



Allen-Bradley

Compact I/O Analog Modules

**1769-IF4, -IF8, -OF2, -OF8C, and
-OF8V**

User Manual

**Rockwell
Automation**

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at <http://www.ab.com/manuals/gi>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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

WARNING

Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

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

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid a hazard
- recognize the consequence

SHOCK HAZARD

Labels may be located on or inside the drive to alert people that dangerous voltage may be present.

BURN HAZARD

Labels may be located on or inside the drive to alert people that surfaces may be dangerous temperatures.

The 1769-IF8, -OF8C, and -OF8V modules have been added to this manual since the last printing.

To help you find new and updated information in this release of the manual, we have included change bars as shown next to this paragraph.

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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
- how to use this manual
- related publications
- conventions used in this manual
- Rockwell Automation support

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 1769 analog I/O modules.

Manual Contents

If you want...	See
An overview of the analog input and output modules	Chapter 1
Installation and wiring guidelines	Chapter 2
Input module addressing, configuration and status information	Chapter 3
Output module addressing, configuration and status information	Chapter 4
Information on module diagnostics and troubleshooting	Chapter 5
Specifications for the input and output modules	Appendix A
Information on addressing and configuration using MicroLogix 1500 and RSLogix 500	Appendix B
Information on configuring the module using CompactLogix and RSLogix 5000	Appendix C
Information on configuring the module using 1769-ADN DeviceNet Adapter and RSNetWorx	Appendix D
Information on understanding two's complement binary numbers	Appendix E
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-UM001
A user manual containing information on how to install, and use your 1769-ADN DeviceNet Adapter.	DeviceNet Adapter User Manual	1769-UM001
A user manual containing information on how to install, use and program your CompactLogix controller.	CompactLogix User Manual	1769-UM007
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-S0001
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.ab.com/literature**
- purchase a printed manual by:
 - contacting your local distributor or Rockwell Automation representative
 - 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

Notes:

Overview

This chapter explains how analog data is used, and describes the 1769-IF4 and -IF8 analog input modules and the 1769-OF2, -OF8C, and -OF8V analog output modules. Included is information about:

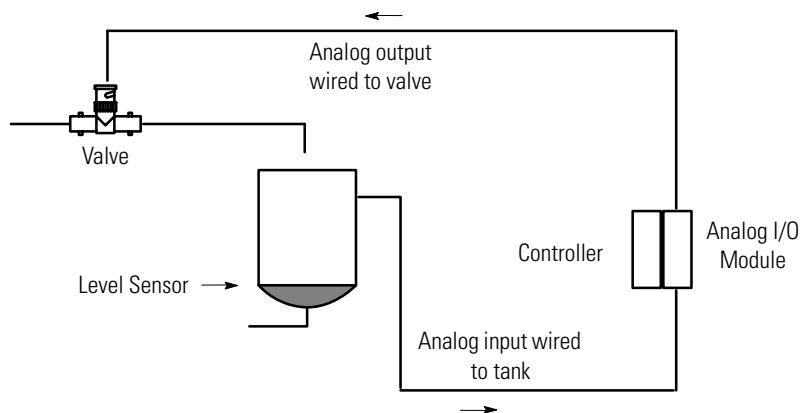
- the use of analog I/O
- the modules' hardware and diagnostic features
- an overview of the 1769 analog input system operation
- an overview of the 1769 analog output system operation

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.

Figure 1.1 Analog I/O Application Example



General Description

The 1769-IF4 and -IF8 analog input modules convert and digitally store analog data for retrieval by controllers, such as the CompactLogix™ or MicroLogix™ 1500. The module supports connections from any combination of up to four voltage or current analog sensors for the 1769-IF4 and up to eight for the 1769-IF8. The high-impedance input channels can be wired as either single-ended or differential inputs.

The 1769-OF2 output module provides two single-ended analog output channels, each individually configurable for voltage or current. The 1769-OF8C and -OF8V output modules each provide eight single-ended analog output channels.

Both modules provide the following input/output types/ranges:

Table 1.1 Normal and Full Ranges

Normal Operating Input Range	Full Module Range
±10V dc	± 10.5V dc
1 to 5V dc	0.5 - 5.25V dc
0 to 5V dc	-0.5 - +5.25V dc
0 to 10V dc	-0.5 - +10.5V dc
0 to 20 mA	0 - 21 mA
4 to 20 mA	3.2 - 21 mA

The data can be configured on board each module as:

- Engineering Units
- Scaled-for-PID
- Percent
- Raw/Proportional Data

Hardware Features

The modules contain removable terminal blocks. The 1769-IF4 and -IF8 channels can be wired as either single-ended or differential inputs. The 1769-OF2, -OF8C, and -OF8V channels are single-ended only. Module configuration is normally done via 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.

Figure 1.2 1769-OF2, -OF8C, -OF8V and -IF4 Analog Module's Hardware Features

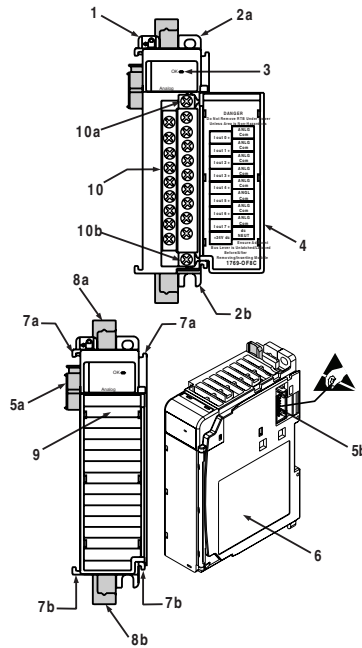
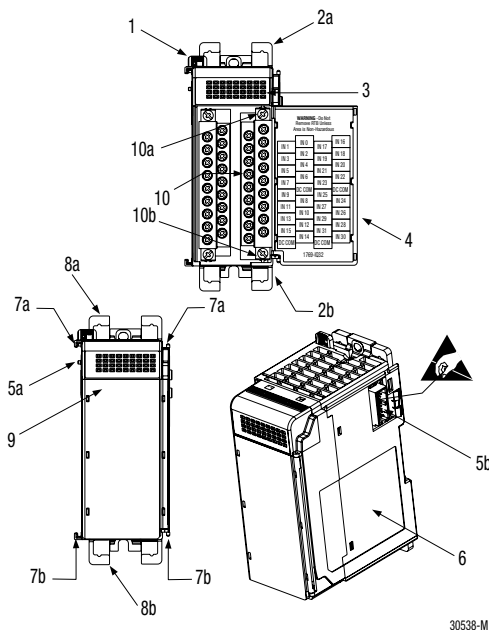


Table 1.2 1769-OF2, -OF8C, -OF8V, and -IF4 Feature Descriptions

Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tab
2b	lower panel mounting tab
3	module status LEDs
4	module door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector 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

Figure 1.3 1769-IF8 Analog Module's Hardware Features



30538-M

Table 1.3 1769-IF8 Feature Descriptions

Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tab
2b	lower panel mounting tab
3	I/O diagnostic LEDs
4	module door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector 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

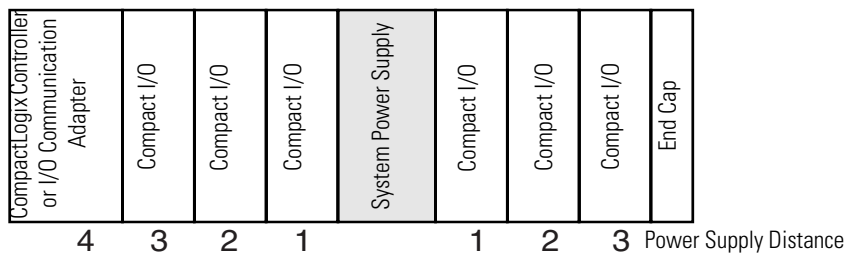
The analog modules contain diagnostic features that can help you identify the source of problems that may occur during power-up or during normal channel operation. These power-up and channel diagnostics are explained in chapter 6, *Module Diagnostics and Troubleshooting*.

System Overview

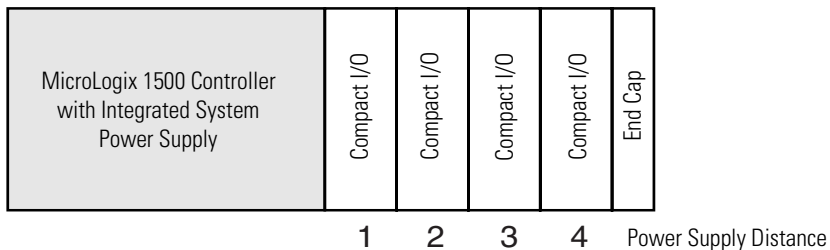
The modules communicate to the controller through the bus interface. The modules also receive 5 and 24V dc power through the bus interface. The 1769-IF4, -OF2, -OF8C, and -OF8V modules feature an external 24V dc power switch, providing you with the option of using an external power supply. See External Power Switch on page 2-10 for details.

You can install as many analog modules as your power supply can support. However, the modules have a power supply distance rating of 8, which means that they may not be located more than 8 modules away from the system power supply.

Figure 1.4 Determine Power Supply Distance



OR



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 Modules

Each time a channel is read by the input modules, that analog data value is tested by the modules for an over-range or under-range condition. If such a condition is detected, a unique bit is set in the channel status word. The channel status word is described in 1769-IF4 Input Data File on page 3-2 and 1769-IF8 Input Data File on page 3-18.

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

Output Modules

The output modules monitor channels for over-range and under-range conditions and also for broken output wires and high load resistance (in current mode only). If such a condition is detected, a unique bit is set in the channel status word. The channel status word is described in 1769-OF2 Output Data File on page 4-2 and 1769-OF8C and -OF8V Output Data File on page 4-18.

The output module receives two's complement binary values from the bus master. 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 output module converts the data to an analog output signal.

Module Operation

Input Module Block Diagram

The input module's input 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.

Figure 1.5 1769-IF4 Block Diagram

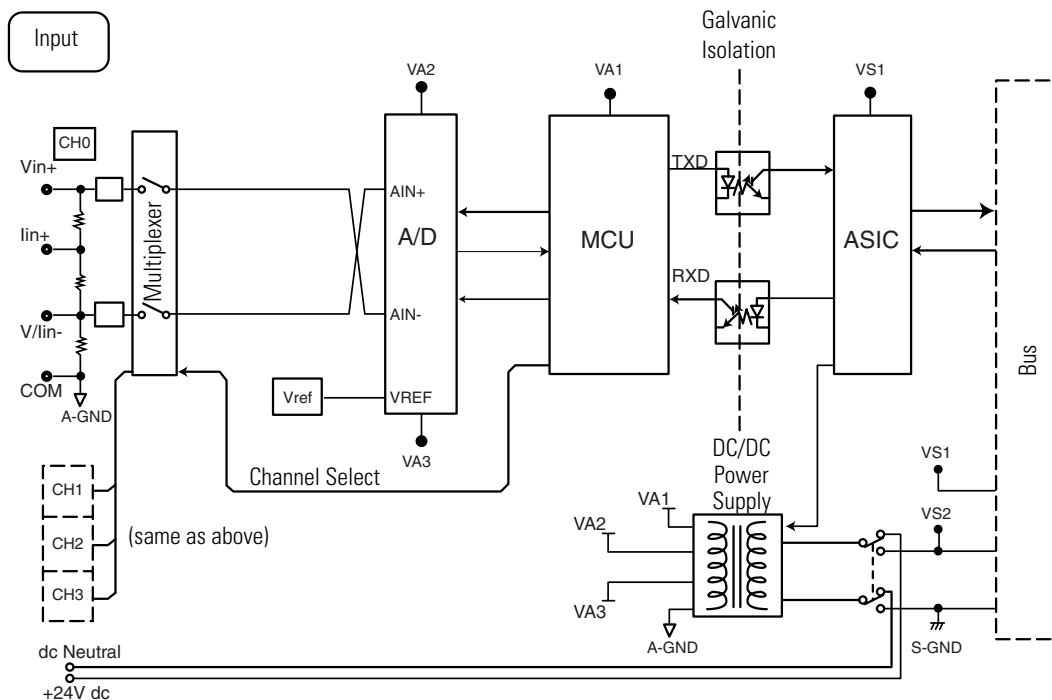
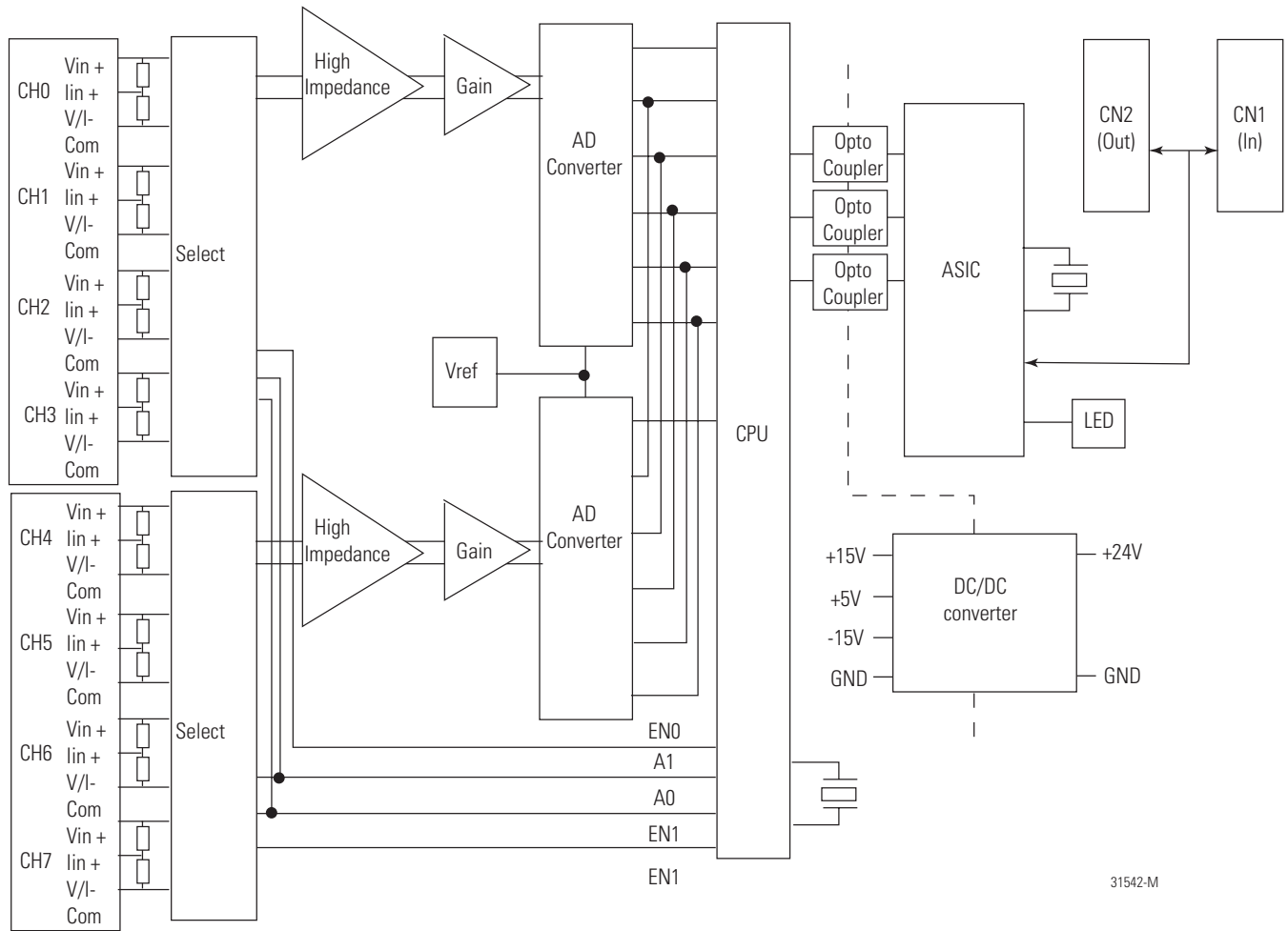


Figure 1.6 1769-IF8 Block Diagram



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Output Module Block Diagram

The output module 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.

Figure 1.7 1769-OF2 Block Diagram

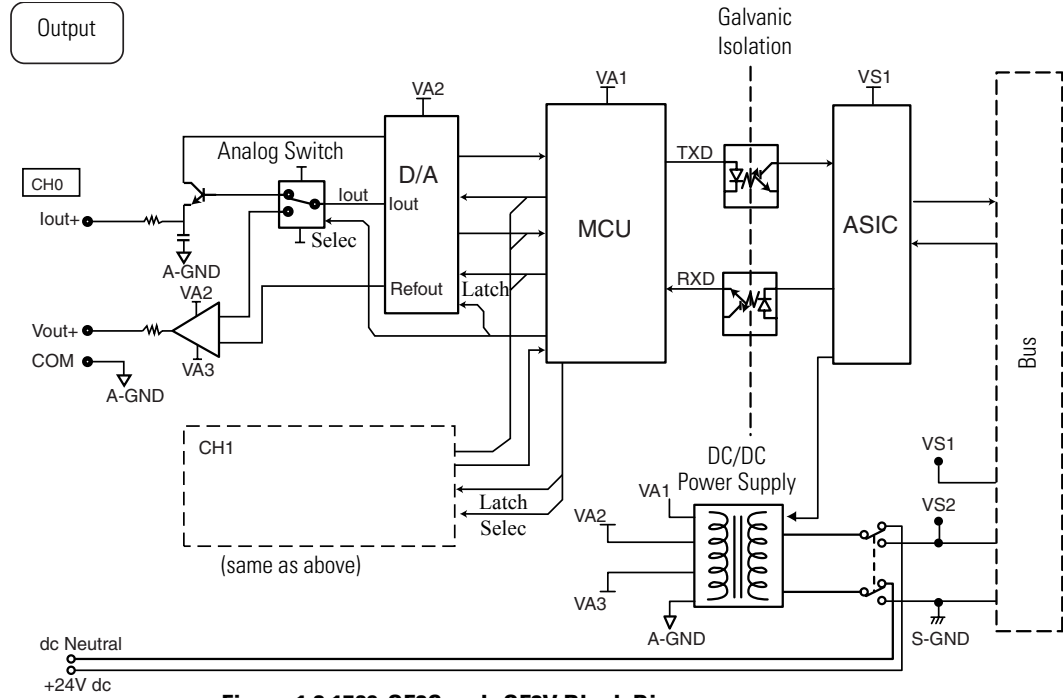
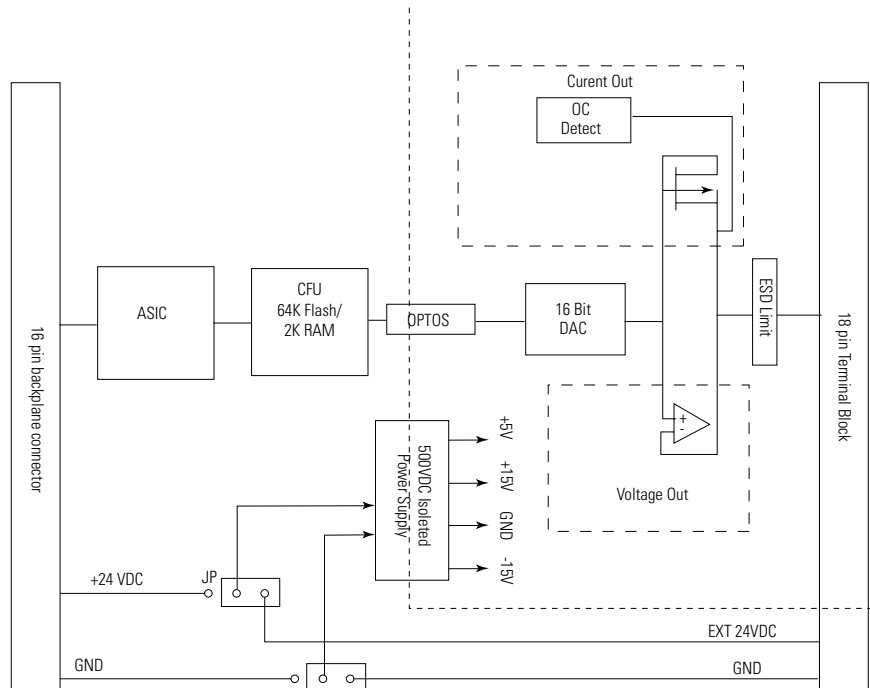


Figure 1.8 1769-OF8C and -OF8V Block Diagram

The following diagram shows only one of eight outputs. For each analog output, only one of the sections shown in broken-line boxes is implemented. The 1769-OF8C module uses only the Current Out section while the 1769-OF8V module uses only the Voltage Out section.



Module Field Calibration

The 1769-IF4 and -IF8 input modules performs autocalibration when a channel is initially enabled. In addition, if a channel is configured differently than the previously scanned channel, an autocalibration cycle is run as part of the reconfiguration process.

The 1769-OF2, -OF8C, and -OF8V output modules's calibration is guaranteed by its design. No field calibration is required.

Installation and Wiring

This chapter tells you how to:

- determine the power requirements for the modules
- avoid electrostatic damage
- install the module
- wire the module's terminal block
- wire input devices
- wire output devices

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 modules receive power through the bus interface from the +5V dc/+24V dc system power supply. Some modules can also be supplied 24V dc power by an external power supply connected to the module's terminal block.

Table 2.1 Maximum Current Draw

Module	5V dc	24V dc
1769-IF4 (Series A)	120 mA	Not applicable
1769-IF4 (Series B)		60 mA ⁽¹⁾
1769-IF8 (Series A)		70 mA
1769-OF2 (Series A)	120 mA	Not applicable
1769-OF2 (Series B)		120 mA ⁽¹⁾
1769-OF8C (Series A)	145 mA	160 mA ⁽¹⁾
1769-OF8V (Series A)		125 mA ⁽¹⁾

⁽¹⁾ If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.

General Considerations

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.

ATTENTION**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 analog I/O module bus connector pins or the terminal block on the input module. 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 it is 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 and may lead to premature failure.

Reducing Noise

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

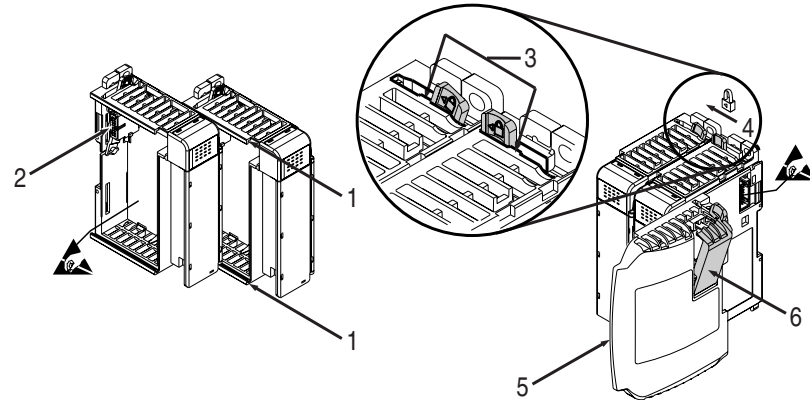
The printed circuit boards of the analog modules must be protected from dirt, oil, moisture, and other airborne contaminants. To protect these boards, the system must be installed in an enclosure suitable for the environment. The interior of the enclosure should be kept clean and the enclosure door should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

System Assembly

The module can be attached to the controller or an adjacent I/O module *before* or *after* mounting. For mounting instructions, see Panel Mounting Using the Dimensional Template on page 2-7, or DIN Rail Mounting on page 2-8. To

work with a system that is already mounted, see Replacing a Single Module within a System on page 2-9.

Figure 2.1 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 (1) to secure the modules together (or to a controller).
4. Move the module back along the tongue-and-groove slots until the bus connectors (2) line up with each other.
5. Push the bus lever back slightly to clear the positioning tab (3). Use your fingers or a small screwdriver.

- To allow communication between the controller and module, move the bus lever fully to the left (4) 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.

- Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.
- Lock the end cap bus terminator (6).

IMPORTANT

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

Mounting

ATTENTION

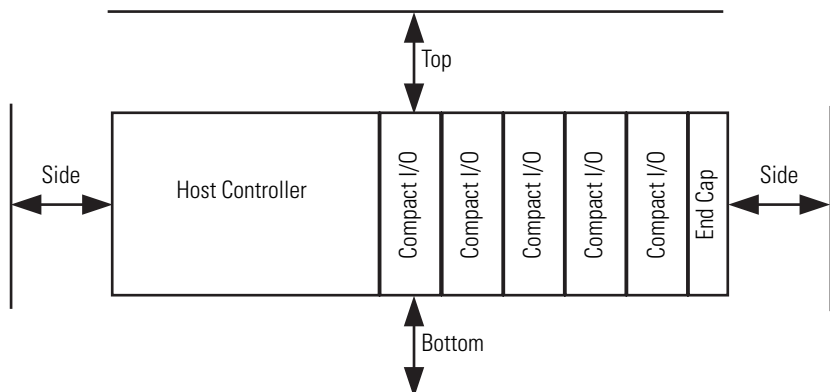


During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage at power up.

Minimum Spacing

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

Figure 2.2 Space Requirements

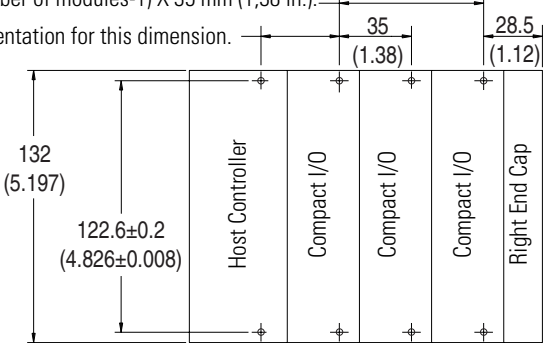


Panel Mounting

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

Figure 2.3 Panel Mounting Using the Dimensional Template

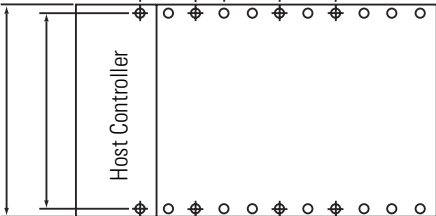
For more than 2 modules: (number of modules-1) X 35 mm (1.38 in.).
 Refer to host controller documentation for this dimension.



NOTE: All dimensions are in mm (inches).
 Hole spacing tolerance: ±0.04 mm (0.016 in.).

Figure 2.4 Panel Mounting for the 1769-IF8 Using the Dimensional Template

Spacing for single-wide modules 35 mm (1.378 in.).
 Spacing for one-and-a-half-wide modules 52.5 mm (2.067 in.).
 Refer to host controller documentation for this dimension.



NOTE: Overall hole spacing tolerance: ±0.4 mm (0.016 in.)

Locate holes every 17.5 mm (0.689 in) to allow for a mix of single-wide and one-and-a-half-wide modules (e.g., 1769-OA16).

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. If you have sophisticated panel mounting equipment, you can use the dimensional template provided on page 2-7. 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 important note on 2-4.
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).

External Power Switch

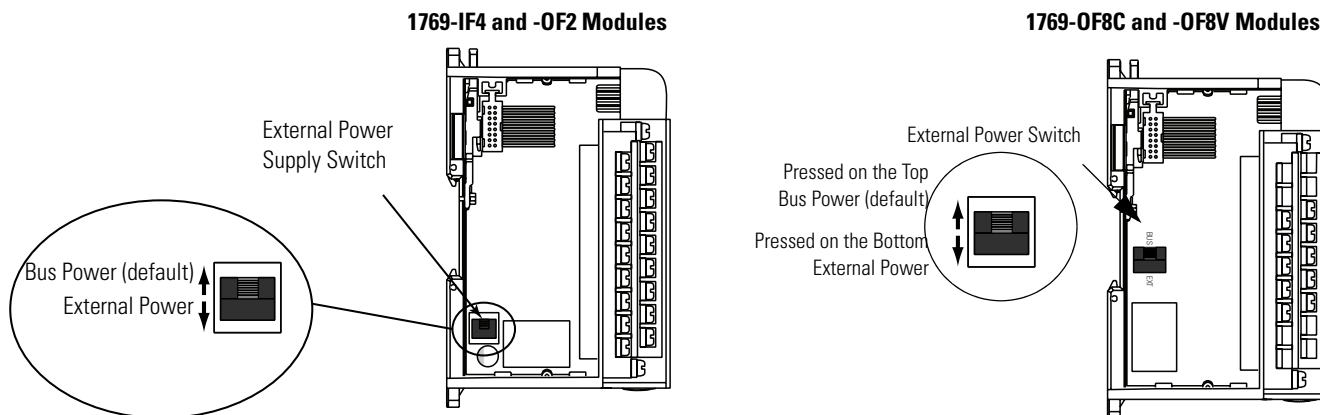
The analog modules have an external 24V dc power switch which gives you the option of using an external power supply. The switch is located in on the lower left portion of the module's circuit board, as shown below. With the switch pressed on the top (default), 24V dc power is drawn from the 1769 system power supply via the 1769 I/O bus. Pressed on the bottom, 24V dc power is drawn from the external power supply.

Wire the external power supply to the module via the module's terminal block. The external power supply must be Class 2 rated, with a 24V dc range of 20.4 to 26.4V dc and a minimum current rating that meets the needs of the modules used in your application. Refer to Maximum Current Draw on page 2-2.

IMPORTANT

Only 1769-IF4 and -OF2 Series B modules have the 24V dc power switch.

Figure 2.5 External Power Switch



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.
- Do not use the analog module's NC terminals as connection points.
- 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.
- Use Belden™ 8761, or equivalent, shielded wire.
- Keep shield connection to ground as short as possible.
- 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.⁽¹⁾

1769-IF4 and -IF8 Input Modules

- If multiple power supplies are used with analog inputs, the power supply commons must be connected together.
- The 1769-IF4 and -IF8 modules do 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 V_{in+} , V_{Iin-} , and I_{in+} of the 1769-IF4 and -IF8 modules must be within $\pm 10V$ dc of analog common.

1769-OF2, -OF8C, and -OF8V Output Modules

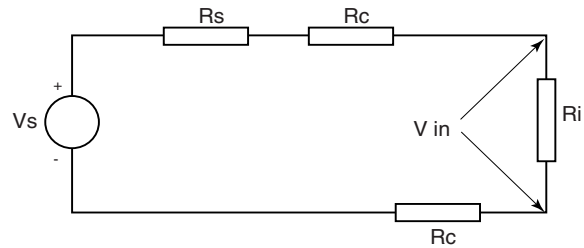
- Voltage outputs ($V_{out 0+}$ and $V_{out 1+}$ for 1769-OF2, $V_{out 0+}$ through $V_{out 7+}$ for 1769-OF8V) of the output modules are referenced to ANLG COM. Load resistance for a voltage output channel must be equal to or greater than $1K \Omega$
- Current outputs ($I_{out 0+}$ and $I_{out 1+}$ for 1769-OF2, $I_{out 0+}$ through $I_{out 7+}$ for 1769-OF8C) of the output modules source current that returns to ANLG COM. Load resistance for a current output channel must remain between 0 and 500Ω

⁽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 $0.1\mu F$ capacitor at the sensor end.

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 1769-IF4 or -IF8 module can affect the accuracy of the data provided by the module.

Figure 2.6 Voltage Input Accuracy



Where:

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

R_s = Source impedance of analog transducer/sensor input

R_i = Impedance of the voltage input
(220 K Ω for 1769-IF4 and -IF8)

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

V_{in} = Measured potential at the module input

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

$$V_{in} = \frac{[R_i \times V_s]}{[R_s + (2 \times R_c) + R_i]}$$

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

$$R_c = 16 \Omega/1000 \text{ ft}$$

$R_s = 0$ (ideal source)

$$\%A_i = \left(1 - \frac{V_{in}}{V_s}\right) \times 100$$

Table 2.2 Effect of Cable Length on Input Accuracy

Length of Cable (m)	dc resistance of the cable, R_c (Ω)	Accuracy impact at the input module
50	2.625	0.00238%
100	5.25	0.00477%
200	10.50	0.00954%
300	15.75	0.0143%

As input source impedance (R_s) and/or resistance (dc) of the cable (R_c) 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.

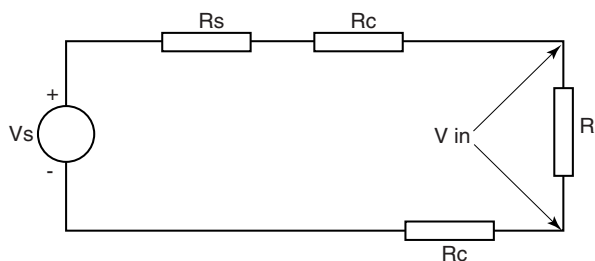
$$V_s = V_{in} \times \frac{[R_s + (2 \times R_c) + R_i]}{R_i}$$

TIP

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

Effect of Device and Cable Output Impedance on Output Module 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.

Figure 2.7 Output Module Accuracy

Where:

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

R_s = Source impedance
(15 Ω for 1769-OF2 and 1 Ω for 1769-OF8V)

R_i = Impedance of the voltage input
(220 K Ω for 1769-IF4)

V_s = Voltage at the output of 1769-OF2

V_{in} = Measured potential at the module input

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

$$V_{in} = \frac{[R_i \times V_s]}{[R_s + (2 \times R_c) + R_i]}$$

For example, for Belden 8761 two conductor, shielded cable and a 1769-IF4 input module:

$$R_c = 16 \Omega/1000 \text{ ft}$$

$$R_s = 15 \Omega$$

$$R_i = 220 \text{ K}\Omega$$

$$\%Ai = \left(1 - \frac{V_{in}}{V_s}\right) \times 100$$

Table 2.3 Effect of Output Impedance and Cable Length on Accuracy

Length of Cable (m)	dc resistance of the cable R_c (Ω)	Accuracy impact at the input module
50	2.625	0.00919%
100	5.25	0.01157%
200	10.50	0.01634%
300	15.75	0.02111%

As output impedance (R_s) and/or resistance (dc) of the cable (R_c) 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.

$$V_s = V_{in} \times \frac{[R_s + (2 \times R_c) + R_i]}{R_i}$$

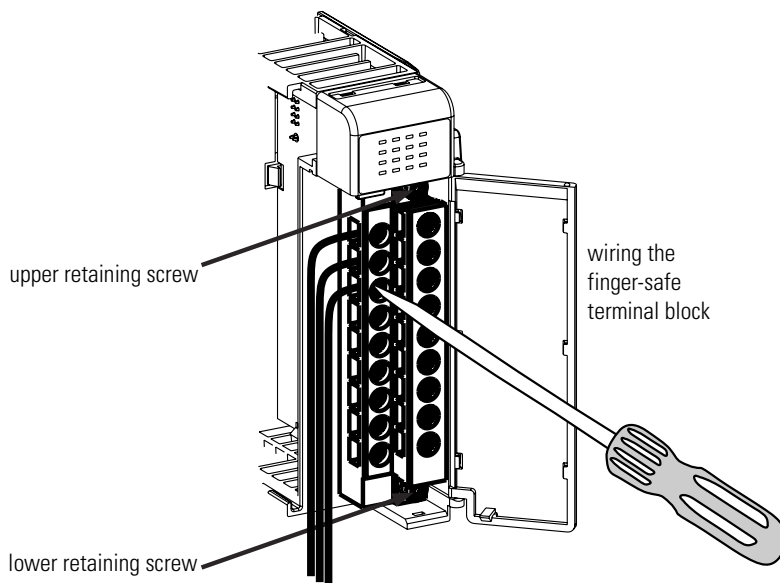
TIP

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

Labeling the Terminals

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.

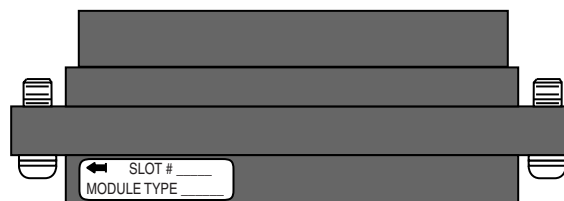
Figure 2.8 Terminal Labels



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. RTB position can be indicated by circling either the 'R' for right side or 'L' for left side.

Figure 2.9 Finger-Safe Terminal Block



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. Begin wiring at the bottom of the terminal block and move up.
3. Route the wire under the terminal pressure plate. You can use the bare wire or a spade lug. The terminals 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.

4. 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 screwdriver 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.

Table 2.4 Terminal Wire Considerations

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)

Wiring the Modules

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.

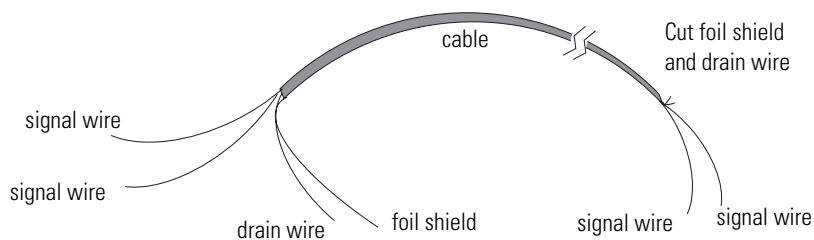
After the analog module is properly installed, follow the wiring procedure below. To ensure proper operation and high immunity to electrical noise, always use Belden™ 8761 (shielded, twisted-pair) or equivalent wire.

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.

Figure 2.10 Belden 8761 Wire



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, it may be necessary to ground the cable shields to earth at the module end via a 0.1 μF capacitor at the sensor end for analog inputs and at the load end for analog outputs.

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 Modules Wiring on page 2-19 and Analog Output Modules Wiring on page 2-24. 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.

Analog Input Modules Wiring

Figure 2.11 1769-IF4 Terminal Layout

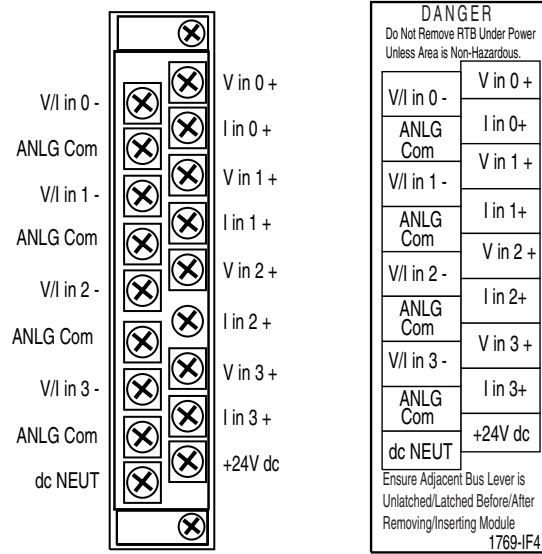
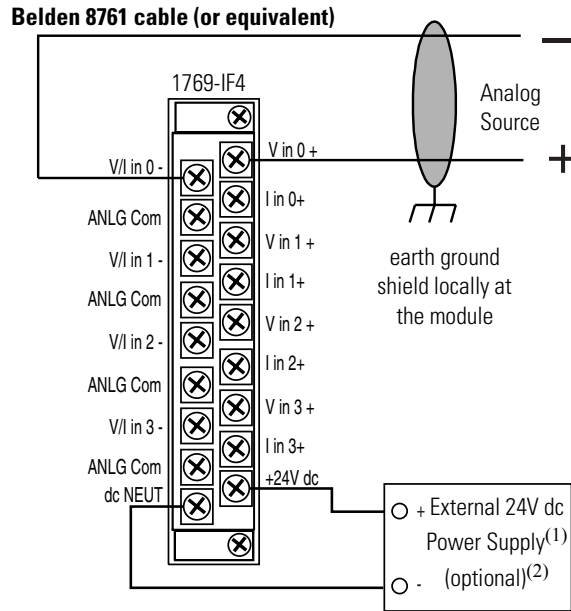


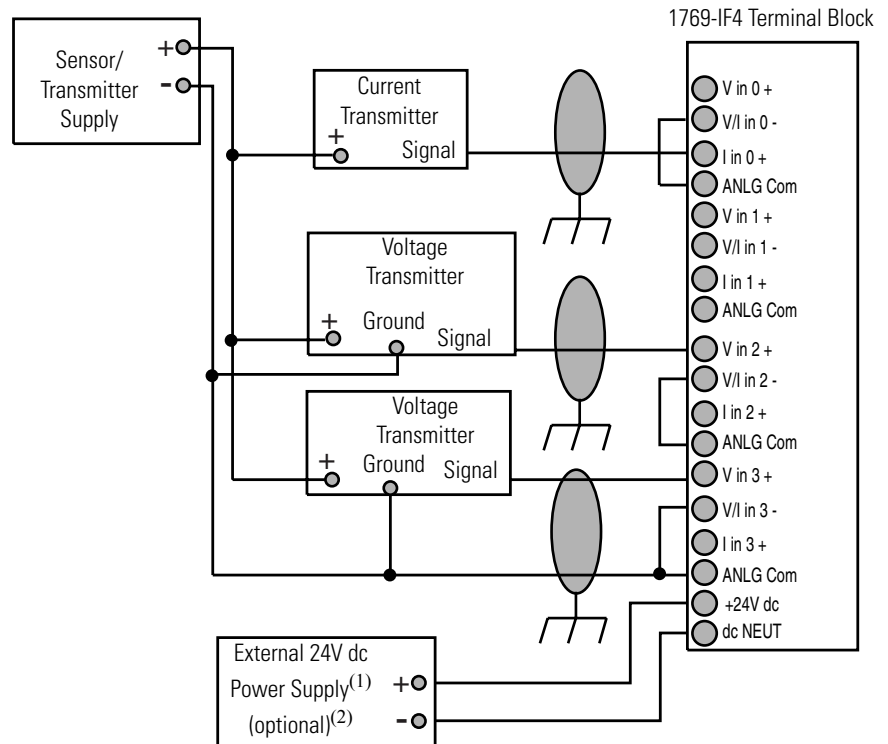
Figure 2.12 1769-IF4 Wiring Diagram Showing Differential Inputs



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum for a single input module.

(2) Series B and later modules provide this option.

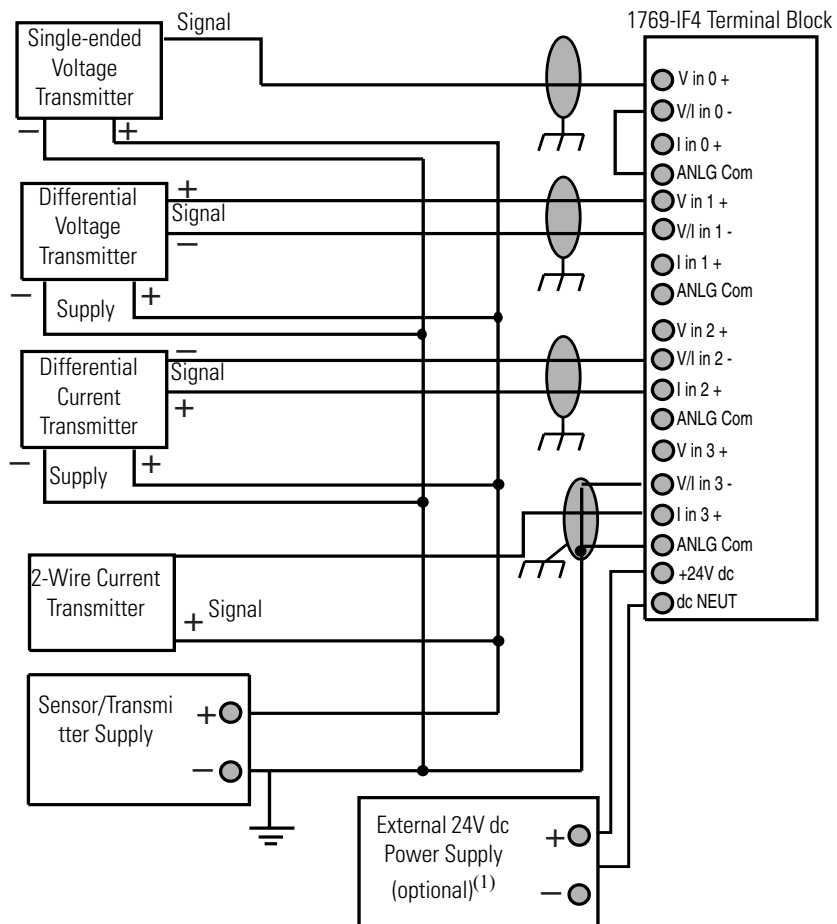
Figure 2.13 1769-IF4 Wiring Single-ended Sensor/Transmitter Types



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum for a single input module.

(2) Series B and later modules provide this option.

Figure 2.14 1769-IF4 Wiring Mixed Transmitter Types



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum for a single input module.

(2) Series B and later modules provide this option.

Figure 2.15 1769-IF8 Terminal Layout

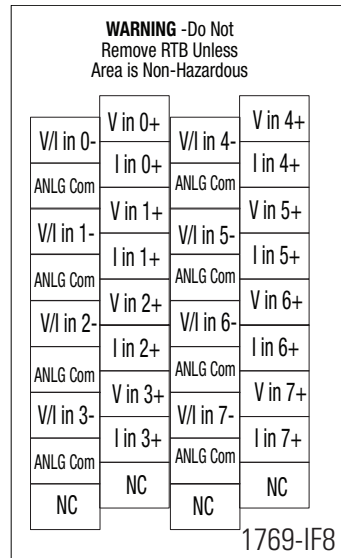
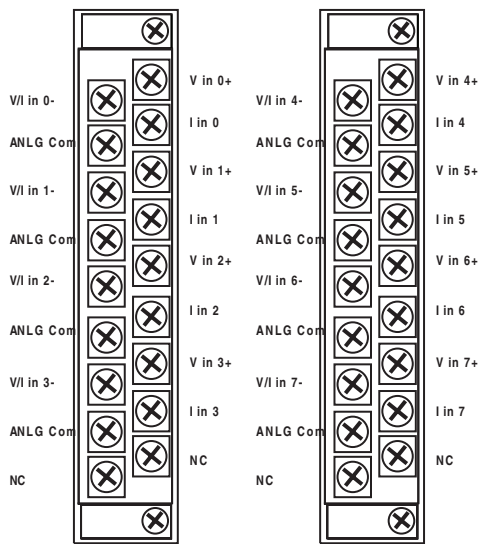


Figure 2.16 1769-IF8 Wiring Differential Inputs

Belden 8761 cable (or equivalent)

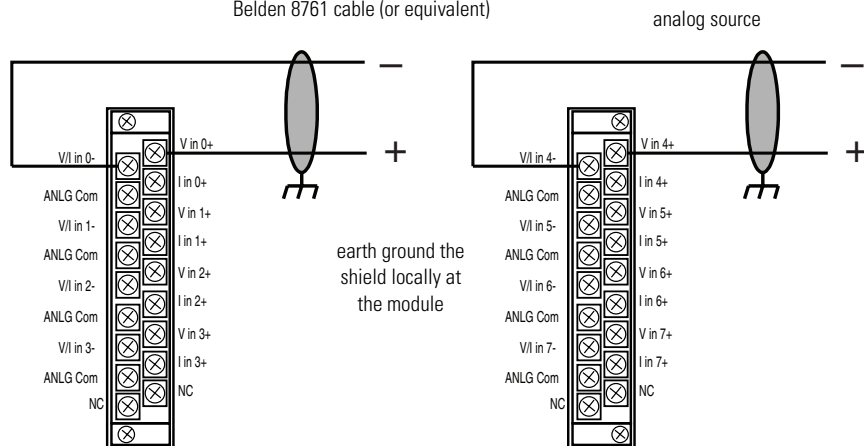
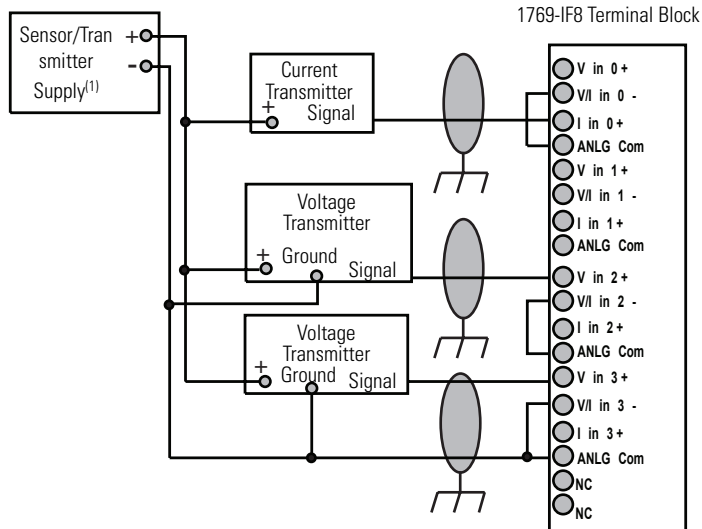


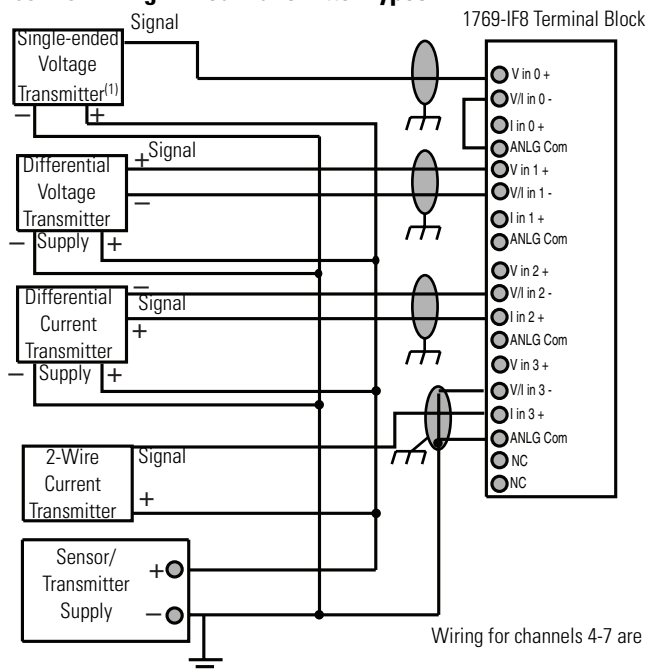
Figure 2.17 1769-IF8 Wiring Single-Ended Sensor/Transmitter Types



Wiring for channels 4-7 are identical.

(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum for a single input module.

Figure 2.18 1769-IF8 Wiring Mixed Transmitter Types



Wiring for channels 4-7 are identical.

(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 60 mA minimum for a single input module.

Analog Output Modules Wiring

Figure 2.19 1769-OF2 Terminal Layout

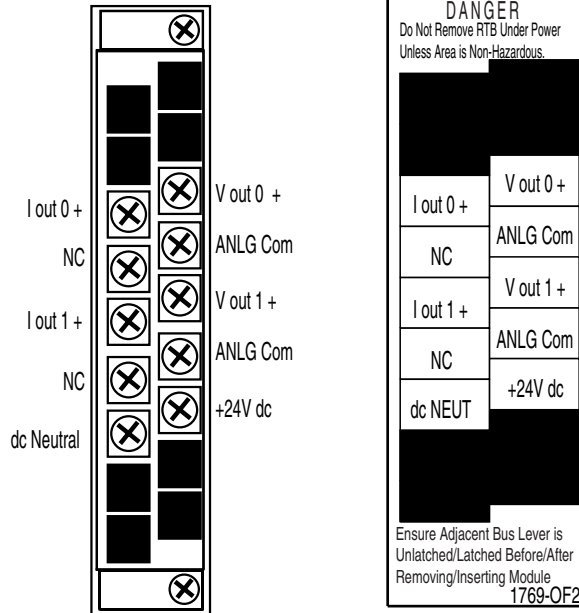
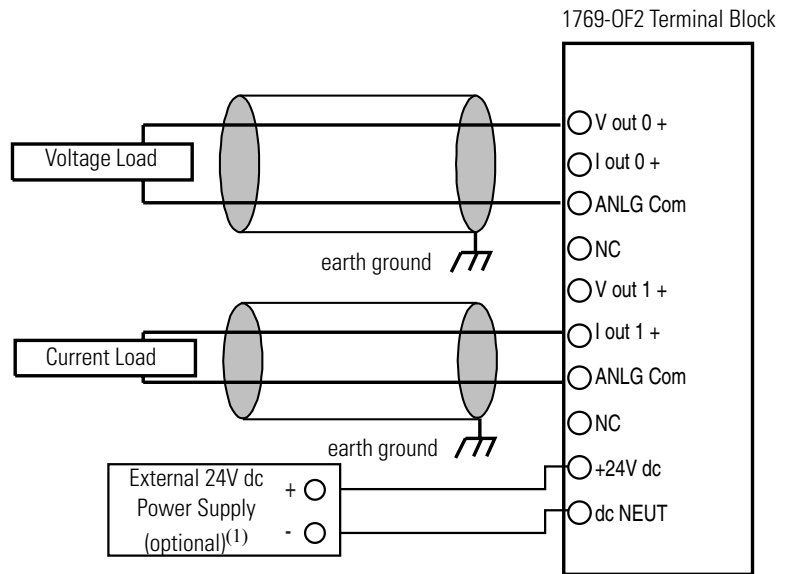


Figure 2.20 1769-OF2 Wiring Diagram



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 120 mA minimum per output module.

Figure 2.21 1769-OF8C Terminal Layout

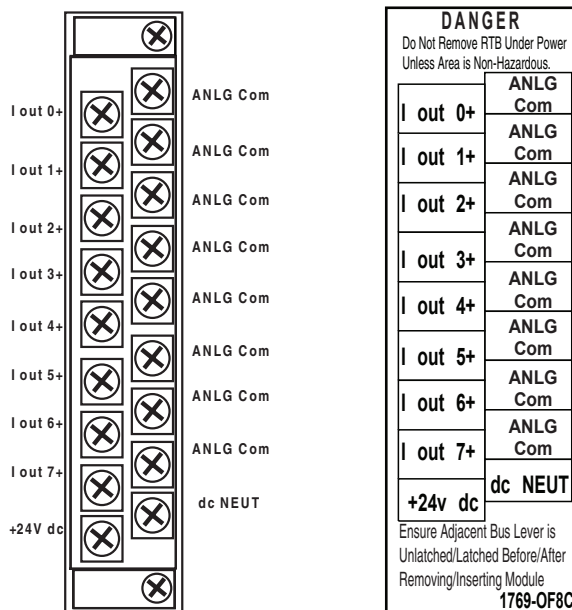
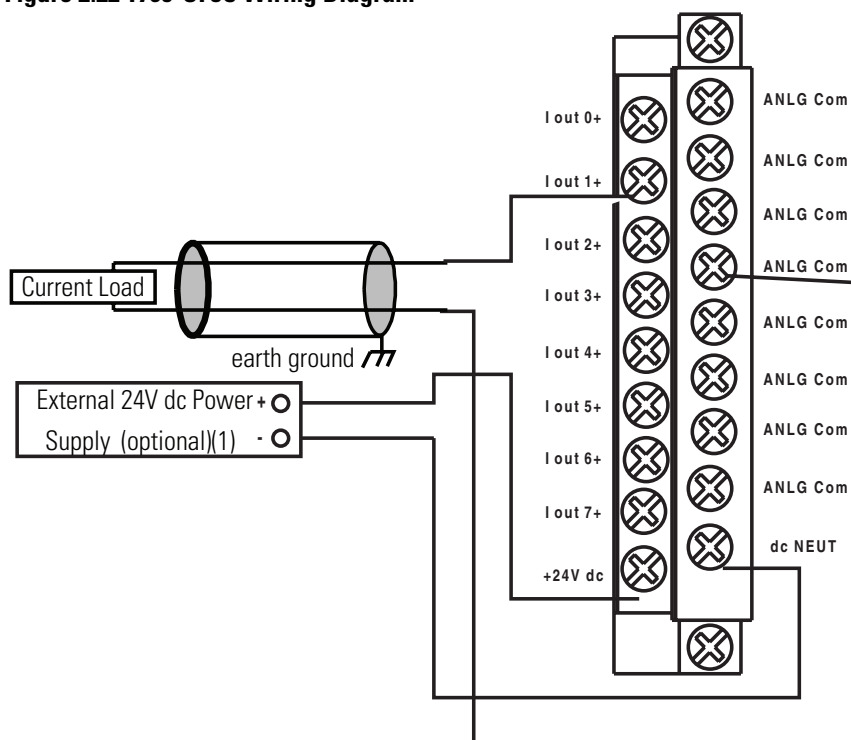


Figure 2.22 1769-OF8C Wiring Diagram



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 120 mA minimum per output module.

Figure 2.23 1769-OF8V Terminal Layout

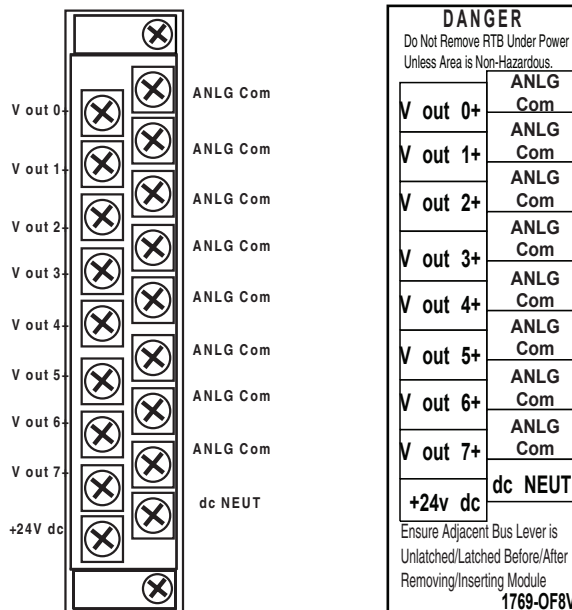
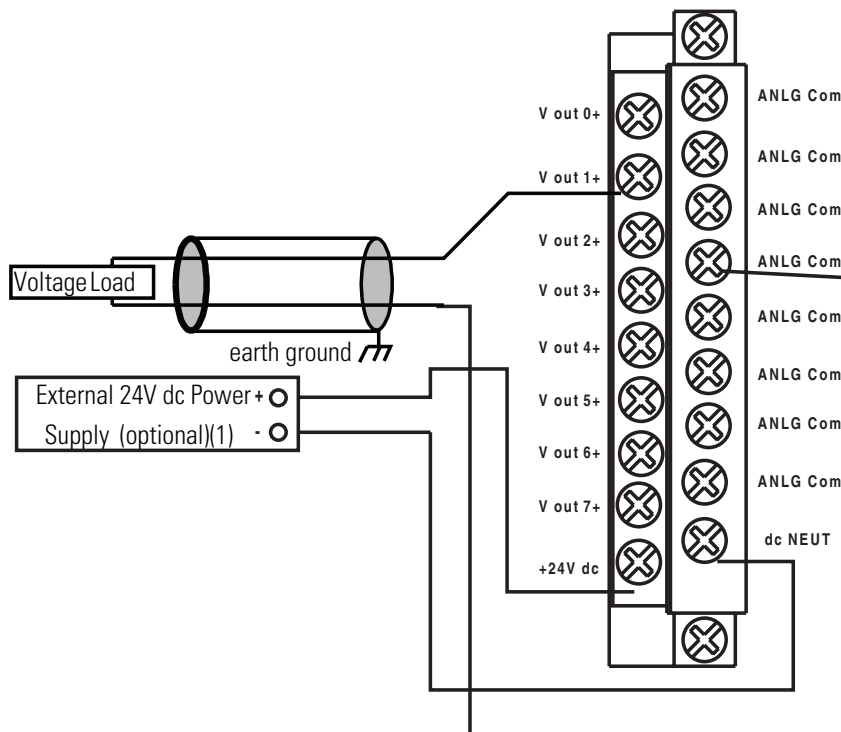


Figure 2.24 1769-OF8V Wiring Diagram



(1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 120 mA minimum per output module.

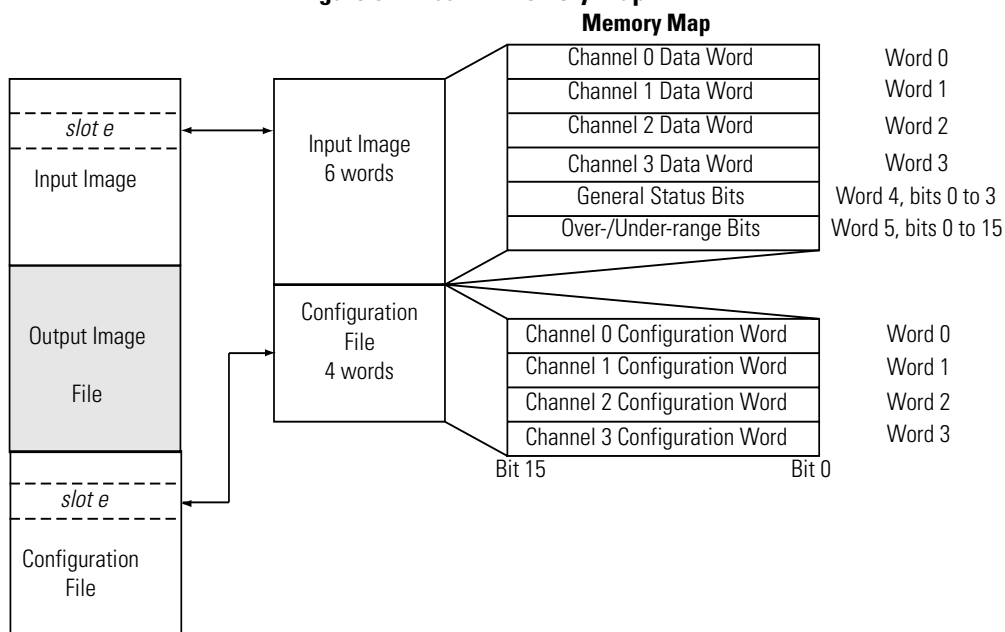
Module Data, Status, and Channel Configuration for the Input Modules

This chapter examines the analog input modules' data table, channel status, and channel configuration word. The 1769-IF4 module information follows. For 1769-IF8 module information, see page 3-16.

1769-IF4 Input Module Addressing

The 1769-IF4 memory map shows the input and configuration image tables for the 1769-IF4. Detailed information on the input image table can be found in 1769-IF4 Input Data File on page 3-2.

Figure 3.1 1769-IF4 Memory Map



1769-IF4 Input Image

The 1769-IF4 input image file represents data words and status bits. Input words 0 through 3 hold the input data that represents the value of the analog inputs for channels 0 through 3. These data words are valid only when the channel is enabled and there are no errors. Input words 4 and 5 hold the status bits. 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.

1769-IF4 Configuration File

The configuration file contains information that you use to define the way a specific channel functions. The configuration file is explained in more detail in 1769-IF4 Configuration Data File on page 3-4.

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

1769-IF4 Input Data File

The input data table lets you access analog input module read data for use in the control program, via word and bit access. The data table structure is shown in table below.

Table 3.1 1769-IF4 Input Data Table

Word/Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	SGN		Analog Input Data Value Channel 0													
Word 1	SGN		Analog Input Data Value Channel 1													
Word 2	SGN		Analog Input Data Value Channel 2													
Word 3	SGN		Analog Input Data Value Channel 3													
Word 4	Not Used (Bits set to 0)												S3	S2	S1	S0
Word 5	U0	00	U1	01	U2	02	U3	03	Set to zero							

1769-IF4 Input Data Values

Words 0 through 3 contain the converted analog input data from the field device. The most significant bit (MSB) is the sign bit.

General Status Bits (S0 through S3)

Word 4, bits 0 through 3 contain the general operational status bits for input channels 0 through 3. If set (1), these bits indicate an error associated with that channel. The over- and under-range bits for channels 0 through 3 are logically ORed to the appropriate general status bit.

Over-Range Flag Bits (O0 through O3)

Over-range bits for channels 3 through 0 are contained in word 5, bits 8, 10, 12, and 14. They apply to all input types. When set (1), this bit indicates input signals beyond the normal operating range. However, the module continues to convert analog data to the maximum full range value. The bit is automatically reset (0) by the module when the over-range condition is cleared and the data value is within the normal operating range.

Under-Range Flag Bits (U0 through U3)

Under-range bits for channels 3 through 0 are contained in word 5, bits 9, 11, 13, and 15. They apply to all input types. When set (1), this bit indicates input signals below the normal operating range. It may also indicate an open circuit condition, when the module is configured for the 4 to 20 mA range. However, the module continues to convert analog data to the minimum full range value. The bit is automatically reset (0) by the module when the under-range condition is cleared and the data value is within the normal operating range.

1769-IF4 Configuration Data File

The configuration file lets you determine how each individual input channel will operate. Parameters such as the input type and data format are set up using this file. This data file is writable and readable. The default value of the configuration data table is all zeros. The structure of the channel configuration file is shown below.

Table 3.2 1769-IF4 Configuration Data Table⁽¹⁾

Word/Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	Enable Channel 0	Input Data Format Select Channel 0			Input Type/Range Select Channel 0			Reserved			Input Filter Select Channel 0					
Word 1	Enable Channel 1	Input Data Format Select Channel 1			Input Type/Range Select Channel 1			Reserved			Input Filter Select Channel 1					
Word 2	Enable Channel 2	Input Data Format Select Channel 2			Input Type/Range Select Channel 2			Reserved			Input Filter Select Channel 2					
Word 3	Enable Channel 3	Input Data Format Select Channel 3			Input Type/Range Select Channel 3			Reserved			Input Filter Select Channel 3					

⁽¹⁾ The ability to change these values using your control program is not supported by all controllers. Refer to your controller manual for details.

The configuration file is typically modified using the programming software configuration screen. For information on configuring the module using MicroLogix 1500 and RSLogix 500, see Appendix B; for CompactLogix and RSLogix 5000, see Appendix C; for 1769-ADN DeviceNet Adapter and RSNetWorx, see Appendix D.

The configuration file can also be modified through the control program, if supported by the controller. The structure and bit settings are shown in Channel Configuration on page 3-5.

Channel Configuration

Each channel configuration word consists of bit fields, the settings of which determine how the channel operates. See the table below and the descriptions that follow for valid configuration settings and their meanings. The default bit status of the configuration file is all zeros.

Table 3.3 Bit Definitions for Channel Configuration Words 0 through 3

Bit(s)	Define	These bit settings																Indicate this
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
0 to 3	Input Filter Select													0	0	0	0	60 Hz
														0	0	0	1	50 Hz
														0	0	1	0	Not Used
														0	0	1	1	250 Hz
														0	1	0	0	500 Hz
4 to 7	Reserved																Reserved ⁽²⁾	
8 to 11	Input Type/Range Select					0	0	0	0	Not Used								-10 to +10V dc
						0	0	0	1		0 to 5V dc							
						0	0	1	0		0 to 10V dc							
						0	0	1	1		4 to 20 mA							
						0	1	0	0		1 to 5V dc							
						0	1	0	1		0 to 20 mA							
																Not Used ¹		
12 to 14	Input Data Format Select		0	0	0												Raw/Proportional Data	
			0	0	1												Engineering Units	
			0	1	0												Scaled for PID ⁽³⁾	
			0	1	1												Percent Range	
																	Not Used ¹	
15	Enable Channel	1															Enabled	
		0															Disabled	

⁽¹⁾ Any attempt to write a non-valid (not used) bit configuration into any selection field results in a module configuration error. See Configuration Errors on page 5-6.

⁽²⁾ If reserved bits are not equal to zero, a configuration error occurs.

⁽³⁾ This range is applicable to the PID function of the MicroLogix 1500 packaged controller, PLC, or SLC controllers. Logix controllers can use this or one of the other ranges for their PID functions.

Enable/Disable Channel

This configuration selection lets each channel to be individually enabled.

TIP

When a channel is not enabled (0), no voltage or current input is provided to the controller by the A/D converter.

Input Filter Selection

The input filter selection field lets you select the filter frequency for each channel and provides system status of the input filter setting for analog input channels 0 through 3. The filter frequency affects the noise rejection characteristics, as explained below. Select a filter frequency considering acceptable noise and step response time.

Noise Rejection

The 1769-IF4 uses a digital filter that provides noise rejection for the input signals. The filter is programmable, allowing you to select from four filter frequencies for each channel. The digital filter provides the highest noise rejection at the selected filter frequency. A lower frequency (60 Hz versus 250 Hz) can provide better noise rejection but it increases channel update time. Transducer power supply noise, transducer circuit noise, or process variable irregularities may also be sources of normal mode noise.

Common Mode Rejection is better than 60 dB at 50 and 60 Hz, with the 50 and 60 Hz filters selected, respectively. The module performs well in the presence of common mode noise as long as the signals applied to the user plus and minus input terminals do not exceed the common mode voltage rating (± 10 V) of the module. Improper earth ground may be a source of common mode noise.

Channel Step Response

The selected channel filter frequency determines the channel's step response. The step response is the time required for the analog input signal to reach 100% 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 3.4 Filter Frequency and Step Response

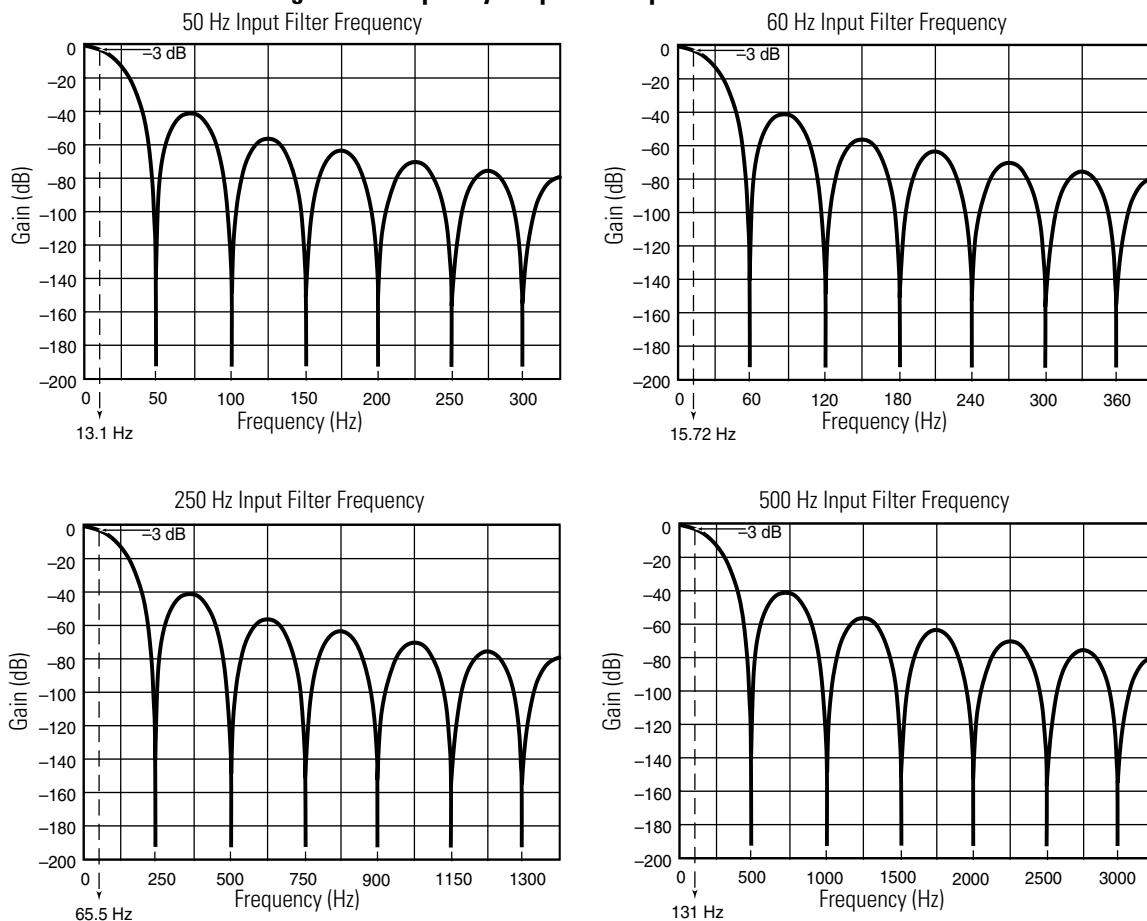
Filter Frequency	Cut-off Frequency	Step Response
50 Hz	13.1 Hz	60 ms
60 Hz	15.7 Hz	50 ms
250 Hz	65.5 Hz	12 ms
500 Hz	131 Hz	6 ms

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 frequency response curve where 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 as shown in the graphs below.

The cut-off frequency for each channel is defined by its filter frequency selection. Choose a filter frequency so that your fastest changing signal is below that of the filter's cut-off frequency. The cut-off frequency should not be confused with the update time. The cut-off frequency relates to how the digital filter attenuates frequency components of the input signal. The update time defines the rate at which an input channel is scanned and its channel data word is updated.

Figure 3.2 Frequency Response Graphs



Module Update Time and Scanning Process

The module update time is defined as the time required for the module to sample and convert the input signals of all 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.

Figure 3.3 Sequential Sampling

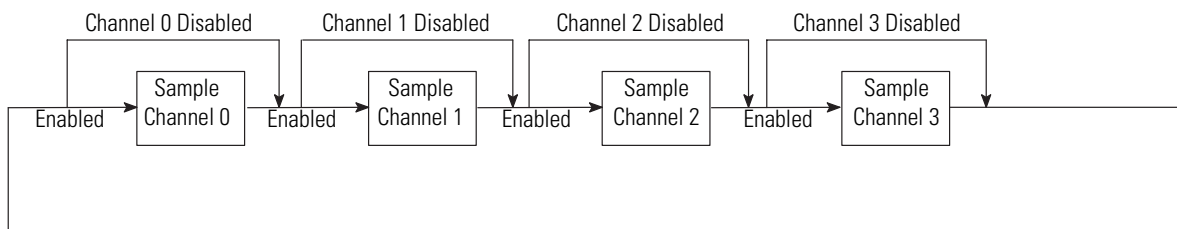


Table 3.5 shows the channel update times. The fastest module update time occurs when only one channel is enabled with a 500 Hz filter (4 ms). If more than one channel is enabled, the update time is faster if both channels have the same configuration. See the first example on page 3-9. The slowest module update time occurs when all four channels are enabled with different configurations. See the second example on page 3-9.

Table 3.5 Channel Update Time

Filter Frequency	Channel Update Time
50 Hz	22 ms
60 Hz	19 ms
250 Hz	6 ms
500 Hz	4 ms

Channel Switching and Reconfiguration Times

The table below provides the channel switching and reconfiguration times for a channel.

Table 3.6 Channel Switching and Reconfiguration Times

	Description	Duration			
		50 Hz	60 Hz	250 Hz	500 Hz
Channel Switching Time	The time it takes the module to switch from one channel to another.	46 ms	39 ms	14 ms	10 ms
Channel-to-Channel Reconfiguration Time	The time it takes the module to change its configuration settings for a difference in configuration between one channel and another.	116 ms	96 ms	20 ms	8 ms

Examples of Calculating Module Update Time

EXAMPLE

1. Two Channels Enabled with Identical Configurations

The following example calculates the 1769-IF4 module update time for two channels enabled with the same configuration and a 500 Hz filter.

$$\text{Module Update Time} = [\text{Ch 0 Update Time} + \text{Ch 0 Switching Time}] + [\text{Ch 1 Update Time} + \text{Ch 1 Switching Time}]$$

$$28 = [4 \text{ ms} + 10 \text{ ms}] + [4 \text{ ms} + 10 \text{ ms}]$$

EXAMPLE

2. Three Channels Enabled with Different Configurations

The following example calculates the module update time for three channels with the following configurations:

- Channel 0: $\pm 10\text{V}$ dc with 60 Hz filter
- Channel 1: $\pm 10\text{V}$ dc with 500 Hz filter
- Channel 2: 4 to 20 mA with 250 Hz filter

$$\text{Module Update Time} = [\text{Ch 0 Reconfiguration Time} + \text{Ch 0 Update Time} + \text{Ch 0 Switching Time}]$$

+

$$[\text{Ch 1 Reconfiguration Time} + \text{Ch 1 Update Time} + \text{Ch 1 Switching Time}]$$

+

$$[\text{Ch 2 Reconfiguration Time} + \text{Ch 2 Scan Time} + \text{Ch 2 Switching Time}]$$

$$216 = [96 \text{ ms} + 19 \text{ ms} + 39 \text{ ms}] + [8 \text{ ms} + 4 \text{ ms} + 10 \text{ ms}] + [20 \text{ ms} + 6 \text{ ms} + 14 \text{ ms}]$$

Input Type/Range Selection

This selection along with proper input wiring lets you configure each channel individually for current or voltage ranges and provides the ability to read the current range selections.

Input Data Selection Formats

This selection configures channels 0 through 3 to present analog data in any of the following formats:

- Raw/Proportional Data
- Engineering Units
- Scaled-for-PID
- Percent Range

Raw/Proportional Data

The value presented to the controller is proportional to the selected input and scaled into the maximum data range allowed by the bit resolution of the A/D converter and filter selected. The full range for a $\pm 10\text{Vdc}$ user input is -32767 to +32767. See Table 3.7 Valid Input Data on page 3-11.

Engineering Units

The module scales the analog input data to the actual current or voltage values for the selected input range. The resolution of the engineering units is dependent on the range selected and the filter selected. See Table 3.7 Valid Input Data on page 3-11.

Scaled-for-PID

The value presented to the controller is a signed integer with zero representing the lower user range and 16383 representing the upper user range. Allen-Bradley controllers, such as the MicroLogix 1500, use this range in their PID equations. The amount over and under user range (full scale range -410 to 16793) is also included. See Table 3.7 Valid Input Data on page 3-11.

Percent Range

The input data is presented as a percentage of the user range. For example, 0V to 10V dc equals 0% to 100%. See Table 3.7 on page 3-11.

TIP

The $\pm 10\text{V}$ dc range does not support the percent user range data format.

Valid Input Data Word Formats/Ranges

The following table shows the valid formats and min./max. data ranges provided by the module.

Table 3.7 Valid Input Data

1769-IF4 Input Range	Input Value	Example Data	Input Range Condition	Raw/Proportional Data	Engineering Unit	Scaled-for-PID	Percent Full Range
				Decimal Range	Decimal Range	Decimal Range	Decimal Range
-10V to +10V dc	Over 10.5V dc	+11.0V dc	Over-range	32767 (max.)	10500 (max.)	16793 (max.)	N/A
	+10.5V dc	+ 10.5V dc	Over-range	32767 (max.)	10500 (max.)	16793 (max.)	N/A
	-10V to +10V dc	+10.0V dc	Normal	31206	10000	16383	N/A
		0.0V dc	Normal	0	0	8192	N/A
		-10.0V dc	Normal	-31206	-10000	0	N/A
	-10.5Vdc	-10.5V dc	Under-range	-32767 (min.)	-10500 (min.)	-410 (min.)	N/A
	Under -10.5V dc	-11.0V dc	Under-range	-32767 (min.)	-10500 (min.)	-410 (min.)	N/A
0V to 5V dc	Over 5.25V dc	5.5V dc	Over-range	32767 (max.)	5250 (max.)	17202 (max.)	10500 (max.)
	5.25V dc	5.25V dc	Over-range	32767 (max.)	5250 (max.)	17202 (max.)	10500 (max.)
	0.0V dc to 5.0V dc	5.0V dc	Normal	31206	5000	16383	10000
		0.0V dc	Normal	0	0	0	0
	-0.5V dc	-0.5V dc	Under-range	-3121 (min.)	-500 (min.)	-1638 (min.)	-1000 (min.)
	Under -0.5V dc	-1.0V dc	Under-range	-3121 (min.)	-500 (min.)	-1638 (min.)	-1000 (min.)
0V to 10V dc	Over 10.5V dc	11.0V dc	Over-range	32767 (max.)	10500 (max.)	17202 (max.)	10500 (max.)
	+10.5V dc	10.5V dc	Over-range	32767 (max.)	10500 (max.)	17202 (max.)	10500 (max.)
	0.0V dc to 10.0V dc	10.0V dc	Normal	31206	10000	16383	10000
		0.0V dc	Normal	0	0	0	0
	-0.5V dc	-0.5V dc	Under-range	-1560 (min.)	-500 (min.)	-819 (min.)	-500 (min.)
	Under -5.0V dc	-1.0V dc	Under-range	-1560 (min.)	-500 (min.)	-819 (min.)	-500 (min.)
4 mA to 20 mA	Over 21.0 mA	22.0 mA	Over-range	32767 (max.)	21000 (max.)	17407 (max.)	10625 (max.)
	21.0 mA	21.0 mA	Over-range	32767 (max.)	21000 (max.)	17407 (max.)	10625 (max.)
	4.0 mA to 20.0 mA	20.0 mA	Normal	31206	20000	16383	10000
		4.0 mA	Normal	6241	4000	0	0
	3.2 mA	3.2 mA	Under-range	4993 (min.)	3200 (min.)	-819 (min.)	-500 (min.)
	Under 3.2 mA	0.0 mA	Under-range	4993 (min.)	3200 (min.)	-819 (min.)	-500 (min.)

Table 3.7 Valid Input Data

1769-IF4 Input Range	Input Value	Example Data	Input Range Condition	Raw/Proportional Data	Engineering Unit	Scaled-for-PID	Percent Full Range
				Decimal Range	Decimal Range	Decimal Range	Decimal Range
1.0V to 5V dc	Over 5.25V dc	5.5V dc	Over-range	32767 (max.)	5250	17407	10625
	+5.25V dc	5.25V dc	Over-range	32767 (max.)	5250	17407	10625
	1.0V to 5.0V dc	5.0V dc	Normal	31206	5000	16383	10000
		1.0V dc	Normal	6243	1000	1	1
	0.5V dc	0.5V dc	Under-range	3121 (min.)	500	-2048	-1250
	Under 0.5V dc	0.0V dc	Under-range	3121 (min.)	500	-2048	-1250
0 mA to 20 mA	Over 21.0 mA	22.0 mA	Over-range	32767	21000	17202	10500
	21.0 mA	21.0 mA	Over-range	32767	21000	17202	10500
	0.0 mA to 20.0 mA	20.0 mA	Normal	31206	20000	16383	10000
		0.0 mA	Normal	0	0	0	0
	Under 0.0 mA	0.0 mA	Under-range	0	0	0	0

Effective Resolution

The effective resolution for an input channel depends upon the filter frequency selected for that channel. The following tables provide the effective resolution for the four frequencies for each of the range selections.

Table 3.8 50Hz / 60Hz Effective Resolution

1769-IF4 Input Range	Raw/Proportional Data Over the Full Input Range		Engineering Units Over the Full Input Range		Scaled-For-PID Over the Full Input Range		Percent Over the Full Input Range	
	Bits and Engineering Units Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value
-10 to +10V dc	Sign +14 0.64 mV/ 2 counts	±32767 Count by 2	1.00 mV/ 1 count	±10500 Count by 1	1.22 mV/ 1 count	-410 to +16793 Count by 1	Not Applicable	Not Applicable
0 to +5V dc	Sign +13 0.64 mV/ 4 counts	-3121 to +32767 Count by 4	1.00 mV/ 1 count	-500 to +5250 Count by 1	0.92 mV/ 3 counts	-1638 to +17202 Count by 3	1.00 mV/ 2 counts	-1000 to +10500 Count by 2
0 to +10V dc	Sign +14 0.64 mV/ 2 counts	-1560 to +32767 Count by 2	1.00 mV/ 1 count	-500 to +10500 Count by 1	1.22 mV/ 2 counts	-819 to +17202 Count by 2	1.00 mV/ 1 count	-500 to +10500 Count by 1
+4 to +20 mA	Sign +14 1.28 µA/ 2 counts	+4993 to +32767 Count by 2	2.00 µA/ 2 counts	+3200 to +2100 Count by 2	1.95 µA/ 2 counts	-819 to +17407 Count by 2	1.60 µA/ 1 count	-500 to +10625 Count by 1
+1 to +5V dc	Sign +13 0.64 mV/ 4 counts	+3121 to +32767 Count by 4	1.00 mV/ 1 count	+500 to +5250 Count by 1	0.73 mV/ 3 counts	-2048 to +17407 Count by 3	0.80 mV/ 2 counts	-1250 to +10625 Count by 2
0 to +20 mA	Sign +14 1.28 µA/ 2 counts	0 to +32767 Count by 2	2.00 µA/ 2 counts	0 to +21000 Count by 2	2.44 µA/ 2 counts	0 to +17202 Count by 2	2.00 µA/ 1 count	0 to +10500 Count by 1

Table 3.9 250Hz Effective Resolution

1769-IF4 Input Range	Raw/Proportional Data Over the Full Input Range		Engineering Units Over the Full Input Range		Scaled-For-PID Over the Full Input Range		Percent Over the Full Input Range	
	Bits and Engineering Units Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value
-10 to +10V dc	Sign +11 5.13 mV/ 16 counts	±32767 Count by 16	6.00 mV/ 6 counts	±10500 Count by 6	6.10 mV/ 5 counts	-410 to +16793 Count by 5	Not Applicable	Not Applicable
0 to +5V dc	Sign +10 5.13 mV/ 32 counts	-3121 to +32767 Count by 32	6.00 mV/ 6 counts	-500 to +5250 Count by 6	5.19 mV/ 17 counts	-1638 to +17202 Count by 17	5.50 mV/ 11 counts	-1000 to +10500 Count by 11
0 to +10V dc	Sign +11 5.13 mV/ 16 counts	-1560 to +32767 Count by 16	6.00 mV/ 6 counts	-500 to +10500 Count by 6	5.49 mV/ 9 counts	-819 to +17202 Count by 9	6.00 mV/ 6 counts	-500 to +10500 Count by 6
+4 to +20 mA	Sign +11 10.25 µA/ 16 counts	+4993 to +32767 Count by 2	11.00 µA/ 11 counts	+3200 to +2100 Count by 11	10.74 µA/ 11 counts	-819 to +17407 Count by 11	11.20 µA/ 7 counts	-500 to +10625 Count by 7
+1 to +5V dc	Sign +10 5.13 mV/ 32 counts	+3121 to +32767 Count by 32	6.00 mV/ 6 counts	+500 to +5250 Count by 6	5.37 mV/ 22 counts	-2048 to +17407 Count by 22	5.20 mV/ 13 counts	-1250 to +10625 Count by 13
0 to +20 mA	Sign +11 10.25 µA/ 16 counts	0 to +32767 Count by 16	11.00 µA/ 11 counts	0 to +21000 Count by 11	10.99 µA/ 9 counts	0 to +17202 Count by 9	12.00 µA/ 6 counts	0 to +10500 Count by 6

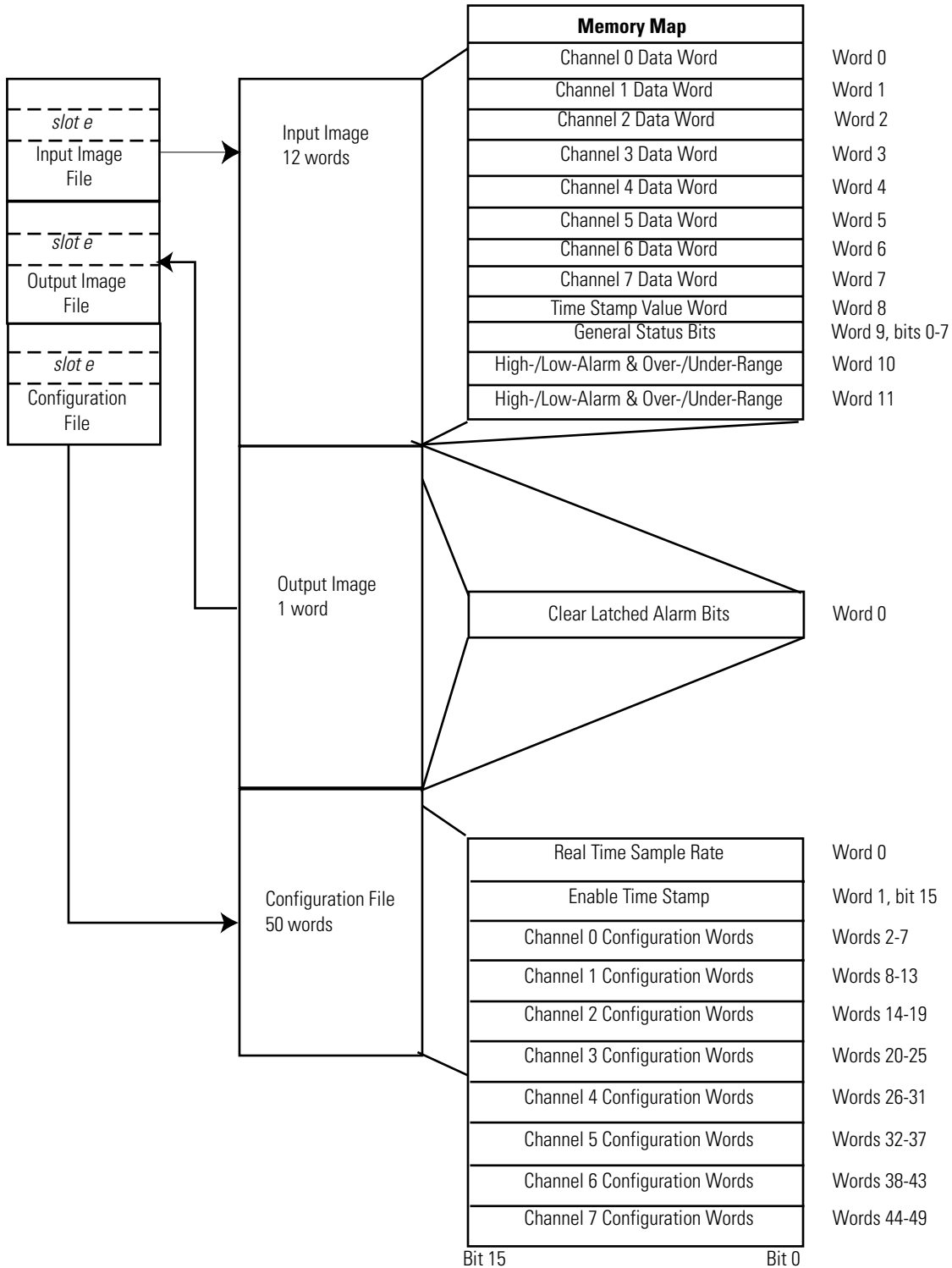
Table 3.10 500 Hz Effective Resolution

1769-IF4 Input Range	Raw/Proportional Data Over the Full Input Range		Engineering Units Over the Full Input Range		Scaled-For-PID Over the Full Input Range		Percent Over the Full Input Range	
	Bits and Engineering Units Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value
-10 to +10V dc	Sign +9 20.51 mV/ 64 counts	±32767 Count by 64	21.00 mV/ 21 counts	±10500 Count by 21	20.75 mV/ 17 counts	-410 to +16793 Count by 17	Not Applicable	Not Applicable
0 to +5V dc	Sign +8 20.51 mV/ 128 counts	-3121 to +32767 Count by 128	21.00 mV/ 21 counts	-500 to +5250 Count by 21	20.75 mV/ 68 counts	-1638 to +17202 Count by 68	21.00 mV/ 42 counts	-1000 to +10500 Count by 42
0 to +10V dc	Sign +9 20.51 mV/ 64 counts	-1560 to +32767 Count by 64	21.00 mV/ 21 counts	-500 to +10500 Count by 21	20.75 mV/ 34 counts	-819 to +17202 Count by 34	21.00 mV/ 21 counts	-500 to +10500 Count by 21
+4 to +20 mA	Sign +9 41.02 µA/ 64 counts	+4993 to +32767 Count by 64	42.00 µA/ 42 counts	+3200 to +2100 Count by 42	41.02 µA/ 42 counts	-819 to +17407 Count by 42	41.60 µA/ 26 counts	-500 to +10625 Count by 26
+1 to +5V dc	Sign +8 20.51 mV/ 128 counts	+3121 to +32767 Count by 128	21.00 mV/ 21 counts	+500 to +5250 Count by 21	20.75 mV/ 84 counts	-2048 to +17407 Count by 84	20.8 mV/ 52 counts	-1250 to +10625 Count by 52
0 to +20 mA	Sign +9 41.02 µA/ 64 counts	0 to +32767 Count by 64	42.00 µA/ 42 counts	0 to +21000 Count by 42	41.51 µA/ 34 counts	0 to +17202 Count by 34	42.00 µA/ 21 counts	0 to +10500 Count by 21

1769-IF8 Input Module Addressing

The 1769-IF8 memory map shows the output, input, and configuration tables for the 1769-IF8.

Figure 3.4 1769-IF8 Memory Map



1769-IF8 Input Image

The 1769-IF8 input image file represents data words and status bits. Input words 0 through 7 hold the input data that represents the value of the analog inputs for channels 0 through 7. These data words are valid only when the channel is enabled and there are no errors. Input words 9 and 11 hold the status bits. 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.

1769-IF8 Output Image

The 1769-IF8 output image file contains the clear alarm control bits for the high- and low-alarm bits on each input channel. These bits are used to clear alarms when alarms are latched.

TIP

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

1769-IF8 Configuration File

The configuration file contains information that you use to define the way a specific channel functions. The configuration file is explained in more detail in 1769-IF8 Configuration Data File on page 3-20.

TIP

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

1769-IF8 Input Data File

The input data table lets you access analog input module read data for use in the control program, via word and bit access. The data table structure is shown in the table below. For each input module, slot x, words 0-7 in the input data file contain the analog values of the inputs.

Table 3.11 1769-IF8 Input Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	SGN	Analog Input Data Channel 0														
1	SGN	Analog Input Data Channel 1														
2	SGN	Analog Input Data Channel 2														
3	SGN	Analog Input Data Channel 3														
4	SGN	Analog Input Data Channel 4														
5	SGN	Analog Input Data Channel 5														
6	SGN	Analog Input Data Channel 6														
7	SGN	Analog Input Data Channel 7														
8	Nu	Time Stamp Value														
9	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	S7	S6	S5	S4	S3	S2	S1	S0
10	L3	H3	U3	O3	L2	H2	U2	O2	L1	H1	U1	O1	L0	H0	U0	O0
11	L7	H7	U7	O7	L6	H6	U6	O6	L5	H5	U5	O5	L4	H4	U4	O4

1769-IF8 Input Data Values

Words 0 through 7 contain the converted analog input data from the field device. The most significant bit (MSB) is the sign bit, which is in two's complement format. (Nu indicates not used with the bit set to 0.)

General Status Bits (S0 through S7)

Word 9, bits 0 through 7 contain the general operational status bits for input channels 0 through 7. If set (1), these bits indicate an error associated with that channel. The over- and under-range bits and the high- and low-alarm bits for channels 0 through 7 are logically ORed to the appropriate general status bit.

Low Alarm Flag Bits (L0 through L7)

Word 10, bits 3, 7, 11, and 15 and Word 11, bits 3, 7, 11, 15 contain the low alarm flag bits for input channels 0 through 7. If set (1), these bits indicate the input signal is outside the user-defined range. The module continues to convert analog data to minimum full-range values. The bit is automatically reset (0) when the low alarm condition clears, unless the channel's alarm bits are latched. If the channel's alarm bits are latched, a set (1) low alarm flag bit clears via the corresponding Clear Alarm Latch bit in your output data file.

High Alarm Flag Bits (H0 through H7)

Word 10, bits 2, 6, 10, 14 and Word 11, bits 2, 6, 10, 14 contain the high alarm flag bits for input channels 0 through 7 and applies to all input types. If set (1), the input signal is output the user-defined range. The module continues to convert analog data to maximum full-range values. The bit is automatically reset (0) when the high alarm condition clears, unless the channel's alarm bits are latched. If the channel's alarm bits are latched, a set (1) high alarm flag bit clears via the corresponding Clear Alarm Latch bit in your output data file.

Over-Range Flag Bits (O0 through O7)

Over-range bits for channels 0 through 7 are contained in Word 10, bits 0, 4, 8, 12 and Word 11, bits 0, 4, 8, 12. They apply to all input types. When set (1), this bit indicates input signals beyond the normal operating range. However, the module continues to convert analog data to the maximum full range value. The bit is automatically reset (0) by the module when the over-range condition is cleared and the data value is within the normal operating range.

Under-Range Flag Bits (U0 through U7)

Under-range bits for channels 0 through 7 are contained in Word 10, bits 1, 5, 9, 13 and Word 11, bits 1, 5, 9, 13. They apply to all input types. When set (1), this bit indicates input signals below the normal operating range. It may also indicate an open circuit condition, when the module is configured for the 4 to 20 mA range. However, the module continues to convert analog data to the minimum full range value. The bit is automatically reset (0) by the module when the under-range condition is cleared and the data value is within the normal operating range.

Time Stamp Value (Word 8)

The 1769-IF8 supports a 15-bit rolling timestamp that is updated during each new sampling period of the analog inputs. The timestamp has a 1 ms resolution. The timestamp value is placed in the input image file, word 8, for each module input data update (if the timestamp function is enabled). Enable and/or disable this timestamp in the configuration file.

1769-IF8 Output Data File

The output data table lets you access analog output module write data for use in the control program, via word and bit access. The data table structure is shown in the table below.

Table 3.12 1769-IF8 Output Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	CL ⁽¹⁾ L7	CL ⁽²⁾ H7	CL L6	CL H6	CL L5	CL H5	CL L4	CL H4	CL L3	CL H3	CL L2	CL H2	CL L1	CL H1	CL L0	CL H0

⁽¹⁾ CL Lx = Cancel Low Process Alarm Latch x. This lets you individually cancel each low process alarm latch. Cancel = 1.

⁽²⁾ CL Hx = Cancel High Process Alarm Latch x. This lets you individually cancel each high process alarm latch.

These bits are written during run mode to clear any latched low- and high-process alarms. The alarm is unlatched when the unlatch bit is set (1) and the alarm condition no longer exists. If the alarm condition persists, then the unlatch bit has no effect until the alarm condition no longer exists. You need to keep the unlatch bit set until verification from the appropriate input channel status word that the alarm status bit has cleared (0). Then you need to reset (0) the unlatch bit. The module will not latch an alarm condition if a transition from no alarm to alarm occurs while a channel's clear latch bit is set.

1769-IF8 Configuration Data File

The configuration file lets you determine how each individual input channel will operate. Parameters such as the input type and data format are set up using this file. This data file is writable and readable. The default value of the configuration data table is all zeros. The structure of the channel configuration file is shown below.

Table 3.13 1769-IF8 Configuration Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Real Time Sample Value															
1	ETS	Reserved														
2	EC	Reserved				EA	AL	EI ⁽¹⁾	Reserved				Input Filter Sel ChI0			
3	Reserved				Inpt Dta Fm ChI0				Reserved				Inpt Tp/RngeSel ChI0			
4	S	Process Alarm High Data Value Channel 0														
5	S	Process Alarm Low Data Value Channel 0														
6	S	Alarm Dead Band Value Channel 0														
7	Reserved															
8	EC	Reserved				EA	AL	EI ⁽¹⁾	Reserved				Inpt Filter Sel ChI1			
9	Reserved				Inpt Dta Fm ChI1				Reserved				Inpt Tp/RngeSel ChI1			
10	S	Process Alarm High Data Value Channel 1														
11	S	Process Alarm Low Data Value Channel 1														

Table 3.13 1769-IF8 Configuration Data Table

12	S	Alarm Dead Band Value Channel 1					
13	Reserved						
14	EC	Reserved	EA	AL	EI ⁽¹⁾	Reserved	Input Filter Sel ChI2
15	Reserved		Inpt Dta Fm ChI2		Reserved		Inpt Tp/RngeSel ChI2
16	S	Process Alarm High Data Value Channel 2					
17	S	Process Alarm Low Data Value Channel 2					
18	S	Alarm Dead Band Value Channel 2					
19	Reserved						
20	EC	Reserved	EA	AL	EI ⁽¹⁾	Reserved	Input Filter Sel ChI3
21	Reserved		Inpt Dta Fm ChI3		Reserved		Inpt Tp/RngeSel ChI3
22	S	Process Alarm High Data Value Channel 3					
23	S	Process Alarm Low Data Value Channel 3					
24	S	Alarm Dead Band Value Channel 3					
25	Reserved						
26	EC	Reserved	EA	AL	EI ⁽¹⁾	Reserved	Input Filter Sel ChI4
27	Reserved		Inpt Dta Fm ChI4		Reserved		Inpt Tp/RngeSel ChI4
28	S	Process Alarm High Data Value Channel 4					
29	S	Process Alarm Low Data Value Channel 4					
30	S	Alarm Dead Band Value Channel 4					
31	Reserved						
32	EC	Reserved	EA	AL	EI ⁽¹⁾	Reserved	Input Filter Sel ChI5
33	Reserved		Inpt Dta Fm ChI5		Reserved		Inpt Tp/RngeSel ChI5
34	S	Process Alarm High Data Value Channel 5					
35	S	Process Alarm Low Data Value Channel 5					
36	S	Alarm Dead Band Value Channel 5					
37	Reserved						
38	EC	Reserved	EA	AL	EI ⁽¹⁾	Reserved	Input Filter Sel ChI6
39	Reserved		Inpt Dta Fm ChI6		Reserved		Inpt Tp/RngeSel ChI6
40	S	Process Alarm High Data Value Channel 6					
41	S	Process Alarm Low Data Value Channel 6					
42	S	Alarm Dead Band Value Channel 6					
43	Reserved						
44	EC	Reserved	EA	AL	EI ⁽¹⁾	Reserved	Input Filter Sel ChI7
45	Reserved		Inpt Dta Fm ChI7		Reserved		Inpt Tp/RngeSel ChI7
46	S	Process Alarm High Data Value Channel 7					
47	S	Process Alarm Low Data Value Channel 7					
48	S	Alarm Dead Band Value Channel 7					
49	Reserved						

⁽¹⁾ CompactLogix L43 controllers will be able to support these interrupts.

The configuration file is typically modified using the programming software configuration screen. For information on configuring the module using MicroLogix 1500 and RSLogix 500, see Appendix B; for CompactLogix and RSLogix 5000, see Appendix C; for 1769-ADN DeviceNet Adapter and RSNetWorx, see Appendix D.

The configuration file can also be modified through the control program, if supported by the controller. The structure and bit settings are shown in Channel Configuration on page 3-22.

Channel Configuration

Each channel's configuration words consist of bit fields, the settings of which determine how the channel operates. See the table below and the descriptions that follow for valid configuration settings and their meanings. The default bit status of the configuration file is all zeros.

Table 3.14 Bit Definitions for Channel Configuration Words

Define	To Select	Make these bit settings													
		15	14	13	12	11	10	9	8	7-4	3	2	1	0	
Input Filter Selection/ -3 dB Frequency	60 Hz											0	0	0	0
	50 Hz											0	0	0	1
	10 Hz											0	0	1	0
	250 Hz											0	0	1	1
	500 Hz											0	1	0	0
Enable Interrupt	Enable														
	Disable														
Process Alarm Latch	Enable								1						
	Disable								0						
Enable Process Alarms	Enable									1					
	Disable									0					
Enable Channel	Enable	1													
	Disable	0													

Table 3.15 Bit Definitions for Input Range and Input Data

Define	Indicate this	These bit settings												
		15-11	10	9	8	7-4	3	2	1	0				
Input Range Select	-10 to +10V dc										0	0	0	0
	0 to 5V dc										0	0	0	1
	0 to 10V dc										0	0	1	0
	4 to 20 mA										0	0	1	1
	1 to 5V dc										0	1	0	0
	0 to 20 mA										0	1	0	1
Input Data Format Select	Raw/Proportional Counts		0	0	0									
	Engineering Units		0	0	1									
	Scaled for PID		0	1	0									
	Percent Range		0	1	1									

Enable/Disable Channel

This configuration selection lets each channel to be individually enabled.

TIP

When a channel is not enabled (0), no voltage or current input is provided to the controller by the A/D converter.

Input Filter Selection

The input filter selection field lets you select the filter frequency for each channel and provides system status of the input filter setting for analog input channels 0 through 3. The filter frequency affects the noise rejection characteristics, as explained below. Select a filter frequency considering acceptable noise and step response time.

Noise Rejection

The 1769-IF8 uses a digital filter that provides noise rejection for the input signals. The filter is programmable, allowing you to select from four filter frequencies for each channel. The digital filter provides -3 dB (50% amplitude) attenuation at the selected filter frequency. A lower frequency (60 Hz versus 250 Hz) can provide better noise rejection but it increases channel update time. Transducer power supply noise, transducer circuit noise, or process variable irregularities may also be sources of normal mode noise.

Common Mode Rejection is better than 60 dB at 50 and 60 Hz, with the 50 and 60 Hz filters selected, respectively. The module performs well in the presence of common mode noise as long as the signals applied to the user plus and minus input terminals do not exceed the common mode voltage rating (± 10 V) of the module. Improper earth ground may be a source of common mode noise.

Channel Step Response

The selected channel filter frequency determines the channel's step response. The step response is the time required for the analog input signal to reach 100% 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.

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 frequency response curve where 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.

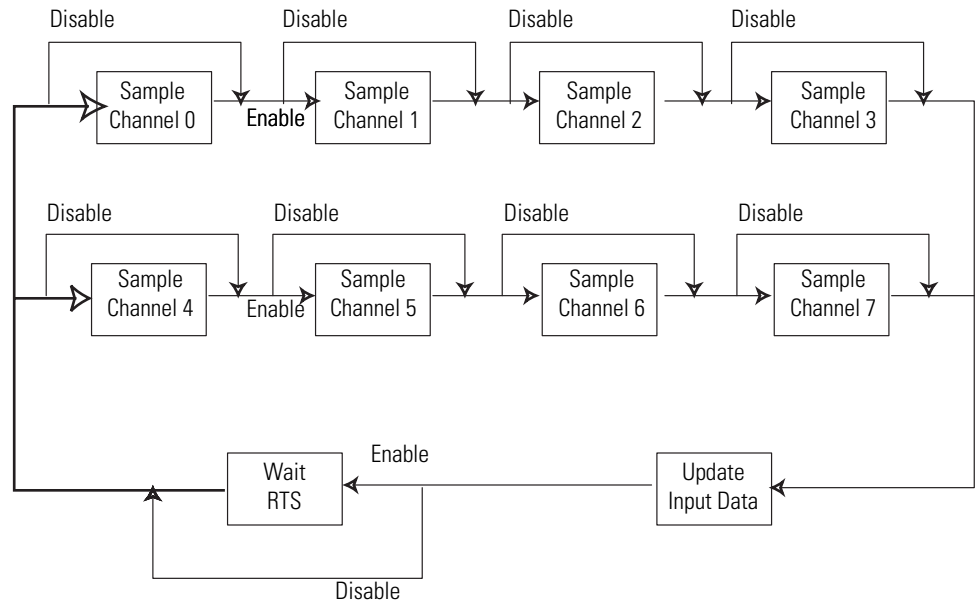
The cut-off frequency for each channel is defined by its filter frequency selection and is equal to the filter frequency setting. Choose a filter frequency so that your fastest changing signal is below that of the filter's cut-off frequency. The cut-off frequency should not be confused with the update time. The cut-off frequency relates to how the digital filter attenuates frequency components of the input signal. The update time defines the rate at which an input channel is scanned and its channel data word is updated.

Module Update Time and Scanning Process

The module update time is defined as the time required for the module to sample and convert the input signals of all 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 1769-IF8 uses two parallel sampling loops as shown in Figure 3.5 to update the entire module (all 8 channels) in an amount of time equal to only four channel update times. The module performs parallel channel sampling on pairs of inputs. Channels 0 and 4 are a pair. The other input channel pairs are 1 and 5, 2 and 6, and 3 and 7.

Figure 3.5 Sequential Sampling



Module update time is calculated as follows:

- Slowest channel update time of pair 0 and 4 (determined by the filter setting selected for each channel and the channel update times from Table 3.16 - channel update time for a channel that is not enabled is equal to 0)

PLUS

- Slowest channel update time of pair 1 and 5

PLUS

- Slowest channel update time of pair 2 and 6

PLUS

- Slowest channel update time of pair 3 and 7

If you use real-time sampling, the user-configured sample rate is used as the module update time.

Table 3.16 Filter Frequency and Update Times

Filter Frequency	Update Time per Channel	Update Time per Module ⁽¹⁾
10 Hz	100 ms	400 ms
50 Hz	30 ms	120 ms
60 Hz	30 ms	120 ms
250 Hz	9 ms	36 ms
500 Hz	6 ms	24 ms

⁽¹⁾ Module update time applies if you use all channel pairs and all enabled channels, and all the enabled channels use the filter frequency from the first column.

Examples of Calculating Module Update Time

EXAMPLE

1. Two Channels Enabled with Identical Filter Setting, But Not a Channel Pair

The following example calculates the 1769-IF8 module update time for two channels enabled with any configuration and a 500 Hz filter but the enabled channels are not a channel pair.

- Channel 0: ± 10 V dc with 500 Hz filter
- Channel 1: 0...10V dc with 500 Hz filter

Module Update Time = [Greater of Channel 0 Update Time or Channel 4 Update Time]
+ [Greater of Channel 1 Update Time or Channel 5 Update Time]

12 ms = [Greater of 6 ms or 0 ms] + [Greater of 6 ms or 0 ms]

EXAMPLE**2. Two Channels Enabled with Different Filter Settings, But are a Channel Pair**

The following example calculates the 1769-IF8 module update time for two channels enabled with any configuration, with different filter settings, but are a channel pair.

- Channel 0: $\pm 10\text{V}$ dc with 60 Hz filter
- Channel 4: 0...10V dc with 500 Hz filter

Module Update Time = [Greater of Channel 0 Update Time or Channel 4 Update Time]

30 ms = [Greater of 30 ms or 6 ms]

IMPORTANT

Configuring the 1769-IF8 module to take advantage of channel pairs can result in module update times that are significantly faster than configuring the 1769-IF8 modules without such channel assignment optimization.

Input Type/Range Selection

This selection along with proper input wiring lets you configure each channel individually for current or voltage ranges and provides the ability to read the configured range selections.

Input Data Selection Formats

This selection configures channels 0 through 3 to present analog data in any of the following formats:

- Raw/Proportional Data
- Engineering Units
- Scaled-for-PID
- Percent Range

Raw/Proportional Data

The value presented to the controller is proportional to the selected input and scaled into the maximum data range allowed by the bit resolution of the A/D converter and filter selected. The full range for a $\pm 10\text{Vdc}$ user input is -32767 to +32767. See Table 3.17 Valid Input Data on page 3-28.

Engineering Units

The module scales the analog input data to the actual current or voltage values for the selected input range. The resolution of the engineering units is dependent on the range selected and the filter selected. See Table 3.17 Valid Input Data on page 3-28.

Scaled-for-PID

The value presented to the controller is a signed integer with zero representing the lower user range and 16383 representing the upper user range. Allen-Bradley controllers, such as the MicroLogix 1500, use this range in their PID equations. The amount over and under user range (full scale range -410 to 16793) is also included. See Table 3.17 Valid Input Data on page 3-28.

Percent Range

The input data is presented as a percentage of the user range. For example, 0V to 10V dc equals 0% to 100%. See Table 3.17 on page 3-28.

Valid Input Data Word Formats/Ranges

The following table shows the valid formats and min./max. data ranges provided by the module.

Table 3.17 Valid Input Data

1769-IF8 Normal Operating Input Range	Full Range (Includes amounts Over and Under Normal Operating Range)	Raw/Pro portional Data	Engineering Units	Scaled-for-PID		Percent	
		Full Range		Normal Operating Range	Full Range	Normal Operating Range	Full Range
-10V to +10V dc	+10.5V to -10.5V	-32767 to +32767	-10500 to +10500	0 to 16383	-410 to 16793	-100 to +100%	-105.00 to 105.00%
0V to 5V dc	0.0V to 5.25V	-27068 to +32767	0 to 5250		0 to 17202	0 to 100%	0 to 105.00%
0V to 10V dc	0.0V to 10.5V	-29788 to +32767	0 to 10500		-819 to +17407		-5.00 to +106.25%
4 mA to 20 mA	3.2 mA to 21 mA	-32767 to +32767	3200 to 21000		-2048 to 17407		-12.50 to +106.25%
1.0V to 5V dc	0.5V to 5.25V		500 to 5250		0 to 17202		0.00 to 105.00%
0 mA to 20 mA	0 mA to 21 mA		0 to 21000				

1769-IF8 Real Time Sampling

This parameter instructs the module how often to scan its input channels and obtain all available data. After the channels are scanned, the module places the data into the Input Data file. This feature is applied on a module-wide basis.

During module configuration, you specify a Real Time Sampling (RTS) period by entering a value into Word 0 of the Configuration Data file. This value entered in Word 0 can be in the range of 0 to 5000 and indicates the sampling rate the module will use in 1 ms increments.

If you enter a 0 for the Real Time Sample Rate, the module should scan its inputs at as fast a rate as possible, controlled by the number of enabled channels and the filter setting selected for those channels.

The module compares the Real Time Sample Rate value entered in Word 0 of the Configuration Data file with a calculated module update time, again based on the number of enabled channels and the filter setting selected for those channels. If the value entered for the Real Time Sample Rate is smaller than the calculated module update time, the module indicates a configuration error.

The longest Real Time Sample Rate supported by the 1769-IF8 is 5 s, the maximum value for Word 0 of the Configuration Data file is 5000 decimal.

1769-IF8 Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. You can latch process alarms. These are set at two user configurable alarm trigger points:

- Process Alarm High
- Process Alarm Low

Each input channel's process alarms are controlled by bits in the Configuration Data file. Enable alarms for a channel by setting (1) the EA bit for that channel. Set the AL bit (1) for a channel to enable the alarm latching.

Each channel's process alarm high data value and process alarm low data value are set by entering values in the corresponding words of the Configuration Data file for that channel.

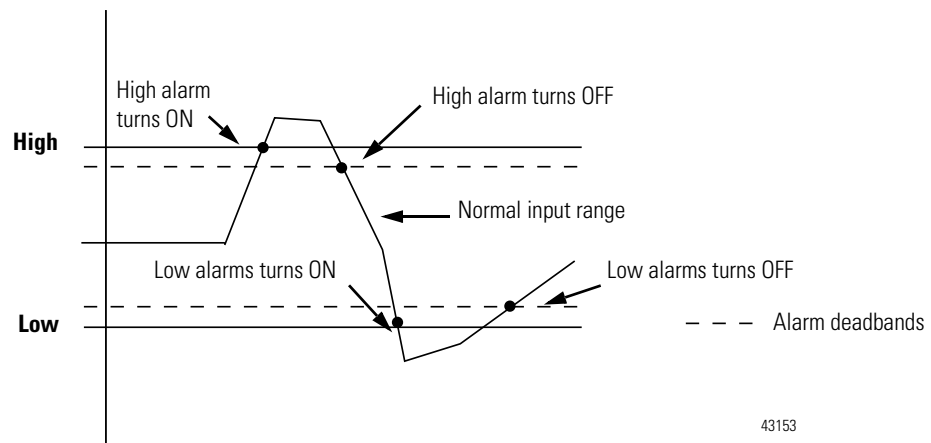
The values entered for a channel's process alarm data values must be within the normal operating data range as set by the input Data Format selected for that channel. If a process alarm data value is entered that is outside the normal operating data range set for a channel, the module indicates a configuration error.

Alarm Deadband

You may configure an **Alarm Deadband** to work with the process alarms. The deadband lets the process alarm status bit to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

Figure 3.6 shows input data that sets each of the two alarms at some point during module operation. In this example, Latching is disabled; therefore, each alarm turns OFF when the condition that caused it to set ceases to exist.

Figure 3.6 Alarm Deadbands



The value entered for a channel's alarm deadband value must be within the normal operating data range as set by the Input Data Format selected for that channel. If an alarm deadband value is entered that is outside the normal operating data range set for a channel, the module indicates a configuration error.

The module also checks for an alarm deadband value that is less than 0 or large enough to exceed one or both of the channel's full range limits. When one of these conditions occurs, the module changes the alarm deadband value that is in violation to one that is allowed. A deadband value less than 0 is set at 0. A deadband value that when added to the process alarm low data value or subtracted from the process alarm high data value results in a value that exceeds the full range limits of the channel is adjusted to the first, smaller value that eliminates this full range violation.

Notes:

1769-OF2 Output Data File

The structure of the output data file is shown in the table below. Words 0 and 1 contain the converted analog output data for channels 0 and 1, respectively. The most significant bit is the sign bit.

Table 4.1 1769-OF2 Output Data Table

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

1769-OF2 Input Data File

This data table file provides immediate access to channel diagnostic information and analog output data at the module for use in the control program. To receive valid data, you must enable the channel. The data table structure is described below.

Table 4.2 1769-OF2 Input Data Table

Word/Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	D0	H0	D1	H1	Not Used (bits set to 0)										S1	S0
Word 1	U0	O0	U1	O1	Bits 0 - 11 set to 0											
Word 2	SGN	Channel 0 - Output Data Loopback/Echo														
Word 3	SGN	Channel 1 - Output Data Loopback/Echo														

1769-OF2 Diagnostic Bits (D0 and D1)

When set (1), these bits indicate a broken output wire or high load resistance (not used on voltage outputs). Bit 15 represents channel 0; bit 13 represents channel 1.

1769-OF2 Hold Last State Bits (H0 and H1)

These bits indicate when channel 0 (bit 14) or channel 1 (bit 12) is in a hold last state condition. When one of these bits is set (1), the corresponding channel is in the hold state. Output data will not change until the condition which caused the hold last state to occur is removed. The bit is reset (0) for all other conditions.

TIP

MicroLogix 1500 controllers **do not** support the hold last state function. Refer to your controller's user manual for details.

1769-OF2 Over-Range Flag Bits (O0 and O1)

Over-range bits for channels 0 and 1 are contained in word 1, bits 14 and 12. When set, the over-range bit indicates that the controller is attempting to drive the analog output above its normal operating range. However, the module continues to convert analog output data to a maximum full range value. The bit is automatically reset (0) by the module when the over-range condition is cleared (the output is within the normal operating range). The over-range bits apply to all output ranges. Refer to Table 4.5 1769-OF2 Valid Output Data Table on page 4-12 to view the normal operating and over-range areas.

1769-OF2 Under-Range Flag Bits (U0 and U1)

Under-range bits for channels 0 and 1 are contained in word 1, bits 15 and 13. When set (1), the under-range bit indicates that the controller is attempting to drive the analog output below its normal operating range. However, the module continues to convert analog output data to a minimum full range value. The bit is automatically reset (0) by the module when the under-range condition is cleared (the output is within the normal operating range). The under-range bits apply to all output ranges. Refer to Table 4.5 1769-OF2 Valid Output Data Table on page 4-12 to view the normal operating and under-range areas.

1769-OF2 General Status Bits (S0 and S1)

Word 0, bits 0 and 1 contain the general status information for output channels 0 and 1. If set (1), these bits indicate an error associated with that channel. The over-range and under-range bits and the diagnostic bit are logically ORed to this position.

1769-OF2 Output Data Loopback/Echo

Words 2 and 3 provide output loopback/data echo through the input array for channels 0 and 1, respectively. The value of the data echo is the analog value currently being converted on-board the module by the D/A converter. This ensures that the logic-directed state of the output is true. Otherwise, the state of the output could vary depending on controller mode.

Under normal operating conditions, the data echo value is the same value that is being sent from the controller to the output module. Under abnormal conditions, the values may differ. For example:

1. During run mode, the control program could direct the module to a value over or under the defined full range. In that case, the module raises the over- or under-range flag and continues to convert and data echo up to the defined full range. However, upon reaching either the maximum upper or lower full range value, the module stops converting and echoes back that maximum upper or lower full range value, not the value being sent from the controller.
2. During program or fault mode with Hold Last State or User-Defined Value selected, the module echoes the hold last value or alternate value you selected. For more information on the hold last and user-defined values, see 1769-OF2 Fault Value (Channel 0 and 1) on page 4-11 and 1769-OF2 Program/Idle Value (Channel 0 and 1) on page 4-11.

1769-OF2 Configuration Data File

The configuration file lets you determine how each individual output channel will operate. Parameters such as the output type/range and data format are set up using this file. The configuration data file is writable and readable. The default value for the configuration data file is all zeros. The structure of the channel configuration file is explained below. Words 0 and 1 are the channel configuration words for channels 0 and 1. They are described in 1769-OF2 Channel Configuration on page 4-6. Words 2 through 5 are explained beginning on page 4-11.

Table 4.3 1769-OF2 Configuration Data Table⁽¹⁾

Word/Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	E	Output Data Format Select Channel 0			Output Type/Range Select Channel 0				Not Used (set to 0)			FM0	PM0	Not Used (set to 0)	PFE0	
Word 1	E	Output Data Format Select Channel 1			Output Type/Range Select Channel 1				Not Used (set to 0)			FM1	PM1	Not Used (set to 0)	PFE1	
Word 2	S	Fault Value - Channel 0														
Word 3	S	Program (Idle) Value - Channel 0														
Word 4	S	Fault Value - Channel 1														
Word 5	S	Program (Idle) Value - Channel 1														

⁽¹⁾ The ability to change these values using your control program is not supported by all controllers. Refer to your controller manual for details.

The configuration file is typically modified using the programming software configuration screen. For information on configuring the module using MicroLogix 1500 and RSLogix 500, see Appendix B; for CompactLogix and RSLogix 5000, see Appendix C; for 1769-ADN DeviceNet Adapter and RSNetWorx, see Appendix D.

The configuration file can also be modified through the control program, if supported by the controller. The structure and bit settings are shown in 1769-OF2 Channel Configuration on page 4-6.

1769-OF2 Channel Configuration

Both channel configuration words (0 and 1) consist of bit fields, the settings of which determine how the corresponding channel operates. See the table below and the descriptions that follow for valid configuration settings and their meanings.

Table 4.4 1769-OF2 Bit Definitions for Channel Configuration Words 0 and 1

Bit(s)	Define	These bit settings														Indicate this		
		15	14	13	12	11	10	9	8	7	6	5	4	3	2		1	0
0	Program/Idle to Fault Enable																0	Program Mode Data Applied
																	1	Fault Mode Data Applied
1	Reserved																	Reserved
2	Program/Idle Mode														0			Program Mode Hold Last State
															1			Program Mode User-Defined Value
3	Fault Mode														0			Fault Mode Hold Last State
															1			Fault Mode User-Defined Value
4-7	Reserved																	Reserved ⁽¹⁾
8-11	Output Type/Range Select					0	0	0	0									-10V dc to +10V dc
						0	0	0	1									0 to 5V dc
						0	0	1	0									0 to 10V dc
						0	0	1	1									4 to 20 mA
						0	1	0	0									1 to 5V dc
						0	1	0	1									0 to 20 mA
																		Not Used ⁽²⁾
12-14	Output Data Format Select		0	0	0													Raw/Proportional Data
			0	0	1													Engineering Units
			0	1	0													Scaled-for-PID ⁽³⁾
			0	1	1													Percent Range
																		Not Used ⁽²⁾
15	Enable Channel	1																Enabled
		0																Disabled

⁽¹⁾ If reserved bits are not equal to zero, a configuration error occurs.
⁽²⁾ Any attempt to write a non-valid (not used) bit configuration into any selection field results in a module configuration error. See Configuration Errors on page 5-6.
⁽³⁾ This range is applicable to the PID function of the MicroLogix 1500 packaged controller, PLC, or SLC controllers. Logix controllers can use this or one of the other ranges for their PID functions.

1769-OF2 Enable/Disable Channel

This configuration selection (bit 15) lets each channel to be individually enabled.

TIP

A channel that is not enabled has zero voltage or current at its terminal.

1769-OF2 Output Data Format Selection

This selection configures each channel to interpret data presented to it by the controller in any of the following formats:

- Raw/Proportional Data
- Engineering Units
- Scaled-for-PID
- Percent Full Range

1769-OF2 Raw/Proportional Data

The control program presents the maximum raw data value allowed by the bit resolution of the D/A converter. The full range for a $\pm 10\text{V}$ dc user input is -32767 to +32767. See Table 4.5 1769-OF2 Valid Output Data Table on page 4-12.

1769-OF2 Engineering Units

The control program presents an engineering data value to the module within the current or voltage range allowed by the D/A converter. The module then scales the data to the appropriate analog output value for the selected user range. See Table 4.5 1769-OF2 Valid Output Data Table on page 4-12.

1769-OF2 Scaled-for-PID

The control program presents an integer value to the module, with zero representing the lower user range and 16383 representing the upper user range, for conversion by the D/A converter. The module then scales this data to the approximate analog output value for the selected user range. See Table 4.5 1769-OF2 Valid Output Data Table on page 4-12.

TIP

Allen-Bradley controllers, such as the MicroLogix 1500, use this range in their PID equations for controlled process outputs.

1769-OF2 Percent Full Range

The control program presents the analog output data to the module as a percent of the full analog output range (for example, valve 50% open). The module scales this data to the appropriate analog output value for the selected user range. For example, 0 to 100% equals 0 to 10V dc. See Table 4.5 1769-OF2 Valid Output Data Table on page 4-12.

TIP

The $\pm 10V$ dc range does not support percent full range.

1769-OF2 Output Type/Range Selection

This selection, along with proper output wiring, lets you configure each output channel individually for current or voltage ranges, and provides the ability to read the range selection.

1769-OF2 Fault Mode (FM0 and FM1)

This configuration selection provides individual 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 enters the 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 1769-OF2 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.

If this selection is enabled [the bit is set (1)] and the system enters the fault mode, it commands the module to convert the *user-specified* integer value from the channel's fault value word (2 or 4) to the appropriate analog output for the range selected. If the default value, 0000, is entered, the output typically converts to the minimum value for the range selected.

EXAMPLE

- If the raw/proportional or engineering units data format is selected and zero (0000) is entered in the $\pm 10\text{V}$ dc operating range, the resulting value would be 0V dc.
- If the raw/proportional or engineering units format is selected and zero is entered as the fault value in either a 1 to 5V dc or 4 to 20 mA range, a configuration error results.
- See Table 4.5 1769-OF2 Valid Output Data Table on page 4-12 for more examples.

TIP

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

1769-OF2 Program/Idle Mode (PM0 and PM1)

This configuration selection provides individual program/idle mode selection for the analog channels 0 (word 0, bit 2) and 1 (word 1, bit 2). When this selection is disabled [the bit is reset (0)], the module *holds* the *last state*, meaning that the analog output remains at the last converted value prior to the condition that caused the control system to enter the program mode.

IMPORTANT

Hold last state is the default condition for the 1769-OF2 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.

If this selection is enabled [the bit is set (1)] and the system enters the program mode, it commands the module to convert the *user-specified* value from the channel's program/idle value word (3 or 5) to the appropriate analog output for the range selected.

EXAMPLE

- If the default value, 0000, is used and the range selected is 0 to 20 mA, the module will output 0 mA for all data formats.
 - If the raw/proportional or engineering units format is selected and zero is entered as the program/idle value in either a 1 to 5V dc or 4 to 20 mA range, a configuration error results.
 - See Table 4.5 1769-OF2 Valid Output Data Table on page 4-12 for more examples.
-

TIP

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

1769-OF2 Program/Idle to Fault Enable (PFE0 and PFE1)

If a system currently in program/idle mode faults, this setting (word 0, bit 0; word 1, bit 0) determines whether the program/idle or fault mode value is applied to the output. If the selection is enabled [the bit is set (1)], the module applies the fault mode data value. If the selection is disabled [the bit is reset (0)], the module applies the program/idle mode data value. The default setting is disabled.

TIP

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

1769-OF2 Fault Value (Channel 0 and 1)

Using words 2 and 4 for channels 0 and 1, you can specify the values the outputs will assume when the system enters the fault mode. The default value is 0. Valid values are dependent upon the range selected in the range selection field. If the value you entered is outside the normal operating range for the output range selected, the module generates a configuration error.

For example, if you select engineering units for the $\pm 10\text{V}$ dc range and enter a fault value within the normal operating range (0 to 10000), the module will configure and operate correctly. However, if you enter a value outside the normal operating range (for example 11000), the module indicates a configuration error.

TIP

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

1769-OF2 Program/Idle Value (Channel 0 and 1)

Use words 3 and 5 to set the integer values for the outputs to assume when the system enters the program mode. The values are dependent upon the range selected in the range selection field. If the value you entered is outside the normal operating range for the output range selected, the module generates a configuration error. The default value is 0.

TIP

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

1769-OF2 Valid Output Data Word Formats/Ranges

The following table shows the valid formats and data ranges accepted by the module.

Table 4.5 1769-OF2 Valid Output Data Table

OF2 Output Range	Input Value	Example Data		Output Range State	Raw/Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
		Controller Ordered	OF2 Output		Decimal Range		Decimal Range		Decimal Range		Decimal Range	
					Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo
±10V dc	Over 10.5V dc	+11.0V dc	+10.5V dc	Over	N/A	N/A	11000	10500	17202	16793	N/A	N/A
	+10.5V dc	+10.5V dc	+10.5V dc	Over	32767	32767	10500	10500	16793	16793	N/A	N/A
	-10V to +10V dc	+10.0V dc	+10.0V dc	Normal	31207	31207	10000	10000	16383	16383	N/A	N/A
		0.0V dc	0.0V dc	Normal	0	0	0	0	8192	8192	N/A	N/A
		-10.0V dc	-10.0V dc	Normal	-31207	-31207	-10000	-10000	0	0	N/A	N/A
	-10.5V dc	-10.5V dc	-10.5V dc	Under	-32767	-32767	-10500	-10500	-410	-410	N/A	N/A
Under -10.5V dc	-11.0V dc	-11.0V dc	Under	N/A	N/A	-11000	-10500	-819	-410	N/A	N/A	
0V to 5V dc	Over 5.25V dc	5.5V dc	+5.25V dc	Over	N/A	N/A	5500	5250	18021	17202	11000	10500
	5.25V dc	5.25V dc	+5.25V dc	Over	32767	32767	5250	5250	17202	17202	10500	10500
	0.0V dc to 5.0V dc	5.0V dc	+5.0V dc	Normal	31207	31207	5000	5000	16383	16383	10000	10000
		0.0V dc	0.0V dc	Normal	0	0	0	0	0	0	0	0
	-0.5V dc	-0.5V dc	-0.5V dc	Under	-3121	-3121	-500	-500	-1638	-1638	-1000	-1000
Under -0.5V dc	-1.0V dc	-0.5V dc	Under	-6241	-3121	-500	-500	-3277	-1638	-2000	-1000	

Table 4.5 1769-OF2 Valid Output Data Table

OF2 Output Range	Input Value	Example Data		Output Range State	Raw/Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
					Decimal Range		Decimal Range		Decimal Range		Decimal Range	
		Controller Ordered	OF2 Output		Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo
0V to 10V dc	Over 10.5V dc	11.0V dc	+10.5V dc	Over	N/A	N/A	11000	10500	18021	17202	11000	10500
	+10.5V dc	+10.5V dc	+10.5V dc	Over	32767	32767	10500	10500	17202	17202	10500	10500
	0.0V dc to 10.0V dc	+10.0V dc	+10.0V dc	Normal	31207	31207	10000	10000	16383	16383	10000	10000
		0.0V dc	0.0V dc	Normal	0	0	0	0	0	0	0	0
	-0.5V dc	-0.5V dc	-0.5V dc	Under	-1560	-1560	-500	-500	-819	-819	-500	-500
	Under -5.0V dc	-1.0V dc	-0.5V dc	Under	-3121	-1560	-1000	-500	-1638	-819	-1000	-500
4 mA to 20 mA	Over 21.0 mA	+22.0 mA	+21.0 mA	Over	N/A	N/A	22000	21000	18431	17407	11250	10625
	21.0 mA	+21.0 mA	+21.0 mA	Over	32767	32767	21000	21000	17407	17407	10625	10625
	4.0 mA to 20.0 mA	+20.0 mA	+20.0 mA	Normal	31207	31207	20000	20000	16383	16383	10000	10000
		+4.0 mA	+4.0 mA	Normal	6241	6241	4000	4000	0	0	0	0
	3.2 mA	+3.2 mA	+3.2 mA	Under	4993	4993	3200	3200	-819	-819	-500	-500
	Under 3.2 mA	0.0 mA	+3.2 mA	Under	0	4993	0	3200	-4096	-819	-2500	-500
1.0V to 5V dc	Over 5.25V dc	+5.5V dc	+5.25V dc	Over	N/A	N/A	5500	5250	18431	17407	11250	10625
	+5.25V dc	+5.25V dc	+5.25V dc	Over	32767	32767	5250	5250	17407	17407	10625	10625
	1.0V to 5.0V dc	+5.0V dc	+5.0V dc	Normal	31207	31207	5000	5000	16383	16383	10000	10000
		+1.0V dc	+1.0V dc	Normal	6241	6241	1000	1000	0	0	0	0
	0.5V dc	+0.5V dc	+0.5V dc	Under	3121	3121	500	500	-2048	-2048	-1250	-1250
	Under 0.5V dc	0.0V dc	0.0V dc	Under	0	3121	0	500	-4096	-2048	-2500	-1250

Table 4.5 1769-OF2 Valid Output Data Table

OF2 Output Range	Input Value	Example Data		Output Range State	Raw/Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
					Decimal Range		Decimal Range		Decimal Range		Decimal Range	
		Controller Ordered	OF2 Output		Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo	Controller Ordered	OF2 Output and Echo
0 mA to 20 mA	Over 21.0 mA	+22.0 mA	+21.0 mA	Over	N/A	N/A	22000	21000	18201	17202	11000	10500
	21.0 mA	21.0 mA	+21.0 mA	Over	32767	32767	21000	21000	17202	17202	10500	10500
	0.0 mA to 20.0 mA	20.0 mA	+20.0 mA	Normal	31207	31207	20000	20000	16383	16383	10000	10000
		0.0 mA	0.0 mA	Normal	0	0	0	0	0	0	0	0
	Under 0.0 mA	-1.0 mA	0.0 mA	Under	-1560	0	0	-1000	-819	0	-500	0

1769-OF2 Module Resolution

The resolution of an analog output channel depends on the output type/range and data format selected. Table 4.6 provides detailed resolution information for the 1769-OF2.

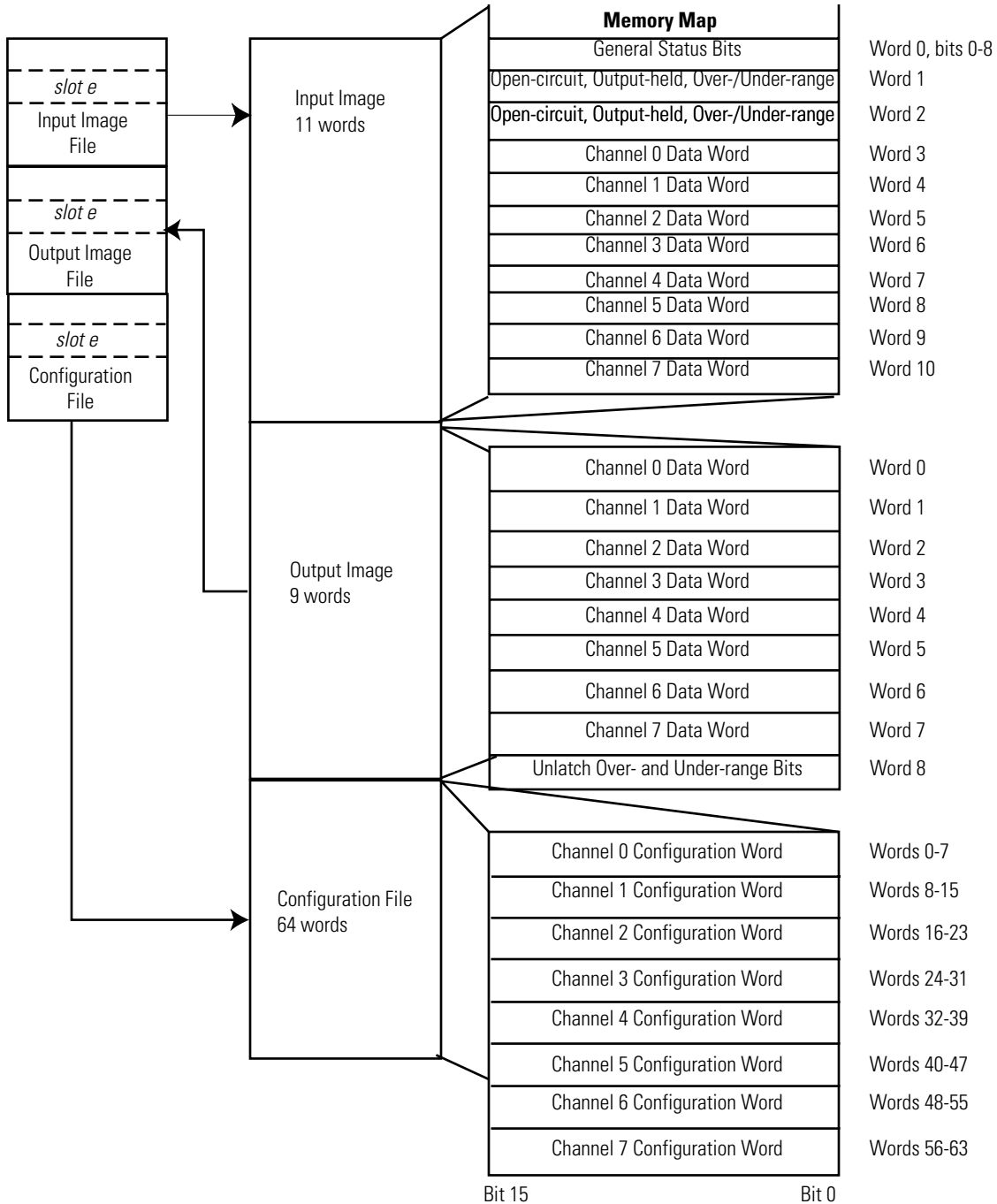
Table 4.6 1769-OF2 Output Resolution

1769-OF2 Output Range	Raw/Proportional Data Over the Full Input Range		Engineering Units Over the Full Input Range		Scaled-For-PID Over the Full Input Range		Percent Over the Full Input Range	
	Bits and Engineering Units Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value	Resolution	Decimal Range and Count Value
-10 to +10V dc	Sign +14 0.64 mV/ 2 counts	±32767 Count by 2	2.00 mV/ 2 counts	±10500 Count by 2	2.44 mV/ 2 counts	-410 to +16793 Count by 2	Not Applicable	Not Applicable
0 to +5V dc	Sign +13 0.64 mV/ 4 counts	-3121 to +32767 Count by 4	2.00 mV/ 2 counts	-500 to +5250 Count by 2	0.92 mV/ 3 counts	-1638 to +17202 Count by 3	1.00 mV/ 2 counts	-1000 to +10500 Count by 2
0 to +10V dc	Sign +14 0.64 mV/ 2 counts	-1560 to +32767 Count by 2	2.00 mV/ 2 counts	-500 to +10500 Count by 2	1.22 mV/ 2 counts	-819 to +17202 Count by 2	2.00 mV/ 2 counts	-500 to +10500 Count by 2
+4 to +20 mA	Sign +14 1.28 µA/ 2 counts	+4993 to +32767 Count by 2	2.00 µA/ 2 counts	+3200 to +2100 Count by 2	1.95 µA/ 2 counts	-819 to +17407 Count by 2	3.20 µA/ 2 counts	-500 to +10625 Count by 2
+1 to +5V dc	Sign +13 0.64 mV/ 4 counts	+3121 to +32767 Count by 4	2.00 mV/ 2 counts	+500 to +5250 Count by 2	0.73 mV/ 3 counts	-2048 to +17407 Count by 3	0.80 mV/ 2 counts	-1250 to +10625 Count by 2
0 to +20 mA	Sign +14 1.28 µA/ 2 counts	0 to +32767 Count by 2	2.00 µA/ 2 counts	0 to +21000 Count by 2	2.44 µA/ 2 counts	0 to +17202 Count by 2	4.00 µA/ 2 counts	0 to +10500 Count by 2

1769-OF8C Output Module Memory Map

The 1769-OF8C memory map shows the output, input, and configuration tables for the 1769-OF8C.

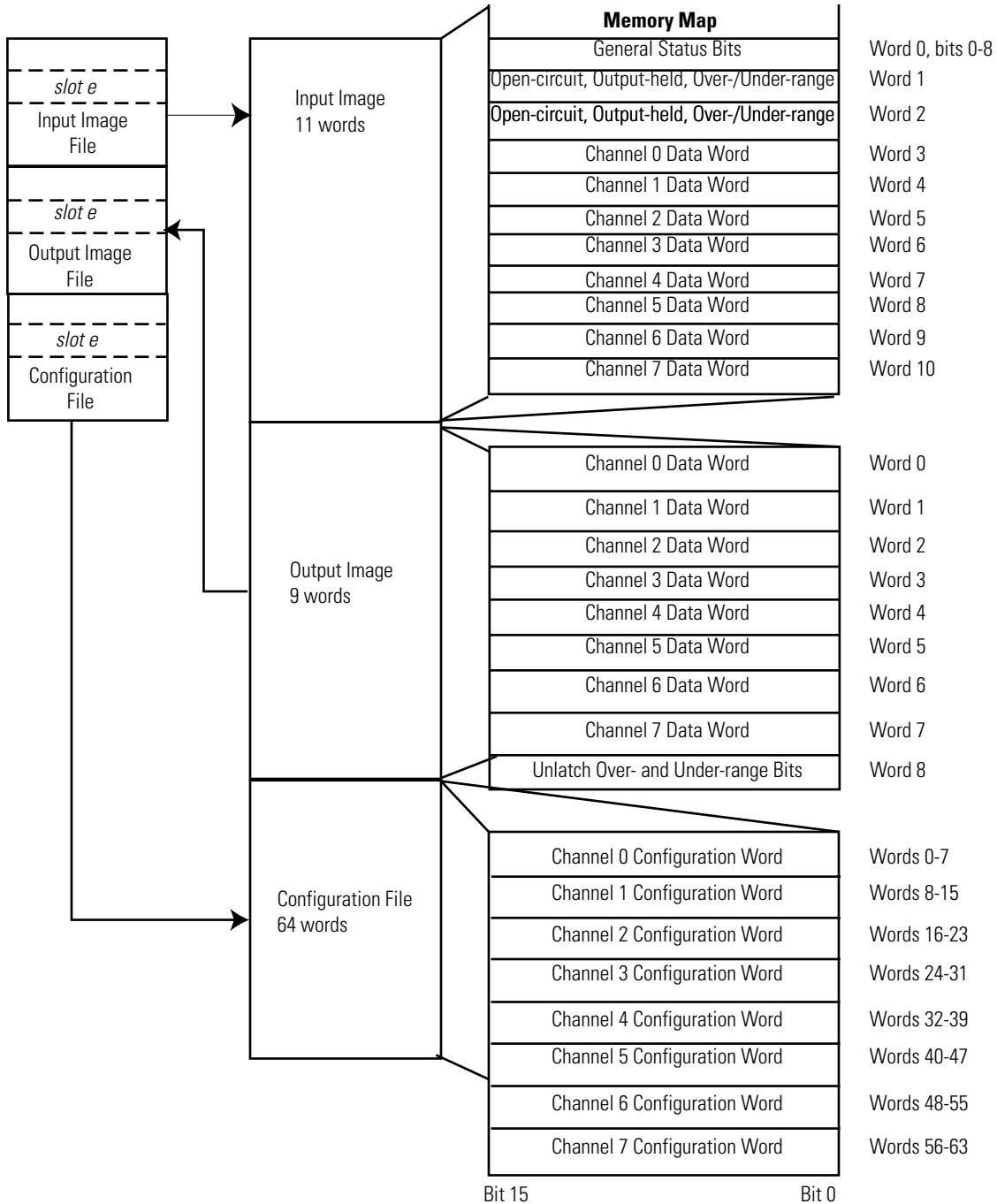
Figure 4.2 1769-OF8C Memory Map



1769-OF8V Output Module Memory Map

The 1769-OF8V memory map shows the output, input, and configuration tables for the 1769-OF8V.

Figure 4.3 1769-OF8V Memory Map



1769-OF8C and -OF8V Output Data File

The structure of the output data file is shown in the table below. Words 0 through 7 contain the commanded analog output data for channels 0 through 7, respectively. The most significant bit is the sign bit. Word 8 contains the control bits for unlatching alarms.

Table 4.7 1769-OF8C and -OF8V Output Data Table

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														
1	SGN	Analog Output Data Channel 1														
2	SGN	Analog Output Data Channel 2														
3	SGN	Analog Output Data Channel 3														
4	SGN	Analog Output Data Channel 4														
5	SGN	Analog Output Data Channel 5														
6	SGN	Analog Output Data Channel 6														
7	SGN	Analog Output Data Channel 7														
8	UU7	U07	UU6	U06	UU5	U05	UU4	U04	UU3	U03	UU2	U02	UU1	U01	UU0	U00

Channel Alarm Unlatch

These bits are written during run mode to clear any latched low- and high-clamps and under- and over-range alarms. The alarm is unlatched when the unlatch bit is set (1) and the alarm condition no longer exists. If the alarm condition persists, then the unlatch bit has no effect. You need to keep the unlatch bit set until verification from the appropriate input channel status word says that the alarm status bit has cleared (0). Then you need to reset (0) the unlatch bit. The module will not latch an alarm condition when a transition from a no alarm condition to an alarm condition occurs while a channel's clear latch bit is set.

Table 4.8 Channel Alarm Unlatch

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	UU7 ⁽¹⁾	U07 ⁽²⁾	UU6	U06	UU5	U05	UU4	U04	UU3	U03	UU2	U02	UU1	U01	UU0	U00

⁽¹⁾ Unlatch channel x under-range or low-clamp exceeded alarm.

⁽²⁾ Unlatch channel x over-range or high-clamp exceeded alarm.

1769-OF8C and -OF8V Input Data File

This data table file provides immediate access to channel diagnostic information and analog output data at the module for use in the control program. To receive valid data, you must enable the channel. The data table structure is described below.

Table 4.9 1769-OF8C and -OF8V Input Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0								PF	S7	S6	S5	S4	S3	S2	S1	S0
1	D3	H3	U3	O3	D2	H2	U2	O2	D1	H1	U1	O1	D0	H0	U0	O0
2	D7	H7	U7	O7	D6	H6	U6	O6	D5	H5	U5	O5	D4	H4	U4	O4
3	Channel 0 Data Value															
4	Channel 1 Data Value															
5	Channel 2 Data Value															
6	Channel 3 Data Value															
7	Channel 4 Data Value															
8	Channel 5 Data Value															
9	Channel 6 Data Value															
10	Channel 7 Data Value															

1769-OF8C and -OF8V Data Values

Words 3 through 10 contain the data echo of the analog data presently commanded by the module for each output.

1769-OF8C and -OF8V Power Fail Bit (PF)

Word 0, bit 8, contains the analog power fail information for the output channels (which is isolated from the system backplane power). If set (1), this bit indicates that the analog power on the isolated output channel has failed. If external user power is selected for the module, the external power supply may be wired incorrectly or not supplying power. If internal (backplane) power is desired, be sure the selector switch on the module is in the internal power position.

1769-OF8C and -OF8V General Status Bits (S0 through S7)

Word 0, bits 0 through 7 contain the general status information for output channels 0 through 7. If set (1), these bits indicate an error associated with that channel. The over-range and under-range bits and the diagnostic bit are logically ORed to this position.

1769-OF8C and -OF8V Over-Range Flag Bits (O0 through O7)

Word 1, bits 0, 4, 8, and 12, and Word 2, bits 0, 4, 8, and 12 contain the over-range bits for channels 0 through 7. When set, the over-range bit indicates that the controller is attempting to drive the analog output above its normal operating range or above the channel's High Clamp level (if clamp limits are set for the channel). However, the module continues to convert analog output data to a maximum full range value if clamp levels are not set for the channel.

If alarm latching is not enabled for the channel, the bit is automatically reset (0) by the module when the over-range condition is cleared or the commanded value no longer exceeds the high clamp (the output is commanded to return to within the normal allowed range). The over-range bits apply to all output ranges. Refer to Table 4.17 1769-OF8C Valid Output Data Table on page 4-33 and Table 4.18 1769-OF8V Valid Output Data Table on page 4-34 to view the normal operating and over-range areas.

1769-OF8C and -OF8V Under-Range Flag Bits (U0 through U7)

Word 1, bits 1, 5, 9, and 13, and Word 2, bits 1, 5, 9, and 13 contain the under-range bits for channels 0 through 7. When set (1), the under-range bit indicates that the controller is attempting to drive the analog output below its normal operating range or below the channel's Low Clamp level (if clamp limits are set for the channel). However, the module continues to convert analog output data to a minimum full range value if clamp levels are not set for the channel.

If alarm latching is not enabled for the channel, the bit is automatically reset (0) by the module when the under-range condition is cleared or the commanded value no longer exceeds the low clamp (the output is commanded to return to within the normal allowed range). The under-range bits apply to all output ranges. Refer to Table 4.17 1769-OF8C Valid Output Data Table on page 4-33 and Table 4.18 1769-OF8V Valid Output Data Table on page 4-34 to view the normal operating and under-range areas.

1769-OF8C and -OF8V Diagnostic Bits (D0 through D7)

Word 1, bits 3, 7, 11, and 15, and Word 2, bits 3, 7, 11, and 15 contain the open-circuit diagnostic bits for input channels 0 through 7. When set (1), these bits indicate a broken output wire or high load resistance. These bits are always cleared (0) for the 1769-OF8V module since open-circuit diagnostics do not apply for analog voltage outputs.

1769-OF8C and -OF8V Output Held Bits (H0 through H7)

Word 1, bits 2, 6, 10, and 14, and Word 2, bits 2, 6, 10, and 14 contain the output held bits for input channels 0 through 7. When one of these bits is set (1), the corresponding channel is in the hold state. Output data will not change until value commanded by the controller matches the value being held by the module for any held output channel.

When the value commanded for a channel by the controller matches the value being held by the module, the Output Held bit for that channel is cleared (0). The output channel can again be directly controlled by the values commanded in the Output Data file by the controller. The control can determine the output value being held by the module for any channel whose Output Held bit is set (1) by reading words 3 to 10 of the Input Data file.

1769-OF8C and -OF8V Output Data Loopback/Echo

Words 3 through 10 provide output loopback/data echo through the input array for channels 0 through 7. The value of the data echo is the analog value currently being converted on-board the module by the D/A converter. This ensures that the logic-directed state of the output is true. Otherwise, the state of the output could vary depending on controller mode.

Under normal operating conditions, the data echo value is the same value that is being sent from the controller to the output module. Under abnormal conditions, the values may differ. For example:

1. During run mode, the control program could direct the module to a value over or under the defined full range. In that case, the module raises the over- or under-range flag and continues to convert and data echo up to the defined full range. However, upon reaching either the maximum upper or lower full range value, the module stops converting and echoes back that maximum upper or lower full range value, not the value being sent from the controller.
2. During program or fault mode with Hold Last State or User-Defined Value selected, the module echoes the hold last value or alternate value you selected. For more information on the hold last and user-defined values, see 1769-OF8C and -OF8V Fault Value on page 4-31 and 1769-OF8C and -OF8V Program/Idle Value on page 4-32.
3. When one or more of the output channel's Output Held bits are set (1). See 1769-OF8C and -OF8V Output Held Bits (H0 through H7) on page 4-21.

1769-OF8C and -OF8V Configuration Data File

The configuration file lets you determine how each individual output channel will operate. Parameters such as the output type/range and data format are set up using this file. The configuration data file is writable and readable. The default value for the configuration data file is all zeros. The structure of the channel configuration file is explained below. The channel configuration words, the first two words of each eight word group, are described in Table 4.10 1769-OF8C and -OF8V Configuration Data File on page 4-22.

Table 4.10 1769-OF8C and -OF8V Configuration Data File

Word	Description	Word	Description
0	Channel 0 Configuration Word 0	24	Channel 3 Configuration Word 0
1	Channel 0 Configuration Word 1	25	Channel 3 Configuration Word 1
2	Channel 0 Fault Value Word	26	Channel 3 Fault Value Word
3	Channel 0 Program Idle Mode Word	27	Channel 3 Program Idle Mode Word
4	Channel 0 Low Clamp	28	Channel 3 Low Clamp
5	Channel 0 High Clamp	29	Channel 3 High Clamp
6	Channel 0 Ramp Rate	30	Channel 3 Ramp Rate
7	Channel 0 Spare	31	Channel 3 Spare
8	Channel 1 Configuration Word 0	32	Channel 4 Configuration Word 0
9	Channel 1 Configuration Word 1	33	Channel 4 Configuration Word 1
10	Channel 1 Fault Value Word	34	Channel 4 Fault Value Word
11	Channel 1 Program Idle Mode Word	35	Channel 4 Program Idle Mode Word
12	Channel 1 Low Clamp	36	Channel 4 Low Clamp
13	Channel 1 High Clamp	37	Channel 4 High Clamp
14	Channel 1 Ramp Rate	38	Channel 4 Ramp Rate
15	Channel 1 Spare	39	Channel 4 Spare
16	Channel 2 Configuration Word 0	40	Channel 5 Configuration Word 0
17	Channel 2 Configuration Word 1	41	Channel 5 Configuration Word 1
18	Channel 2 Fault Value Word	42	Channel 5 Fault Value Word
19	Channel 2 Program Idle Mode Word	43	Channel 5 Program Idle Mode Word
20	Channel 2 Low Clamp	44	Channel 5 Low Clamp
21	Channel 2 High Clamp	45	Channel 5 High Clamp
22	Channel 2 Ramp Rate	46	Channel 5 Ramp Rate
23	Channel 2 Spare	47	Channel 5 Spare

Word	Description	Word	Description
48	Channel 6 Configuration Word 0	56	Channel 7 Configuration Word 0
49	Channel 6 Configuration Word 1	57	Channel 7 Configuration Word 1
50	Channel 6 Fault Value Word	58	Channel 7 Fault Value Word
51	Channel 6 Program Idle Mode Word	59	Channel 7 Program Idle Mode Word
52	Channel 6 Low Clamp	60	Channel 7 Low Clamp
53	Channel 6 High Clamp	61	Channel 7 High Clamp
54	Channel 6 Ramp Rate	62	Channel 7 Ramp Rate
55	Channel 6 Spare	63	Channel 7 Spare

Table 4.11 1769-OF8C and -OF8V Word 0 and 1 Bit Descriptions

Word/ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	E	Reserved							SIU	SIO	LA	ER	FM	PM	HI	PFE
Word 1	Reserved					Output Data Format Select			Reserved				Output Type/Range			

The configuration file is typically modified using the programming software configuration screen. For information on configuring the module using MicroLogix 1500 and RSLogix 500, see Appendix B; for CompactLogix and RSLogix 5000, see Appendix C; for 1769-ADN DeviceNet Adapter and RSNetWorx, see Appendix D.

The configuration file can also be modified through the control program, if supported by the controller. The structure and bit settings are shown in 1769-OF8C and -OF8V Channel Configuration on page 4-24.

1769-OF8C and -OF8V Channel Configuration

The first two words of each eight word group in the configuration file allow you to change the parameters of each channel independently. For example, words 8 and 9 correspond to channel 1 while words 56 and 57 correspond to channel 7.

Table 4.12 1769-OF8C Channel Configuration⁽¹⁾

Define	Indicate this	These bit settings															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Program (Idle) to Fault Enable	Program (Idle) Mode Data Applied ⁽²⁾																0
	Fault Mode Data Applied ⁽²⁾																1
Hold for Initialization	Disabled															0	
	Enabled															1	
Program (Idle) Mode	Hold Last State ⁽²⁾														0		
	User-Defined Value ⁽²⁾														1		
Fault Mode	Hold Last State ⁽²⁾													0			
	User-Defined Fault Value ⁽²⁾													1			
Enable Ramping	Disabled												0				
	Enabled												1				
Enable Clamp/ Alarm Latching	Disabled											0					
	Enabled											1					
Enable High Clamp/ Alarm Interrupt	Disabled										0						
	Enabled										1						
Enable Low Clamp/ Alarm Interrupt	Disabled									0							
	Enabled									1							
Enable Channel	Disabled	0															
	Enabled	1															

⁽¹⁾ Refer to the 1769-OF8C and -OF8V Output Channel Configuration table.

⁽²⁾ These functions are not supported by all controllers (e.g. MicroLogix 1500) using any configuration method. Refer to your controller manual for details.

Table 4.13 1769-OF8C and -OF8V Output Channel Configuration

Define	Indicate this	These bit settings																
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
1769-OF8C	Output Range Select	0 to 20 mA dc														0	0	0
		4 to 20 mA dc														0	0	1
	Output Data Select	Raw/Proportional Counts						0	0	0								
		Engineering Units						0	0	1								
		Scaled for PID						0	1	0								
		Percent Range						0	1	1								
1769-OF8V	Output Range Select	-10...+10V dc													0	0	0	
		0...5V dc													0	0	1	
		0...10V dc													0	1	0	
		1...5V dc													0	1	1	
	Output Data Select	Raw/Proportional Counts						0	0	0								
Engineering Units							0	0	1									
Scaled for PID							0	1	0									
Percent Range							0	1	1									

1769-OF8C and -OF8V Enable/Disable Channel

This configuration selection (bit 15) allows each channel to be individually enabled.

TIP

A channel that is not enabled has zero voltage or current at its terminal.

Clamping/Limiting

Clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp.

Once clamps are determined for a module, any data received from the controller that exceeds those clamps sets an appropriate limit alarm and transitions the output to that limit but not beyond the requested value.

For example, an application may set the high clamp on a 1769-OF8C module for 15 mA and the low clamp for 5 mA. If a controller sends a value corresponding to 16 mA to the module, the module will only apply 15 mA to its screw terminals.

Clamping is disabled on a per channel basis by entering a 0 value for both the high and low clamps in the Configuration Data file. Interrupts are generated on a high- or low-alarm by setting (1) the SIO bit (for high-clamp or over-range alarm) or setting (1) the SIU bit (for low-clamp or under-range alarm). Alarms caused by exceeding over-/under-range or clamp limits can be latched by setting (1) a channel's LA bit on a per channel basis.

Clamp/Limit Alarms

This function works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies signal values at the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

With reference to the example in the Clamping/Limiting section, if a 1769-OF8C module has clamping limits of 15 mA and 5 mA but then receives data to apply 16 mA, only 15 mA is applied to the screw terminals. The module sends a status bit back to the controller informing it that the 16 mA value exceeds the module's clamping limits.

Ramping

Ramping limits the speed at which an analog output signal can change. This prevents fast transitions in the output from damaging the devices that an output module controls.

Table 4.14 Ramping Types

Ramping Type	Description
Ramp to Fault Mode	This type of ramping occurs when the present output value changes to the Fault Value after a communications fault occurs. This is the only type of ramping for the 1769-OF8C and -OF8V modules.

The ramp rate is defined in terms of the selected range/format in units per second. For example, in the 0 to 20 mA range and percent of full scale format, a ramp rate of 1000 is 10%/second (since 1000 is 10% of the total number of counts in the full scale of the 0 to 20 mA range) or a maximum of 2 mA per second. Table 4.15 and Table 4.16 describes how ramp rate is defined for all output range/types and output data formats.

Table 4.15 1769-OF8C Output Range/Types and Output Data Formats

Output Data Format Output Range/Type	Total Counts in Full Scale	Number of Counts for Every 1% of Ramp Rate	Real Units/Second for Every 1% of Ramp Rate
Proportional Counts			
0...20 mA	65534	655	0.2 mA/s
4...20 mA			0.16 mA/s
Engineering Units			
0...20 mA	21000	210	0.2 mA/s
4...20 mA	17800	178	0.16 mA/s
Scaled for PID			
0...20 mA	16383	164	0.2 mA/s
4...20 mA			0.16 mA/s
Percent of Full Scale			
0...20 mA	10000	100	0.2 mA/s
4...20 mA			0.16 mA/s

Table 4.16 1769-OF8V Output Range/Types and Output Data Formats

Output Data Format Output Range/Type	Total Counts in Full Scale	Number of Counts for Every 1% of Ramp Rate	Real Units/Second for Every 1% of Ramp Rate
Proportional Counts			
-10...+10V	65534	655	0.2V/s
0...5V			0.05V/s
0...10V			0.1V/s
1...5V			0.04V/s
Engineering Units			
-10...+10V	21000	210	0.2V/s
0...5V	5750	58	0.05V/s
0...10V	11000	110	0.1V/s
1...5V	4750	48	0.04V/s
Scaled for PID			
-10...+10V	16383	164	0.2V/s
0...5V			0.05V/s
0...10V			0.1V/s
1...5V			0.04V/s

Table 4.16 1769-OF8V Output Range/Types and Output Data Formats

Output Data Format Output Range/Type	Total Counts in Full Scale	Number of Counts for Every 1% of Ramp Rate	Real Units/Second for Every 1% of Ramp Rate
Percent of Full Scale			
-10...+10V	10000	100	0.2V/s
0...5V			0.05V/s
0...10V			0.1V/s
1...5V			0.04V/s

Ramping only takes place, if configured, when the output is being commanded to go to a fault state. Ramping is not done in normal run operation. The ramp rate values are entered in the Configuration Data file and are accepted as valid only if:

- The number of counts entered for a channel's ramp rate is greater than or equal to a minimum of 1% of the total number of full scale counts for the channel's selected data format (see Table 4.14 and Table 4.15 for minimum values).

OR

- The number of counts entered for a channel's ramp rate may be equal to 0 if ramping is not enabled for the channel.

Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value held by the module providing a bumpless transfer.

If Hold for Initialization is selected, outputs hold if any of these three conditions occur:

- initial connection is established after power-up
- new connection is established after a communications fault occurs
- transition to Run Mode from Program state

The Output Held bit (see the Input Data file) for a channel indicates that the channel is holding.

Open Wire Detection (1769-OF8C Only)

This feature detects when current flow is not present on an output channel that is enabled and has a non-zero output value commanded.

When an open wire condition occurs channel, the diagnostic bit (D bit in Input Data file status words) is set for that channel.

1769-OF8C and -OF8V Fault Mode (FM)

This configuration selection provides individual fault mode selection for the analog channels. When this selection is disabled [the bit is reset (0)], the module *holds the last state*, meaning that the analog output remains at the last converted value prior to the condition that caused the control system to enter the program mode.

IMPORTANT

Hold last state is the default condition for the 1769-OF8C and -OF8V 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.

If this selection is enabled [the bit is set (1)] and the system enters the program mode, it commands the module to convert the *user-specified* value from the channel's Fault mode word to the appropriate analog output for the range selected.

TIP

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

1769-OF8C and -OF8V Program/Idle Mode (PM)

This configuration selection provides individual program/idle mode selection for the analog channels 0. When this selection is disabled [the bit is reset (0)], the module *holds* the *last state*, meaning that the analog output remains at the last converted value prior to the condition that caused the control system to enter the program mode.

IMPORTANT

Hold last state is the default condition for the 1769-OF8C and -OF8V 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.

If this selection is enabled [the bit is set (1)] and the system enters the program mode, it commands the module to convert the *user-specified* value from the channel's Program/Idle mode word to the appropriate analog output for the range selected.

TIP

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

1769-OF8C and -OF8V Program/Idle to Fault Enable (PFE)

If a system currently in program/idle mode faults, this setting determines whether the program/idle or fault value is applied to the output. If the selection is enabled [the bit is set (1)], the module applies the fault value. If the selection is disabled [the bit is reset (0)], the module applies the program/idle mode data value. The default setting is disabled.

TIP

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

1769-OF8C and -OF8V Fault Value

Using words each channel's Fault Value word, you can specify the values the outputs will assume when the system enters the fault mode. The default value is 0. Valid values are dependent upon the range selected in the range selection field. If the value you entered is outside the normal operating range for the output range selected, the module generates a configuration error.

For example, if you select engineering units for the 0 to 20 mA range and enter a fault value within the normal operating range (0 to 20000), the module will configure and operate correctly. However, if you enter a value outside the normal operating range (for example 21000), the module indicates a configuration error.

TIP

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

EXAMPLE

- If the default value, 0000, is used and the range selected is 0 to 20 mA, the module will output 0 mA for all data formats.
- If the raw/proportional or engineering units format is selected and zero is entered as Program/Idle mode word in the 4 to 20 mA range (for 1769-OF8C) or the 1 to 5V range (for 1769-OF8V), a configuration error results.
- See Table 4.17 1769-OF8C Valid Output Data Table on page 4-33 and Table 4.18 1769-OF8V Valid Output Data Table on page 4-34 for more examples.

1769-OF8C and -OF8V Program/Idle Value

Use each channel's Program/Idle Mode word to set the integer values for the outputs to assume when the system enters the program mode. The values are dependent upon the range selected in the range selection field. If the value you entered is outside the normal operating range for the output range selected, the module generates a configuration error. The default value is 0.

For example, if you select engineering units for the 0 to 20 mA range and enter a program/idle value within the normal operating range (0 to 20000), the module will configure and operate correctly. However, if you enter a value outside the normal operating range (for example 21000), the module indicates a configuration error.

TIP

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

EXAMPLE

- If the default value, 0000, is used and the range selected is 0 to 20 mA, the module will output 0 mA for all data formats.
 - If the raw/proportional or engineering units format is selected and zero is entered as Program/Idle mode word in the 4 to 20 mA range (for 1769-OF8C) or the 1 to 5V range (for 1769-OF8V), a configuration error results.
 - See Table 4.17 1769-OF8C Valid Output Data Table on page 4-33 and Table 4.18 1769-OF8V Valid Output Data Table on page 4-34 for more examples.
-

1769-OF8C Valid Output Data Word Formats/Ranges

The following table shows the valid formats and data ranges accepted by the module.

Table 4.17 1769-OF8C Valid Output Data Table

OF8C Normal Operating Range	Input Value	Example Data		Output Range State	Raw/Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
		Controller Ordered	OF8C Output		Decimal Range		Decimal Range		Decimal Range		Decimal Range	
					Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo
4 mA to 20 mA	Over 21.0 mA	+22.0 mA	+21.0 mA	Over	N/A	N/A	22000	21000	18431	17407	11250	10625
	21.0 mA	+21.0 mA	+21.0 mA	Over	32767	32767	21000	21000	17407	17407	10625	10625
	4.0 mA to 20.0 mA	+20.0 mA	+20.0 mA	Normal	29085	29085	20000	20000	16383	16383	10000	10000
		+4.0 mA	+4.0 mA	Normal	-29822	-29822	4000	4000	0	0	0	0
	3.2 mA	+3.2 mA	+3.2 mA	Under	-32767	-32767	3200	3200	-819	-819	-500	-500
	Under 3.2 mA	0.0 mA	+3.2 mA	Under	N/A	N/A	0	3200	-4096	-819	-2500	-500
0 mA to 20 mA	Over 21.0 mA	+22.0 mA	+21.0 mA	Over	N/A	N/A	22000	21000	18201	17202	11000	10500
	21.0 mA	21.0 mA	+21.0 mA	Over	32767	32767	21000	21000	17202	17202	10500	10500
	0.0 mA to 20.0 mA	20.0 mA	+20.0 mA	Normal	29646	29646	20000	20000	16383	16383	10000	10000
		0.0 mA	0.0 mA	Normal	-32767	-32767	0	0	0	0	0	0
	Under 0.0 mA	-1.0 mA	0.0 mA	Under	N/A	N/A	-1000	0	-819	0	-500	0

1769-OF8V Valid Output Data Word Formats/Ranges

The following table shows the valid formats and data ranges accepted by the module.

Table 4.18 1769-OF8V Valid Output Data Table

OF8V Normal Operating Output Range	Input Value	Example Data		Output Range State	Raw/Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
		Controller Ordered	OF8C Output		Decimal Range		Decimal Range		Decimal Range		Decimal Range	
					Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo
±10V dc	Over 10.5V dc	+11.0V dc	+10.5V dc	Over	N/A	N/A	11000	10500	17202	16793	11000	10500
	+10.5V dc	+10.5V dc	+10.5V dc	Over	32767	32767	10500	10500	16793	16793	10500	10500
	-10V to +10V dc	+10.0V dc	+10.0V dc	Normal	31207	31207	10000	10000	16383	16383	10000	10000
		0.0V dc	0.0V dc	Normal	0	0	0	0	8192	8192	0	0
		-10.0V dc	-10.0V dc	Normal	-31207	-31207	-10000	-10000	0	0	-10000	-10000
	-10.5V dc	-10.5V dc	-10.5V dc	Under	-32767	-32767	-10500	-10500	-410	-410	-10500	-10500
	Under -0.5V dc	-11.0V dc	-11.0V dc	Under	N/A	N/A	-11000	-10500	-819	-410	-11000	-10500
0V to 5V dc	Over 5.25V dc	5.5V dc	+5.25V dc	Over	N/A	N/A	5500	5250	18021	17202	11000	10500
	5.25V dc	5.25V dc	+5.25V dc	Over	32767	32767	5250	5250	17202	17202	10500	10500
	0.0V dc to 5.0V dc	5.0V dc	+5.0V dc	Normal	29918	29918	5000	5000	16383	16383	10000	10000
		0.0V dc	0.0V dc	Normal	-27068	-27068	0	0	0	0	0	0
	-0.5V dc	-0.5V dc	-0.5V dc	Under	-32767	-32767	-500	-500	-1638	-1638	-1000	-1000
Under -0.5V dc	-1.0V dc	-0.5V dc	Under	N/A	N/A	-1000	-500	-3277	-1638	-2000	-1000	

Table 4.18 1769-OF8V Valid Output Data Table

OF8V Normal Operating Output Range	Input Value	Example Data		Output Range State	Raw/Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
		Controller Ordered	OF8C Output		Decimal Range		Decimal Range		Decimal Range		Decimal Range	
					Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo	Controller Ordered	OF8C Output and Echo
0V to 10V dc	Over 10.5V dc	11.0V dc	+10.5V dc	Over	N/A	N/A	11000	10500	18021	17202	11000	10500
	+10.5V dc	+10.5V dc	+10.5V dc	Over	32767	32767	10500	10500	17202	17202	10500	10500
	0.0V dc to 10.0V dc	+10.0V dc	+10.0V dc	Normal	29788	29788	10000	10000	16383	16383	10000	10000
		0.0V dc	0.0V dc	Normal	-29788	-29788	0	0	0	0	0	0
	-0.5V dc	-0.5V dc	-0.5V dc	Under	-32767	-32767	-500	-500	-819	-819	-500	-500
	Under -5.0V dc	-1.0V dc	-0.5V dc	Under	N/A	N/A	-1000	-500	-1638	-819	-1000	-500
1.0V to 5V dc	Over 5.25V dc	+5.5V dc	+5.25V dc	Over	N/A	N/A	5500	5250	18431	17407	11250	10625
	+5.25V dc	+5.25V dc	+5.25V dc	Over	32767	32767	5250	5250	17407	17407	10625	10625
	1.0V to 5.0V dc	+5.0V dc	+5.0V dc	Normal	29318	29318	5000	5000	16383	16383	10000	10000
		+1.0V dc	+1.0V dc	Normal	-25869	-25869	1000	1000	0	0	0	0
	0.5V dc	+0.5V dc	+0.5V dc	Under	-32767	-32767	500	500	-2048	-2048	-1250	-1250
	Under 0.5V dc	0.0V dc	0.0V dc	Under	N/A	N/A	0	500	-4096	-2048	-2500	-1250

Notes:

Module Diagnostics and Troubleshooting

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

- safety considerations when troubleshooting
- module vs. channel operation
- the module's diagnostic features
- critical vs. non-critical errors
- module condition data

Safety Considerations

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 UVROM 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 controller.

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

Table 5.1 Diagnostics

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. Call your local distributor or Rockwell Automation for assistance.
Blinking ⁽¹⁾	Isolated 24V Power Not Present	Check external power switch setting. Check wiring to external power supply terminals. Check external power supply.

⁽¹⁾ 1769-OF8V and -OF8C only.

Channel Diagnostics

When an input or output module 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, over-range and under-range, open-circuit (input module in 4 to 20 mA range only) and output wire broken/high load resistance (output module only) conditions.

Out-of-Range Detection (Input and Output Modules)

For input modules, whenever the data received at the channel word is out of the defined operating range, an over-range or under-range error is indicated in the Input Data file.

For output modules, whenever the controller is driving data over or under the defined operating range, an over-range or under-range error is indicated in the Input Data file.

Open-Circuit Detection (Input Modules Only)

The module performs an open-circuit test on all enabled channels configured for 4 to 20 mA inputs. Whenever an open-circuit condition occurs, the under-range bit for that channel is set in the Input Data file.

Possible causes of an open circuit include:

- the sensing device may be broken
- a wire may be loose or cut
- the sensing device may not be installed on the configured channel

Output Wire Broken/High Load Resistance (Output Modules Only)

A check is performed on all enabled channels to determine if an output wire is broken, or if the load resistance is high, in the case of current mode outputs. Whenever one of these conditions is present, the diagnostic bit for that channel is set in the Input Data file.

Non-critical vs. Critical Module Errors

Non-critical module errors are typically recoverable. Channel errors (over-range or under-range errors) are non-critical. Non-critical error conditions are indicated in the module input data table. Non-critical configuration errors are indicated by the extended error code. See Table 5.4 1769-IF4 and -OF2 Extended Error Codes on page 5-6.

Critical module errors are conditions that prevent normal or recoverable operation of the system. When these types of errors occur, the system typically leaves the run or program mode of operation until the error can be dealt with. Critical module errors are indicated in Table 5.4 1769-IF4 and -OF2 Extended Error Codes on page 5-6.

Module Error Definition Table

Analog module errors are expressed in two fields as four-digit Hex format with the most significant digit as “don’t care” and irrelevant. The two fields are “Module Error” and “Extended Error Information”. The structure of the module error data is shown below.

Table 5.2 Module Error Table

"Don't Care" Bits				Module Error			Extended Error Information								
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hex Digit 4				Hex Digit 3			Hex Digit 2				Hex Digit 1				

Module Error Field

The purpose of the module error field is to classify module errors into three distinct groups, as described in the table below. The type of error determines what kind of information exists in the extended error information field. These types of module errors are typically reported in the controller's I/O status file. Refer to your controller manual for details.

Table 5.3 Module Error Types

Error Type	Module Error Field Value Bits 11 through 09 (Bin)	Description
No Errors	000	No error is present. The extended error field holds no additional information.
Hardware Errors	001	General and specific hardware error codes are specified in the extended error information field.
Configuration Errors	010	Module-specific error codes are indicated in the extended error field. These error codes correspond to options that you can change directly. For example, the input range or input filter selection.

Extended Error Information Field

Check the extended error information field when a non-zero value is present in the module error field. Depending upon the value in the module error field, the extended error information field can contain error codes that are module-specific or common to all 1769 analog modules.

TIP

If no errors are present in the module error field, the extended error information field will be set to zero.

Hardware Errors

General or module-specific hardware errors are indicated by module error code 2. See Table 5.4 1769-IF4 and -OF2 Extended Error Codes on page 5-6, Table 5.5 1769-IF8 Extended Error Codes on page 5-7, and Table 5.6 1769-OF8C and -OF8V Extended Error Codes on page 5-10.

Configuration Errors

If you set the fields in the configuration file to invalid or unsupported values, the module ignores the invalid configuration, generates a non-critical error, and keeps operating with the previous configuration.

Each type of analog module has different features and different error codes. See Table 5.4 1769-IF4 and -OF2 Extended Error Codes on page 5-6, Table 5.5 1769-IF8 Extended Error Codes on page 5-7, and Table 5.6 1769-OF8C and -OF8V Extended Error Codes on page 5-10.

Error Codes

Error codes can help troubleshoot your module.

Table 5.4 1769-IF4 and -OF2 Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	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	0 1000 0000	General hardware error, loss of external 24V dc power
	X301	001	0 1000 0001	Microprocessor hardware error
1769-IF4 Specific Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	invalid input range selected (channel 0)
	X402	010	0 0000 0010	invalid input range selected (channel 1)
	X403	010	0 0000 0011	invalid input range selected (channel 2)
	X404	010	0 0000 0100	invalid input range selected (channel 3)
	X405	010	0 0000 0101	invalid input filter selected (channel 0)
	X406	010	0 0000 0110	invalid input filter selected (channel 1)
	X407	010	0 0000 0111	invalid input filter selected (channel 2)
	X408	010	0 0000 1000	invalid input filter selected (channel 3)
	X409	010	0 0000 1001	invalid input format selected (channel 0)
	X40A	010	0 0000 1010	invalid input format selected (channel 1)
	X40B	010	0 0000 1011	invalid input format selected (channel 2)
	X40C	010	0 0000 1100	invalid input format selected (channel 3)

Table 5.4 1769-IF4 and -OF2 Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
1769-OF2 Specific Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	invalid output range selected (channel 0)
	X402	010	0 0000 0010	invalid output range selected (channel 1)
	X403	010	0 0000 0011	invalid output data format selected (channel 0)
	X404	010	0 0000 0100	invalid output data format selected (channel 1)
	X405	010	0 0000 0101	invalid fault value entered for data format selected (channel 0)
	X406	010	0 0000 0110	invalid fault value entered for data format selected (channel 1)
	X407	010	0 0000 0111	invalid program value entered for data format selected (channel 0)
	X408	010	0 0000 1000	invalid program value entered for data format selected (channel 1)

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

Table 5.5 1769-IF8 Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	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	0 1000 0000	General hardware error, loss of external 24V dc power
	X301	001	0 1000 0001	Microprocessor hardware error
	X302	001	1 0000 0010	A/D converter communication error

Table 5.5 1769-IF8 Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
1769-IF8 Specific Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	invalid input range selected (channel 0)
	X402	010	0 0000 0010	invalid input range selected (channel 1)
	X403	010	0 0000 0011	invalid input range selected (channel 2)
	X404	010	0 0000 0100	invalid input range selected (channel 3)
	X405	010	0 0000 0101	invalid input range selected (channel 4)
	X406	010	0 0000 0110	invalid input range selected (channel 5)
	X407	010	0 0000 0111	invalid input range selected (channel 6)
	X408	010	0 0000 1000	invalid input range selected (channel 7)
	X409	010	0 0000 1001	invalid input filter selected (channel 0)
	X40A	010	0 0000 1010	invalid input filter selected (channel 1)
	X40B	010	0 0000 1011	invalid input filter selected (channel 2)
	X40C	010	0 0000 1100	invalid input filter selected (channel 3)
	X40D	010	0 0000 1101	invalid input filter selected (channel 4)
	X40E	010	0 0000 1110	invalid input filter selected (channel 5)
	X40F	010	0 0000 1111	invalid input filter selected (channel 6)
	X410	010	0 0001 0000	invalid input filter selected (channel 7)
	X411	010	0 0001 0001	invalid input format selected (channel 0)
	X412	010	0 0001 0010	invalid input format selected (channel 1)
	X413	010	0 0001 0011	invalid input format selected (channel 2)
	X414	010	0 0001 0100	invalid input format selected (channel 3)
X415	010	0 0001 0101	invalid input format selected (channel 4)	
X416	010	0 0001 0110	invalid input format selected (channel 5)	
X417	010	0 0001 0111	invalid input format selected (channel 6)	
X418	010	0 0001 1000	invalid input format selected (channel 7)	
X419	010	0 0001 1001	alarm not enabled (channel 0)	
X41A	010	0 0001 1010	alarm not enabled (channel 1)	

Table 5.5 1769-IF8 Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
1769-IF8 Specific Configuration Error	X41B	010	0 0001 1011	alarm not enabled (channel 2)
	X41C	010	0 0001 1100	alarm not enabled (channel 3)
	X41D	010	0 0001 1101	alarm not enabled (channel 4)
	X41E	010	0 0001 1110	alarm not enabled (channel 5)
	X41F	010	0 0001 1111	alarm not enabled (channel 6)
	X420	010	0 0010 0000	alarm not enabled (channel 7)
	X421	010	0 0010 0001	invalid alarm data selected (channel 0)
	X422	010	0 0010 0010	invalid alarm data selected (channel 1)
	X423	010	0 0010 0011	invalid alarm data selected (channel 2)
	X424	010	0 0010 0100	invalid alarm data selected (channel 3)
	X425	010	0 0010 0101	invalid alarm data selected (channel 4)
	X426	010	0 0010 0110	invalid alarm data selected (channel 5)
	X427	010	0 0010 0111	invalid alarm data selected (channel 6)
	X428	010	0 0010 1000	invalid alarm data selected (channel 7)
	X429	010	0 0010 1001	invalid real time sample rate value

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

Table 5.6 1769-OF8C and -OF8V Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	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
	X216	001	0 0001 0110	Microprocessor watchdog error
	X220	001	0 0010 0000	Firmware corrupt (checksum failure)
	X221	001	0 0010 0001	Firmware checksum error in NVRAM (calibration data checksum failure)
Hardware-Specific Error	X300	001	1 0000 0000	General hardware error (ASIC)
1769-OF8C and -OF8V Specific Configuration Error	X401	010	0 0000 0001	invalid input range selected (channel 0)
	X402	010	0 0000 0010	invalid input range selected (channel 1)
	X403	010	0 0000 0011	invalid input range selected (channel 2)
	X404	010	0 0000 0100	invalid input range selected (channel 3)
	X405	010	0 0000 0101	invalid input range selected (channel 4)
	X406	010	0 0000 0110	invalid input range selected (channel 5)
	X407	010	0 0000 0111	invalid input range selected (channel 6)
	X408	010	0 0000 1000	invalid input range selected (channel 7)
	X409	010	0 0000 1001	invalid data format selected (channel 0)
	X40A	010	0 0000 1010	invalid data format selected (channel 1)
	X40B	010	0 0000 1011	invalid data format selected (channel 2)
	X40C	010	0 0000 1100	invalid data format selected (channel 3)
	X40D	010	0 0000 1101	invalid data format selected (channel 4)
	X40E	010	0 0000 1110	invalid data format selected (channel 5)
	X40F	010	0 0000 1111	invalid data format selected (channel 6)
	X410	010	0 0001 0000	invalid data format selected (channel 7)
	X411	010	0 0001 0001	invalid fault value (channel 0)
	X412	010	0 0001 0010	invalid fault value (channel 1)
	X413	010	0 0001 0011	invalid fault value (channel 2)
	X414	010	0 0001 0100	invalid fault value (channel 3)
X415	010	0 0001 0101	invalid fault value (channel 4)	
X416	010	0 0001 0110	invalid fault value (channel 5)	
X417	010	0 0001 0111	invalid fault value (channel 6)	
X418	010	0 0001 1000	invalid fault value (channel 7)	
X419	010	0 0001 1001	invalid idle value (channel 0)	

Table 5.6 1769-OF8C and -OF8V Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
1769-OF8C and -OF8V Specific Configuration Error	X41A	010	0 0001 1010	invalid idle value (channel 1)
	X41B	010	0 0001 1011	invalid idle value (channel 2)
	X41C	010	0 0001 1100	invalid idle value (channel 3)
	X41D	010	0 0001 1011	invalid idle value (channel 4)
	X41E	010	0 0001 1100	invalid idle value (channel 5)
	X41F	010	0 0001 1101	invalid idle value (channel 6)
	X420	010	0 0010 0000	invalid idle value (channel 7)
	X421	010	0 0010 0001	invalid clamps (channel 0)
	X422	010	0 0010 0010	invalid clamps (channel 1)
	X423	010	0 0010 0011	invalid clamps (channel 2)
	X424	010	0 0010 0100	invalid clamps (channel 3)
	X425	010	0 0010 0101	invalid clamps (channel 4)
	X426	010	0 0010 0110	invalid clamps (channel 5)
	X427	010	0 0010 0111	invalid clamps (channel 6)
	X428	010	0 0010 1000	invalid clamps (channel 7)
	X429	010	0 0010 1001	invalid ramp rate (channel 0)
	X42A	010	0 0010 1010	invalid ramp rate (channel 1)
	X42B	010	0 0010 1011	invalid ramp rate (channel 2)
	X42C	010	0 0010 1100	invalid ramp rate (channel 3)
	X42D	010	0 0010 1101	invalid ramp rate (channel 4)
	X42E	010	0 0010 1110	invalid ramp rate (channel 5)
	X42F	010	0 0010 1111	invalid ramp rate (channel 6)
	X430	010	0 0011 0000	invalid ramp rate (channel 7)
	X431	010	0 0011 0001	configuration word 0 illegal bits set (channel 0)
	X432	010	0 0011 0010	configuration word 0 illegal bits set (channel 1)
	X433	010	0 0011 0011	configuration word 0 illegal bits set (channel 2)
	X434	010	0 0011 0100	configuration word 0 illegal bits set (channel 3)
	X435	010	0 0011 0101	configuration word 0 illegal bits set (channel 4)
	X436	010	0 0011 0110	configuration word 0 illegal bits set (channel 5)
	X437	010	0 0011 1011	configuration word 0 illegal bits set (channel 6)
	X438	010	0 0011 1000	configuration word 0 illegal bits set (channel 7)
	X439	010	0 0011 1001	configuration word 1 illegal bits set (channel 0)
	X43A	010	0 0011 1010	configuration word 1 illegal bits set (channel 1)

Table 5.6 1769-OF8C and -OF8V Extended Error Codes

Error Type	Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
1769-OF8C and -OF8V Specific Configuration Error	X43B	010	0 0011 1011	configuration word 1 illegal bits set (channel 2)
	X43C	010	0 0011 1100	configuration word 1 illegal bits set (channel 3)
	X43D	010	0 0011 1101	configuration word 1 illegal bits set (channel 4)
	X43E	010	0 0011 1110	configuration word 1 illegal bits set (channel 5)
	X43F	010	0 0011 1111	configuration word 1 illegal bits set (channel 6)
	X440	010	0 0100 0000	configuration word 1 illegal bits set (channel 7)

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

Module Inhibit Function

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

Whenever the output modules are inhibited, the modules enter the program mode and the output channel is changed to the state configured for the program mode. Whenever the input modules are inhibited, the modules 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 for 1769-IF4, -IF8, -OF2, -OF8C, and -OF8V Modules

Table A.1 General Specifications

Specification	Value
Dimensions	118 mm (height) x 87 mm (depth) x 35 mm (width) [52.5 mm (width) for 1769-IF8] Height including mounting tabs is 138 mm 4.65 in (height) x 3.43 in (depth) x 1.38 in (width) [2.07 in (width) for 1769-IF8] Height including mounting tabs is 5.43 in
Approximate Shipping Weight (with carton)	300g (0.65 lbs.) 1769-IF8 - 450g (0.99 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
Shock	Operating: 30G, 11 ms panel mounted (20G, 11 ms DIN rail mounted) Relay Operation: 7.5G panel mounted (5G DIN rail mounted) Non-Operating: 40G panel mounted (30G DIN rail mounted)
System Power Supply Distance Rating	8 (The module may not be more than 8 modules away from a system power supply.)
Optional 24V dc Class 2 Power Supply Voltage Range ⁽¹⁾	20.4 V to 26.4V dc
Recommended Cable	Belden™ 8761 (shielded)
Maximum Cable Length	1769-IF4 and -IF8: See "Effect of Transducer/Sensor and Cable Length Impedance on Voltage Input Accuracy" on page 2-12 1769-OF2, -OF8C, and -OF8V: See "Effect of Device and Cable Output Impedance on Output Module Accuracy" on page 2-13
Agency Certification	<ul style="list-style-type: none"> • C-UL certified (under CSA C22.2 No. 142) • UL 508 listed • CE compliant for all applicable directives
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

Specification	Value
<i>Electrical /EMC:</i>	<i>The module has passed testing at the following levels:</i>
<ul style="list-style-type: none"> • ESD Immunity (IEC1000-4-2) 	<ul style="list-style-type: none"> • 4 kV contact, 8 kV air, 4 kV indirect
<ul style="list-style-type: none"> • Radiated Immunity (IEC1000-4-3) 	<ul style="list-style-type: none"> • 10 V/m , 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
<ul style="list-style-type: none"> • Fast Transient Burst (IEC1000-4-4) 	<ul style="list-style-type: none"> • 2 kV, 5kHz
<ul style="list-style-type: none"> • Surge Immunity (IEC1000-4-5) 	<ul style="list-style-type: none"> • 1kV galvanic gun
<ul style="list-style-type: none"> • Conducted Immunity (IEC1000-4-6) 	<ul style="list-style-type: none"> • 10V, 0.15 to 80MHz⁽²⁾

⁽¹⁾ Failure to use a Class 2 power supply without regulation within these limits could result in improper module operation.

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

1769-IF4 Input Specifications

Table A.2 1769-IF4 Specifications

Specification	1769-IF4 (Series B and later)
Analog Normal Operating Ranges	Voltage: $\pm 10V$ dc, 0 to 10V dc, 0 to 5V dc, 1 to 5V dc Current: 0 to 20 mA, 4 to 20 mA
Full Scale ⁽¹⁾ Analog Ranges	Voltage: $\pm 10.5V$ dc, -0.5 to 10.5V dc, -0.5 to 5.25V dc, 0.5 to 5.25V dc Current: 0 to 21 mA, 3.2 to 21 mA
Number of Inputs	4 differential or single-ended
Bus Current Draw (max.)	120 mA at 5V dc 60 mA at 24V dc ⁽⁷⁾
Heat Dissipation	2.63 Total Watts (The Watts per point, plus the minimum Watts, with all points energized.)
Converter Type	Delta Sigma
Response Speed per Channel	Input filter and configuration dependent. See "Channel Step Response" on page 3-6.
Resolution (max.)	14 bits (unipolar) 14 bits plus sign (bipolar) See "Effective Resolution" on page 3-13.
Rated Working Voltage ⁽²⁾	30V ac/30V dc
Common Mode Voltage Range ⁽³⁾	$\pm 10V$ maximum per channel
Common Mode Rejection	greater than 60 dB at 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively
Normal Mode Rejection Ratio	-50 dB at 50/60 Hz with the 50 or 60 Hz filter selected, respectively
Input Impedance	Voltage Terminal: 220K Ω (typical) Current Terminal: 250 Ω
Overall Accuracy ⁽⁴⁾	Voltage Terminal: $\pm 0.2\%$ full scale at 25°C Current Terminal: $\pm 0.35\%$ full scale at 25°C
Accuracy Drift with Temperature	Voltage Terminal: $\pm 0.003\%$ per °C Current Terminal: $\pm 0.0045\%$ per °C
Calibration	The module performs autocalibration on channel enable and on configuration change between channels.
Non-linearity (in percent full scale)	$\pm 0.03\%$
Repeatability ⁽⁵⁾	$\pm 0.03\%$
Module Error over Full Temperature Range (0 to +60°C [+32°F to +140°F])	Voltage: $\pm 0.3\%$ Current: $\pm 0.5\%$

Specification	1769-IF4 (Series B and later)
Input Channel Configuration	via configuration software screen or the user program (by writing a unique bit pattern into the module's configuration file). Refer to your controller manual to determine if user program configuration is supported.
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.
Channel Diagnostics	Over or under range by bit reporting
Maximum Overload at Input Terminals ⁽⁶⁾	Voltage Terminal: $\pm 30V$ continuous, 0.1 mA Current Terminal: ± 32 mA continuous, ± 7.6 V
Input 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)
Vendor I.D. Code	1
Product Type Code	10
Product Code	35

- (1) The over- or under-range flag will come on when the normal operating range (over/under) 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 signal and 20V dc potential above ground).
- (3) For proper operation, both the plus and minus input terminals must be within $\pm 10V$ 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.
- (7) If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.

1769-IF8 Input Specifications

Table A.3 1769-IF8 Specifications

Specification	1769-IF8
Analog Normal Operating Ranges ⁽¹⁾	Voltage: $\pm 10V$ dc, 0 to 10V dc, 0 to 5V dc, 1 to 5V dc Current: 0 to 20 mA, 4 to 20 mA
Full Scale Analog Ranges ⁽¹⁾	Voltage: $\pm 10.5V$ dc, 0 to 10.5V dc, 0 to 5.25V dc, 0.5 to 5.25V dc Current: 0 to 21 mA, 3.2 to 21 mA
Number of Inputs	8 differential or single-ended
Bus Current Draw (max.)	120 mA at 5V dc 70 mA at 24V dc
Heat Dissipation	3.24 Total Watts (The Watts per point, plus the minimum Watts, with all points energized.)
Converter Type	Delta Sigma
Response Speed per Channel	Input filter and configuration dependent. See your user's manual.
Resolution (max.) ⁽²⁾	16 bits (unipolar) 15 bits plus sign (bipolar)
Rated Working Voltage ⁽³⁾	30V ac/30V dc
Common Mode Voltage Range ⁽⁴⁾	$\pm 10V$ dc maximum per channel
Common Mode Rejection	greater than 60 dB at 50 and 60 Hz with the 10 Hz filter selected, respectively.
Normal Mode Rejection Ratio	-50 dB at 50 and 60 Hz with the 10 Hz filter selected, respectively.
Input Impedance	Voltage Terminal: 220K Ω (typical) Current Terminal: 250 Ω
Overall Accuracy ⁽⁵⁾	Voltage Terminal: $\pm 0.2\%$ full scale at 25°C Current Terminal: $\pm 0.35\%$ full scale at 25°C

(1) The over- or under-range flag will come on when the normal operating range (over/under) 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) Resolution is dependent upon your filter selection. The maximum resolution is achieved with the 10 Hz filter selected. For resolution with other filter selections, refer to the user manual, publication 1769-UM002.

(3) 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 signal and 20V dc potential above ground).

(4) For proper operation, both the plus and minus input terminals must be within $\pm 10V$ dc of analog common.

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

Specification	1769-IF8
Accuracy Drift with Temperature	Voltage Terminal: $\pm 0.003\%$ per $^{\circ}\text{C}$ Current Terminal: $\pm 0.0045\%$ per $^{\circ}\text{C}$
Calibration	The module performs autocalibration on channel enable and on a configuration change between channels.
Non-linearity (in percent full scale)	$\pm 0.03\%$
Repeatability ⁽¹⁾	$\pm 0.03\%$
Module Error over Full Temperature Range (0 to $+60^{\circ}\text{C}$ [$+32^{\circ}\text{F}$ to $+140^{\circ}\text{F}$])	Voltage: $\pm 0.3\%$ Current: $\pm 0.5\%$
Input Channel Configuration	via 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.
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.
Channel Diagnostics	Over- or under-range by bit reporting, process alarms
Maximum Overload at Input Terminals ⁽²⁾	Voltage Terminal: $\pm 30\text{V}$ dc continuous, 0.1 mA Current Terminal: ± 32 mA continuous, ± 7.6 V dc
System Power Supply Distance Rating	8 (The module may not be more than 8 modules away from the system power supply.)
Recommended Cable	Belden™ 8761 (shielded)
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)
Vendor I.D. Code	1
Product Type Code	10
Product Code	38

⁽¹⁾ Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.

⁽²⁾ Damage may occur to the input circuit if this value is exceeded.

1769-OF2 Output Specifications

Table A.4 1769-OF2 Specifications

Specification	1769-OF2 (Series B and later)
Analog Ranges ⁽¹⁾	Voltage: $\pm 10\text{V dc}$, 0 to 10V dc, 0 to 5V dc, 1 to 5V dc Current: 0 to 20 mA, 4 to 20 mA
Full Scale Analog Ranges	Voltage: $\pm 10.5\text{V dc}$, -0.5 to 10.5V dc, -0.5 to 5.25V dc, 0.5 to 5.25V dc Current: 0 - 21 mA, 3.2 - 21 mA
Number of Outputs	2 single-ended
Bus Current Draw (max.)	120 mA at 5V dc 120 mA at 24V dc ⁽⁷⁾
Heat Dissipation	2.52 Total Watts (<i>The Watts per point, plus the minimum Watts, with all points energized.</i>)
Converter Type	Sigma-Delta
Analog Data Format	14-bit, two's complement. The Most Significant Bit is the sign bit.
Digital Resolution Across Full Range	14 bits (unipolar) 14 bits plus sign (bipolar) See "1769-OF2 Module Resolution" on page 4-15.
Conversion Rate (all channels) max.	2.5 ms
Step Response to 63% ⁽²⁾	2.9 ms
Current Load on Voltage Output	10 mA max.
Resistive Load on Current Output	0 to 500 Ω (includes wire resistance)
Load Range on Voltage Output	>1 k Ω at 10V dc
Max. Inductive Load (Current Outputs)	0.1 mH
Max. Capacitive Load (Voltage Outputs)	1 μF
Overall Accuracy ⁽³⁾	Voltage Terminal: $\pm 0.5\%$ full scale at 25°C Current Terminal: $\pm 0.35\%$ full scale at 25°C
Accuracy Drift with Temperature	Voltage Terminal: $\pm 0.0086\%$ FS per °C Current Terminal: $\pm 0.0058\%$ FS per °C
Output Ripple ⁽⁴⁾ range 0 - 50 kHz (referred to output range)	$\pm 0.05\%$
Calibration	None required (guaranteed by hardware design).
Non-linearity (in percent full scale)	$\pm 0.05\%$
Repeatability ⁽⁵⁾ (in percent full scale)	$\pm 0.05\%$

Specification	1769-OF2 (Series B and later)
Output Error Over Full Temperature Range (0 to 60°C [32 to +140°F])	Voltage: ±0.8% Current: ±0.55%
Output Offset Error (0 to 60°C [32 to +140°F])	±0.05%
Output Impedance	15 Ω (typical)
Open and Short-Circuit Protection	Yes
Maximum Short-Circuit Current	21 mA
Output Overvoltage Protection	Yes
Time to Detect Open Wire Condition (Current Mode)	10 ms typical 13.5 ms maximum
Output Response at Power Up and Power Down	±0.5 V spike for <5 ms
Rated Working Voltage ⁽⁶⁾	30V ac/30V dc
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.
Channel Diagnostics	Over or under range by bit reporting output wire broken or load resistance high by bit reporting (current mode only)
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)
Vendor I.D. Code	1
Product Type Code	10
Product Code	32

- (1) The over- or under-range flag will come on when the normal operating range (over/under) 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) Step response is the period of time between when the D/A converter was instructed to go from minimum to full range until the device is at 63% of full range. Time applies to one or both channels.
- (3) Includes offset, gain, non-linearity and repeatability error terms.
- (4) Output ripple is the amount a fixed output varies with time, assuming a constant load and temperature.
- (5) 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.
- (6) 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 signal and 20V dc potential above ground).
- (7) If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.

1769-OF8C Output Specifications

Table A.5 1769-OF8C Specifications

Specification	1769-OF8C
Analog Normal Operating Ranges ⁽¹⁾	0 to 20 mA, 4 to 20 mA
Full Scale Analog Ranges ⁽¹⁾	0 to 21 mA, 3.2 to 21 mA
Number of Outputs	8 single-ended
Bus Current Draw (max.)	145 mA at 5V dc 160 mA at 24V dc ⁽²⁾
Heat Dissipation	2.69 Total Watts (<i>All points - 21 mA into 250Ω - worst case calculated.</i>)
Digital Resolution Across Full Range	16 bits (unipolar) +4 to +20 mA: 15.59 bits, 0.323 μA/bit 0 to +20 mA: 15.91 bits, 0.323 μA/bit
Conversion Rate (all channels) max.	5 ms
Step Response to 63% ⁽³⁾	<2.9 ms
Resistive Load on Current Output	0 to 500 Ω (includes wire resistance)
Max. Inductive Load	0.1 mH
Field Calibration	None required
Overall Accuracy ⁽⁴⁾	±0.35% full scale at 25°C

⁽¹⁾ The over- or under-range flag will come on when the normal operating range (over/under) 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 unless configured to latch.

⁽²⁾ If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.

⁽³⁾ Step response is the period of time between when the D/A converter was instructed to go from minimum to full range until the device is at 63% of full range.

⁽⁴⁾ Includes offset, gain, drift, non-linearity and repeatability error terms.

Specification	1769-OF8C
Accuracy Drift with Temperature	±0.0058% FS per °C
Output Ripple ⁽¹⁾ range 0 to 50 kHz (referred to output range)	±0.05%
Non-linearity (in percent full scale)	±0.05%
Repeatability ⁽²⁾ (in percent full scale)	±0.05%
Output Error Over Full Temperature Range (0 to 60°C [+32 to +140°F])	Current: ±0.55%
Output Offset Error (0 to 60°C [+32 to +140°F])	±0.05%
Output Impedance	>1 MΩ
Open and Short-Circuit Protection	Yes
Maximum Short-Circuit Current	21 mA
Output Overvoltage Protection	Yes
Time to Detect Open Wire Condition	5 ms
Output Response at System Power Up and Power Down	± 0.5V dc spike for < 5 ms
Rated Working Voltage ⁽³⁾	30V ac/30V dc
Output 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)
Module OK LED	On: module has power, has passed internal diagnostics, and is communicating over the bus. Flashing: external power failure. Off: Any of the above is not true.
Channel Diagnostics	Over- or under-range by bit reporting output wire broken or load resistance high by bit reporting

⁽¹⁾ Output ripple is the amount a fixed output varies with time, assuming a constant load and temperature.

⁽²⁾ 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.

⁽³⁾ 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 signal and 20V dc potential above ground).

1769-OF8V Output Specifications

Table A.6 1769-OF8V Specifications

Specification	1769-OF8V
Analog Normal Operating Ranges ⁽¹⁾	± 10V dc, 0 to 10V dc, 0 to 5V dc, 1 to 5V dc
Full Scale Analog Ranges ⁽¹⁾	± 10.5V dc, -0.5 to 10.5V dc, -0.5 to 5.25V dc, 0.5 to 5.25V dc
Number of Outputs	8 single-ended
Bus Current Draw (max.)	145 mA at 5V dc 125 mA at 24V dc ⁽²⁾
Heat Dissipation	2.16 Total Watts (<i>All points - 10.5V into 1 kΩ - worst case calculated.</i>)
Digital Resolution Across Full Range	16 bits plus sign (bipolar) ±10V dc: 15.89 bits, 330 μV/bit 0 to +5V dc: 13.89 bits, 330 μV/bit 0 to +10V dc: 14.89 bits, 330 μV/bit +1 to +5V dc: 13.57 bits, 330 μV/bit
Conversion Rate (all channels) max.	5.0 ms
Step Response to 63% ⁽³⁾	<2.9 ms
Current Load Output	10 mA max.
Load Range Output	> 1 kΩ at 10V dc
Max. Capacitive Load	1 μF
Field Calibration	None required
Overall Accuracy ⁽⁴⁾	±0.5% full scale at 25°C

⁽¹⁾ The over- or under-range flag will come on when the normal operating range (over/under) 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⁾ If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.

⁽³⁾ Step response is the period of time between when the D/A converter was instructed to go from minimum to full range until the device is at 63% of full range.

⁽⁴⁾ Includes offset, gain, drift, non-linearity and repeatability error terms.

Specification	1769-OF8V
Accuracy Drift with Temperature	±0.0086% FS per °C
Output Ripple ⁽¹⁾ range 0 to 50 kHz (referred to output range)	±0.05%
Non-linearity (in percent full scale)	±0.05%
Repeatability ⁽²⁾ (in percent full scale)	±0.05%
Output Error Over Full Temperature Range (0 to 60°C [+32 to +140°F])	±0.8%
Output Offset Error (0 to 60°C [+32 to +140°F])	±0.05%
Output Impedance	<1 Ω
Open and Short-Circuit Protection	Yes
Maximum Short-Circuit Current	30 mA
Output Overvoltage Protection	Yes
Output Response at System Power Up and Power Down	± 0.5V dc spike for < 5 ms
Rated Working Voltage ⁽³⁾	30V ac/30V dc
Output 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)
Module OK LED	On: module has power, has passed internal diagnostics, and is communicating over the bus. Flashing: external power failure. Off: Any of the above is not true.
Channel Diagnostics	Over- or under-range by bit reporting

⁽¹⁾ Output ripple is the amount a fixed output varies with time, assuming a constant load and temperature.

⁽²⁾ 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.

⁽³⁾ 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 signal and 20V dc potential above ground).

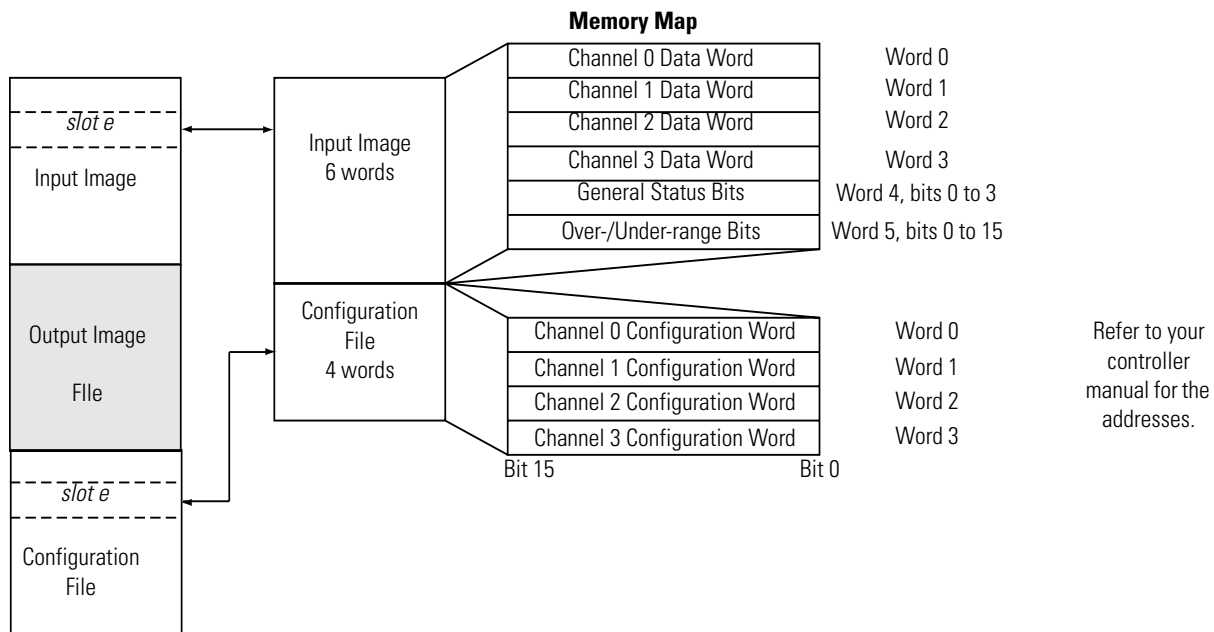
Module Addressing and Configuration with MicroLogix 1500

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

Input Module Addressing

In the following example, the 1769-IF4 is used. Detailed information on the input image table can be found in 1769-IF4 Input Data File on page 3-2.

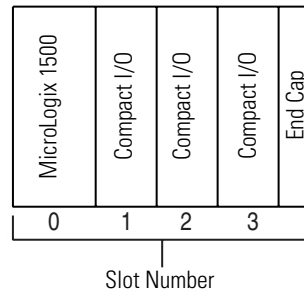
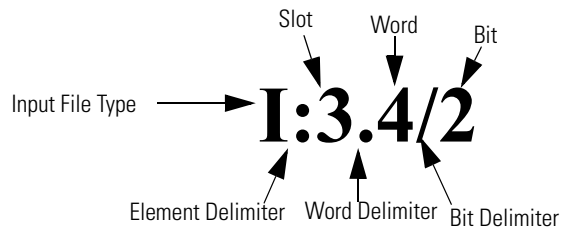
Figure B.1 1769-IF4 Memory Map Including Configuration



Input Modules Input Image

The input modules' input image file represents data words and status bits. Input words 0 through 3 hold the input data that represents the value of the analog inputs for channels 0 through 3. These data words are valid only when the channel is enabled and there are no errors. Input words 4 and 5 hold the status bits. To receive valid status information, the channel must be enabled.

For example, to obtain the general status of channel 2 of the analog module located in slot 3, use address I:3.4/2.



TIP

The end cap does not use a slot address.

Input Modules' Configuration File

The configuration file contains information that you use to define the way a specific channel functions. The configuration file is explained in more detail in chapter 4.

The configuration file is modified using the programming software configuration screen. For an example of module configuration using RSLogix 500, see *Configuring Analog I/O Modules in a MicroLogix 1500 System* on page B-4.

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

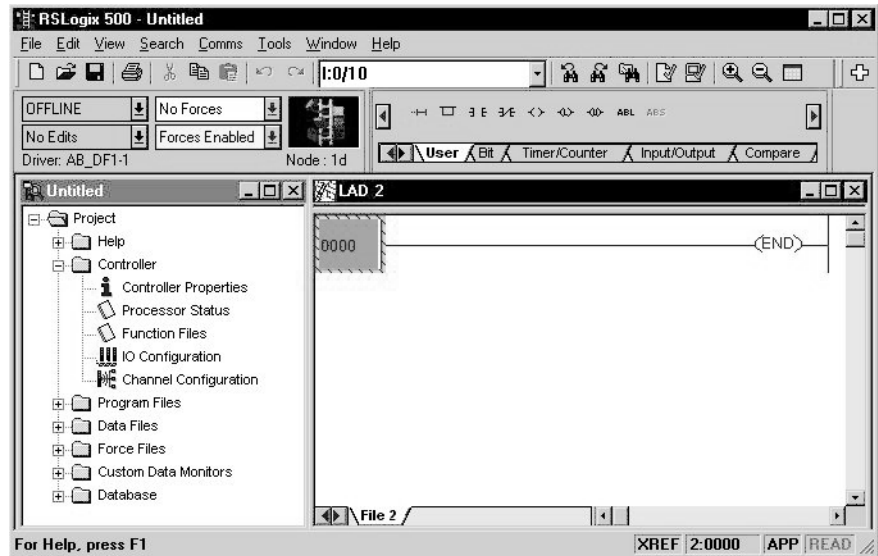
1769-IF4 and -IF8		1769-OF2, -OF8C, and -OF8V	
Parameter	Default Setting	Parameter	Default Setting
Enable/Disable Channel ⁽¹⁾	Enabled	Enable/Disable Channel	Enabled
Filter Selection	60 Hz	Output Range Selection	±10V dc
Input Range	±10V dc	Data Format	Raw/Proportional
Data Format	Raw/Proportional		

⁽¹⁾ The 1769-IF4, -IF8, -OF2, -OF8C, and -OF8V modules are disabled by default. You will need to enable the channels.

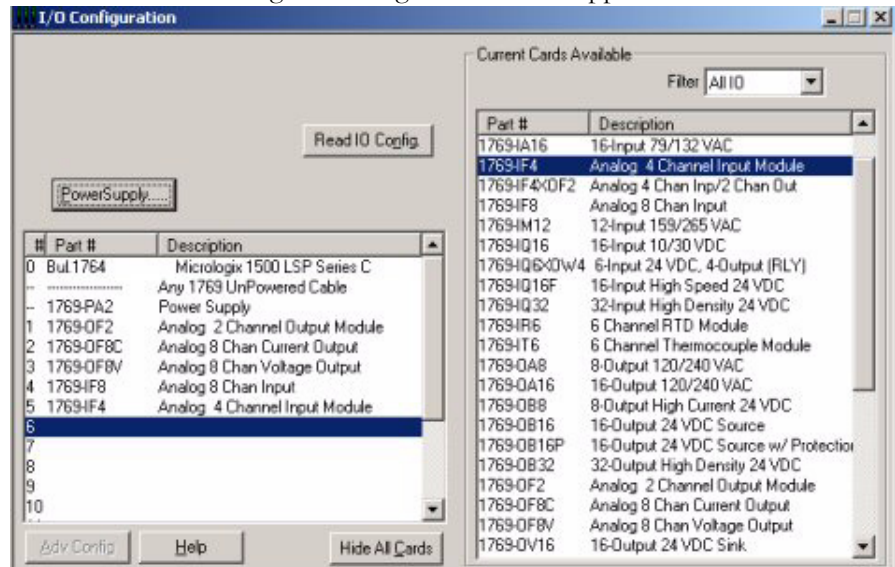
Configuring Analog I/O Modules in a MicroLogix 1500 System

This example takes you through configuring your 1769 analog input and output modules with RSLogix 500 programming software. This application example assumes your input and output modules are 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:

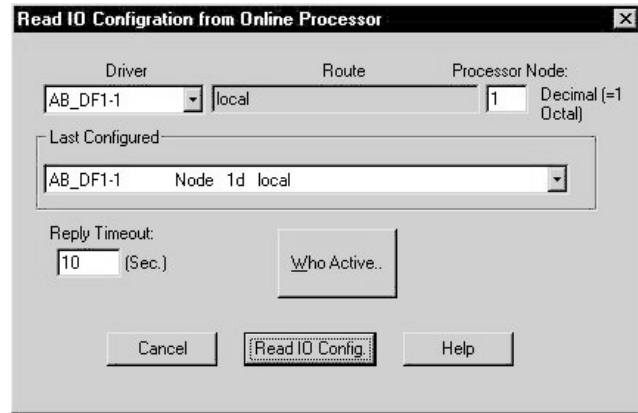


While offline, double-click on the IO Configuration icon under the controller folder and the following IO Configuration screen appears.

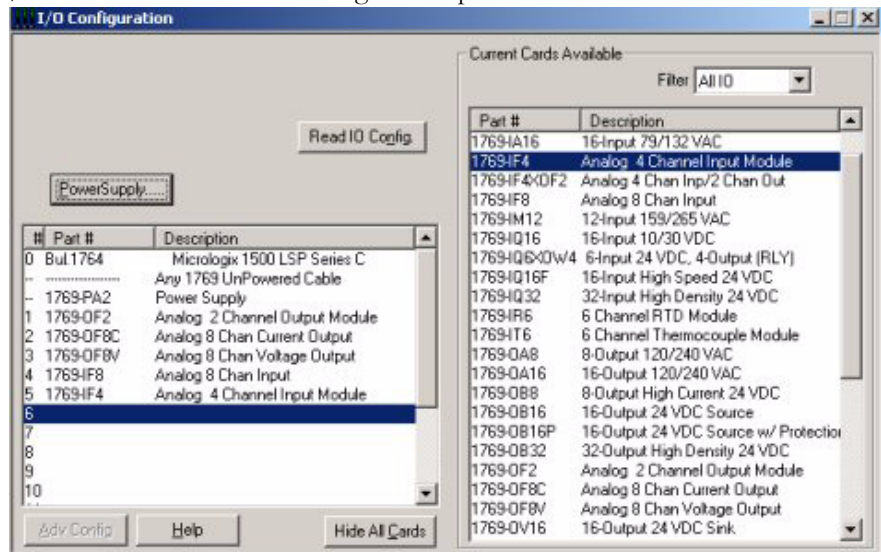


This screen allows you to manually enter expansion modules into expansion slots, or to automatically read the configuration of the controller. To read the existing controller configuration, click on the Read IO Config button.

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, a second tier of I/O is attached to the MicroLogix 1500 processor.

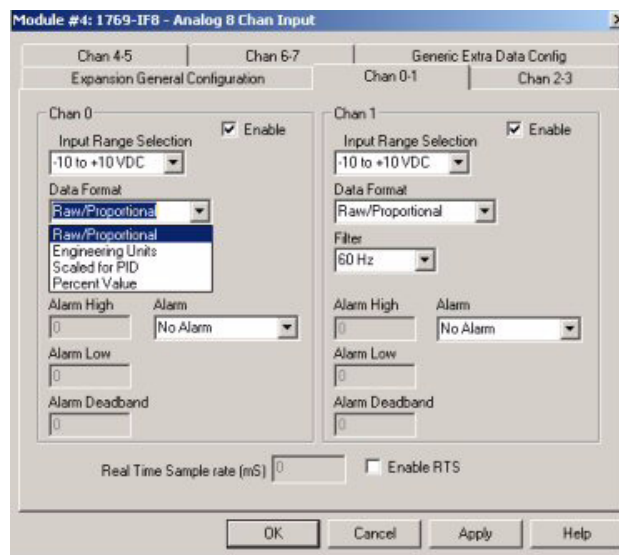
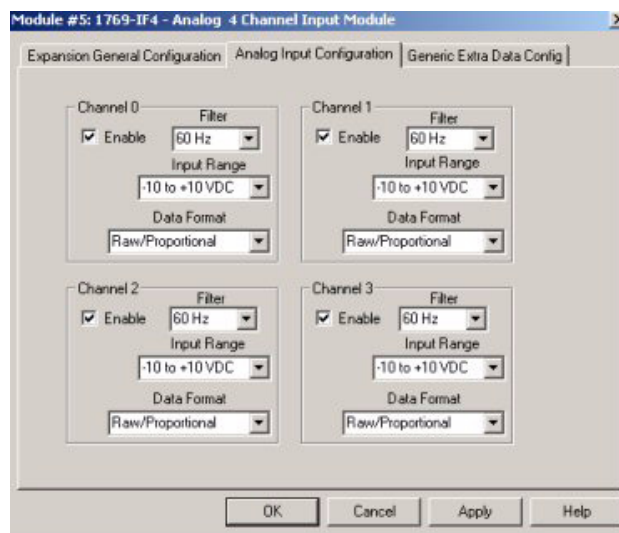


Configuring the Input Modules

For this example, the 1769-IF4 analog input module is installed in slot 1. To configure the module, double-click on the module/slot.

Analog Input Configuration

Each of the four analog input words (channels) are enabled 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. Then, choose your Filter Frequency, Input Range, and Data Format for each channel.

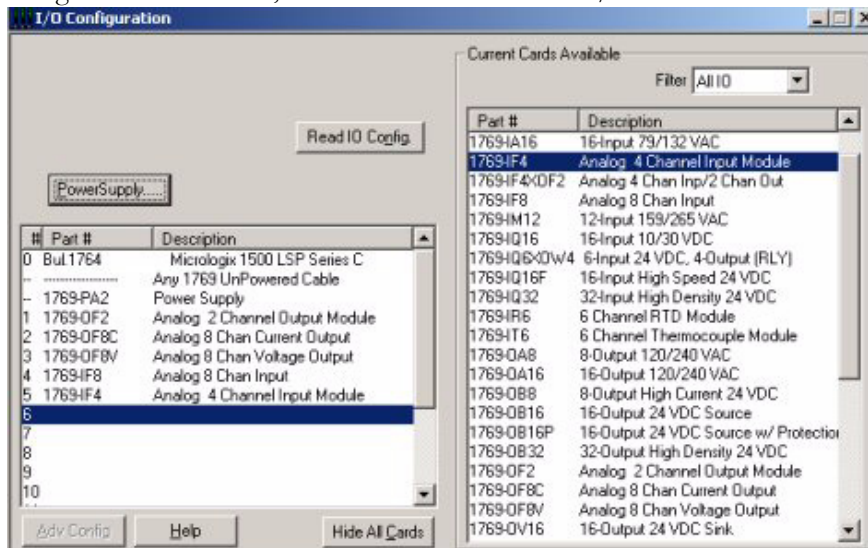


TIP

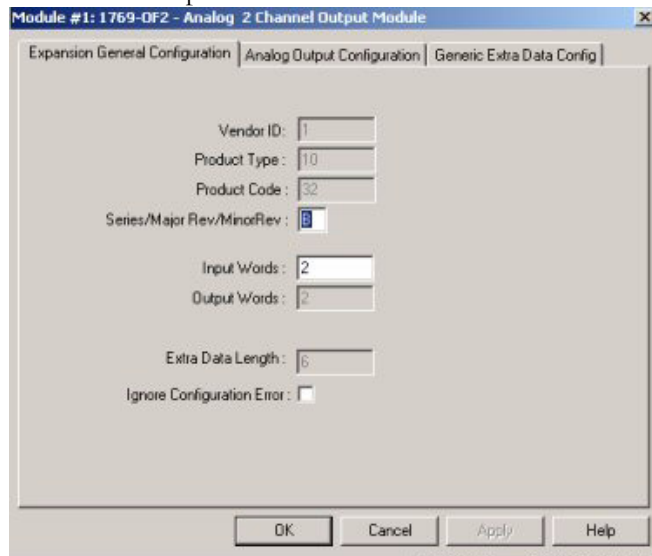
For maximum noise immunity, choose 50 Hz. For the highest speed (fastest signal detection), choose 250 Hz.

Configuring the Output Modules

For this example, the 1769-OF2 analog output module is installed in slot 2. To configure the 1769-OF2, double-click on the module/slot.

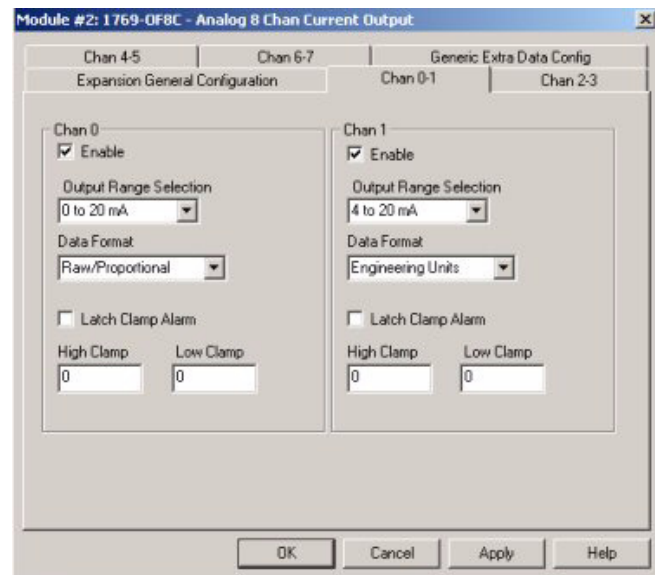
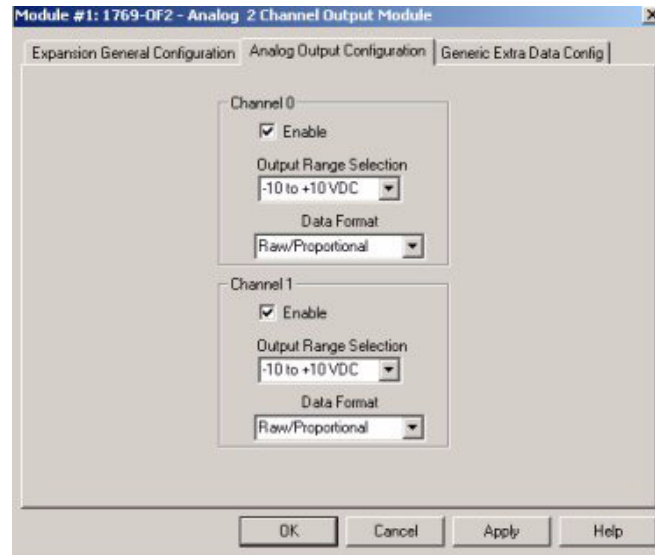


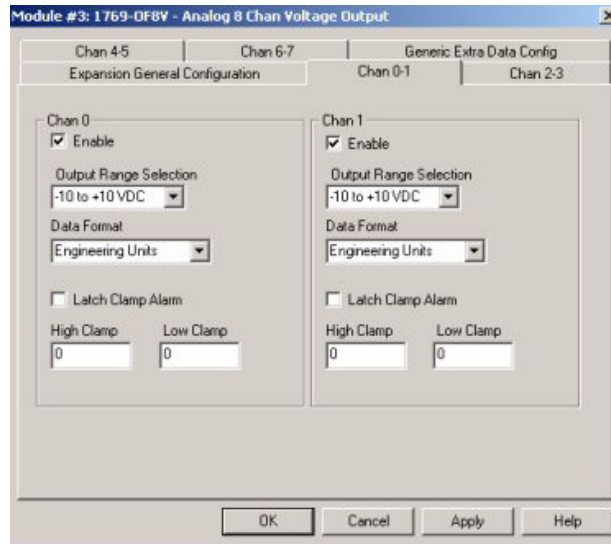
The following general configuration screen appears for the 1769-OF2, -OF8C, and -OF8V output modules.



Analog Output Configuration

Both of the output words (channels) are enabled 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. Then, choose your Filter Frequency, Input Range, and Data Format for each channel.

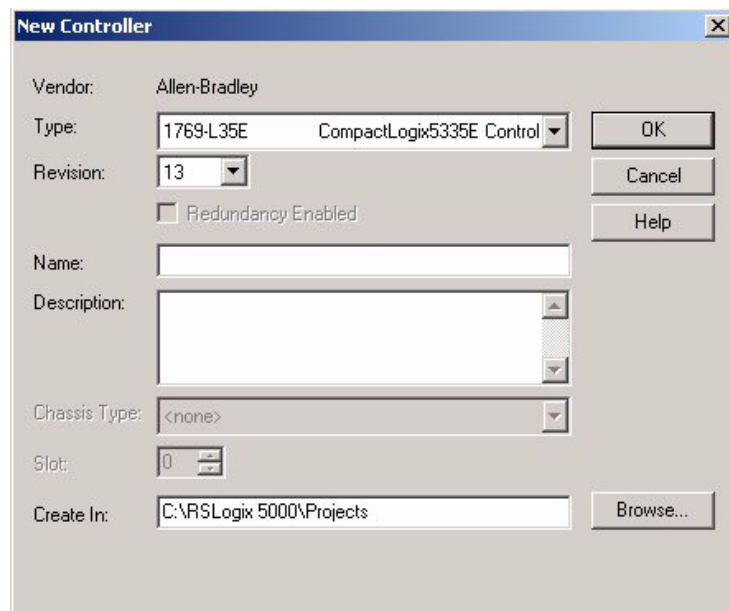




Notes:

Configuration Using the RSLogix 5000 Generic Profile for CompactLogix Controllers

To configure a 1769 analog I/O module for a CompactLogix Controller in RSLogix 5000 using the Generic Profile, you must first begin a new project in RSLogix 5000. Click on the new project icon or on the FILE pull down menu and select NEW. The following screen appears:

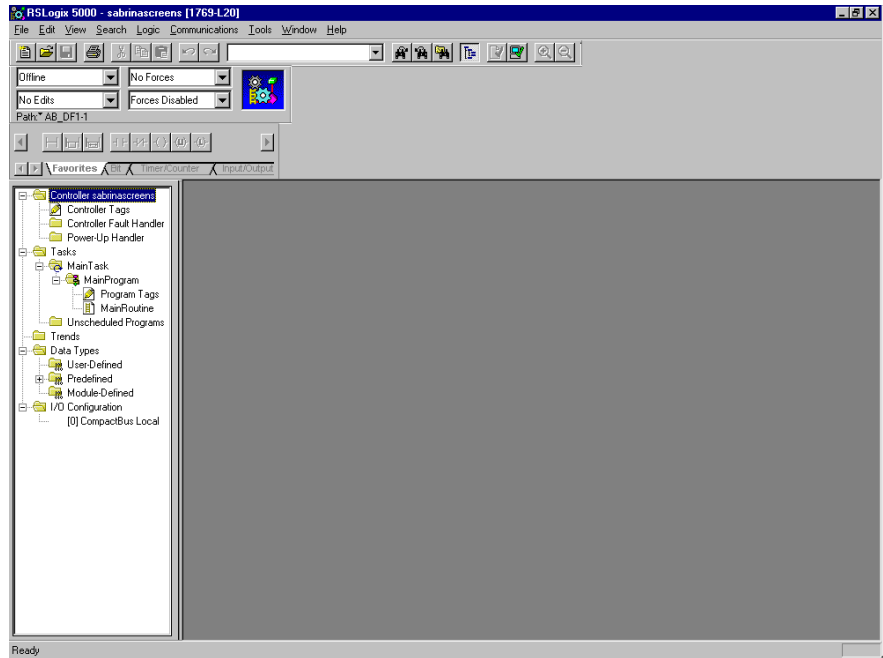


The screenshot shows the 'New Controller' dialog box with the following fields and options:

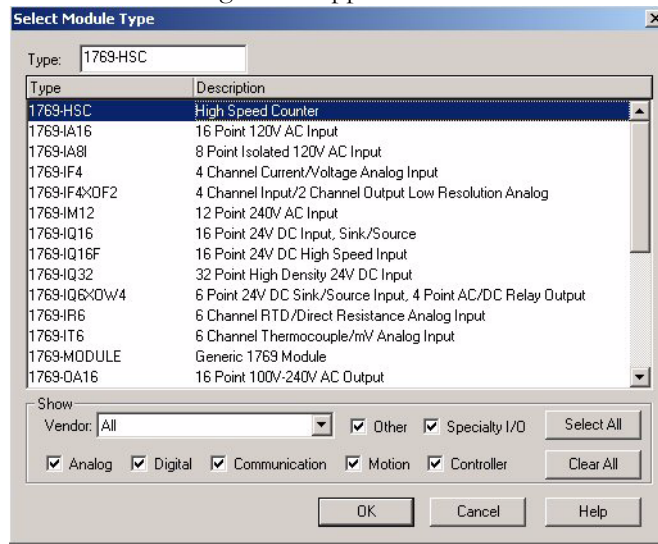
- Vendor: Allen-Bradley
- Type: 1769-L35E CompactLogix5335E Control
- Revision: 13
- Redundancy Enabled
- Name: (empty text box)
- Description: (empty text box)
- Chassis Type: <none>
- Slot: 0
- Create In: C:\RSLogix 5000\Projects

Buttons: OK, Cancel, Help, Browse...

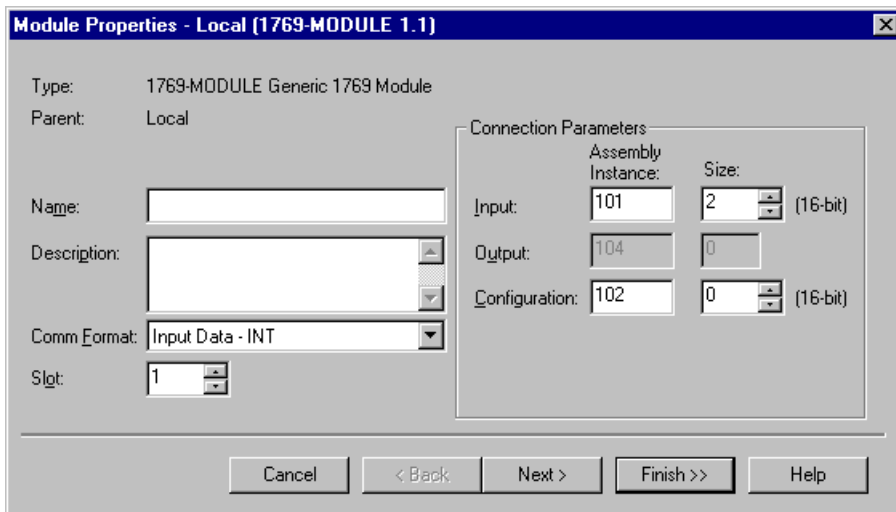
Choose your controller type and enter a name for your project, then click OK. The following main RSLogix 5000 screen appears:



The last entry in the controller organizer on the left of the screen shown above is a line labeled “[0] CompactBus Local”. Right click on this line, select “New Module” and the following screen appears:



This screen narrows your search for I/O modules to configure into your system. Click the OK button and the following default Generic Profile screen appears:



This is the default Generic Profile screen. The first area to fill in for the Generic Profile screen is the name. This helps to easily identify the module type configured on your local Compact Bus. The “Description” field is optional and may be used to provide more details concerning this I/O module in your application.

The next parameter to configure is the “Comm Format”. Click the down arrow for this parameter to reveal the choices. For the 1769-OF8C and -OF8V modules, “Data – INT” is used. “Input Data –INT” is used for the 1769-IF8 module.

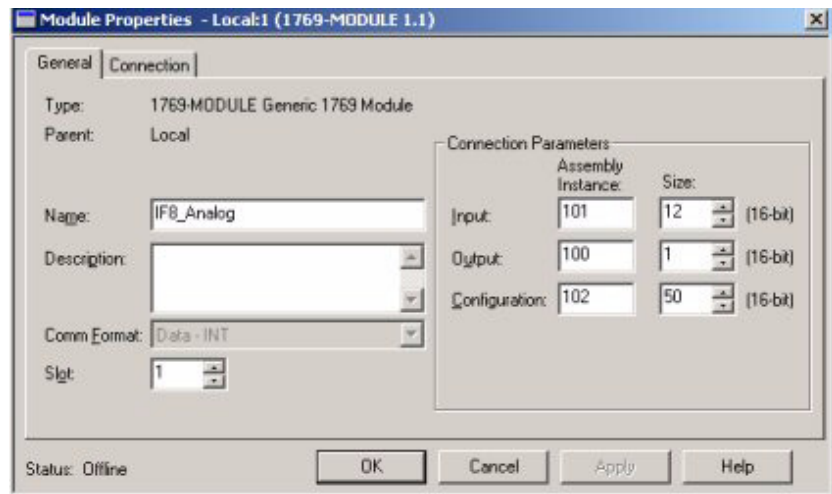
The slot number must be selected next, even though it begins with the first available slot number, 1, and increments automatically for each subsequent Generic Profile you configure.

Use the following table for the “Comm Format”, “Assembly Instance” and “Size” values for the 1769-IF8, -OF8C, and -OF8V modules if you have an earlier version of RSLogix5000, version 15.

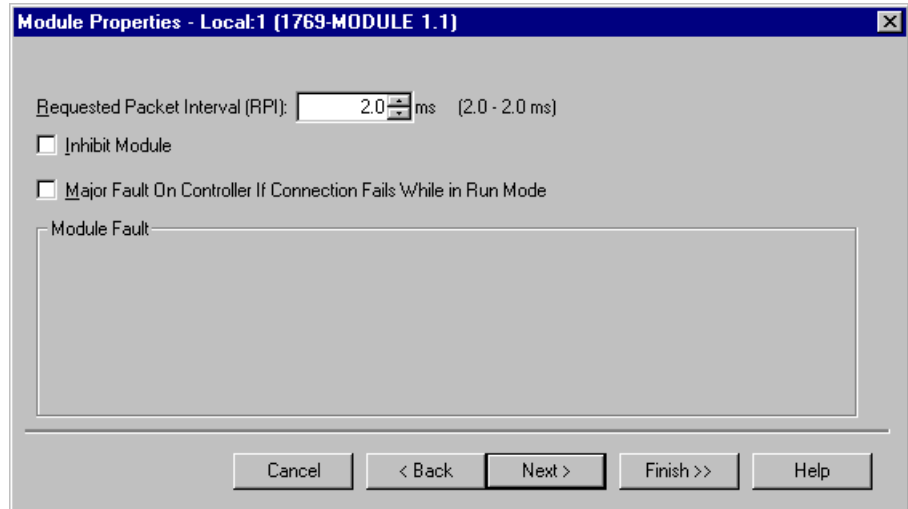
1769 I/O Modules ⁽¹⁾	Comm Format	Parameter	Assembly Instance	Size (16-bit)
IF8	Input Data – INT	Input	101	12
		Output	100	1
		Config	102	50
OF8C and OF8V	Data – INT	Input	101	11
		Output	100	9
		Config	102	64

⁽¹⁾ 1769-OF2 and -IF4 modules do not use the generic profile.

Note the Comm Format, Assembly Instance numbers and their associated sizes for each analog I/O module type and enter them into the Generic Profile.



At this point, you may click “Finish” to complete the configuration of your I/O module. If you click “Next”, the following screen appears:



You may choose to inhibit the module or have the controller fault if the connection to this I/O module fails. The defaults for these two parameters are not to inhibit the module and not to fault the controller should an I/O module connection fail.

TIP

Refer to the Help screens in RSLogix 5000, under “Connection Tab Overview” for a complete explanation of these features.

You may now click “Finish” to complete the configuration of your analog output module. If you click “Next”, you will see the Module Information screen, which is only filled in when you are online with your controller. If you clicked “Next” to get the Module Information screen, click “Finish” to complete the configuration of your I/O module.

Configure each analog I/O module in this manner.

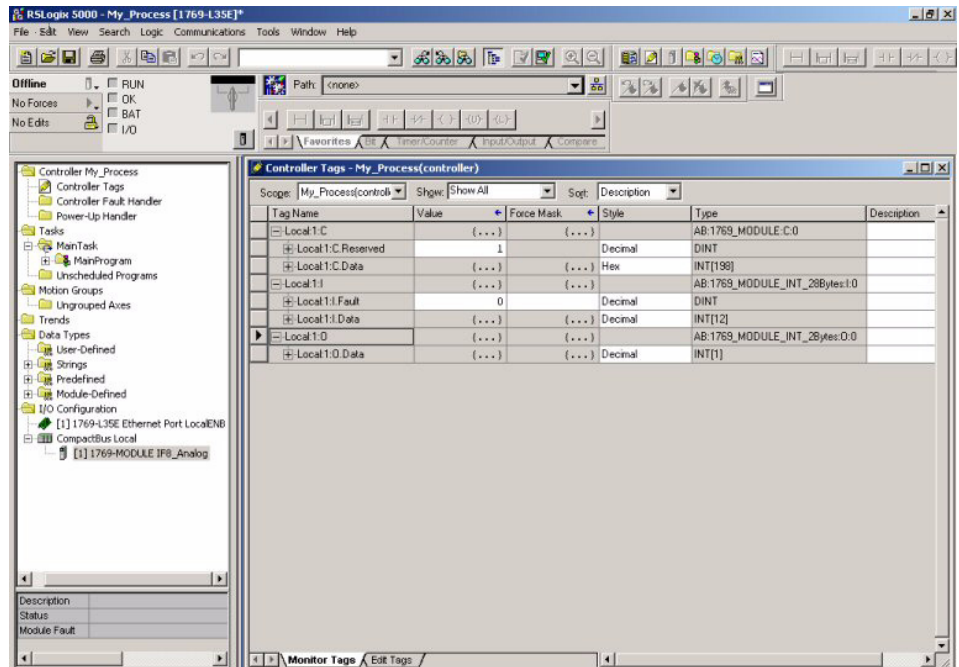
Configuring I/O Modules

Once you have created Generic Profiles for each analog I/O module in your system, you must then enter configuration information into the Tag database that has been automatically created from the Generic Profile information you entered for each of these modules. This configuration information is downloaded to each module at program download, going to run, and at power up.

This section shows how and where to enter configuration data for each analog I/O module, once Generic Profiles have been created for them.

You must first enter the Controller Tag database, by double-clicking on “Controller Tags” in the upper portion of the controller organizer. The example to follow demonstrates entering configuration data for 1769-OF2 and -IF4 modules.

For demonstration purposes, Generic Profiles have been created for 1769-IF8, -OF8C, and -OF8V modules. The Controller Tags screen looks like the following:



Tag addresses are automatically created for configured I/O modules. All local I/O addresses are preceded by the word Local. These addresses have the following format:

- Input Data: Local:s.I
- Output Data: Local:s.O
- Configuration Data: Local:s.C

where s is the slot number assigned the I/O modules in the Generic Profiles.

In order to configure an I/O module, you must open up the configuration tag for that module by clicking on the plus sign to the left of its configuration tag in the tag data base.

Configuring Analog Output Modules

To configure the 1769-OF8C or -OF8V module in slot 1, click on the plus sign left of Local:1.C. Configuration data is entered under the Local:1.C.Data tag. Click the plus sign to the left of Local:1.C.Data to reveal the 8 integer data words where configuration data may be entered for the 1769-OF8C or -OF8V module.

Configuring Analog Input Modules

To configure the input modules in slot 2, click on the plus sign left of Local:2.C. Click on the plus sign to the left of Local:2.C.Data to reveal the 4 integer data words where the configuration data may be entered for the module. The tag addresses for these 4 words are Local:2.C.Data[0] through Local:2.C.Data[3].

Notes:

Configuring Modules in a Remote DeviceNet System with a 1769-ADN DeviceNet Adapter

Overview

In this example, the 1769-IF4 and 1769-OF8C modules are in a remote DeviceNet system controlled by a 1769-ADN DeviceNet adapter. RSNetWorx for DeviceNet software, version 2.23 or later, is used to configure the network and the I/O modules.

The configuration method described here must be done prior to configuring the DeviceNet adapter in the DeviceNet scanner's scanlist. This applies if you are configuring an I/O module offline, then downloading to the adapter, or if you do the configuration online. After the adapter is placed in the scanner's scanlist, you can only configure or re-configure the I/O module using explicit messages or by removing the adapter from the scanner's scanlist, modifying the configuration of the I/O module, and then adding the adapter back into the scanner's scanlist.

For additional information on configuring DeviceNet scanners and adapters, refer to the documentation for those products. The DeviceNet Adapter User Manual, publication 1769-UM001, contains examples on modifying I/O module configurations with explicit messages while the system is running.

IMPORTANT

You must use a Series B 1769-ADN adapter with the 1769-IF8, -OF8C, and -OF8V modules.

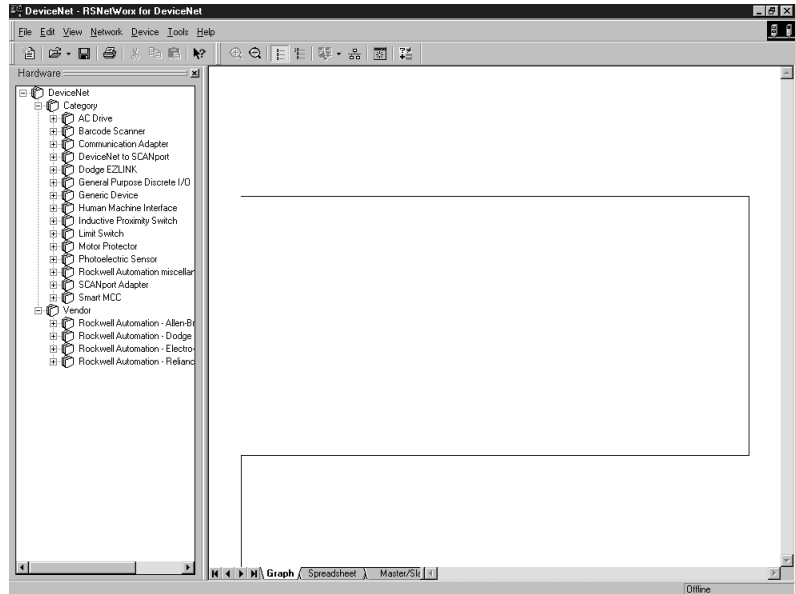
TIP

After setting up each slot, be sure to choose Apply.

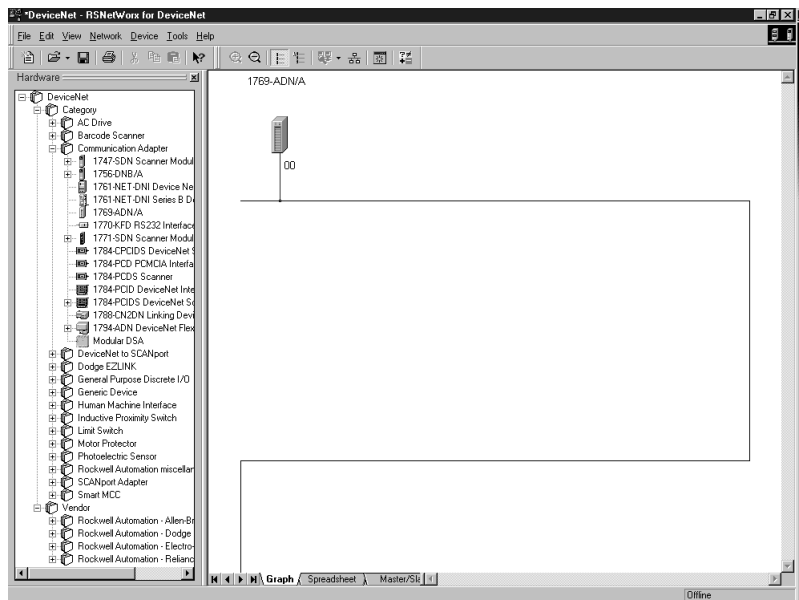
Add the DeviceNet Adapter to the Scanlist

In this part of the example, the 1769-ADN adapter is added to the DeviceNet scanner's scanlist.

1. Start the RSNetWorx for DeviceNet software.



2. In the left column under Category, click the + sign next to Communication Adapters.
3. In the list of products, double-click the 1769-ADN to place it on the network.



TIP

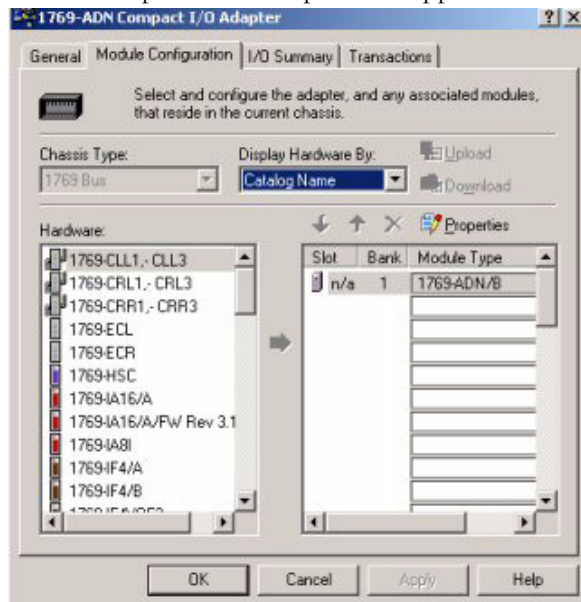
If 1769-ADN is not an option, you have an earlier version of RSNetWorx for DeviceNet software.

Configure the 1769-IF4 Input Module Example

The 1769-ADN adapter appears in slot 0. Your I/O modules, power supplies, end caps, and interconnect cables must be entered in the proper order, following the 1769 I/O rules contained in the DeviceNet Adapter User Manual, publication 1769-UM001A. To simplify this example, we placed the 1769-IF4 in slot 1 to show how it is configured.

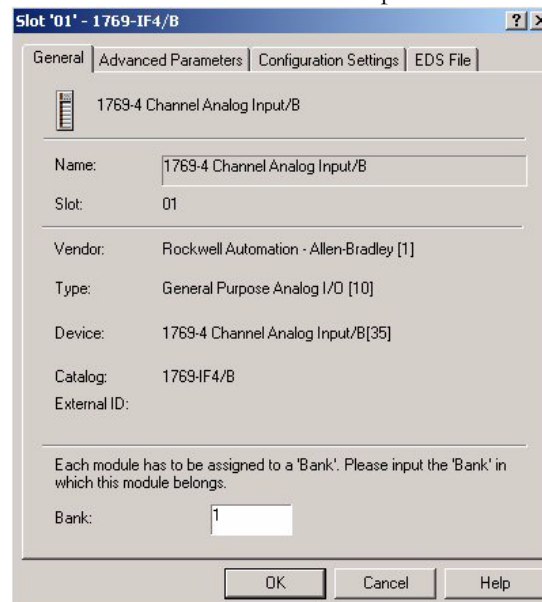
1. To place the input module into slot 1, click Module Configuration.

A list of all possible 1769 products appears.

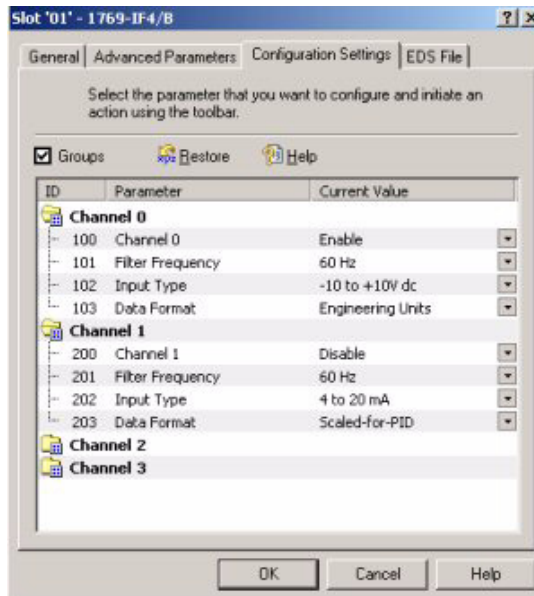


2. Select the 1769-IF4/B.
3. Under the General tab, select the appropriate bank.

Bank 1 was selected in this example.



4. Double-click this slot 1 box.



By default, the 1769-IF4 module contains six input words and no output words.

5. Click the Data Description button to see what the six input words represent.

The first four words are the actual analog input data, while the last two words contain status and over- and under-range bits for the four channels.

6. Click OK or Cancel to exit this screen and return to the Configuration screen.
7. If your application requires only four data words and not the status information, click the Set for I/O only button

The input size changes to four words. The revision number for the series B 1769-IF4 module is two. With this setting, you may leave the electronic keying to Exact Match. It is not recommended to disable keying, but if you are not sure of the exact revision of your module, selecting Compatible Module allows your system to operate, while still requiring a 1769-IF4 module in slot 1.

The series B 1769-IF4 module differs from the series A module only in that it allows external 24V dc power. The external power connection allows you to draw 24V dc power for the module from your external source, should your 1769 power supply not provide enough 24V dc power for your particular set of 1769 I/O modules.

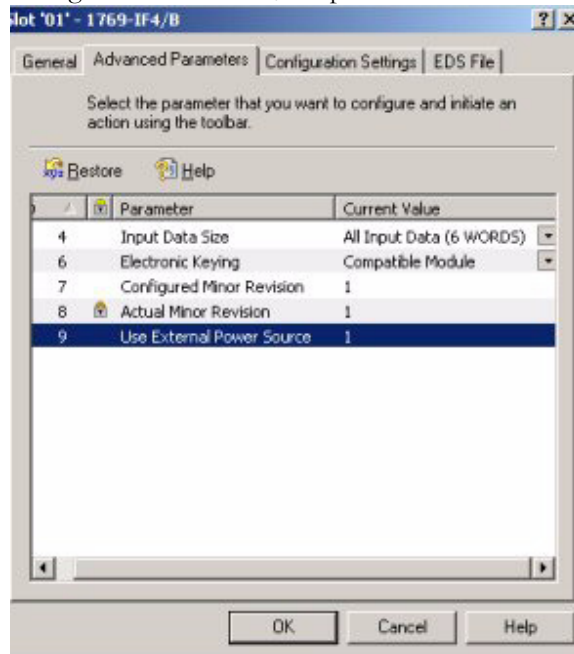
If you are using external 24V dc power for your 1769-IF4 module, you must click the white box to the left of “Using External +24v Power Source”, so that a check mark appears in the box. Do not click on the box if you are not using external 24V dc power.

Each of the four analog input channels are disabled by default. To enable a channel, click its Enable box, so that a check mark appears in it. Then, choose your Filter frequency, Input Range, and Data Format for each channel. See chapter 4 of this manual for a complete description of each of these configuration categories.

1769-IF4 Example of External Power

In this example, channels 0 through 4 are used and external power is being supplied from an external 24V dc power source. In addition, channels 0 and 1 are driven by 4 to 20 mA transducers, while channels 2 and 3 are driven by devices generating 0 to 10V dc analog signals.

Throughput is not a concern for this application. However, noise immunity is. Therefore, the filter frequency for maximum noise immunity, 50 Hz, has been chosen. The analog input on channel 0 is used as the PV (input) value for a PID loop. Therefore, the Data Format for this channel is Scaled-for-PID. Channels 1 through 3 are not being used with a PID loop and have been configured for the Raw/Proportional Data Format for maximum resolution.



Click OK, and your configuration for the 1769-IF4 analog input module is complete.

3. Click on the Configuration Settings button to see what the eleven input and nine output words represent.

The eleven input words contain channel diagnostic data for the eight channels. The nine output words contain the actual analog output data for the eight channels along with one additional word containing the control bits for unlatching alarms.

4. Click OK or Cancel to exit this screen and return to the Configuration screen.
5. Select No Input Data under Input Data Size if your application requires only the data words and not the status information.

The Input Size changes to 0, while the Output Size remains at nine words. The Revision number for the series B 1769-OF8C module is two. With this, you may leave the Electronic Keying to Exact Match. It is not recommended to disable keying, but if you are unsure of the exact revision of your module, selecting Compatible Module allows your system to operate, while still requiring a 1769-OF8C module in slot 2.

1769-OF8C Example of External Power

The series B 1769-OF8C module differs from the series A module only in that it allows external 24V dc power. The external power connection allows you to draw 24V dc power for the module from your external source, should your 1769 power supply not provide enough 24V dc power for your particular set of 1769 I/O modules.

If you are using external 24V dc power for your 1769-OF8C module, you must click the white box to the left of “Using External +24v Power Source”, so that a check mark appears in the box. Do not click on the box if you are not using external 24V dc power.

1769-OF8C Example of Output Channels

Each of the two analog output channels are disabled by default. To enable a channel, click its Enable box so that a check mark appears in it. Then, choose your Output Range, Data Format, and the state or your outputs should the controlling processor be placed into the program mode, fault, or lose communications.

Program State and Fault State each have two options:

- Hold Last State

Hold last state will hold the analog output at the last value received before the processor was placed in program mode or before it faulted.

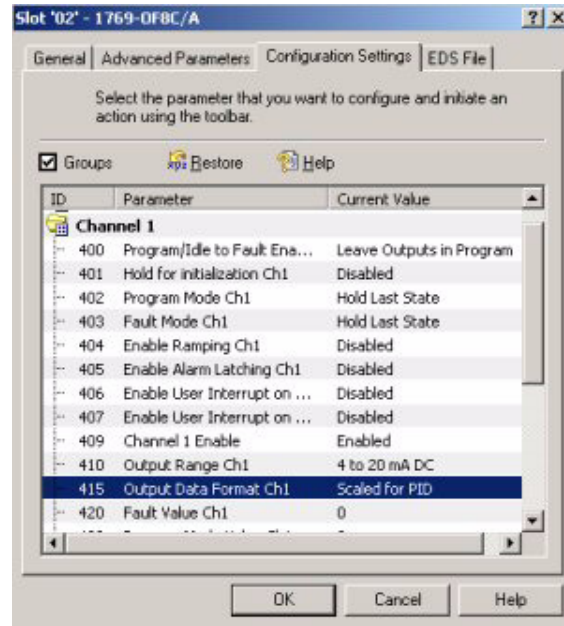
- User-defined State

When selecting user-defined state, you must specify a value for the analog output to revert to should the processor be placed in program mode or fault. The values used for user-defined state must be valid values determined by the selected Data Format and Output Range. If communications fail, you may also choose whether your Program State or Fault State options take place for each channel.

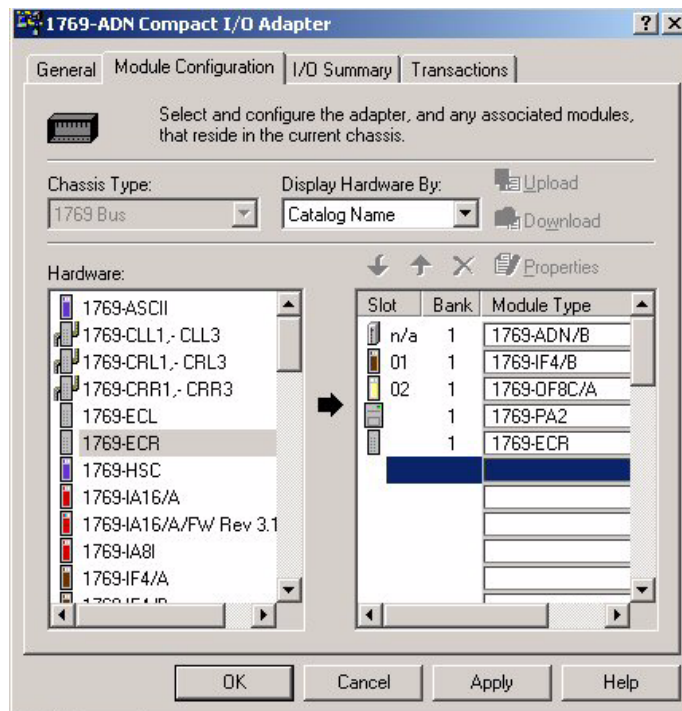
In this example, channels 0 and 1 are enabled and configured for 4 to 20 mA Output Ranges. The Data Format for channel 0 is Scaled-for-PID, because it is the CV (output) value from your PID instruction. Hold last state was chosen for all possible conditions other than Run mode for channel 0.

Channel 1 is also enabled and configured for 4 to 20 mA Output Range. Raw/Proportional Data Format was chosen for maximum resolution. In addition, a requirement of the system is that this analog output must always be at 4 mA if the system is not in control of it.

Therefore, a value of 6241 (decimal) must be used in the event the controlling processor is placed into program mode, faults, or loses communications. The decimal number 6241 represents 4 mA, when using the Raw/Proportional Data Format.



Click OK, and your configuration for the 1769-OF8C analog output module is complete.



IMPORTANT

Be sure to add appropriate power supplies and end caps.

Two's Complement Binary Numbers

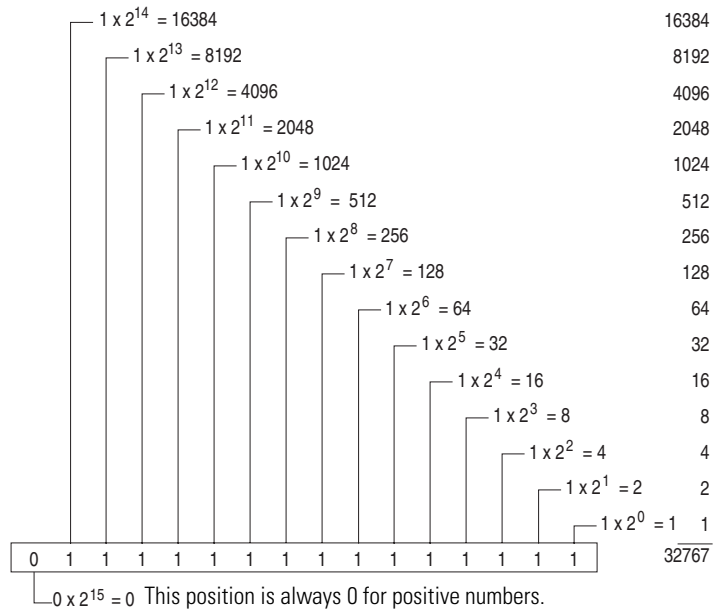
The processor memory stores 16-bit binary numbers. Two's complement binary is used when performing mathematical calculations internal to the processor. Analog input values from the analog modules are returned to the processor in 16-bit two's complement binary format. For positive numbers, the binary 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. This limits the maximum positive decimal value to 32767 (all positions are 1 except the far left position).

Figure E.1 Positive Decimal Values



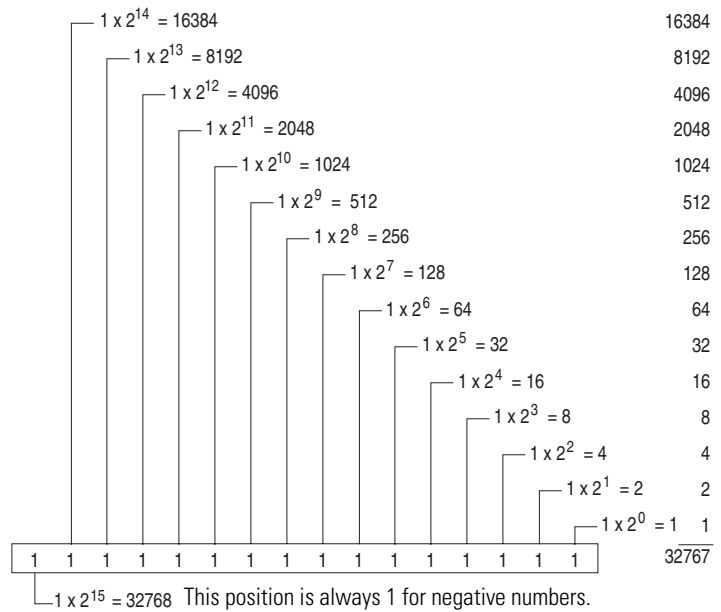
EXAMPLE 0000 1001 0000 1110 = $2^{11} + 2^8 + 2^3 + 2^2 + 2^1 =$
 $2048 + 256 + 8 + 4 + 2 = 2318$

0010 0011 0010 1000 = $2^{13} + 2^9 + 2^8 + 2^5 + 2^3 =$
 $8192 + 512 + 256 + 32 + 8 = 9000$

Negative Decimal Values

In two's complement notation, the far left position is always 1 for negative values. The equivalent decimal value of the binary number is obtained by subtracting the value of the far left position, 32768, from the sum of the values of the other positions. In Figure E.2 all positions are 1 and the value is $32767 - 32768 = -1$.

Figure E.2 Negative Decimal Values



EXAMPLE $1111\ 1000\ 0010\ 0011 = (2^{14} + 2^{13} + 2^{12} + 2^{11} + 2^5 + 2^1 + 2^0) - 2^{15} =$
 $(16384 + 8192 + 4096 + 2048 + 32 + 2 + 1) - 32768 =$
 $30755 - 32768 = -2013$

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. $CMRR = 20 \text{ Log}_{10} (V_1/V_2)$

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 its 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.

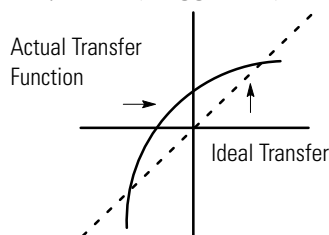
hold last state – A configuration selection that instructs the module to keep the outputs at the last converted value prior to the condition that caused the control system to enter the fault or program mode.

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 modules, 16-bit, two’s complement binary codes are used in the I/O image in the card.

For analog inputs, the LSB is defined as the rightmost bit, bit 0, of the 16-bit field. For analog outputs, the three rightmost bits are not significant, and the LSB is defined as the third bit from the right, bit 2, 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 \pm 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 12-bit system has 4096 possible output states. It can therefore measure 1 part in 4096.

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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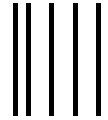
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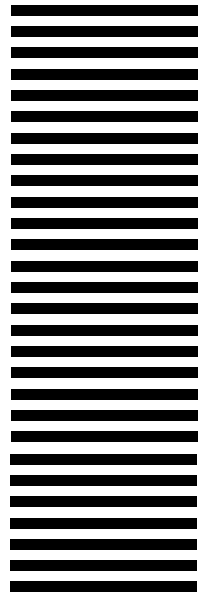
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Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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