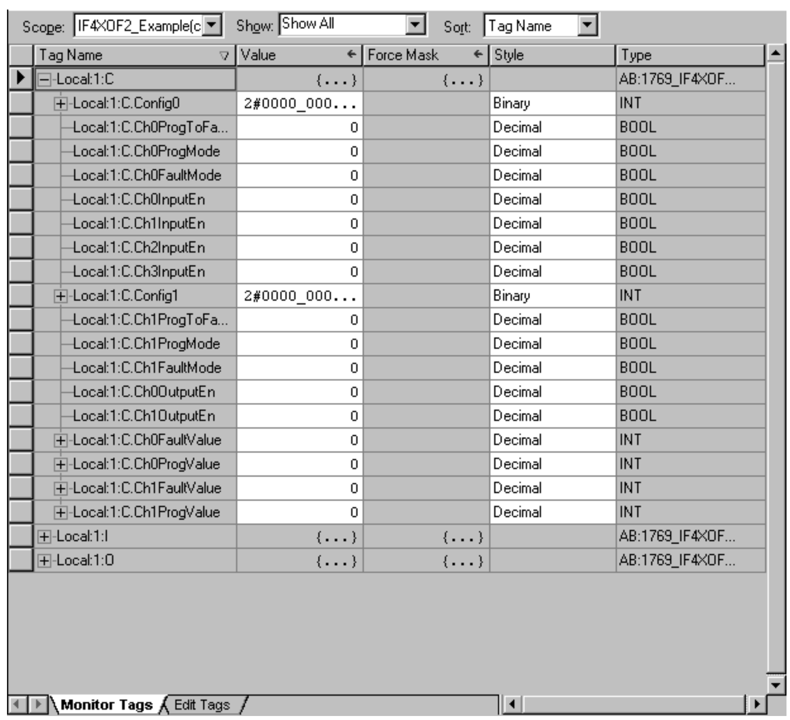


Scope: IF4XOF2_Generic(cc Show: Show All Sort: Tag Name

Tag Name	Value	Force Mask	Style	Type
-Local:1:C	{...}	{...}		AB:1769_MODULE:C:0
+Local:1:C.Reserved	1		Decimal	DINT
-Local:1:C.Data	{...}	{...}	Hex	INT[198]
+Local:1:C.Data[0]	16#0000		Hex	INT
+Local:1:C.Data[1]	16#0000		Hex	INT
+Local:1:C.Data[2]	16#0000		Hex	INT
+Local:1:C.Data[3]	16#0000		Hex	INT
+Local:1:C.Data[4]	16#0000		Hex	INT
+Local:1:C.Data[5]	16#0000		Hex	INT
+Local:1:C.Data[6]	16#0000		Hex	INT
+Local:1:C.Data[7]	16#0000		Hex	INT
+Local:1:C.Data[8]	16#0000		Hex	INT
+Local:1:C.Data[9]	16#0000		Hex	INT
+Local:1:C.Data[10]	16#0000		Hex	INT
+Local:1:C.Data[11]	16#0000		Hex	INT
+Local:1:C.Data[12]	16#0000		Hex	INT
+Local:1:C.Data[13]	16#0000		Hex	INT
+Local:1:C.Data[14]	16#0000		Hex	INT
+Local:1:C.Data[15]	16#0000		Hex	INT
+Local:1:C.Data[16]	16#0000		Hex	INT
+Local:1:C.Data[17]	16#0000		Hex	INT
+Local:1:C.Data[18]	16#0000		Hex	INT
+Local:1:C.Data[19]	16#0000		Hex	INT
+Local:1:C.Data[20]	16#0000		Hex	INT

Monitor Tags / Edit Tags

RSLogix 5000 Version 10 - Thin Profile



Scope: IF4XOF2_Example(c Show: Show All Sort: Tag Name

Tag Name	Value	Force Mask	Style	Type
-Local:1:C	{...}	{...}		AB:1769_IF4XOF...
+Local:1:C.Config0	2#0000_000...		Binary	INT
Local:1:C.Ch0ProgToFa...	0		Decimal	BOOL
Local:1:C.Ch0ProgMode	0		Decimal	BOOL
Local:1:C.Ch0FaultMode	0		Decimal	BOOL
Local:1:C.Ch0InputEn	0		Decimal	BOOL
Local:1:C.Ch1InputEn	0		Decimal	BOOL
Local:1:C.Ch2InputEn	0		Decimal	BOOL
Local:1:C.Ch3InputEn	0		Decimal	BOOL
+Local:1:C.Config1	2#0000_000...		Binary	INT
Local:1:C.Ch1ProgToFa...	0		Decimal	BOOL
Local:1:C.Ch1ProgMode	0		Decimal	BOOL
Local:1:C.Ch1FaultMode	0		Decimal	BOOL
Local:1:C.Ch0OutputEn	0		Decimal	BOOL
Local:1:C.Ch1OutputEn	0		Decimal	BOOL
+Local:1:C.Ch0FaultValue	0		Decimal	INT
+Local:1:C.Ch0ProgValue	0		Decimal	INT
+Local:1:C.Ch1FaultValue	0		Decimal	INT
+Local:1:C.Ch1ProgValue	0		Decimal	INT
+Local:1:I	{...}	{...}		AB:1769_IF4XOF...
+Local:1:O	{...}	{...}		AB:1769_IF4XOF...

Monitor Tags / Edit Tags

This Configuration tag is 198 words long. Only the first 6 are needed to configure this module. The remainder of the words in this tag should be a value of 0 decimal.

The 6 words of configuration data are entered in the following tags, assuming the module was configured in slot 1:

Tags	**in RSLogix 5000 Version 8 Generic Profile**	**in RSLogix 5000 Version 10 Thin Profile**
Configuration Data for Analog Input Channels	Local:1:C.Data[0]	Local:1.C.Config0
Configuration Data for Analog Output Channels	Local:1:C.Data[1]	Local:1.C.Config1
Channel 0 Fault Value	Local:1:C.Data[2]	Local:1.C.Ch0FaultValue
Channel 0 Program Value	Local:1:C.Data[3]	Local:1.C.Ch1FaultValue
Channel 1 Fault Value	Local:1:C.Data[4]	Local:1.C.Ch0ProgValue
Channel 1 Program Value	Local:1:C.Data[5]	Local:1.C.Ch1ProgValue

The four input channels for this module are not configurable. Each input channel supports either 4 to 20mA current or 0 to 10V dc voltage. This choice is determined by the module terminal to which you are wired. There is a current and a voltage terminal for each analog channel.

TIP

CompactLogix controllers do not yet support Hold Last State (HLS) or User Defined Safe State (UDSS) for Fault and Program modes for outputs. Analog modules, by default, hold outputs in their last state if the connection is lost to the controller (Fault State) or if the controller is placed into the Program mode or Faults (Program State).

You can only modify the configuration file to enable the input and output channels being used.

To enable channels:	
Using RSLogix 5000 version 8 Generic Profile	**Using RSLogix 5000 version 10 Thin Profile**
Enter a 1 in bits Local:1:C.Data[0]/4 though Local:1:C.Data[0]/7 for input channels 0 through 3.	Set Local:1:C.Ch0InputEn through Local:1:C.Ch3InputEn equal to 1.
Enter a 1 in bits Local:1:C.Data[1]/4 and Local:1:C.Data[0]/5 for input channels 0 and 1.	Set Local:1:C.Ch0OutputEn through Local:1:C.Ch3OutputEn equal to 1.

TIP

All other selections in the 6 word configuration file for the analog combination module concern HLS and UDSS, which is not yet supported by the CompactLogix controllers. Leave these settings at their default values.

Once the configuration is complete for the 1769-IF4XOF2 module, and any other modules in your system have been entered and configured, you can write your program, and save and download your project to the controller. The configuration files are downloaded to the controller at the same time the project is downloaded to the controller. They are also sent to the module at power up and when an inhibited module is uninhibited.

Accessing the Input and Output Tags

Thin Profile

The analog input data file may be accessed by clicking the plus sign to the left of the input tag, Local:1:I. Fault and status information for the module can be found in this input tag. Refer to Chapter 5 concerning the 32-bit Fault value (Local:1:I.Fault). 4, pages 4-3 through 4-6 describe each value in the input file for the 1769-IF4XOF2 module.

The actual analog input data for this module can be found in the following tags under Local:1:I.

- Local:1:I.Ch0Data Data for input Channel 0
- Local:1:I.Ch1Data Data for input Channel 1
- Local:1:I.Ch2Data Data for input Channel 2
- Local:1:I.Ch3Data Data for input Channel 3

The analog output data for the two analog output channels must be written to the following tags under Local:1:O :

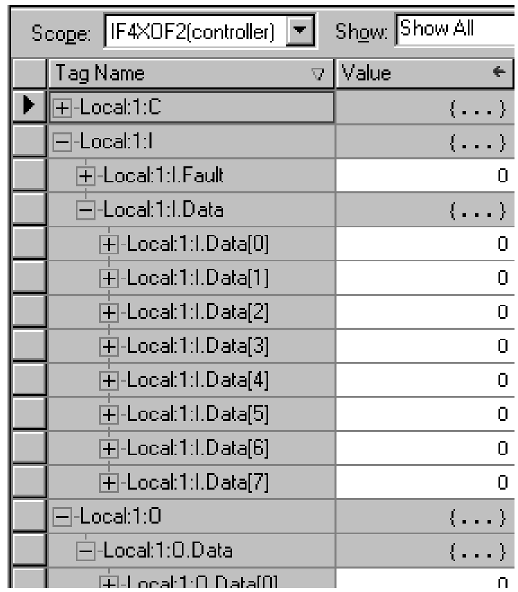
- Local:1:O.Ch0Data Data for output Channel 0
- Local:1:O.Ch1DataData for output Channel 1

Generic Profile

Wire the module to your analog devices, or for test purposes, wire an output on the module to an input on the module. The analog input and output data can be found at the following tag locations:

- Local:1:I.Data[0] Input Channel 0 Data
- Local:1:I.Data[1] Input Channel 1 Data
- Local:1:I.Data[2] Input Channel 2 Data
- Local:1:I.Data[3] Input Channel 3 Data
- Local:1:I.Data[4] Input Channels Status Flags
- Local:1:I.Data[5] Output Channels Status Flags
- Local:1:I.Data[6] Output Data Echo [0]
- Local:1:I.Data[7] Output Data Echo [1]
- Local:1:O.Data[0] Output Channel 0 Data
- Local:1:O.Data[1] Output Channel 1 Data

When the Input and Output tags for the 1769-IF4XOF2 module are expanded in the CompactLogix Controller Tags screen, they look like the following:



The analog data is presented to the controller in Raw/Proportional format. This means the data for the two possible analog types is:

0 to 20mA Raw/Proportional data range 0 to 31104 decimal

0 to 10V dc Raw/proportional data range 0 to 31104 decimal

TIP This module only uses bits 7 through 14 to represent the analog data.

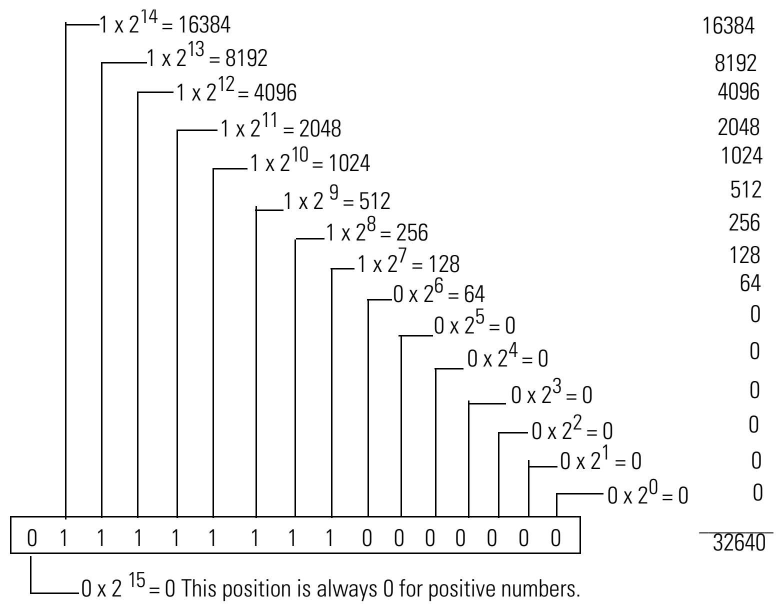
Two's Complement Binary Numbers

The processor memory stores 16-bit binary numbers. Two's complement binary is used when performing mathematical calculations internal to the processor. Analog input values from the analog modules are returned to the processor in 16-bit two's complement binary format. For positive numbers, the binary notation and two's complement binary notation are identical.

As indicated in the figure on the next page, each position in the number has a decimal value, beginning at the right with 2^0 and ending at the left with 2^{15}. Each position can be 0 or 1 in the processor memory. A 0 indicates a value of 0; a 1 indicates the decimal value of the position. The equivalent decimal value of the binary number is the sum of the position values.

Positive Decimal Values

The far left position is always 0 for positive values. As indicated in the figure below, this limits the maximum positive decimal value to 32640 (all positions are 1 except the far left position).



The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here refer to *Allen-Bradley's Industrial Automation Glossary*, Publication AG-7.1.

A/D Converter – Refers to the analog to digital converter inherent to the module. The converter produces a digital value whose magnitude is proportional to the magnitude of an analog input signal.

alternate last state – A configuration selection that instructs the module to convert a user-specified value from the channel fault or program/idle word to the output value when the module enters the fault or program mode.

analog input module – A module that contains circuits that convert analog voltage or current input signals to digital values that can be manipulated by the processor.

attenuation – The reduction in the magnitude of a signal as it passes through a system.

bus connector – A 16-pin male and female connector that provides electrical interconnection between the modules.

channel – Refers to analog input or output interfaces available on the module's terminal block. Each channel is configured for connection to a variable voltage or current input or output device, and has its own data and diagnostic status words.

channel update time – The time required for the module to sample and convert the input signals of one enabled input channel and update the channel data word.

common mode rejection – For analog inputs, the maximum level to which a common mode input voltage appears in the numerical value read by the processor, expressed in dB.

common mode rejection ratio – The ratio of a device's differential voltage gain to common mode voltage gain. Expressed in dB, CMRR is a comparative measure of a device's ability to reject interference caused by a voltage common to its input terminals relative to ground. $CMRR=20\ Log_{10\ (V1/V2)}$

common mode voltage – For analog inputs, the voltage difference between the negative terminal and analog common during normal differential operation.

common mode voltage range – For analog inputs, the largest voltage difference allowed between either the positive or negative terminal and analog common during normal differential operation.

configuration word – Contains the channel configuration information needed by the module to configure and operate each channel.

D/A Converter– Refers to the digital to analog converter inherent to the output module. The converter produces an analog dc voltage or current signal whose instantaneous magnitude is proportional to the magnitude of a digital value.

dB – (decibel) A logarithmic measure of the ratio of two signal levels.

data echo – The analog value currently being converted by the D/A converter and shown in words 2 and 3 of the output module's input data file. Under normal operating conditions, the data echo value is the same value that is being sent from the bus master to the output module.

data word – A 16-bit integer that represents the value of the analog input or output channel. The channel data word is valid only when the channel is enabled and there are no channel errors. When the channel is disabled the channel data word is cleared (0).

differential operation – The difference in voltage between a channel's positive terminal and negative terminal.

digital filter – A low-pass filter incorporated into the A/D converter. The digital filter provides very steep roll-off above it's cut-off frequency, which provides high frequency noise rejection.

filter – A device that passes a signal or range of signals and eliminates all others.

filter frequency – (-3 dB frequency) The user-selectable frequency.

full scale – The magnitude of voltage or current over which normal operation is permitted.

full scale error – (gain error) The difference in slope between the actual and ideal analog transfer functions.

full scale range – (FSR) The difference between the maximum and minimum specified analog input values.

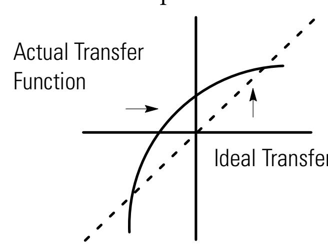
hold last state – A configuration selection that instructs the module to keep the outputs at the last converted value prior to the condition that caused the control system to enter the fault or program mode.

input image – The input from the module to the controller. The input image contains the module data words and status bits.

LSB – (Least Significant Bit) The bit that represents the smallest value within a string of bits. For analog combo modules, 8-bit, binary codes are used in the I/O image in the card.

For analog combo inputs, the LSB is defined as the bit 7, of the 16-bit field. For analog outputs, the seven rightmost bits are not significant, and the LSB is defined as the eighth bit from the right, bit 7, of the 16-bit field.

linearity error – An analog input or output is composed of a series of voltage or current values corresponding to digital codes. For an ideal analog input or output, the values lie in a straight line spaced by a voltage or current corresponding to 1 LSB. Any deviation of the converted input or actual output from this line is the linearity error of the input or output. The linearity is expressed in percent of full scale input or output. See the variation from the straight line due to linearity error (exaggerated) in the example below.



number of significant bits – The power of two that represents the total number of completely different digital codes an analog signal can be converted into or generated from.

module scan time – same as *module update time*

module update time – For input modules, the time required for the module to sample and convert the input signals of all enabled input channels and make the resulting data values available to the processor. For output modules, the time required for the module to receive the digital code from the processor, convert it to the analog output signal, and send it to the output channel.

multiplexer – An switching system that allows several signals to share a common A/D or D/A converter.

normal mode rejection – (differential mode rejection) A logarithmic measure, in dB, of a device's ability to reject noise signals between or among circuit signal conductors.

normal operating range – Input or output signals are within the configured range. See page 1-2 for a list of input and output types/ranges.

overall accuracy – The worst-case deviation of the output voltage or current from the ideal over the full output range is the overall accuracy. For inputs, the worst-case deviation of the digital representation of the input signal from the ideal over the full input range is the overall accuracy. this is expressed in percent of full scale.

Gain error, offset error, and linearity error all contribute to input and output channel accuracy.

output accuracy – The difference between the actual analog output value and what is expected, when a given digital code is applied to the d/a converter. Expressed as a ± percent of full scale. The error will include gain, offset and drift elements, and is defined at 25°C, and also over the full operating temperature range (0 to 60°C).

output image – The output from the controller to the output module. The output image contains the analog output data.

analog output module – An I/O module that contains circuits that output an analog dc voltage or current signal proportional to a digital value transferred to the module from the processor.

repeatability – The closeness of agreement among repeated measurements of the same variable under the same conditions.

resolution – The smallest detectable change in a measurement, typically expressed in engineering units (e.g. 1 mV) or as a number of bits. For example a 8-bit system has 256 possible output states. It can therefore measure 1 part in 256.

status word – Contains status information about the channel's current configuration and operational state. You can use this information in your ladder program to determine whether the channel data word is valid.

step response time – For inputs, this is the time required for the channel data word signal to reach a specified percentage of its expected final value, given a large step change in the input signal.

update time – see "module update time"

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Publication 1769-UM008A-EN-P - November 2001