

Compact I/O Combination Fast Analog I/O Module



User Manual

(Catalog Number 1769-IF4FX0F2F)

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://literature.rockwellautomation.com>) 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.

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Throughout this manual, when necessary, 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, and recognize the consequence
SHOCK HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

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Introduction

Read this preface to familiarize yourself with the rest of the manual.

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About This Publication

This manual is a guide for using the Compact I/O Combination Fast Analog I/O Module, catalog number 1769-IF4FXOF2F. It describes the procedures you use to configure, operate, and troubleshoot your module.

For detailed information on related topics like programming your CompactLogix or MicroLogix controller, or DeviceNet adapter, or for information on CompactLogix components, see the list of [Additional Resources on page 8](#).

Who Should Use This Publication

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

Additional Resources

These documents contain additional information about control systems that use Compact I/O modules.

Resource	Description
MicroLogix 1500 User Manual, publication 1764-UM001	A user manual containing information on how to install, use, and program your MicroLogix 1500 controller.
DeviceNet Adapter User Manual, publication 1769-UM001	A user manual containing information on how to install and use your 1769-ADN DeviceNet adapter.
CompactLogix System User Manual, publication 1769-UM007	A user manual containing information on how to install, use, and program your 1769-L20 and 1769-L30 CompactLogix controllers.
CompactLogix Controllers User Manual, publication 1769-UM011	A user manual containing information on how to install, use, and program your 1769-L31, 1769-L32C, 1769-L32E, 1769-L35CR, and 1769-L35E CompactLogix controllers.
Compact I/O Selection Guide, publication 1769-SG002	An overview of 1769 Compact I/O modules.
MicroLogix Programmable Controllers Selection Guide, publication 1761-SG001	An overview of the MicroLogix 1500 System, including the 1769 Compact I/O system.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	In-depth information on grounding and wiring Allen-Bradley programmable controllers.

You can view or download publications at <http://literature.rockwellautomation.com>. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Overview

Introduction

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Module Description

The module converts and digitally stores analog data for retrieval by controllers, such as the CompactLogix or MicroLogix 1500 controllers. The module also converts digital data from controllers to provide analog output data. The module provides the following input and output types and ranges.

Normal and Full Ranges

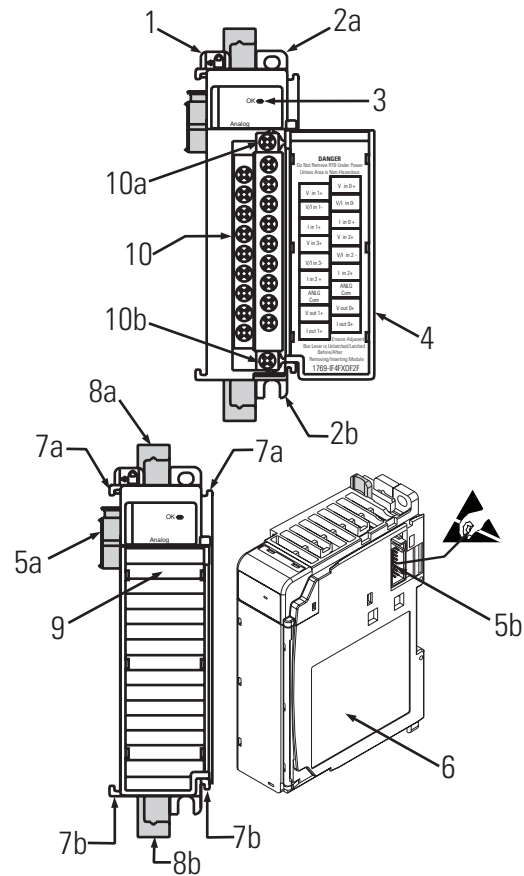
Signal Type	Normal Operating Input Range	Full Module Range
Voltage	$\pm 10\text{V DC}$	$\pm 10.5\text{V DC}$
	$1 \dots 5\text{V DC}$	$0.5 \dots 5.25\text{V DC}$
	$0 \dots 5\text{V DC}$	$-0.5 \dots 5.25\text{V DC}$
	$0 \dots 10\text{V DC}$	$-0.5 \dots 10.5\text{V DC}$
Current	$0 \dots 20\text{ mA}$	$0 \dots 21\text{ mA}$
	$4 \dots 20\text{ mA}$	$3.2 \dots 21\text{ mA}$

The data can be configured as:

- engineering units.
- scaled-for-PID.
- percent range.
- raw/proportional data.

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.

Hardware Features



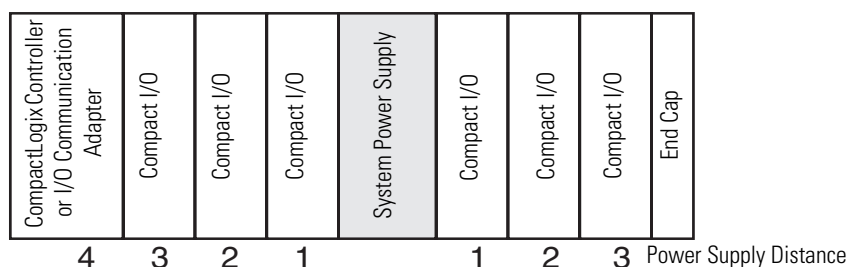
Item	Description
1	Bus lever (with locking function)
2a	Upper-panel mounting tab
2b	Lower-panel mounting tab
3	Module status indicators
4	Module door with terminal identification label
5a	Movable bus connector with female pins
5b	Stationary bus connector with male pins
6	Nameplate label
7a	Upper tongue-and-groove 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 retaining screw
10b	RTB retaining screw

System Overview

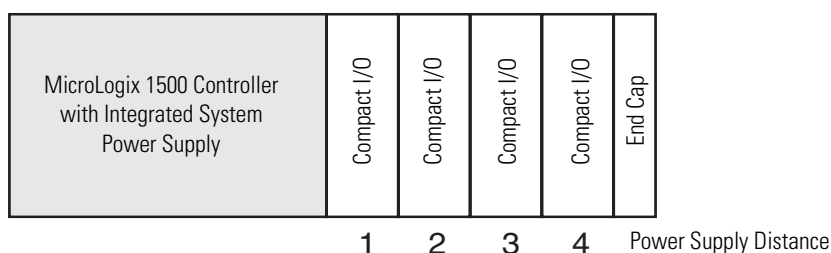
The module communicates to the controller through the bus interface. The module also receives 5 and 24V DC power through the bus interface.

You can install as many analog modules as your power supply can support. However, the modules may not be located more than eight modules away from the system power supply.

Determine Power Supply Distance



or



Module Operation

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

After power-cycle 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, the module begins its conversion process.

Each time an input channel is read, the converted analog data value is tested for an over-range or under-range condition. In addition, the module supports user-configured high and low alarm condition tests for each input channel. If any of these conditions are detected, unique bits are set in the input-channel status word.

Each time a new output value is sent to the module, it is tested for an over-range or under-range condition. In addition, the module supports user-configured high and low output clamps for each output channel. If any of these conditions are detected, unique bits are set in the output-channel status word.

The channel status words are described in the [Input Data File on page 36](#).

The controller uses two's complement binary data when communicating with the module. This typically occurs at the end of the program scan or when commanded by the control program. If the controller and the module determine that the bus data transfer was made without error, the input data is used in your control program and the output data is used by the module.

No field calibration is required.

Installation and Wiring

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General Considerations

The Compact I/O system 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 nonhazardous locations only. The following attention 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 nonhazardous.
 - Do not connect or disconnect components unless power has been switched off or the area is known to be nonhazardous.
 - 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.
 - Use a static-safe work station, if available.
 - Keep the module in its static-shield box, when it is not in use.
-

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.

Reduce 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 and outputs reduces 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 that generate significant radiated heat, such as the 1769-IA16 module. Refer to the module's heat dissipation specification.

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

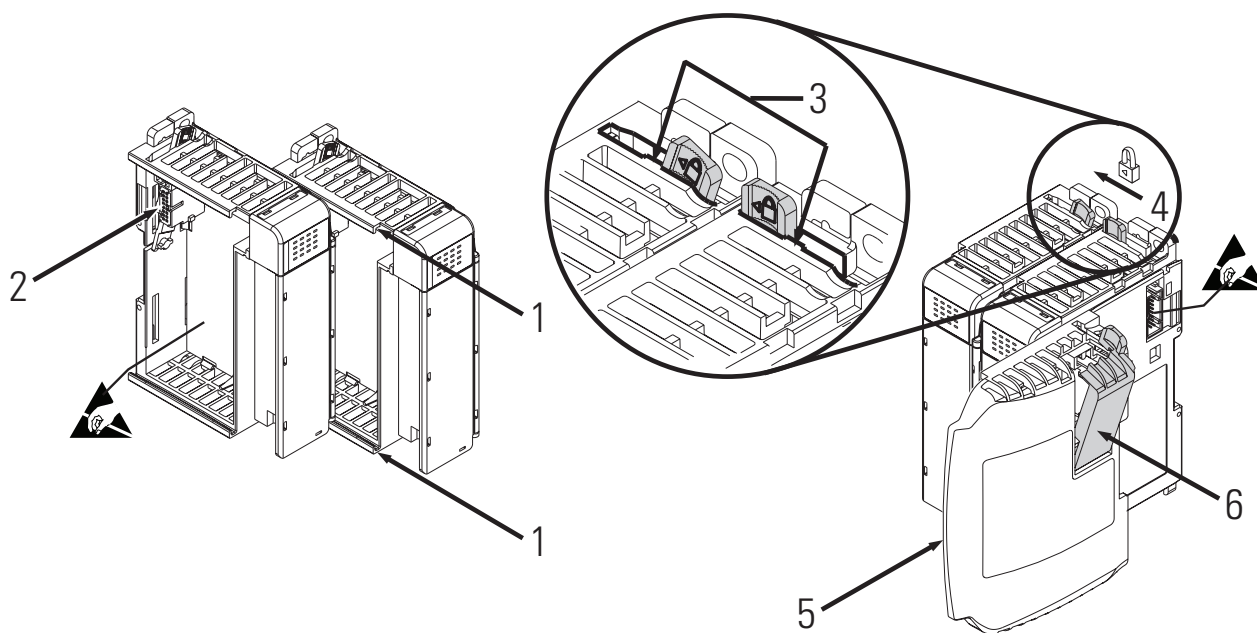
Protecting the Circuit Board from Contamination

The printed circuit board of the module must be protected from dirt, oil, moisture, and other airborne contaminants. To protect the board, 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.

Assemble the Compact I/O System

The module can be attached to the controller or an adjacent I/O module **before** or **after** mounting.

For mounting instructions, see [Panel Mounting By Using the Dimensional Template on page 18](#), or [Mount to a DIN Rail on page 19](#). To work with a system that is already mounted, see [Replace a Single Module Within a System on page 19](#).



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. Use your fingers or a small screwdriver to push the bus lever back slightly to clear the positioning tab (3).

6. To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks.

Make sure 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 be sure of proper electrical connection.

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

Modules may be mounted to a panel or to a DIN rail.

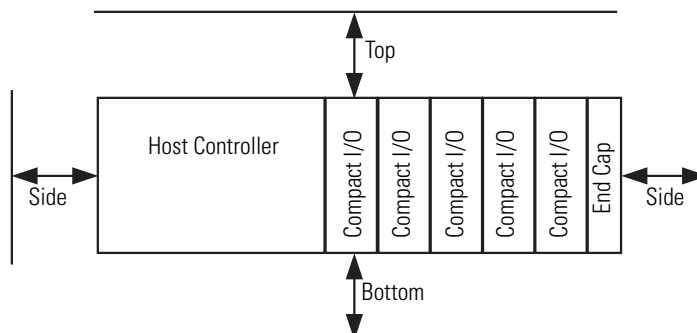
ATTENTION


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

Minimum Spacing

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

Space Requirements

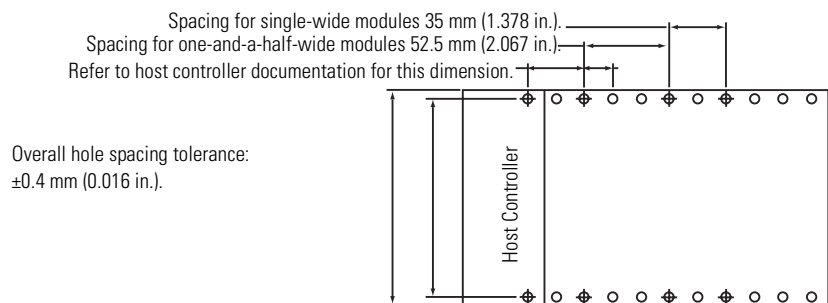


Mount to a Panel

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

Panel Mounting By Using the Dimensional Template

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



Panel Mounting By Using the Modules as a Template

This procedure lets you 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. 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 by 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...6 for any remaining modules.

Mount to a DIN Rail

The module can be mounted by using the following DIN rails:

- 35 x 7.5 mm (EN 50 022 - 35 x 7.5)
- 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.

Replace 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.

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.

2. On the module to be removed, remove the upper and lower mounting screws from the module or open the DIN latches by using a flat-blade or Phillips 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.

Grounding the Module

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, publication [1770-4.1](#), for additional information.

System Wiring Guidelines

Consider the following when wiring your system:

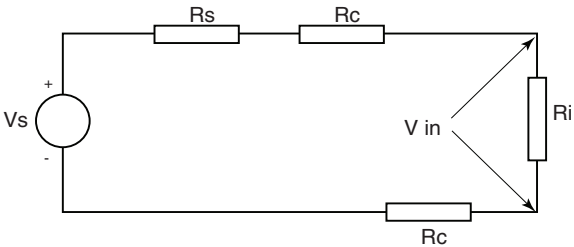
- All module commons (ANLG Com) are connected in the analog module.
- The analog common (ANLG Com) is not connected to earth ground inside the module.
- Channels are not isolated from each other.
- For optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.
- Use Belden 8761, or equivalent, shielded wire.
- 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⁾ Keep shield connection to ground as short as possible.
- If multiple power supplies are used with analog inputs, the power supply commons must be connected.
- The module does not provide loop power for analog inputs. Use a Class 2 power supply that matches the input transmitter specifications.
- Differential analog inputs are more immune to noise than single-ended analog inputs.
- Voltage outputs (Vout 0+ and Vout 1+) of the 1769-IF4FXOF2F module are referenced to ANLG Com. Load resistance for a voltage output channel must be equal to or greater than 1 k Ω .
- Current outputs (Iout 0+ and Iout 1+) of the 1769-IF4FXOF2F module source current that returns to ANLG Com. Load resistance for a current output channel must remain between 0 and 500 Ω .
- Voltages on Vin+, V/Iin-, and Iin+ terminals of the 1769-IF4FXOF2F module must be within ± 10 V DC of analog common (ANLG Com).

(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 μ F capacitor at the sensor end.

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

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

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)

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

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:

R_c = 5.25 Ω /1000 m

R_s = 0 (ideal source)

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

Effect of Cable Length on Input Accuracy

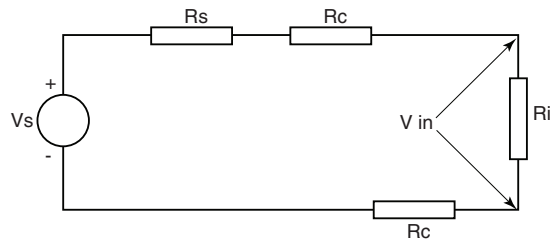
Length of Cable, m (ft)	DC Resistance of the Cable, R_c (Ω)	Accuracy Impact at the Input Module
50 (164)	2.625	0.002385%
100 (328)	5.25	0.00477%
200 (656)	10.50	0.00954%
300 (984)	15.75	0.01431%

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

For current signals, source and cable impedance do not impact system accuracy.

Voltage Output Accuracy


Where:

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

R_s = Source impedance (1Ω)

R_i = Impedance of the voltage input

V_s = Voltage at the output of 1769-IF4FXOF2F module

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:

$$R_c = 52.5 \, \Omega / 1000 \, \text{m}$$
$$R_s = 1 \, \Omega$$
$$R_i = 220 \, \text{K}\Omega$$

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

Effect of Output Impedance and Cable Length on Accuracy

Length of Cable	DC Resistance of the Cable Rc	Accuracy Impact at the Input Module
50 m (164 ft)	2.625 Ω	0.00284%
100 m (328 ft)	5.25 Ω	0.00523%
200 m (656 ft)	10.50 Ω	0.01%
300 m (984 ft)	15.75 Ω	0.01477%

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

TIP

For current outputs, source and cable impedance do not impact system accuracy as long as the total resistance of the cable and input impedance of the load remain within the specified maximum limits for the module's current outputs.

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

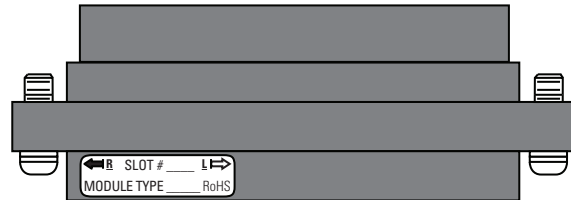
Label the Terminals

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.

Remove the Finger-safe Terminal Block

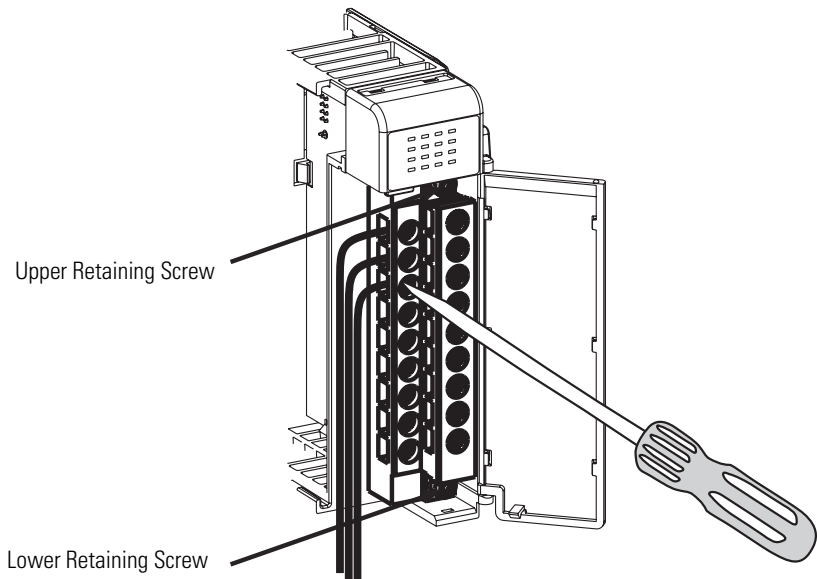
When wiring field devices to the module, it is not necessary to remove the terminal block. If you remove the terminal block, use the write-on label on the side of the terminal block to identify the module slot location and type. RTB position (for one-and-a-half size modules) can be indicated by circling either the R for right side or L for left side.

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 N•m (4.1 lb•in).

Wire 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 in. o.d. with a 0.139 in. 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 N•m (6 lb•in).

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.

Wire Type		Wire Size	Terminal Screw Torque	Retaining Screw Torque
Solid	Cu-90 °C (194 °F)	0.325...2.080 mm ² (22...14 AWG)	0.68 N•m (6 lb•in)	0.46 N•m (4.1 lb•in)
Stranded	Cu-90 °C (194 °F)	0.325...1.310 mm ² (22...16 AWG)	0.68 N•m (6 lb•in)	0.46 N•m (4.1 lb•in)

Wire the Modules

ATTENTION

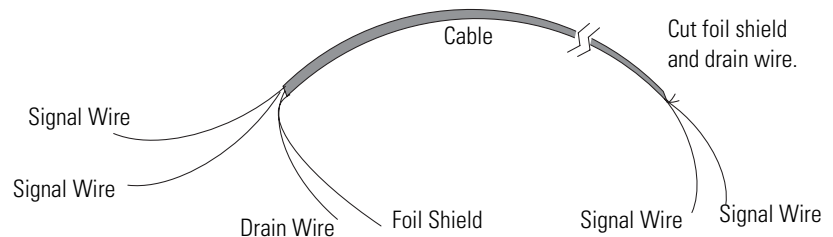
To prevent shock hazard, care should be taken when wiring the module to analog signal sources. Before wiring any analog module, disconnect power from the system power supply and from any other source to the analog module.

After the analog module is properly installed, follow the wiring procedure below. For 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.

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-in. lengths.
3. Strip about 5 mm (3/16 in.) 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 when you cycle power.

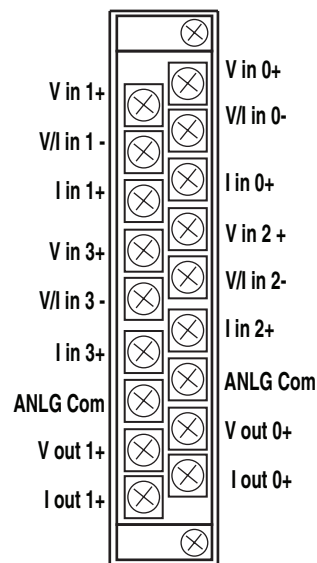
4. At one end of the cable, twist the drain wire and foil shield together.

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.

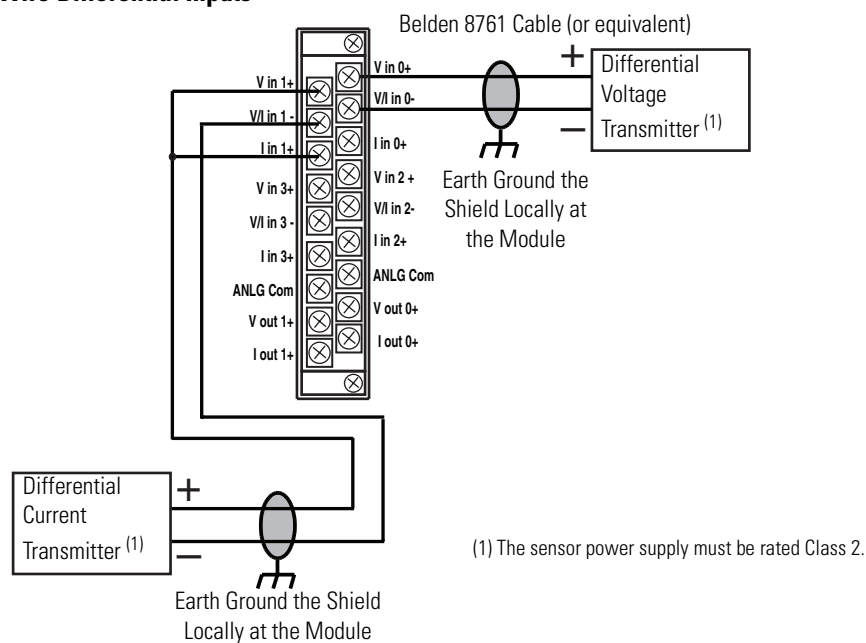
In environments where high frequency noise may be present, it may be necessary to also ground the cable shields to earth via a 0.1 μ F capacitor at the sensor end.

5. At the other end of the cable, cut the drain wire and foil shield back to the cable, unless the sensor end of the cable requires the shields to be connected to earth ground via the capacitor described in step 4.
6. Connect the signal wires to the terminal block.
7. Connect the other end of the cable to the analog input or output device.
8. Repeat steps 1...6 for each channel on the module.

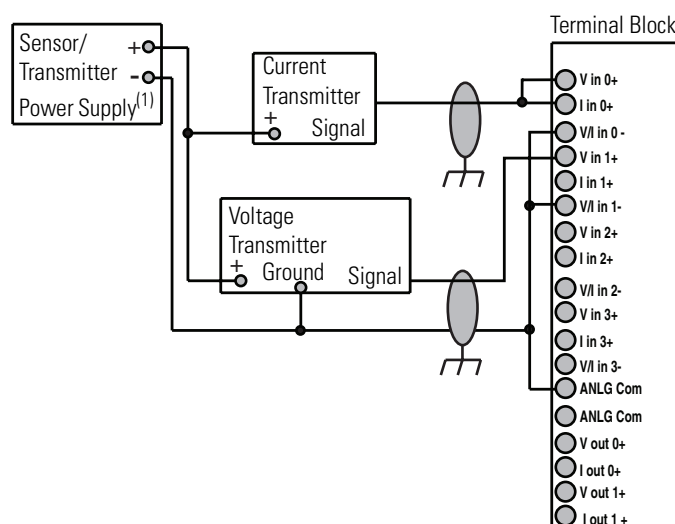
Terminal Layout



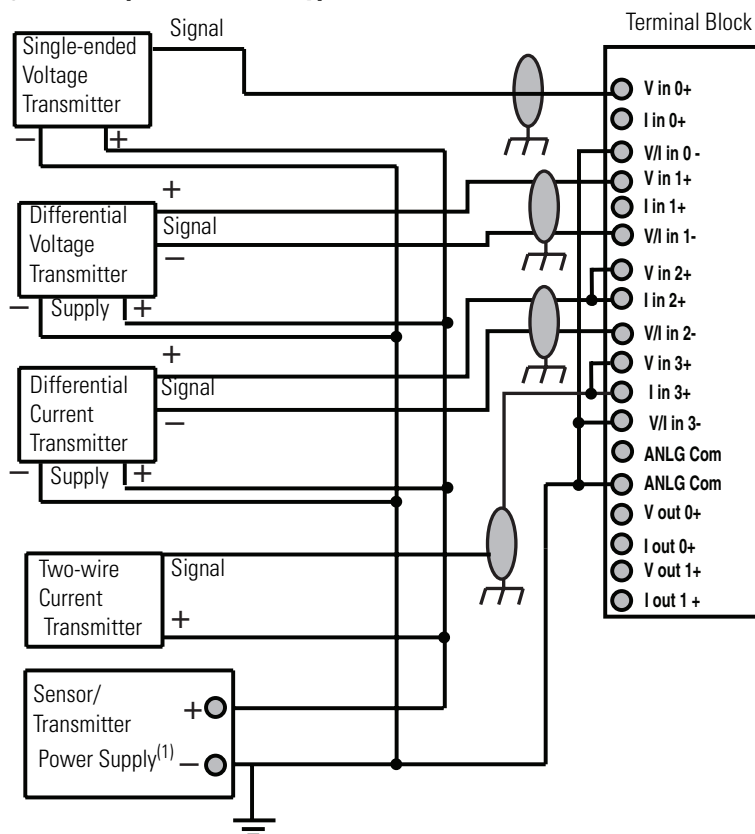
Wire Differential Inputs



Wiring Single-ended Sensor/Transmitter Types



Wiring Mixed-input Transmitter Types



(1) The sensor power supply must be rated Class 2.

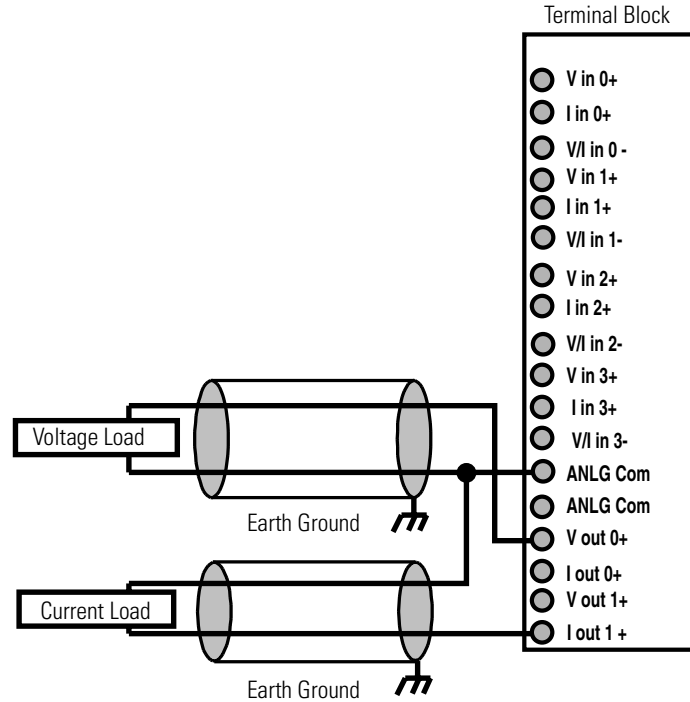
IMPORTANT

When wiring analog inputs from current transmitters, you must place a jumper between the input channel's Vin+ and lin+ terminals or measurement accuracy of current input signals will be impacted.

TIP

Any analog input channel that is not wired to a voltage or current source should not be enabled in the module configuration file. Enabling unused analog inputs can result in non-zero values being displayed in the module input data file. Either disable all unused analog inputs or place a jumper wire between the Vin+ and V/Iin- terminals for those channels.

Wiring Analog Outputs



ATTENTION



Analog outputs may fluctuate for less than a second when power is applied or removed. This characteristic is common to most analog outputs. While the majority of loads will not recognize this short signal, take preventative measures to make sure that connected equipment is not affected. Failure to take these preventative measures may result in unexpected load reactions.

Notes:

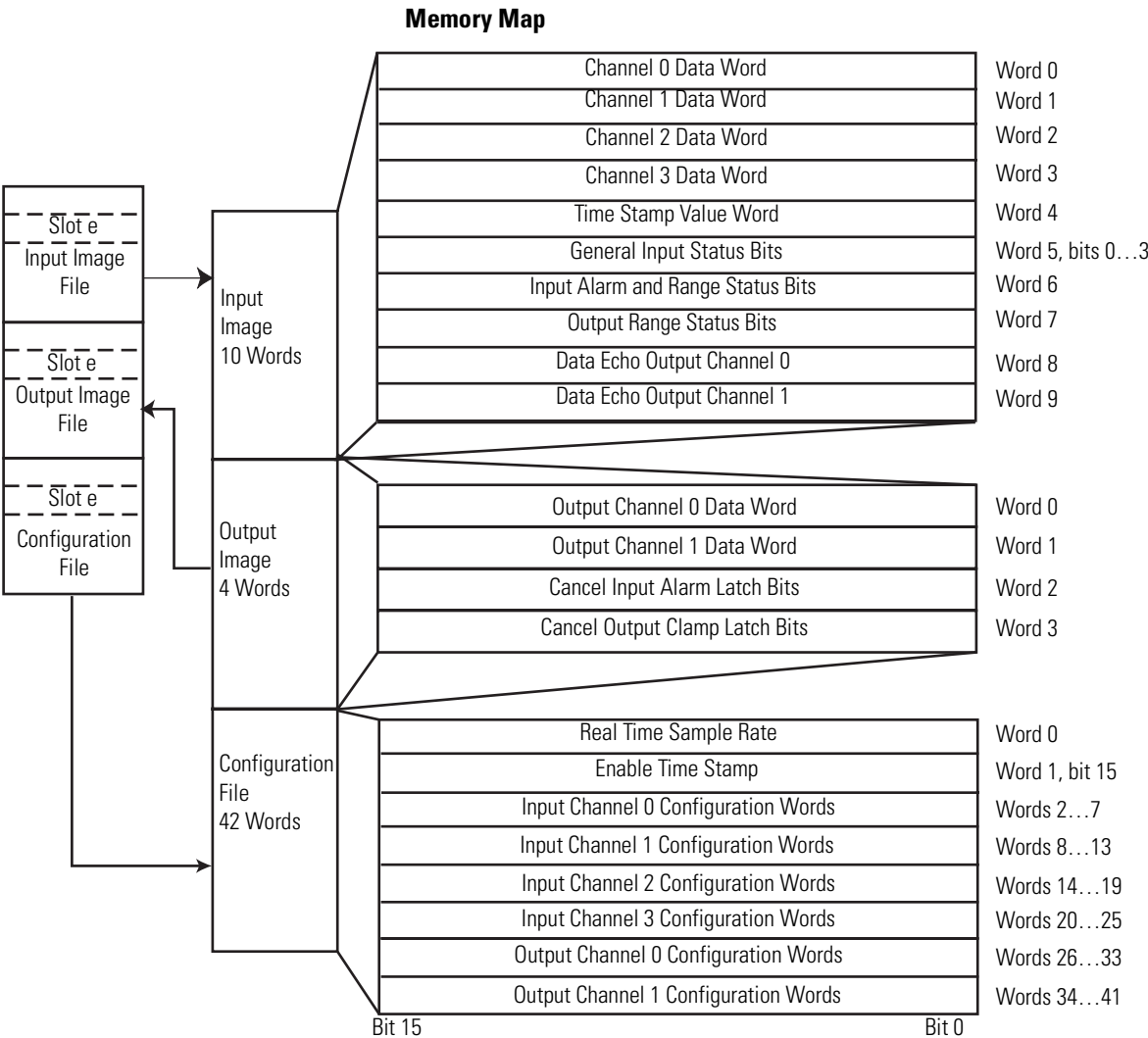
Module Data, Status, and Channel Configuration

Introduction

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Module Addressing

This memory map shows the output, input, and configuration tables for the module.



Input Image

The input image file represents data words and status bits. Input words 0...3 hold the input data that represents the value of the analog inputs for channels 0...3. These data words are valid only when the channel is enabled and there are no errors. If time stamping is enabled, Word 4 in the input data file contains the time stamp value that corresponds to the module's last input-data sampling period. Input words 5 and 6 hold the general status bits for each input channel as well as the high and low alarm and over-range and under-range bits. To receive valid status information, the input channel must be enabled.

Word 7 holds the general status bits for each output channel as well as the over and under output-clamp status bits. To receive valid status information, the output channel must be enabled. Words 8 and 9 contain the data echo values for the most recent data sent to the output channels.

Output Image

Output words 0 and 1 contain the digital data to be converted by outputs 0 and 1 into analog output signals. Word 2 contains the cancel latched-alarm control bits for the high and low alarms on each input channel. These bits are used to cancel alarms when alarms are latched. Word 3 contains the cancel latched output-clamp status control bits for the high and low output-clamp statuses on each output channel. These bits are used to cancel output-clamp statuses when the clamp statuses are latched.

Configuration File

The configuration file contains information that you use to define the way a specific channel functions.

The manipulation of bits from this file is normally done with programming software (for example, RSLogix 5000, RSLogix 500, or RSNetWorx for DeviceNet software) during initial configuration of the system. In that case, graphical screens provided by the programming software simplify configuration.

Some systems, like the 1769-ADN DeviceNet adapter system, also allow the bits to be altered as part of the control program by using communication rungs. In that case, it is necessary to understand the bit arrangement.

TIP

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

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...3 in the input data file contain the converted values of the analog inputs. 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 zero.

Input Data Array

Word/ Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	SGN	Analog Read (Input) Data Value Channel 0														
Word 1	SGN	Analog Read (Input) Data Value Channel 1														
Word 2	SGN	Analog Read (Input) Data Value Channel 2														
Word 3	SGN	Analog Read (Input) Data Value Channel 3														
Word 4	0	Time Stamp Value														
Word 5	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	SI3	SI2	SI1	SI0
Word 6	LI3	HI3	UI3	OI3	LI2	HI2	UI2	OI2	LI1	HI1	UI1	OI1	LI1	HI1	UI1	OI1
Word 7	Nu	Nu	UO1	OO1	Nu	Nu	UO0	OO0	Nu	Nu	Nu	Nu	Nu	Nu	SO1	SO0
Word 8	SGN	Output Data Loopback/Echo Channel 0														0
Word 9	SGN	Output Data Loopback/Echo Channel 1														0

Time Stamp Value (Word 4)

The module supports a 15-bit rolling time stamp that is updated during each new update of the analog input and output values. The time stamp has a 1 ms resolution. If the time stamp function is enabled, the time stamp value is placed in the Input Data file, word 16, following each module conversion cycle. Enable and/or disable this time stamp in word 1, bit 15 of the Configuration Data file.

General Input Status Bits (SI0...SI3)

Word 5, bits 0...3 contain the general operational status bits for input channels 0...3. If set (1), these bits indicate an alarm or range error associated with that channel. The over- and under-range bits and the high- and low-alarm bits for channels 0...3 are logically ORed to the appropriate general status bit.

Low Alarm Flag Bits (LI0 ...LI3)

Word 6, bits 3, 7, 11, and 15 contain the low alarm flag bits for input channels 0...3. 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 Cancel Low Process Alarm Latch bit in your output data file.

High Alarm Flag Bits (HI0...HI3)

Word 6, bits 2, 6, 10, and 14 contain the high alarm flag bits for input channels 0...3. If set (1), the input signal is outside 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 Cancel High Process Alarm Latch bit in your output data file.

Over-range Flag Bits (OI0...OI3)

Over-range bits for channels 0...3 are contained in Word 6, bits 0, 4, 8, and 12. When set (1), this bit indicates an input signal is 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 (UI0...UI3)

Under-range bits for channels 0...3 are contained in Word 6, bits 1, 5, 9, and 13. When set (1), this bit indicates an input signal is below the normal operating 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.

General Output Status Bits (S00 and S01)

Word 7, bits 0 and 1 contain the general operational status bits for output channels 0 and 1. When set (1), these bits indicate an output-clamp range error associated with that channel. The over- and under-range bits are logically ORed to the appropriate general status bit.

High Clamp (over-range) Flag Bits (000 and 001)

High clamp (over-range) bits for output channels 0 and 1 are contained in Word 7, bits 8 and 12. When set (1), these bits indicate an output value sent to the module is over the user-configured high clamp value for the output channel. The module clamps the analog output signal at the high clamp value. These bits are automatically reset (0) by the module when the high clamp condition clears, unless the channel's clamp alarm bits are latched. If the channel's clamp alarm bits are latched, a set (1) high clamp flag bit clears via the corresponding Cancel High Clamp Latch bit in your output data file.

Low Clamp (under-range) Flag Bits (U00 and U01)

Low clamp (under-range) bits for output channels 0 and 1 are contained in Word 7, bits 9 and 13. When set, these bits indicate an output value sent to the module is under the user-configured low clamp value for the output channel. The module clamps the analog output signal at the low clamp value. These bits are automatically reset (0) by the module when the low clamp condition clears, unless the channel's clamp alarm bits are latched. If the channel's clamp alarm bits are latched, a set (1) low clamp flag bit clears via the corresponding Cancel Low Clamp Latch bit in your output data file.

Output Data File

The output data table lets you write analog output data and unlatch command data to the module with the control program and bit access. The data table structure is shown in the table below. For each module, slot x, words 0 and 1 in the output data file contain the digital values of the data to be converted to analog signals by the module outputs. The most significant bit (MSB) is the sign bit, in two's complement format. 'Nu' indicates not used with the bit set to zero.

Word/ Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	SGN	Analog Output Data Channel 0													0	0
Word 1	SGN	Analog Output Data Channel 1													0	0
Word 2	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	CLI3	CHI3	CLI2	CHI2	CLI1	CHI1	CLIO	CHIO
Word 3	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	CLO1	CHO1	CLO0	CH00

Cancel Input Alarm Control Bits (CLL0...CLL3 and CLH0...CLH3)

These bits are written during Run mode to cancel 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 cancel latch bit is set.

Cancel Output Clamp Flag Control Bits (CLO0...CLO1 and CH00...CH01)

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

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 by using this file. This data file is writable and readable. The default value of the configuration data table is all zeros.

Configuration Data File

Word/Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	0	Real Time Sample Value														
Word 1	ETS	Reserved														
Word 2	EC	Reserved				EA	AL	EI ⁽¹⁾	Reserved				Input Filter Sel Ch0			
Word 3	Reserved					Input Data Format Ch0			Reserved				Input Type/Range Select Ch0			
Word 4	SGN	Process Alarm High Data Value Channel 0														
Word 5	SGN	Process Alarm Low Data Value Channel 0														
Word 6	SGN	Alarm Dead Band Value Channel 0														
Word 7	Reserved															
Word 8	EC	Reserved				EA	AL	EI ⁽¹⁾	Reserved				Input Filter Sel Ch1			
Word 9	Reserved					Input Data Format Ch1			Reserved				Input Type/Range Select Ch1			
Word 10	SGN	Process Alarm High Data Value Channel 1														
Word 11	SGN	Process Alarm Low Data Value Channel 1														
Word 12	SGN	Alarm Dead Band Value Channel 1														
Word 13	Reserved															
Word 14	EC	Reserved				EA	AL	EI ⁽¹⁾	Reserved				Input Filter Sel Ch2			
Word 15	Reserved					Input Data Format Ch2			Reserved				Input Type/Range Select Ch2			
Word 16	SGN	Process Alarm High Data Value Channel 2														
Word 17	SGN	Process Alarm Low Data Value Channel 2														
Word 18	SGN	Alarm Dead Band Value Channel 2														
Word 19	Reserved															
Word 20	EC	Reserved				EA	AL	EI ⁽¹⁾	Reserved				Input Filter Sel Ch3			
Word 21	Reserved					Input Data Format Ch3			Reserved				Input Type/Range Select Ch3			
Word 22	SGN	Process Alarm High Data Value Channel 3														
Word 23	SGN	Process Alarm Low Data Value Channel 3														
Word 24	SGN	Alarm Dead Band Value Channel 3														
Word 25	Reserved															

Configuration Data File

Word/Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 26	EC	Reserved							EHI	ELI	LC	ER	FM	PM	0	PFE
Word 27	Reserved					Output Data Format Ch0			Reserved				Output Type/Range Select Ch0			
Word 28	SGN	Fault Value Channel 0													0	0
Word 29	SGN	Program (Idle) Value Channel 0													0	0
Word 30	SGN	Clamp High Data Value Channel 0													0	0
Word 31	SGN	Clamp Low Data Value Channel 0													0	0
Word 32	SGN	Ramp Rate Channel 0													0	0
Word 33	Reserved															
Word 34	EC	Reserved							EHI	ELI	LC	ER	FM	PM	0	PFE
Word 35	Reserved					Output Data Format Ch1			Reserved				Output Type/Range Select Ch1			
Word 36	SGN	Fault Value Channel 1													0	0
Word 37	SGN	Program (Idle) Value Channel 1													0	0
Word 38	SGN	Clamp High Data Value Channel 1													0	0
Word 39	SGN	Clamp Low Data Value Channel 1													0	0
Word 40	SGN	Ramp Rate Channel 1													0	0
Word 41	Reserved															

(1) Alarm interrupts are not supported by all bus masters. Check your controller's user manual to determine if expansion I/O interrupts are supported.

For information on configuring the module by using MicroLogix 1500 and RSLogix 500 software, see [Appendix B](#); for CompactLogix and RSLogix 5000 software, see [Appendix C](#); for 1769-ADN DeviceNet adapter and RSNetWorx software, 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 [Input Channel Configuration](#) below.

Input Channel Configuration

Each input channel is independently configured via a group of six consecutive words in the Configuration Data file. The first two words of the group consist of bit fields, the settings of which determine how the input channel operates. See the tables on [page 42](#) and the descriptions that follow for valid configuration settings and their meanings. The default bit status of the configuration file is all zeros.

Bit Definitions for Input Channel Configuration Words

Define	To choose	Make these bit settings															
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Input Filter Selection/ -3 dB Frequency	60 Hz													0	0	0	0
	50 Hz													0	0	0	1
	5 Hz													0	0	1	0
	10 Hz													0	0	1	1
	100 Hz													0	1	0	0
	250 Hz													0	1	0	0
	500 Hz													0	1	1	0
	1000 Hz													0	1	1	1
	No Filter													1	0	0	0
Enable Interrupt ^{(1) (2)} (EI)	Enable								1								
	Disable								0								
Process Alarm Latch ⁽²⁾ (AL)	Enable							1									
	Disable							0									
Enable Process Alarms (EA)	Enable						1										
	Disable						0										
Enable Channel (EC)	Enable	1															
	Disable	0															

(1) Alarm interrupts are not supported by all bus masters. Check your controller's user manual to determine if expansion I/O interrupts are supported.

(2) Do not set this bit to 1 unless the Enable Process Alarms (EA) bit is also set to 1 for the same channel.

Bit Definitions for Input Range and Input Data Configuration Words

Define	To choose	Make these bit settings															
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Input Type/Range Select	-10...10V DC													0	0	0	0
	0...5V DC													0	0	0	1
	0...10V DC													0	0	1	0
	4...20 mA													0	0	1	1
	1...5V DC													0	1	0	0
	0...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 (EC)

This configuration selection lets each channel be enabled individually.

TIP

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

Any analog input channel that is not wired to a voltage or current source should not be enabled in the module configuration file. Enabling unused analog inputs can result in non-zero values being displayed in the module input-data file. Either disable all unused analog inputs or place a jumper wire between the V_{in+} and V_{lin-} terminals for those channels.

Input Filter Selection

The input filter selection field lets you select the filter frequency for each channel. The filter frequency affects the noise rejection characteristics, channel step response, and module update time, as explained below.

Noise Rejection

The module uses firmware that provides noise rejection for the input signals. The filter is programmable, allowing you to select from nine filter frequencies for each channel. A lower frequency (60 Hz versus 1000 Hz) can provide better noise rejection but it increases channel step-response time.

Normal Mode Rejection is better than 50 dB at 50 and 60 Hz, with the 50 and 60 Hz filters selected, respectively. 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 70 dB at 50 and 60 Hz, with the 50 and 60 Hz filters selected, respectively. The modules perform well in the presence of common mode noise as long as the signals applied to the $IN+$ and $ANLG$ Com input terminals do not exceed the working voltage rating 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.

Filter Selection	Channel Step Response
5 Hz	802 ms
10 Hz	401 ms
50 Hz	81 ms
60 Hz	65 ms
100 Hz	42 ms
250 Hz	17 ms
500 Hz	10 ms
1000 Hz	5 ms

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 Data Input file. In addition, if any output channels are enabled, a constant amount of time must be added to the variable input update times to arrive at the total module-update time. Module-update time can be calculated by adding the sum of all enabled channel-update times. Channel update times include channel scan time, channel switching time, and converter configuration time. The module sequentially samples the channels in a continuous loop, and then requires a constant amount of time to write to any enabled output channels.

Module update time is calculated by adding up all of the input channel update times and then adding a constant time if any of the output channels are enabled. Each enabled input channel has one of two channel-update times assigned. If No Filter is selected as the filter setting for an input channel, its channel update time is 100 μ s. If any other filter setting is selected for an input channel, then its channel update time is 200 μ s. If one or both output channels are enabled, an additional 100 μ s must be added to the input-channel update time total to arrive at the total module update time. The 100 μ s added for output channels being enabled is constant whether one or both output channels are enabled.

Input Type/Range Selection

This selection lets you configure each input channel individually and provides the ability to read the configured range selections.

Input Data Selection Formats

This selection configures each input channel to present analog data in any of the following formats:

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

See [Valid Input Data on page 46](#).

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. For example, the data value range for a $\pm 10\text{V}$ DC user input is $-32,766 \dots 32,766$, which covers the full-scale range of $-10.5 \dots 10.5\text{V}$.

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 0.001V or 0.001 mA per count.

Scaled-for-PID

The value presented to the controller is a signed integer with 0 representing the lower limit of the normal operating range and 16,383 representing the upper limit of the normal operating range. Allen-Bradley controllers, such as the MicroLogix 1500 controller, use this range in their PID equations. The amount over and under the normal operating range (the full-scale range) is also supported.

Percent Range

The input data is presented as a percentage of the normal operating range. For example, 0...10V DC equals 0...100%. The amount over and under the normal operating range (the full-scale range) is also supported.

Valid Input Data Word Formats/Ranges

This table shows the valid formats and minimum/maximum data ranges provided by the module.

Valid Input Data

Normal Operating Input Range	Full Range ⁽¹⁾	Raw/Proportional Data	Engineering Units ⁽²⁾	Scaled-for-PID		Percent Range ⁽³⁾	
		Full Range	Full Range	Normal Operating Range	Full Range	Normal Operating Range	Full Range
-10...10V DC	-10.5...10.5V	-32,766...32,766	-10,500...10,500	0...16,383	-410...16,792	-10,000...10,000	-10,500...10,500
0...5V DC	-0.5...5.25V		-500...5250		-1638...17,202	0...10,000	-1000...10,500
0...10V DC	-0.5...10.5V		-500...10,500		-818...17,202		-500...10,500
1...5V DC	0.5...5.25V		500...5250		-2048...17,406		-1250...10,624
0...20 mA	0...21 mA		0...21,000		0...17,202		0...10,500
4...20 mA	3.2...21 mA		3200... 21,000		-818...17,406		-500...10,624

(1) Includes amounts over and under normal operating range.

(2) 1 count = 0.001V or 0.001 mA.

(3) 1 count = 0.01%.

Real Time Sampling

This parameter instructs the module how often to initiate a conversion cycle that will convert each enabled input channel and then place that data into the Input Data file. A conversion cycle is defined as the sequential conversion of each input that is enabled. When the module has performed a conversion on each of the enabled inputs, it is ready to begin the next conversion cycle. 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...5000 and indicates the conversion cycle rate the module will use in 1 ms increments.

If you enter a zero for the Real Time Sample Rate, the module initiates conversion cycles at the fastest rate possible, controlled by the filter setting selected for each enabled channel. Once all of the channels' input data have been converted, the Input Data file is updated for all enabled channels at the same time.

If you enter a non-zero value for the Real Time Sample Rate, the module compares the Real Time Sample Rate value with the minimum and maximum values allowed by the module. If the value entered for the Real Time Sample Rate is less than 0 or greater than 5000 decimal, the module indicates a configuration error. The longest Real Time Sample Rate supported by the modules is 5 seconds, which corresponds to the maximum value for Word 0 of the Configuration Data file of 5000 decimal.

Time Stamping

This parameter instructs the module to insert a time stamp value into the Input Data file every time the file is updated.

During module configuration, you enable time stamping by using Word 1, bit 15 of the Configuration Data file: Enable Time Stamping (ETS). Setting the ETS bit (ETS = 1) enables the module's time stamping function. Clearing the ETS bit (ETS = 0) disables the function. The default condition of the ETS bit is disabled (ETS = 0).

When time stamping is enabled, the module provides a rolling time stamp value of 0...32,767 with each count representing 1 ms. When the time stamp count reaches 32,767, the value is reset to 0 and continues to increment 1 count every millisecond.

When enabled, the Input Data file is updated with the latest time stamp value that corresponds to the end of each module conversion cycle. Sequentially, each enabled input is converted once per conversion cycle. When Real Time Sampling is not enabled, conversion cycles are repeatedly initiated at the module update rate. If Real Time Sampling is used, the conversion cycles are initiated at a rate equal to the real-time sampling rate. The time stamp value is updated at the end of every conversion cycle.

Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each input channel**. You can latch process alarms. Process alarms can generate interrupts.⁽¹⁾ A channel's process alarms are set at two user-configurable alarm trigger points.

- Process Alarm High
- Process Alarm Low

The operation of each input channel's process alarms are controlled by bits in the Configuration Data file. Enable alarms for a channel by setting (EA = 1) the EA bit for that channel. Set the AL bit (AL = 1) for a channel to enable alarm latching. Set the EI bit (EI = 1) for a channel to enable interrupts on that channel's process alarms.⁽¹⁾

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.

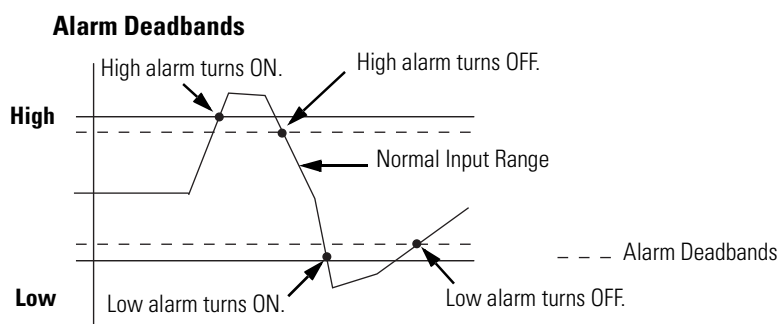
The values entered for a channel's process alarms must be within the full-scale data range as set by the Input Data Format selected for that channel. If the process alarm data value entered is outside the full-scale data range set for a channel, the module indicates a configuration error.

Alarm Deadband

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

This illustration shows an example of 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 and the input data clears the alarm deadband regions.

(1) Module interrupts are not supported by all bus masters. Refer to your controller's user manual to determine whether it can support module interrupts.



The module checks for an alarm deadband value that is less than 0 or large enough to be equal to or exceed one-half of the difference between the high alarm and low alarm values. When one of these conditions occurs, a module configuration fault results.

Output Channel Configuration

Each output channel is independently configured via a group of eight consecutive words in the Configuration Data file. The first two words of the group consist of bit fields, the settings of which determine how the output channel operates. See the tables below and the descriptions that follow for valid configuration settings and their meanings. The default bit status of the configuration file is all zeros.

Bit Definitions for Output Channel Configuration Words

Define	To choose	Make these bit settings															
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Program to Fault Enable (PFE) ⁽¹⁾	Program Data																1
	Fault Data																0
Program Mode (PM) ⁽¹⁾	User-defined														1		
	Hold Last State														0		
Fault Mode (FM) ⁽¹⁾	User-defined													1			
	Hold Last State													0			
Enable Ramping (ER) ⁽¹⁾	Enable												1				
	Disable												0				
Latch Clamp Status (LC)	Enable											1					
	Disable											0					
Enable Low Clamp Alarm Interrupt (ELI) ⁽²⁾	Enable										1						
	Disable										0						
Enable Low Clamp Alarm Interrupt (ELI) ⁽²⁾	Enable									1							
	Disable									0							
Enable Channel (EC)	Enable	1															
	Disable	0															

(1) Alternate output states are not supported by all controllers. Refer to your controller's user manual to determine whether alternate output states and this module function are supported.

(2) Module interrupts are not supported by all controllers. Refer to your controller's user manual to determine whether module interrupts are supported.

Bit Definitions for Output Range and Output Data Configuration Words

Define	To choose	Make these bit settings															
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Output Type/Range Select	-10...10V DC													0	0	0	0
	0...5V DC													0	0	0	1
	0...10V DC													0	0	1	0
	4...20 mA													0	0	1	1
	1...5V DC													0	1	0	0
	0...20 mA													0	1	0	1
Output 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 (EC)

This configuration lets each channel be enabled individually. When a channel is not enabled (EC = 0), the output channel is set to 0V or 0 mA.

Program Mode (PM)

This configuration selection provides individual Program mode selection for the output channels. When this selection is disabled (PM = 0), the module holds the last state. This means that the output remains at the last converted value prior to the condition that caused the control system to enter Program mode.

IMPORTANT

Hold last state is the default condition for the module during a control system Run-to-Program mode change.

If this selection is enabled (PM = 1), and the system enters the Program mode, the module converts the user-specified value from the channel's Program Mode word to the appropriate analog output for the range selected.

TIP

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

Program Value

Use each output channel's program value word to set the analog values for the outputs to assume when the system enters the Program mode. Valid values are dependent upon the type/range and data format selected for each output channel or the user-defined output clamp values. If the value you enter is outside the full range for the output type/range and data format selected, or outside the limits set by the channel's low and high clamp values, the module generates a configuration error. The default value is 0.

TIP

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

Fault Mode (FM)

This configuration selection provides individual Fault mode selection for the output channels. When this selection is disabled (FM = 0), the module holds the last state, meaning that the output remains at the last converted value prior to the condition that caused the control system to enter the Fault mode.

IMPORTANT

Hold last state is the default condition for the module during a control system Run-to-Fault mode change.

If this selection is enabled (FM = 1), and the system enters the Fault mode, the module converts 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 alternate output states and this function. Refer to your controller's user manual for details.

Fault Value

Use each output channel's fault value word to set the analog values for the outputs to assume when the system enters the Fault mode. Valid values depend upon the type/range and data format selected for each output channel or the user-defined output clamp values. If the value you enter is outside of the full range for the output type/range and data format selected, or outside of the limits set by the channel's low and high clamp values, the module generates a configuration error. The default value is 0.

TIP

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

Program to Fault Enable (PFE)

If a system currently in Program mode faults, this setting determines whether the program or fault value is applied to the output. If the selection is enabled (PFE = 1), the module applies the Fault mode data value. If the selection is disabled (PFE = 0), the module applies the Program mode data value. The default setting is disabled.

TIP

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

Clamping (Limiting)

Clamping limits the outputs from the module to within a user-configured range when the controller commands an output to a value outside of that range. The module supports a high clamp value and a low clamp value for each output channel. Once clamps are set for a module, any data received from the controller that exceeds those clamp values sets an appropriate clamp status bit and transitions the output to that limit but not beyond.

Clamp High and Clamp Low Data Values

Clamping is disabled on a per channel basis for each output channel by entering a 0 value in both the clamp high data value and clamp low data value words in the configuration-data file. If either the clamp high data value or clamp low data value words have a non-zero value entered, clamping is enabled for the corresponding output channel. Non-zero clamp data values are considered valid only if they are within the full-range limits set by the type/range and data format selections for the channel. Also, the clamp data values are valid only if the high clamp data value for an output channel is greater than or equal to the low clamp data value.

Latch Clamp Status (LC)

If the selection is enabled (LC = 1), the module latches any clamp status bits that are set in the Input Data file. Latched clamp status bits must be reset via the Output Data file. If the selection is disabled (LC = 0), any clamp status bits that are set in the Input Data file are automatically reset when the clamp limits are no longer exceeded by the controller. The default setting is disabled.

Enable Low Clamp Alarm Interrupt and Enable High Clamp Alarm Interrupt (ELI and EHI)

If the selection is enabled (ELI = 1 or EHI = 1), the module generates a module interrupt to the controller. A separate interrupt can be enabled for each output channel's high clamp status and low clamp status. If the selection is disabled (ELI = 0 or EHI = 0), no module interrupts are generated when output clamp status bits are set. The default setting is disabled.

TIP

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

Output Ramping

Ramping limits the speed at which an output signal can change. This prevents vast transitions in the output from damaging the output controls.

Ramp to Fault mode is the only type of ramping supported by the module. This type of ramping occurs when the present output value changes to the fault value after a change in the controller's status to Fault mode has occurred.

Enable Ramping (ER)

If the selection is enabled (ER = 1), the module controls the ramp rate of the output when the system transitions from Run to Fault mode based on the value entered in the channel's ramp-rate configuration word. If the selection is disabled (ER = 0), no ramping control of the output is provided. The default setting is disabled.

TIP

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

Ramp Rate

The ramp rate is defined in terms of the selected range/format in units per second. For example, in the 0...20 mA range and percent full scale format, a ramp rate of 1050 is 10% per second (2 mA/s), since 1050 is 10% of the total number of counts in the full scale of the 0...20 mA range when using percent full scale format.

This table describes how the ramp rate is determined for all output types/ranges and output data formats.

Ramp Rates for Output Type/Range and Data Formats

Output Data Format	Output Type/Range	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 DC	65,334 ⁽¹⁾	652	0.20V/s
	0...5V DC			0.05V/s
	0...10V DC			0.10V/s
	1...5V DC			0.04V/s
	0...20 mA			0.20 mA/s
	4...20 mA			0.16 mA/s
Engineering Units	-10...10V DC	21,000	208	0.20V/s
	0...5V DC	5,748	56	0.05V/s
	0...10V DC	11,000	108	0.10V/s
	1...5V DC	4,748	48	0.04V/s
	0...20 mA	21,000	208	0.20 mA/s
	4...20 mA	17,800	176	0.16 mA/s
Scaled for PID	-10...10V DC	17,203	172	0.20V/s
	0...5V DC	18,840	188	0.05V/s
	0...10V DC	18,021	180	0.10V/s
	1...5V DC	19,452	195	0.04V/s
	0...20 mA	17,200	172	0.20 mA/s
	4...20 mA	18,224	180	0.16 mA

Ramp Rates for Output Type/Range and Data Formats

Output Data Format	Output Type/Range	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 DC	21,000	208	0.20V/s
	0...5V DC	11,500	112	0.05V/s
	0...10V DC	11,000	108	0.10V/s
	1...5V DC	11,872	116	0.04V/s
	0...20 mA	10,500	104	0.20 mA/s
	4...20 mA	11,124	108	0.16 mA/s

(1) Limited to 32,764 by programming software.

If configured, ramping takes place only when the output is commanded to go to a fault state. Ramping does not occur during 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.
- the number of counts entered for a channel's ramp rate is equal to zero and ramping is not enabled for that channel.

TIP

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

Output Type/Range Selection

This selection lets you configure each output channel individually and provides the means of designating whether the output is a voltage or current source. The output range for each output channel is also configured by this selection.

Output Data Selection Formats

This selection configures each output channel to accept digital data in any of the following formats:

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

See [Valid Output Data on page 57](#).

Raw/Proportional Data

The value sent by the controller to the output channel is proportional to the selected output and scaled into the maximum data range allowed by the bit resolution of the D/A converter. For example, the data value range for a $\pm 10\text{V}$ DC user input is $-32,764 \dots 32,764$, which covers the full-scale range of $-10.5 \dots 10.5\text{V}$.

Engineering Units

The value sent by the controller to the output channel is the actual current or voltage value for the selected output range. The resolution of the engineering units is 0.001V or 0.001 mA per count.

Scaled-for-PID

The value sent by the controller to the output channel is a signed integer with 0 representing the lower limit of the normal operating range and 16,380 representing the upper limit of the normal operating range. Allen-Bradley controllers, such as the MicroLogix 1500 controller, use this range in their PID equations. The amount over and under the normal operating range (the full-scale range) is also supported.

Percent Range

The value sent by the controller to the output channel is presented as a percentage of the normal operating range selected for that output channel. For example, $0 \dots 10\text{V}$ DC equals $0 \dots 100\%$. The resolution of the percent range is 0.01% per count. The amount over and under the normal operating range (the full-scale range) is also supported.

Valid Output Data Word Formats/Ranges

This table shows the valid formats and minimum/maximum data ranges provided by the module.

Valid Output Data

Normal Operating Output Range	Full Range ⁽¹⁾	Raw/Proportional Data	Engineering Units ⁽²⁾	Scaled-for-PID		Percent Range ⁽³⁾	
		Full Range	Full Range	Normal Operating Range	Full Range	Normal Operating Range	Full Range
-10...10V DC	-10.5...10.5V	-32,764...32,764	-10,500...10,500	0...16,380	-408...16,792	-10,000...10,000	-10,500...10,500
0...5V DC	-0.5...5.25V		-500...5,248		-1638...17,200	0...10,000	-1000...10,500
0...10V DC	-0.5...10.5V		-500...10,500		-820...17,200		-500...10,624
1...5V DC	0.5...5.25V		500...5,248		-2048...17,404		-1250...10,624
0...20 mA	0...21 mA		0...21,000		0...17,200		0...10,500
4...20 mA	3.2...21 mA		3,200...21,000		-820...17,404		-500...10,624

(1) Includes amounts over and under normal operating range.

(2) 1 count = 0.001V or 0.001 mA.

(3) 1 count = 0.01%.

Notes:

Module Diagnostics and Troubleshooting

Introduction

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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.

Power Status Indicator

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

Activate 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 UVPRM 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.

Power Cycle Diagnostics

When you cycle power to the module, a series of internal diagnostic tests are performed. These diagnostic tests must be successfully completed or the module status indicator remains off and a module error results and is reported to the controller.

Module Status Indicator	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.

Channel Diagnostics

When any 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 during every conversion cycle for input channel over-range and under-range, input channel high and low process alarm conditions, and output channel high and low clamp conditions.

Out-of-range Detection

Whenever data received at an input is out of the defined normal operating range, an over-range or under-range error is indicated in the Input Data file.

Process Alarm Detection

Whenever data received at an input meets or exceeds that channel's configured process alarm limits, a high alarm or low alarm error is indicated at the Input Data file.

Output Clamp Detection

Whenever data is sent to an output that meets or exceeds that channel's configured clamp limits, a low or high clamp error is indicated in the Input Data file.

Non-critical Versus Critical Module Errors

Non-critical module errors are typically recoverable. Channel errors (over-range or under-range errors, process alarms, and open circuit errors) are non-critical. Non-critical errors are indicated in the module input data table.

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 [Error Codes on page 63](#).

Module Error Definition Table

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.

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. Refer to your controller manual for details.

Error Type	Module Error Field Value Bits 11...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

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.

Error Codes

Error codes can help troubleshoot your module.

Extended Error Codes for Hardware Errors

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	1 0000 0000	General hardware error; no additional information
	X201	001	1 0000 0001	Power-up reset state
Hardware-Specific Error	X300	001	1 0000 0000	General hardware error
	X301	001	1 0000 0001	Microprocessor hardware error
	X302	001	1 0000 0010	A/D converter communication error

(1) X represents the Don't Care digit. Module hardware error codes are typically presented in their Hex Equivalent by the programming software.

During system configuration, if you set the fields in the configuration file to invalid or unsupported values, the module generates a configuration error and the system controller enters a Fault condition. The invalid configuration data must be corrected and the program downloaded again for the system to enter Run mode. You cannot change module configuration data while the system is in Run mode. Any changes are ignored by the module, which continues to operate with its previous configuration.

Extended Error Codes for Configuration Errors

Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	Error Description
	Binary	Binary	
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 format selected (channel 0)
X406	010	0 0000 0110	Invalid input format selected (channel 1)
X407	010	0 0000 0111	Invalid input format selected (channel 2)
X408	010	0 0000 1000	Invalid input format selected (channel 3)
X409	010	0 0000 1001	Input alarm not enabled (channel 0)
X40A	010	0 0000 1010	Input alarm not enabled (channel 1)
X40B	010	0 0000 1011	Input alarm not enabled (channel 2)
X40C	010	0 0000 1100	Input alarm not enabled (channel 3)

Extended Error Codes for Configuration Errors

Hex Equivalent ⁽¹⁾	Module Error Code	Extended Error Information Code	Error Description
	Binary	Binary	
X40D	010	0 0000 1101	Invalid alarm data (channel 0)
X40E	010	0 0000 1110	Invalid alarm data (channel 1)
X40F	010	0 0000 1111	Invalid alarm data (channel 2)
X410	010	0 0001 0000	Invalid alarm data (channel 3)
X411	010	0 0001 0001	Invalid input filter selected (channel 0)
X412	010	0 0001 0010	Invalid input filter selected (channel 1)
X413	010	0 0001 0011	Invalid input filter selected (channel 2)
X414	010	0 0001 0100	Invalid input filter selected (channel 3)
X415	010	0 0001 0101	Invalid output range selected (channel 0)
X416	010	0 0001 0110	Invalid output range selected (channel 1)
X417	010	0 0001 0111	Invalid output format selected (channel 0)
X418	010	0 0001 1000	Invalid output format selected (channel 1)
X419	010	0 0001 1001	Invalid output fault value selected (channel 0) ⁽²⁾
X41A	010	0 0001 1010	Invalid output fault value selected (channel 1) ⁽²⁾
X41B	010	0 0001 1011	Invalid output program/idle value selected (channel 0) ⁽²⁾
X41C	010	0 0001 1100	Invalid output program/idle value selected (channel 1) ⁽²⁾
X41D	010	0 0001 1101	Invalid output clamp value selected (channel 0)
X41E	010	0 0001 1110	Invalid output clamp value selected (channel 1)
X41F	010	0 0001 1111	Invalid ramp rate selected (channel 0) ⁽²⁾
X420	010	0 0010 0000	Invalid ramp rate selected (channel 1) ⁽²⁾
X421	010	0 0010 0001	Invalid real time sample value

(1) X represents the Don't Care digit. Module configuration error codes are typically presented in their Hex Equivalent by the programming software.

(2) Some controllers do not support alternate output states. Refer to your controller user manual to determine whether alternate output states and these associated functions are supported.

Invalid Input Range Selected

These error codes occur when the 4-bit input range code for the indicated channel is not one of the assigned input range codes for the module.

See [Bit Definitions for Input Range and Input Data Configuration Words on page 42](#) for details on the assigned input range codes for each module.

Invalid Input Format Selected

These error codes occur when the 3-bit input format code for the indicated channel is not one of the assigned input format codes for the module.

See [Bit Definitions for Input Range and Input Data Configuration Words on page 42](#) for details on the assigned input format codes for the module.

Alarm Not Enabled

These error codes occur when a channel is enabled and the Alarm Latch and/or the Enable Interrupt control bits for that channel are set but the Enable Alarm bit is not set.

See [Bit Definitions for Input Channel Configuration Words on page 42](#) for details on setting the process alarm control bits for the module.

Invalid Alarm Data

These error codes occur when the data entered for the high or low process alarms for a channel exceed the full-range limits of the channel. The full-range limits for a channel are a function of the input range and the input format selected for the channel.

See [Valid Input Data Word Formats/Ranges on page 46](#) for details on the full-range limits for each data range and data format.

These error codes may also occur if the deadband value entered for a channel is less than 0, or is greater than or equal to one-half times the channel's high alarm value minus the channel's low alarm value.

Invalid Input Filter Selected

These error codes occur when the 4-bit input filter code for the indicated channel is not one of the assigned input filter codes for the module.

See [Bit Definitions for Input Channel Configuration Words on page 42](#) for details on the assigned input filter codes for the module.

Invalid Output Range Selected

These error codes occur when the 4-bit output range code for the indicated channel is not one of the assigned output range codes for the module.

See [Bit Definitions for Output Range and Output Data Configuration Words on page 50](#) for details on the assigned output range codes for the module.

Invalid Output Format Selected

These error codes occur when the 3-bit output format code for the indicated channel is not one of the assigned output format codes for the module.

See [Bit Definitions for Output Range and Output Data Configuration Words on page 50](#) for details on the assigned output range codes for the module.

Invalid Fault Value Selected⁽¹⁾

These error codes occur when the value entered is not within the full-range limits of the indicated channel, as determined by the channel's output range/type and format setting, or the value entered is not within the limits set by the indicated channel's output clamp values.

Invalid Program/Idle Value Selected⁽¹⁾

These error codes occur when the value entered is not within the full-range limits of the indicated channel, as determined by the channel's output range/type and format setting, or the value entered is not within the limits set by the indicated channel's output clamp values.

(1) Some controllers do not support alternate output states. Refer to your controller user manual to determine whether alternate output statuses and these associated functions are supported.

Invalid Clamp Value Selected

These error codes occur when the value entered is not within the full-range limits of the indicated channel, as determined by the channel's output range/type and format setting, or if the low clamp value is greater than the high clamp value.

Invalid Ramp Rate Selected⁽¹⁾

These codes occur when the value entered is less than 1% or more than 100% of the total full-range counts for the indicated channel, as determined by the channel's output range/type and format setting, unless output ramping is disabled for the indicated channel. In that case, the ramp rate may be set to zero without causing a configuration error.

Invalid Real Time Sample Value

This error code occurs when the data entered for the Real Time Sample value is less than 0 or is greater than 5000 (decimal).

See [Real Time Sampling on page 46](#) for details.

Module Inhibit Function

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

Whenever the module is inhibited, it continues to provide information about changes at its inputs to the 1769 Compact Bus Master (for example, a CompactLogix controller).

(1) Some controllers do not support alternate output states. Refer to your controller user manual to determine whether alternate output states and these associated functions are supported.

Contacting Rockwell Automation

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

- A clear statement of the problem, including a description of what the system is actually doing. Note the state of the status indicators; also note input and output image words for the module.
- List of remedies you have already tried
- Controller type and firmware number (See the label on the controller.)
- Hardware types in the system, including all I/O modules
- Fault code, if the controller is faulted

See the back cover for contact information.

Specifications

Introduction

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General Specifications

Attribute	Value
Dimensions (HxWxD), approx.	118 x 87 x 35 mm (4.65 x 3.43 x 1.38 in.) Height including mounting tabs is 138 mm (5.43 in.)
Shipping weight, approx. (with carton)	290 g (0.64 lb)
Temperature, storage	-40...85 °C (-40...185 °F)
Temperature, operating	0...60 °C (32...140 °F)
Operating humidity	5...95% noncondensing
Operating altitude	2000 m (6561 ft)
Vibration, operating	10...500 Hz, 5 g, 0.030 in. peak-to-peak
Shock, operating	30 g, 11 ms panel-mounted (20 g, 11 ms DIN rail-mounted)
Shock, nonoperating	40 g panel-mounted (30 g DIN rail-mounted)
Bus current draw, max	220 mA @ 5V DC 120 mA @ 24V DC
Heat dissipation	3.39 total Watts (<i>Watts per point plus the minimum Watts with all points energized.</i>)
Module OK status indicator	On: The module has power, has passed internal diagnostics, and is communicating over the bus. Off: Any of the above is not true.
System power supply distance rating	The module may not be more than 8 modules away from the system power supply.
Recommended cable	Belden 8761 (shielded)
Vendor I.D. code	1
Product type code	10
Product code	43
Input words	10
Output words	2
Configuration words	42

Input Specifications

Attribute	Value
Analog normal operating ranges ⁽¹⁾	±10V DC 0...10V DC 0...5V DC 1...5V DC 0...20 mA 4...20 mA
Full scale analog ranges ⁽¹⁾	±10.5V DC -0.5...10.5V DC -0.5...5.25V DC 0.5...5.25V DC 0...21 mA 3.2...21 mA
Number of inputs	4 differential or single-ended
Converter type	Successive Approximation
Response speed per channel	Input filter and configuration dependent
Resolution, max ⁽²⁾	14 bits (unipolar) 14 bits plus sign (bipolar)
Rated working voltage ⁽³⁾	30V AC/30V DC
Common mode voltage range ⁽⁴⁾	±10V DC max per channel
Common mode rejection	Greater than 70 dB at 50 and 60 Hz with the 10 Hz filter selected, respectively
Input impedance, voltage terminal	220 kΩ
Input impedance, current terminal	250 Ω
Overall accuracy, voltage terminal ⁽⁵⁾	0.15% full scale @ 25 °C (77 °F)
Overall accuracy, current terminal ⁽⁵⁾	0.2% full scale @ 25 °C (77 °F)
Accuracy drift with temperature, voltage terminal	±0.003% per °C
Accuracy drift with temperature, current terminal	±0.0045% per °C
Calibration	None required
Non-linearity (in percent full scale)	±0.03%
Repeatability ⁽⁶⁾	±0.03%
Module error over full temperature range 0...60 °C (32...140 °F), voltage	0.2%
Module error over full temperature range 0...60 °C (32...140 °F), current	0.3%
Channel diagnostics	Over- or under-range by bit reporting, process alarms
Max overload at input terminals, voltage ⁽⁷⁾	±30V DC continuous, 0.1 mA
Max overload at input terminals, current ⁽⁷⁾	±32 mA continuous, ±7.6V DC
Input group to bus isolation	500V AC or 710V DC for 1 minute (qualification test) 30V AC/30V DC working voltage (IEC Class 2 reinforced insulation)

(1) The over- 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.

(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, the plus input terminals must be within ±10V DC of analog common.

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

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

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

Output Specifications

Attribute	Value
Analog normal operating ranges ⁽¹⁾	$\pm 10\text{V DC}$ $0 \dots 5\text{V DC}$ $0 \dots 20\text{ mA}$ $0 \dots 10\text{V DC}$ $1 \dots 5\text{V DC}$ $4 \dots 20\text{ mA}$
Full scale analog ranges ⁽¹⁾	$\pm 10.5\text{V DC}$ $-0.5 \dots 5.25\text{V DC}$ $0 \dots 21\text{ mA}$ $-0.5 \dots 10.5\text{V DC}$ $0.5 \dots 5.25\text{V DC}$ $3.2 \dots 21\text{ mA}$
Number of outputs	Two single-ended
Digital resolution across full range	13 bits unipolar, 13 bits plus sign bipolar
Conversion rate (all channels) max	1 ms
Step response to 63% ⁽²⁾	2.0 ms
Resistive load, current	$0 \dots 500\ \Omega$ (includes wire resistance)
Resistive load, voltage	1 k Ω or greater
Max inductive load, current	0.1 mH
Max inductive load, voltage	1.0 μF
Field calibration	None required
Overall accuracy ⁽³⁾	0.2% full scale @ 25 °C (77 °F)
Accuracy drift with temperature, current load	$\pm 0.0058\%$ FS per °C
Accuracy drift with temperature, voltage load	$\pm 0.0086\%$ FS per °C
Output ripple ⁽⁴⁾ range 0...50 kHz (referred to output range)	$\pm 0.05\%$
Non-linearity (in percent full scale)	$\pm 0.05\%$
Repeatability ⁽⁵⁾ (in percent full scale)	$\pm 0.05\%$
Output error over full temperature range [0...60°C (32...140°F)], current	$\pm 0.4\%$ of full scale
Output error over full temperature range [0...60°C (32...140°F)], voltage	$\pm 0.3\%$ of full scale
Open and short-circuit protection	Yes
Max short-circuit current	50 mA
Output overvoltage protection	Yes
Rated working voltage	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)
Channel diagnostics	High or Low Clamps Limit Exceeded, by status bit reporting

(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) 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.

(3) Includes offset, gain, drift, 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.

Certifications

Certification	Value
Agency certification	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
Electrical /EMC:	The module has passed testing at the following levels:
ESD Immunity (IEC1000-4-2)	4 kV contact, 8 kV air, 4 kV indirect
Radiated Immunity (IEC1000-4-3)	10 V/m, 80...1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
Fast Transient Burst (IEC1000-4-4)	2 kV, 5 kHz
Surge Immunity (IEC1000-4-5)	1 kV galvanic gun
Conducted Immunity (IEC1000-4-6)	10V DC, 0.15...80 MHz ⁽¹⁾

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

Replacement Parts

The module has the following replacement parts:

- Terminal block, catalog number 1769-RTBN18 (one per kit)
- Door, catalog number 1769-RD (two per kit)

Module Addressing and Configuration with MicroLogix 1500 Controller

Introduction

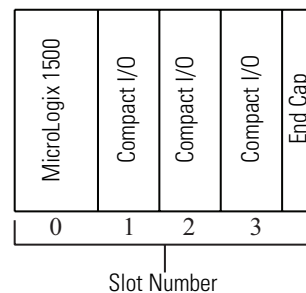
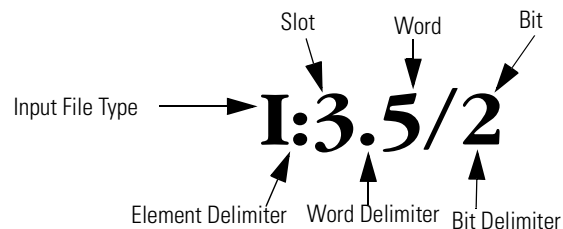
Topic	Page
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Module Configuration File	74
Configure Analog I/O Modules in a MicroLogix 1500 System	75

This appendix examines the modules' addressing scheme and describes module configuration using RSLogix 500 software and a MicroLogix 1500 controller.

Module Input Image

The module's input image file represents data words and status bits. Input words 0...3 hold the input data that represents the value of the analog inputs for channels 0...3. These data words are valid only when the channel is enabled and there are no errors. Input words 5...7 hold the status bits. To receive valid status information, the channel must be enabled.

For example, to obtain the general input status of channel 2 of the analog module located in slot 3, use address I:3.5/2.



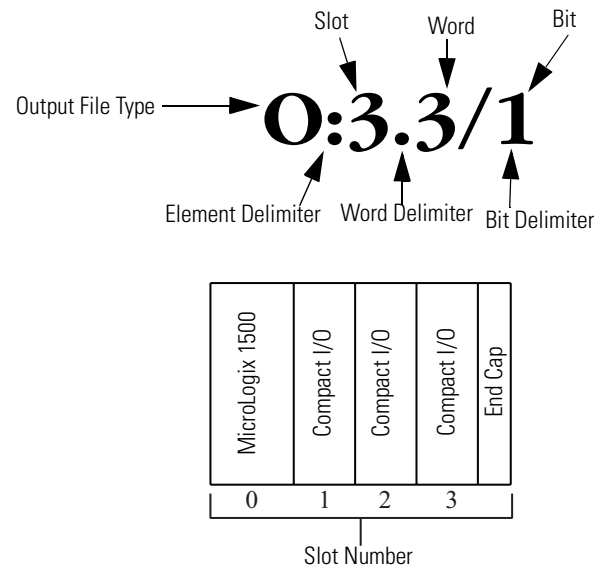
TIP

The end cap does not use a slot address.

Module Output Image

The module's output image file represents data words and unlatch control bits. Output words 0...1 are written with output data that represents the analog value commanded to the module's output channels 0...1. These data words only represent the state of the module's outputs when the channel is enabled and there are no errors. Output words 2...3 are written to control the unlatching of input process alarms or output clamp status bits.

For example, to control the unlatching of a latched output clamp status bit of output channel 1 of the module located in slot 3, use address O:3.3/1.



TIP

The end cap does not use a slot address.

Module 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 3](#).

The configuration file is modified using the programming software configuration screen.

For an example of module configuration using RSLogix 500 software, see [Configure Analog I/O Modules in a MicroLogix 1500 System](#).

TIP

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

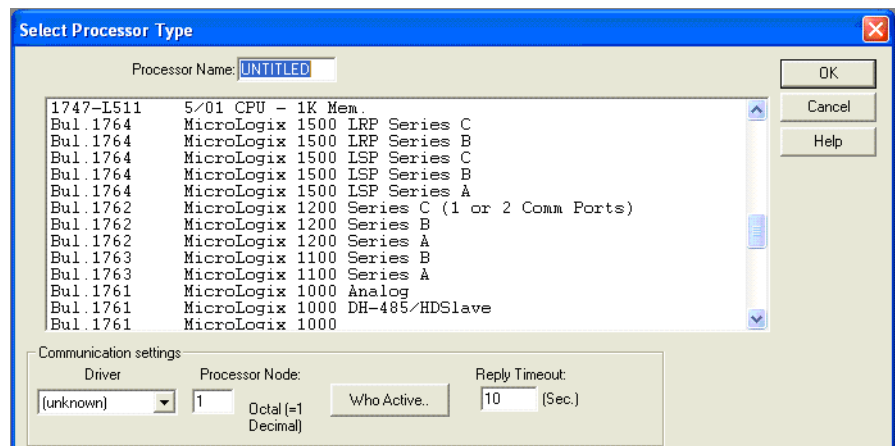
Software Configuration Channel Defaults

Parameter	Default Setting
Enable/Disable Channel	Disabled
Input Filter Selection	60 Hz
Input/Output Range	-10...10V DC
Data Format	Raw/Proportional

Configure Analog I/O Modules in a MicroLogix 1500 System

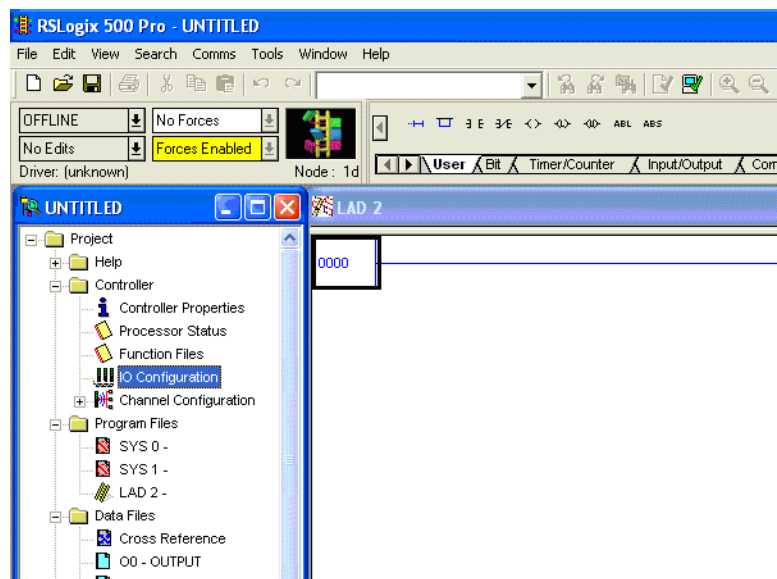
This example takes you through configuring your 1769-IF4FXOF2F module with RSLogix 500 programming software. This application example assumes your module is installed as expansion I/O in a MicroLogix 1500 system, that RSLinx software is properly configured, and a communication link has been established between the MicroLogix controller and RSLogix 500 software.

1. From the File menu, choose New to create a new project.

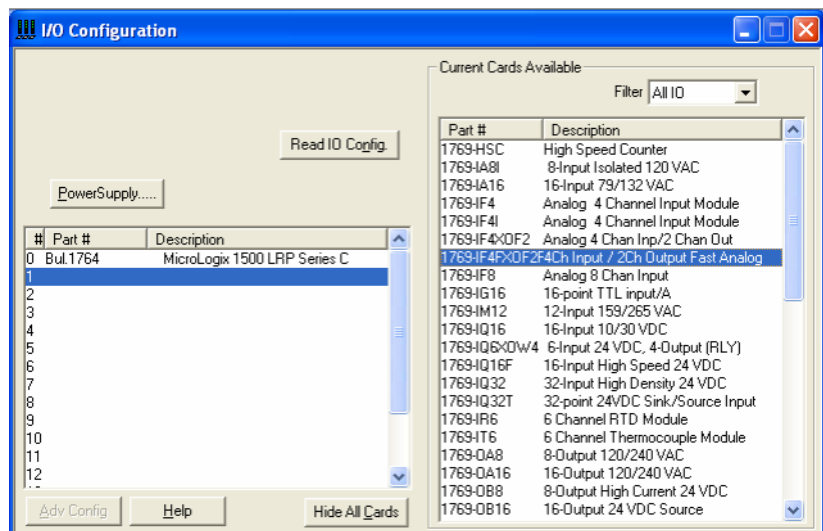


2. Type a name for the project in the Processor Name field.
3. Select your MicroLogix 1500 controller from the list and click OK.

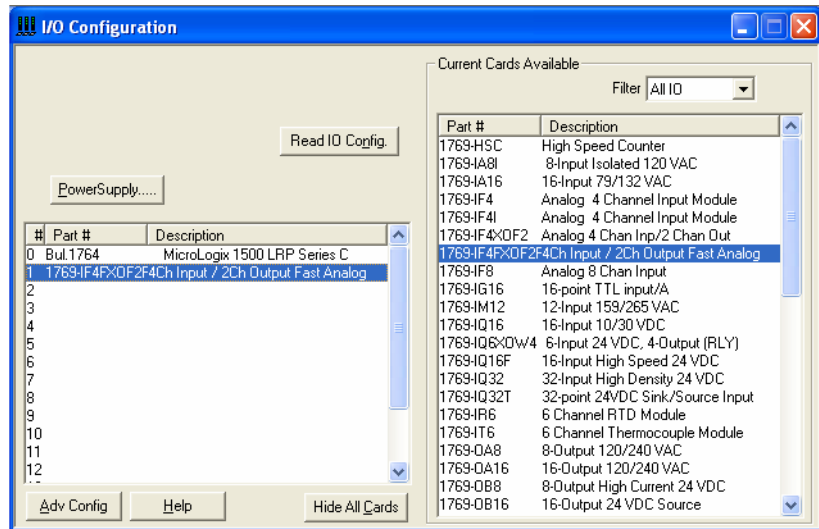
4. Double-click I/O Configuration in the project tree to open the I/O Configuration dialog box.



5. On the I/O Configuration dialog box, select the slot position where you want to add your module.
6. In the Current Cards Available list, double-click 1769-IF4FXOF2F4CH Input / 2CH Output Fast Analog to add the module to the project in the indicated slot position.

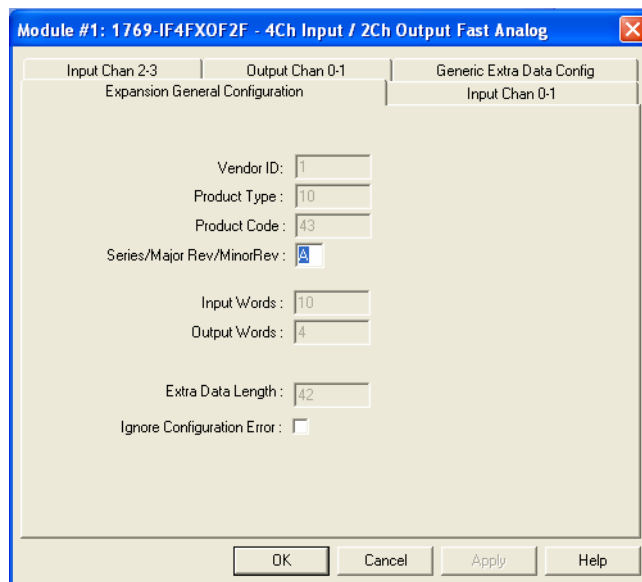


7. Double-click the newly-added module.



8. Configure the module's input and output channels by accessing the corresponding configuration tabs and selecting or entering the appropriate data.

Raw configuration data can be viewed on the Generic Extra Data Config tab.



9. When you are finished entering all of the data, click Apply and then OK.
10. Download the project to the MicroLogix 1500 controller.

Notes:

Configuration Using the RSLogix 5000 Generic Profile for CompactLogix Controllers

Introduction

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If the Add-on Profile for the 1769-IF4FXOF2F module is not yet available, follow this procedure to configure your module by using a generic profile.

Add the Module to Your Project

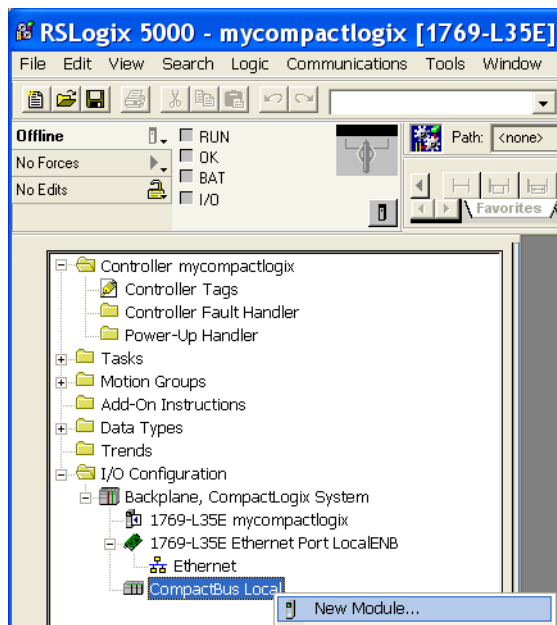
1. Open an existing project in RSLogix 5000 software or start a new project by choosing File>New.
2. If this is a new project select a CompactLogix controller, type a name for the controller, and click OK.

The 'New Controller' dialog box is shown with the following fields and values:

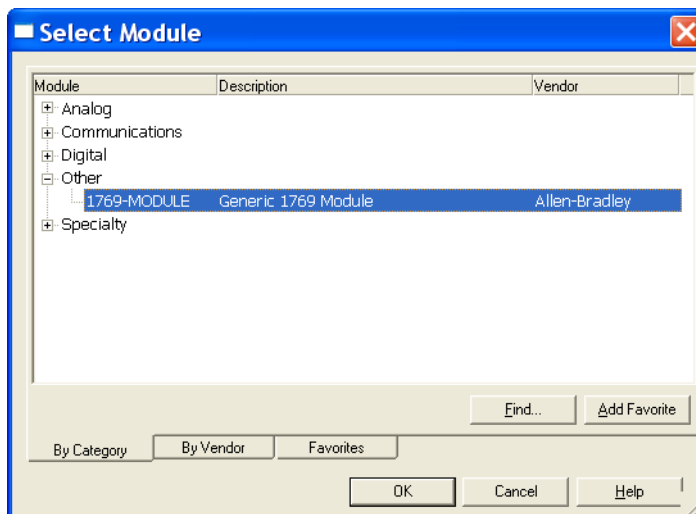
- Vendor: Allen-Bradley
- Type: 1769-L35E CompactLogix5335E Controller
- Revision: 16
- ☐ Redundancy Enabled
- Name: (empty text box)
- Description: (empty text box)
- Chassis Type: <none>
- Slot: 0
- Safety Partner Slot: (empty text box)
- Create In: C:\RSLogix 5000\Projects

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

3. In the controller organizer, right-click CompactBus Local, and choose New Module.

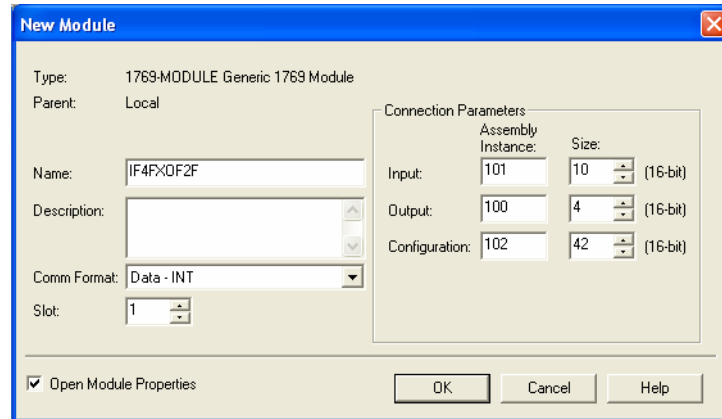


4. Expand the Other group and select the 1769-MODULE Generic Profile.



5. Click OK.

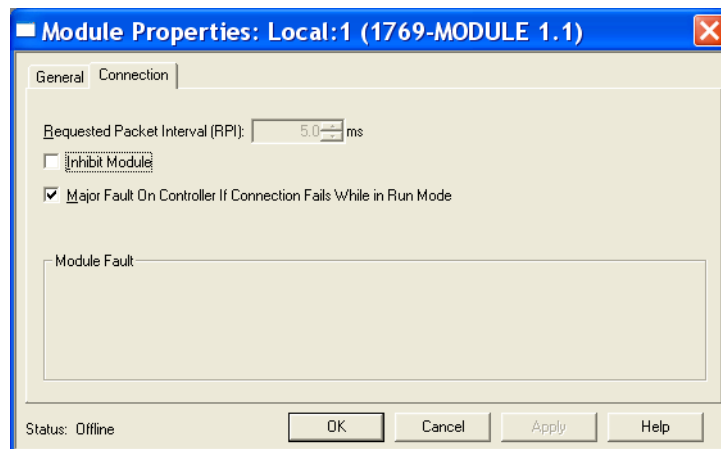
6. Type a Name for the module and an optional Description.



7. Select the slot number.

The slot number begins with the first available slot number, 1, and increments automatically for each subsequent Generic Profile you configure.

8. Enter the Comm Format, Assembly Instance numbers and their associated sizes.
9. Click OK.
10. On the Connection tab, you can choose to inhibit the module or configure the module to fault if the connection fails.

**TIP**

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

11. Click OK.

Configure Each I/O Module

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, at going to run, and at power cycle.

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.

1. Open the Controller Tag database by double-clicking Controller Tags in the upper portion of the controller organizer.
2. Open the configuration tag for your module by clicking on the plus sign to the left of its configuration tag in the tag database.
3. To configure the input modules in slot 1, click the plus sign left of Local:1.C.
4. Click the plus sign to the left of Local:1.C.Data to reveal the 98 data words where the configuration data may be entered for the module.

Name	Value	Force Mask	Style	Data Type
Local:1.C	{...}	{...}		AB:1769_MODUL...
+ Local:1.C.Reserved	1		Decimal	DINT
- Local:1.C.Data	{...}	{...}	Hex	INT[198]
+ Local:1.C.Data[0]	16#0000		Hex	INT
+ Local:1.C.Data[1]	16#0000		Hex	INT
+ Local:1.C.Data[2]	16#0000		Hex	INT
+ Local:1.C.Data[3]	7 6 5 4 3 2 1 0		Hex	INT
+ Local:1.C.Data[4]	7-0 0 0 0 0 0 0 0		Hex	INT
+ Local:1.C.Data[5]	15-8 0 0 0 0 0 0 0		Hex	INT
+ Local:1.C.Data[6]	16#0000		Hex	INT

Two's Complement Binary Numbers

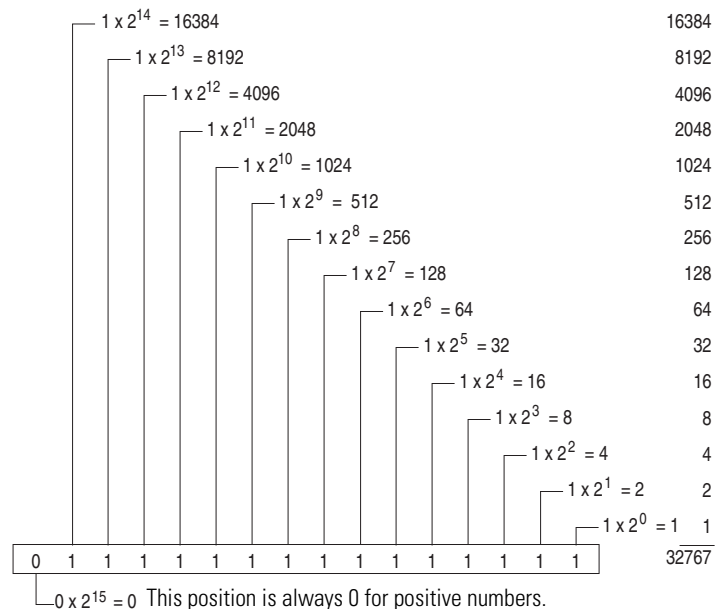
The controller memory stores 16-bit binary numbers. Two's complement binary is used when performing mathematical calculations internal to the controller. Analog input values from the analog modules are returned to the controller in 16-bit two's complement binary format. For positive numbers, the binary 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 controller 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 32,767 (all positions are 1 except the far left position).

Positive Decimal Values



EXAMPLE

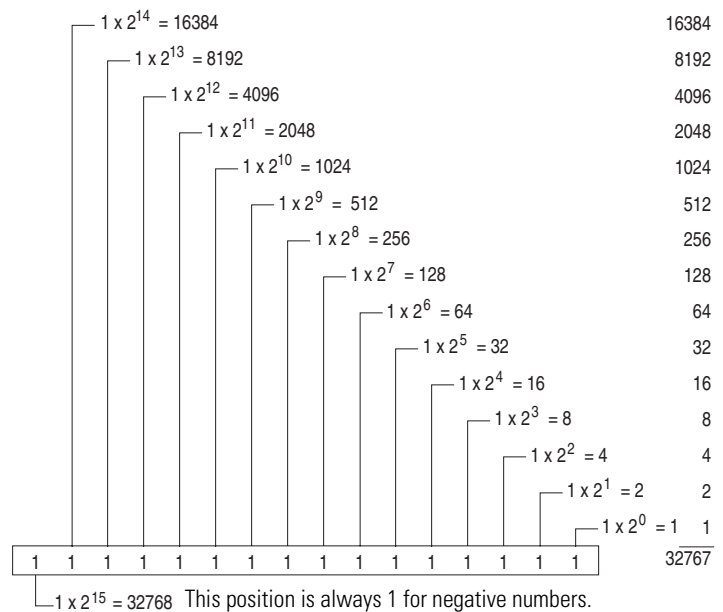
$$0000\ 1001\ 0000\ 1110 = 2^{11} + 2^8 + 2^3 + 2^2 + 2^1 = 2048 + 256 + 8 + 4 + 2 = 2318$$

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

Negative Decimal Values

In two's complement notation, the leftmost position is always 1 for negative values. The equivalent decimal value of the binary number is obtained by subtracting the value of the leftmost position, 32,768, from the sum of the values of the other positions. All positions are 1 and the value is $32,767 - 32,768 = -1$.

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 the Allen-Bradley 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 controller.

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 controller, 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.
$$\text{CMRR} = 20 \log_{10} (V_1/V_2)$$

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 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 digital value currently being converted by the D/A converter and shown in words 8 and 9 of the 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.

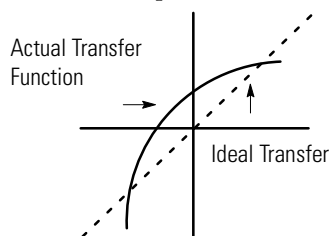
hold last state – A configuration selection that instructs the module to keep the outputs at the last converted value prior to the condition that caused the control system to enter the Fault or Program mode.

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 inputs, 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 controller. If output channels are enabled, a constant amount of time must be added to the input update time to arrive at the total module update time.

multiplexer – A 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.

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 (77 °F), and also over the full operating temperature range, 0...60 °C (0...140 °F).

output image – The output from the controller to the module outputs. The output image contains the digital output data to be converted to analog output signals by the module.

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 (for example, 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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