Compact High-density Analog Input Modules

User Manual

(Catalog Numbers 1769-IF16C, 1769-IF16V)

ALLEN-BRADLEY • ROCKWELL SOFTWARE Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://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.

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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.

Chapter 4

Module Diagnostics and Troubleshooting

Introduction

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

About this Publication

This manual is a guide for using Compact High Density Analog Input Modules, catalog numbers 1769-IF16C and 1769-IF16V. 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 User Manual, publication 1769-UM007	A user manual containing information on how to install, use and program your 1769-L20 and -L30 CompactLogix controllers.
CompactLogix System User Manual, publication 1769-UM011	A user manual containing information on how to install, use and program your 1769-L31, -L32C, -L32E, -L35CR and -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.

Conventions

These conventions are used throughout this manual:

- Bulleted lists, such as this one, provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- **Bold** type is used for emphasis.

Overview

Introduction

Module Description

The modules convert and digitally store analog data for retrieval by controllers, such as the CompactLogix or MicroLogix 1500 controllers. The modules provide the following input types and ranges.

Normal and Full Ranges

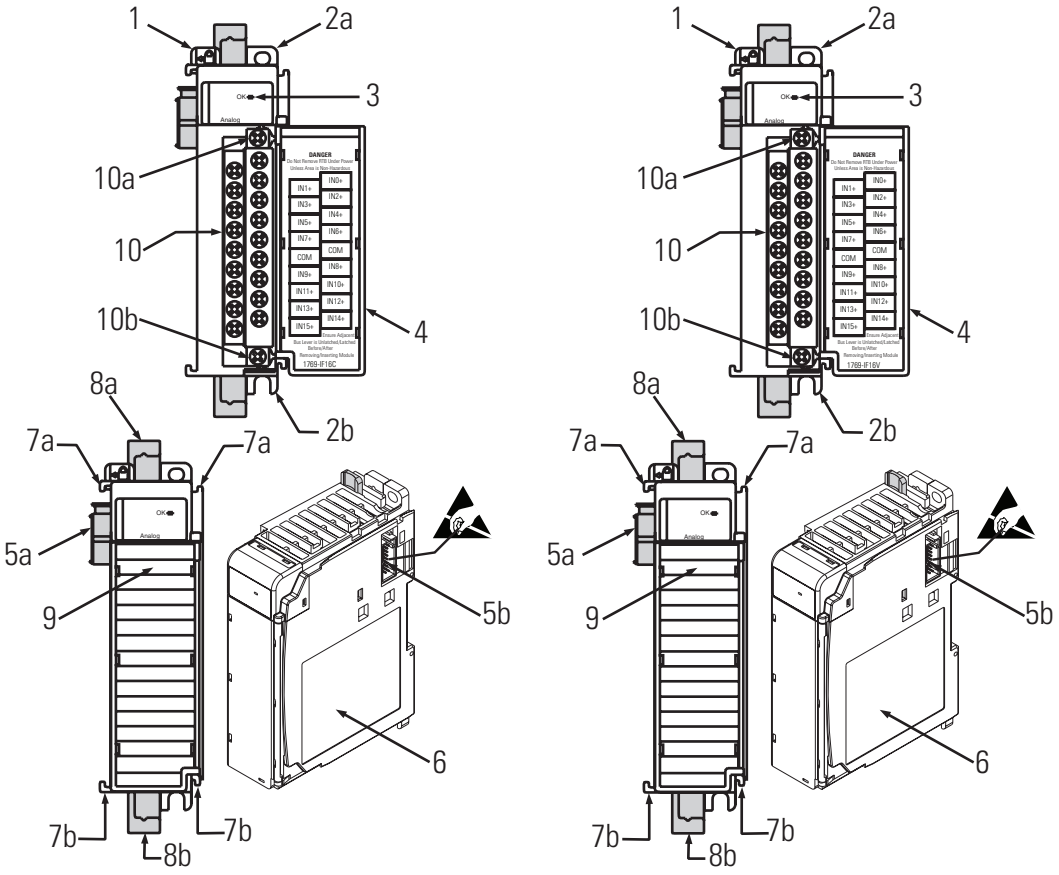
Cat. No.	Normal Operating Input Range	Full Module Range
1769-IF16V	±10V DC	± 10.5V DC
	1…5V DC	0.5…5.25V DC
	0…5V DC	-0.5…+5.25V DC
	0…10V DC	-0.5…+10.5V DC
1769-IF16C	0…20 mA	0…21 mA
	4…20 mA	3.2…21 mA

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



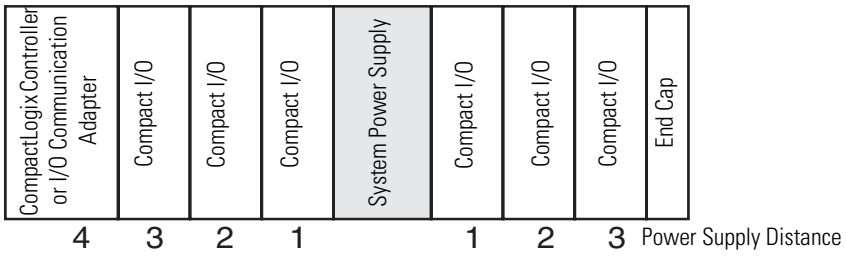
Item	Description
1	Bus lever (with locking function)
2a	Upper-panel mounting tab
2b	Lower-panel mounting tab
3	Module status LEDs
4	Module door with terminal identification label
5a	Movable bus connector with female pins
5b	Stationary bus connector with male pins
6	Nameplate label
7a	Upper tongue-and-groove slots
7b	Lower tongue-and-groove slots
8a	Upper DIN-rail latch
8b	Lower DIN-rail latch
9	Write-on label for user identification tags
10	Removable terminal block (RTB) with finger-safe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw

System Overview

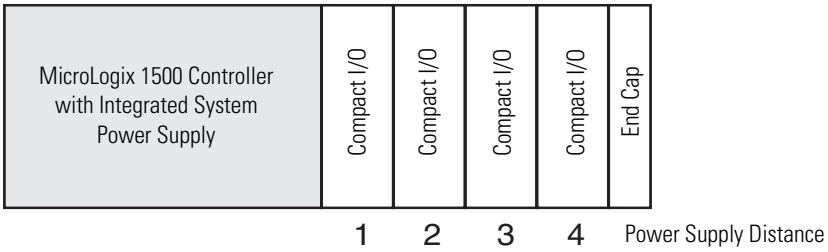
The modules communicate to the controller through the bus interface. The modules also receive 5 and 24V DC power through the bus interface.

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 modules perform a check of their 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 modules wait for valid channel configuration data. If an invalid configuration is detected, the modules generate a configuration error. Once a channel is properly configured and enabled, it begins the analog-to-digital conversion process.

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

The channel status words are described in the Input Data File on page 31.

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

No field calibration is required.

Installation and Wiring

Introduction

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 non-hazardous 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 non-hazardous.
- Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.
- This product must be installed in an enclosure.
- All wiring must comply with N.E.C. article 501-4(b).

Prevent Electrostatic Discharge

ATTENTION

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

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

Remove Power

ATTENTION

Remove power before removing or inserting this module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion.
- causing an explosion in a hazardous environment.

  Electrical arcing causes excessive wear to contacts on both the module and its mating connector and may lead to premature failure.

Reduce Noise

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

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

- away from sources of electrical noise such as hard-contact switches, relays, and ac motor drives.
- away from modules which generate significant radiated heat, such as the 1769-IA16 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.

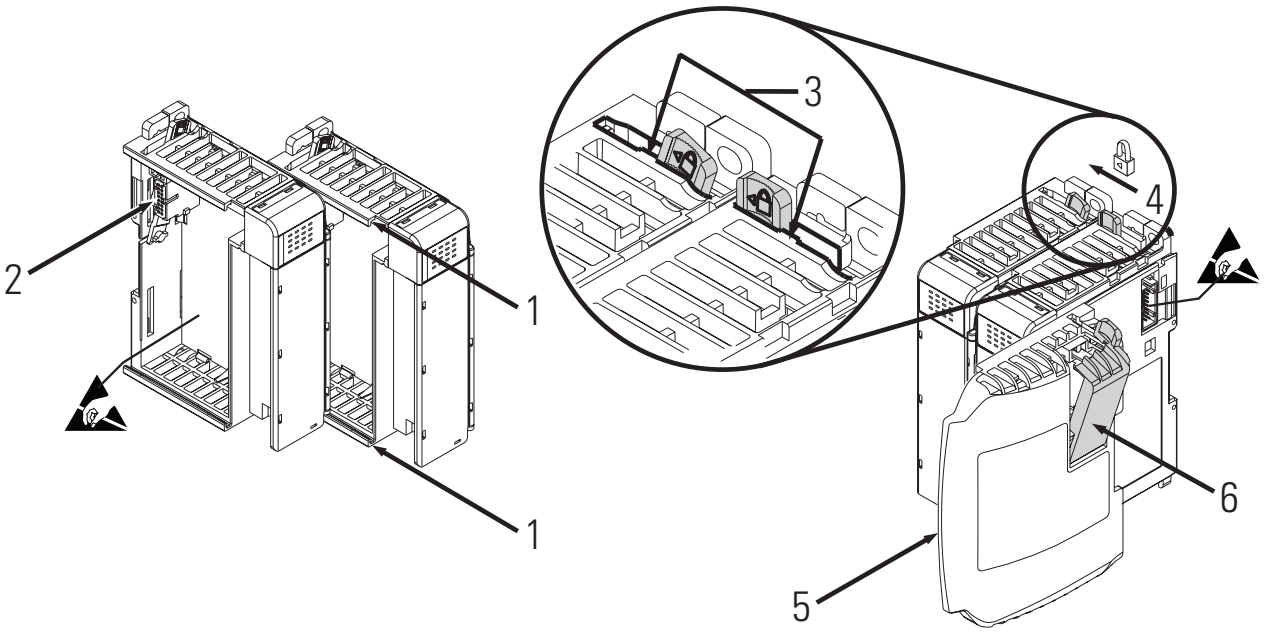
Protecting the Circuit Board from Contamination

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

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 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

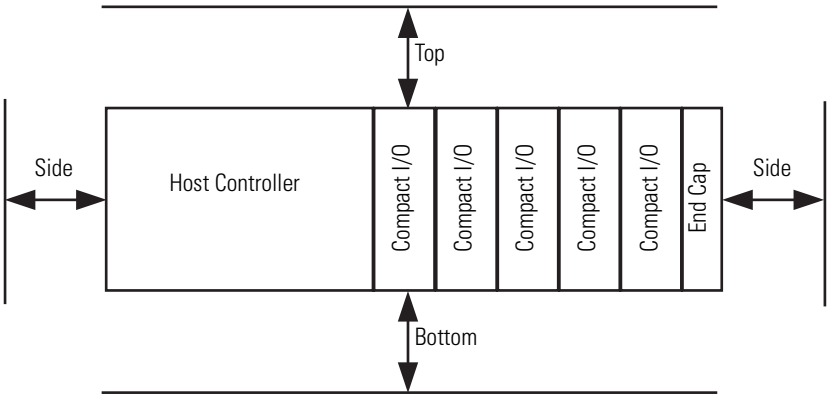
ATTENTION

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

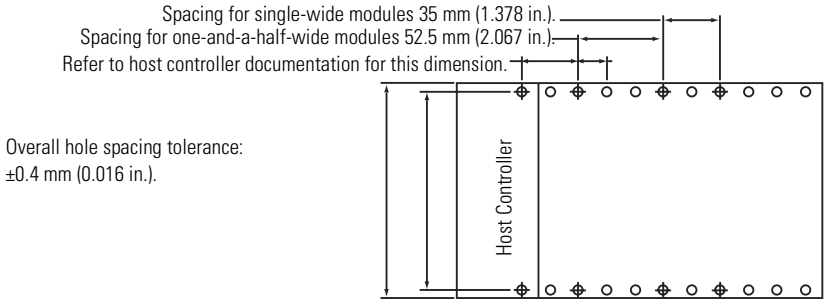


Mount to a Panel

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

Panel Mounting 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 Using the Modules as a Template

This procedure lets you to use the assembled modules as a template for drilling holes in the panel. If you have sophisticated panel-mounting equipment, you can use the dimensional template provided. Due to module mounting hole tolerance, it is important to follow these procedures.

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

6. Attach the modules to the panel using the mounting screws.

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

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

Mount to a DIN Rail

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

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

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 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, Allen-Bradley publication 1770-4.1, for additional information.

System Wiring Guidelines

Consider the following when wiring your system:

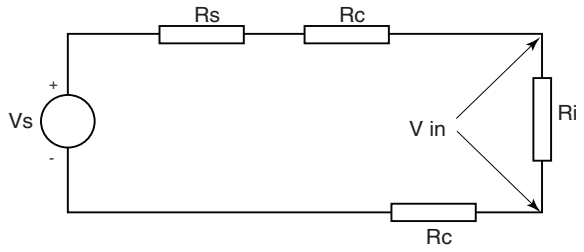
- All module commons (COM) are connected in the analog module.
- The analog common (COM) is not connected to earth ground inside the module.
- Channels are not isolated from each other.
- To ensure optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.
- Use Belden 8761, or equivalent, shielded wire.
- 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 modules do not provide loop power for analog inputs. Use a Class 2 power supply that matches the input transmitter specifications.
- Voltages on IN+ terminals of the modules must be within ±10V DC of module common (COM).

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

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

(1) In environments where high-frequency noise may be present, it may be necessary to directly ground cable shields to earth at the module end and via a 0.1µF capacitor at the sensor end.

Voltage Input Accuracy



Where:

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

Rs = Source impedance of analog transducer/sensor input

Ri = Impedance of the voltage input (1 MΩ for 1769-IF16V module)

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

Vin = Measured potential at the module input

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

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

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

Rc = 16 Ω/1000 ft

Rs = 0 (ideal source)

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

Table 2.1 Effect of Cable Length on Input Accuracy

Length of Cable, m (ft)	DC Resistance of the Cable, Rc (Ω)	Accuracy Impact at the Input Module
50 (164)	2.625	0.000525%
100 (328)	5.25	0.00105%
200 (656)	10.50	0.0021%
300 (984)	15.75	0.00315%

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

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

TIP For the 1769-IF16C module, source and cable impedance do not impact system accuracy.

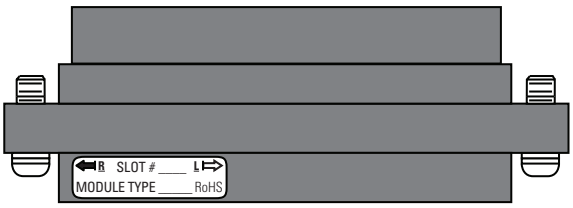
Label the Terminals

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

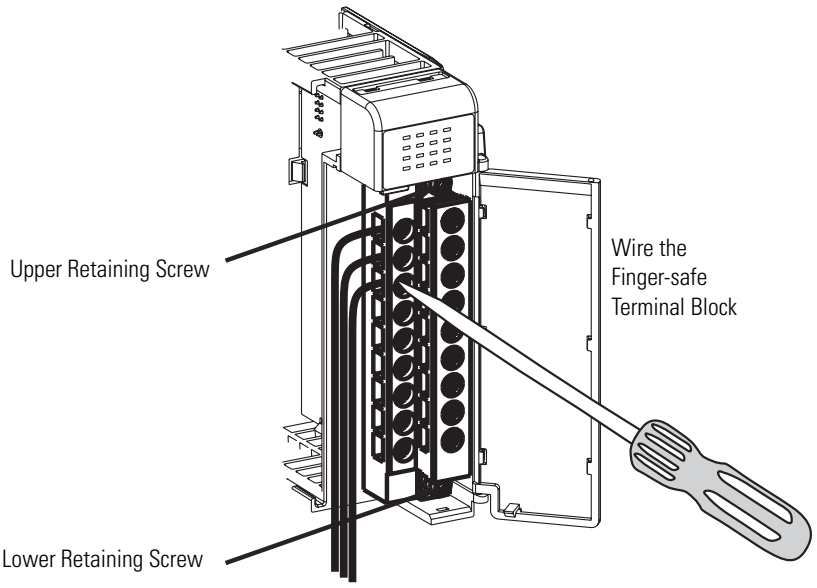
When wiring field devices to the module, it is not necessary to remove the terminal block. If you remove the terminal block, use the write-on label on the side of the terminal block to identify the module slot location and type. RTB position (for one-and-a-half size modules) can be indicated by circling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

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 in•lb).

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 in•lb)	0.46 N•m (4.1 in•lb)
Stranded	Cu-90 °C (194 °F)	0.325…1.310 mm^2 (22…16 AWG)	0.68 N•m (6 in•lb)	0.46 N•m (4.1 in•lb)

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.

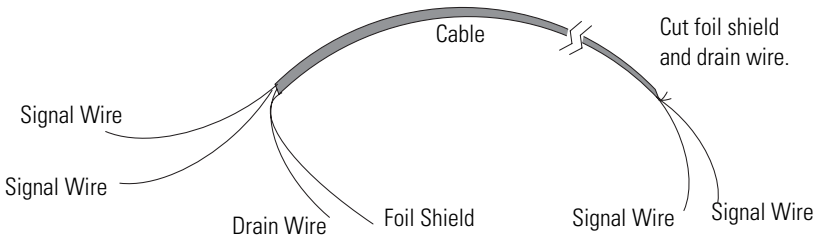
After the analog module is properly installed, follow the wiring procedure below. To ensure proper operation and high immunity to electrical noise, always use Belden 8761 (shielded, twisted-pair) or equivalent wire.

ATTENTION

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

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

Belden 8761 Wire



To wire your module, follow these steps.

1. At each end of the cable, strip some casing to expose the individual wires.
2. Trim the signal wires to 2-inch lengths. Strip about 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.

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

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

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

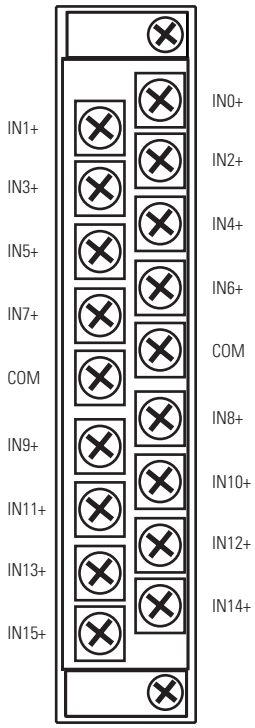
4. At the other end of the cable, cut the drain wire and foil shield back to the cable, unless the sensor end of the cable requires the shields to be connected to earth ground via the capacitor described in step 3.

5. Connect the signal wires to the terminal block.

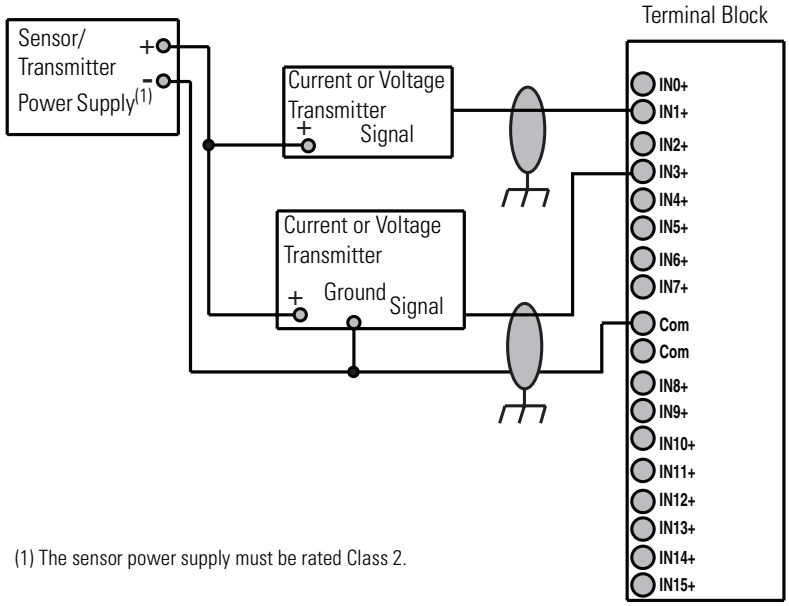
6. Connect the other end of the cable to the analog input or output device.

7. Repeat steps 1…5 for each channel on the module.

Terminal Layout



Wiring Single-ended Sensor/Transmitter Types



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

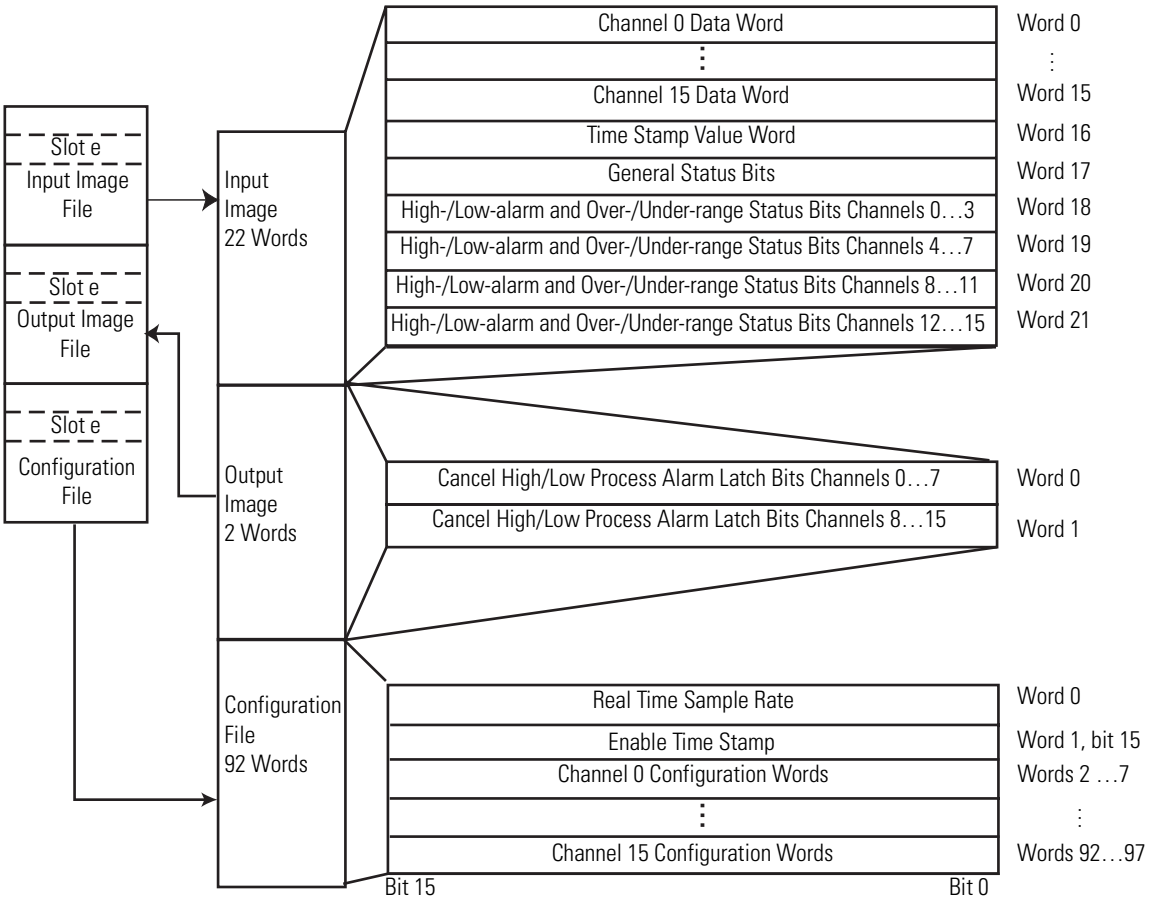
Module Data, Status, and Channel Configuration

Introduction

Module Addressing

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

Memory Map



Input Image

The input image file represents data words and status bits. Input words 0…15 hold the input data that represents the value of the analog inputs for channels 0…15. These data words are valid only when the channel is enabled and there are no errors. If time stamping is enabled, Word 16 in the input data file contains the time stamp value that corresponds to the module's last input data sampling period. Input words 17…21 hold the general status bits for each channel as well as the high and low alarm and over-range and under-range bits. To receive valid status information, the channel must be enabled.

Output Image

The output image file 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.

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 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…15 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 0.

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	SGN	Analog Read (Input) Data Value Channel 4														
Word 5	SGN	Analog Read (Input) Data Value Channel 5														
Word 6	SGN	Analog Read (Input) Data Value Channel 6														
Word 7	SGN	Analog Read (Input) Data Value Channel 7														
Word 8	SGN	Analog Read (Input) Data Value Channel 8														
Word 9	SGN	Analog Read (Input) Data Value Channel 9														
Word 10	SGN	Analog Read (Input) Data Value Channel 10														
Word 11	SGN	Analog Read (Input) Data Value Channel 11														
Word 12	SGN	Analog Read (Input) Data Value Channel 12														
Word 13	SGN	Analog Read (Input) Data Value Channel 13														
Word 14	SGN	Analog Read (Input) Data Value Channel 14														
Word 15	SGN	Analog Read (Input) Data Value Channel 15														
Word 16	Nu	Time Stamp Value														
Word 17	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
Word 18	L3	H3	U3	O3	L2	H2	U2	O2	L1	H1	U1	O1	L0	H0	U0	O0
Word 19	L7	H7	U7	O7	L6	H6	U6	O6	L5	H5	U5	O5	L4	H4	U4	O4
Word 20	L11	H11	U11	O11	L10	H10	U10	O10	L9	H9	U9	O9	L8	H8	U8	O8
Word 21	L15	H15	U15	O15	L14	H14	U14	O14	L13	H13	U13	O13	L12	H12	U12	O12

Time Stamp Value (Word 16)

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

General Status Bits (S0…S15)

Word 17, bits 0…15 contain the general operational status bits for input channels 0…15. 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…15 are logically ORed to the appropriate general status bit.

Low Alarm Flag Bits (L0 …L15)

Words 18…21, bits 3, 7, 11, and 15 contain the low alarm flag bits for input channels 0…15. 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 (H0…H15)

Words 18…21, bits 2, 6, 10, and 14 contain the high alarm flag bits for input channels 0…15. 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 (O0…O15)

Over-range bits for channels 0…15 are contained in Words 18…21, bits 0, 4, 8, and 12. When set (1), this bit indicates an input signal is beyond the normal operating range. For the 1769-IF16V module, it may also indicate an open circuit condition. However, the module continues to convert analog data to the maximum full range value. The bit is automatically reset (0) by the module when the over-range condition is cleared and the data value is within the normal operating range.

Under-Range Flag Bits (U0…U15)

Under-range bits for channels 0…15 are contained in Words 18…21, bits 1, 5, 9, and 13. When set (1), this bit indicates an input signal is below the normal operating range. For the 1769-IF16C module, it may also indicate an open circuit condition. 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.

Output Data File

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

Word/ Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 0	CLL7	CLH7	CLL6	CLH6	CLL5	CLH5	CLL4	CLH4	CLL3	CLH3	CLL2	CLH2	CLL1	CLH1	CLL0	CLH0
Word 1	CLL15	CLH15	CLL14	CLH14	CLL13	CLH13	CLL12	CLH12	CLL11	CLH11	CLL10	CLH10	CLL9	CLH9	CLL8	CLH8

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.

Configuration Data File

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

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															

Word/Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 26	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch4			
Word 27	Reserved					Input Data Format Ch4			Reserved				Input Type/Range Select Ch4			
Word 28	SGN	Process Alarm High Data Value Channel 4														
Word 29	SGN	Process Alarm Low Data Value Channel 4														
Word 30	SGN	Alarm Dead Band Value Channel 4														
Word 31	Reserved															
Word 32	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch5			
Word 33	Reserved					Input Data Format Ch5			Reserved				Input Type/Range Select Ch5			
Word 34	SGN	Process Alarm High Data Value Channel 5														
Word 35	SGN	Process Alarm Low Data Value Channel 5														
Word 36	SGN	Alarm Dead Band Value Channel 5														
Word 37	Reserved															
Word 38	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch6			
Word 39	Reserved					Input Data Format Ch6			Reserved				Input Type/Range Select Ch6			
Word 40	SGN	Process Alarm High Data Value Channel 6														
Word 41	SGN	Process Alarm Low Data Value Channel 6														
Word 42	SGN	Alarm Dead Band Value Channel 6														
Word 43	Reserved															
Word 44	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch7			
Word 45	Reserved					Input Data Format Ch7			Reserved				Input Type/Range Select Ch7			
Word 46	SGN	Process Alarm High Data Value Channel 7														
Word 47	SGN	Process Alarm Low Data Value Channel 7														
Word 48	SGN	Alarm Dead Band Value Channel 7														
Word 49	Reserved															
Word 50	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch8			
Word 51	Reserved					Input Data Format Ch8			Reserved				Input Type/Range Select Ch8			
Word 52	SGN	Process Alarm High Data Value Channel 8														
Word 53	SGN	Process Alarm Low Data Value Channel 8														
Word 54	SGN	Alarm Dead Band Value Channel 8														
Word 55	Reserved															

Word/Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 56	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch9			
Word 57	Reserved					Input Data Format Ch9			Reserved				Input Type/Range Select Ch9			
Word 58	SGN	Process Alarm High Data Value Channel 9														
Word 59	SGN	Process Alarm Low Data Value Channel 9														
Word 60	SGN	Alarm Dead Band Value Channel 9														
Word 61	Reserved															
Word 62	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch10			
Word 63	Reserved					Input Data Format Ch10			Reserved				Input Type/Range Select Ch10			
Word 64	SGN	Process Alarm High Data Value Channel 10														
Word 65	SGN	Process Alarm Low Data Value Channel 10														
Word 66	SGN	Alarm Dead Band Value Channel 10														
Word 67	Reserved															
Word 68	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch11			
Word 69	Reserved					Input Data Format Ch11			Reserved				Input Type/Range Select Ch11			
Word 70	SGN	Process Alarm High Data Value Channel 11														
Word 71	SGN	Process Alarm Low Data Value Channel 11														
Word 72	SGN	Alarm Dead Band Value Channel 11														
Word 73	Reserved															
Word 74	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch12			
Word 75	Reserved					Input Data Format Ch12			Reserved				Input Type/Range Select Ch12			
Word 76	SGN	Process Alarm High Data Value Channel 12														
Word 77	SGN	Process Alarm Low Data Value Channel 12														
Word 78	SGN	Alarm Dead Band Value Channel 12														
Word 79	Reserved															
Word 80	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch13			
Word 81	Reserved					Input Data Format Ch13			Reserved				Input Type/Range Select Ch13			
Word 82	SGN	Process Alarm High Data Value Channel 13														
Word 83	SGN	Process Alarm Low Data Value Channel 13														
Word 84	SGN	Alarm Dead Band Value Channel 13														
Word 85	Reserved															

Word/Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word 86	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch14			
Word 87	Reserved					Input Data Format Ch14			Reserved				Input Type/Range Select Ch14			
Word 88	SGN	Process Alarm High Data Value Channel 14														
Word 89	SGN	Process Alarm Low Data Value Channel 14														
Word 90	SGN	Alarm Dead Band Value Channel 14														
Word 91	Reserved															
Word 92	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Ch15			
Word 93	Reserved					Input Data Format Ch15			Reserved				Input Type/Range Select Ch15			
Word 94	SGN	Process Alarm High Data Value Channel 15														
Word 95	SGN	Process Alarm Low Data Value Channel 15														
Word 96	SGN	Alarm Dead Band Value Channel 15														
Word 97	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 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 Channel Configuration on page 38.

Channel Configuration

Each 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 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 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	60 Hz													0	0	0	0
	50 Hz													0	0	0	1
	16 Hz													0	0	1	0
	315 Hz													0	0	1	1
	1365 Hz													0	1	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.

1769-IF16C Module: 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 Range Select	4…20 mA													0	0	0	0
	0…20 mA													0	0	0	1
Input Data Format Select	Proportional Counts						0	0	0								
	Engineering Units						0	0	1								
	Scaled for PID						0	1	0								
	Percent Range						0	1	1								

1769-IF16V Module: 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 Range Select	-10…+10V													0	0	0	0
	0…5V													0	0	0	1
	0…10V													0	0	1	0
	1…5V													0	0	1	1
Input Data Format Select	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 (0), no voltage or current reading is provided to the controller by the A/D converter.

Input Filter Selection

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

Noise Rejection

The modules use a digital filter that provides noise rejection for the input signals. The filter is programmable, allowing you to select from five filter frequencies for each channel. A lower frequency (60 Hz versus 315 Hz) can provide better noise rejection but it increases channel update 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 60 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 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
16 Hz	1550 ms
50 Hz	500 ms
60 Hz	420 ms
315 Hz	90 ms
1365 Hz	35 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. 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.

The 1769-IF16C and 1769-IF16V modules use parallel sampling to update the entire module (all 16 channels, if enabled) in an amount of time equal to only 8 channel update times. The module performs parallel channel sampling on pairs of inputs.

The input channels are paired as follows: [0,1], [2,3], [4,5], [6,7], [8,9], [10,11] [12,13], [14, 15]. The channels in the same pair are sampled at the same time. Channel update time is thus input pair update time. If channels in the same input pair have different filter settings, the input pair update time is determined by the channel with the lowest filter setting. A channel that is not enabled has a channel update time of 0 ms. If neither channel of an input pair is enabled, the input pair update time is 0 ms.

Module update time is calculated by adding up all of the input pair update times. This table shows the input pair update times when the lowest filter setting for the input pair is as shown. The table also shows the module update time assuming all input pairs have at least one channel enabled and the lowest filter setting is the same for each input pair.

Filter Setting and Update Times

Filter Setting	Update Time per Input Pair	Update Time per Module(1) (2)
16 Hz	200 ms	1600 ms
50 Hz	70 ms	560 ms
60 Hz	60 ms	480 ms
315 Hz	15 ms	120 ms
1365 Hz	5 ms	40 ms

(1) Eight input pairs having at least one channel enabled with the lowest filter setting as shown selected for all.
(2) If you use real-time sampling, the user-configured sample rate is used as the module update time.

Input Type/Range Selection

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

Input Data Selection Formats

This selection configures each 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 42.

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 ±10V DC user input is -32,767…32,767, which covers the full-scale range of -10.5…10.5V.

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 zero 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, 0V…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

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

Valid Input Data

Module	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
1769-IF16V	-10…10V DC	-10.5…10.5V	-32,767… 32,767	-10,500… 10,500	0…16383	-410… 16,793	-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		-819… 17,202		-500… 10,500
	1…5V DC	0.5…5.25V		500…5250		-2048… 17,407		-1250… 10,625
1769-IF16C	0…20 mA	0…21 mA	-32,767… 32,767	0…21,000	0…16383	0… 17,202	0…10,000	0… 10,500
	4…20 mA	3.2…21 mA		3200… 21,000		-819… +17,407		-500… 10,625

(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 pair that has at least one of its channels enabled. When the module has performed a conversion on each of the input pairs, 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 0 for the Real Time Sample Rate, the modules initiate conversion cycles at the fastest rate possible, controlled by the filter setting selected for each enabled channel within the input pairs. Once all of the channels' input data has 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 calculated module update time, again based on the filter setting selected for each enabled channel within the input pairs. If the value entered for the Real Time Sample Rate is smaller than the calculated module update time, the module indicates a configuration error. The longest Real Time Sample Rate supported by the modules is 5 seconds, which corresponds to the maximum value for Word 0 of the Configuration Data file of 5000 decimal. See Module Update Time and Scanning Process on page 40 for details on calculating the module update time.

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 using Word 1, bit 15 of the Configuration Data file: Enable Time Stamping (ETS). Setting the ETS bit (1) enables the module's time stamping function. Clearing the ETS bit (0) disables the function. The default condition of the ETS bit is disabled (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 one count every millisecond.

When enabled, the Input Data file is updated with the latest time stamp value which corresponds to the end of each module conversion cycle. Sequentially, each input pair, where at least one of the channels is enabled, is converted once per conversion cycle. In normal sampling mode, 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 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 (1) the EA bit for that channel. Set the AL bit (1) for a channel to enable the alarm latching. Set the EI bit (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 a process alarm data value is entered that is outside the full-scale data range set for a channel, the module indicates a configuration error.

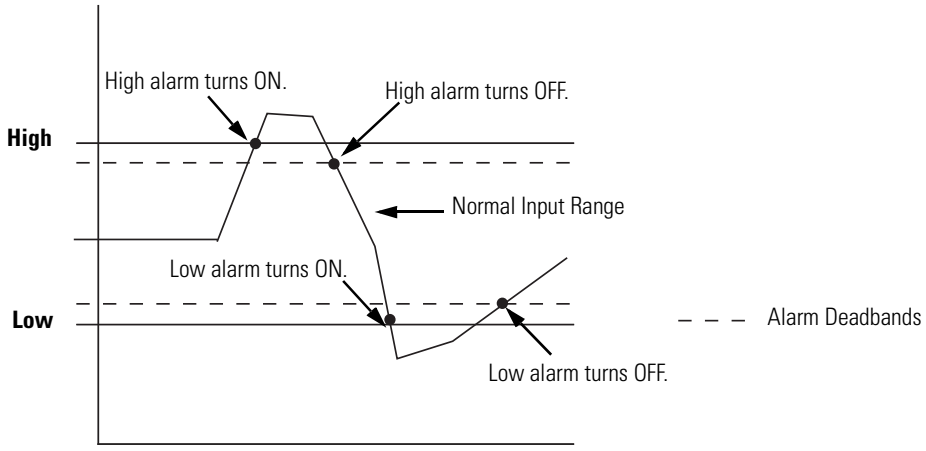
(1) Module interrupts are not supported by all bus masters. Refer to your controller's user manual to determine whether it can support module interrupts.

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.

Alarm Deadbands



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.

Module Diagnostics and Troubleshooting

Introduction

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.

Status Indicators

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 UVPROM memory module.

Safety Circuits

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

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.

Diagnostics

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 an input channel is enabled, the modules perform a diagnostic check to see that the channel has been properly configured. In addition, the modules check each channel during every conversion cycle for over-range and under-range, high and low process alarm conditions, and open-circuit 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.

Open-circuit Detection

The 1769-IF16V module provides open-circuit detection on all enabled channels. Whenever an open-circuit condition occurs, the over-range error bit for that channel is set and the channel's input data reading will be at the maximum, full-range value in the Input Data file.

The 1769-IF16C module also provides open-circuit detection on all enabled channels. Whenever an open-circuit condition occurs, the under-range error bit for that channel is set and the channel's input data reading will be at the minimum, full-range value in the Input Data file.

Possible causes of an open circuit include:

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

Non-critical vs. 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 51.

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.

Module Error Table

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

Module Error Field

The purpose of the module error field is to classify module errors into three distinct groups, as described in the table below. The type of error determines what kind of information exists in the extended error information field. Refer to your controller manual for details.

Module Error Types

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 modules generate 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 modules, which continue to operate with their 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)

Extended Error Codes for Configuration Errors

Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
	Binary	Binary	
X404	010	0 0000 0100	Invalid input range selected (channel 3)
X405	010	0 0000 0101	Invalid input range selected (channel 4)
X406	010	0 0000 0110	Invalid input range selected (channel 5)
X407	010	0 0000 0111	Invalid input range selected (channel 6)
X408	010	0 0000 1000	Invalid input range selected (channel 7)
X409	010	0 0000 1001	Invalid input range selected (channel 8)
X40A	010	0 0000 1010	Invalid input range selected (channel 9)
X40B	010	0 0000 1011	Invalid input range selected (channel 10)
X40C	010	0 0000 1100	Invalid input range selected (channel 11)
X40D	010	0 0000 1101	Invalid input range selected (channel 12)
X40E	010	0 0000 1110	Invalid input range selected (channel 13)
X40F	010	0 0000 1111	Invalid input range selected (channel 14)
X410	010	0 0001 0000	Invalid input range selected (channel 15)
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 input filter selected (channel 4)
X416	010	0 0001 0110	Invalid input filter selected (channel 5)
X417	010	0 0001 0111	Invalid input filter selected (channel 6)
X418	010	0 0001 1000	Invalid input filter selected (channel 7)
X419	010	0 0001 1001	Invalid input filter selected (channel 8)
X41A	010	0 0001 1010	Invalid input filter selected (channel 9)
X41B	010	0 0001 1011	Invalid input filter selected (channel 10)
X41C	010	0 0001 1100	Invalid input filter selected (channel 11)
X41D	010	0 0001 1101	Invalid input filter selected (channel 12)
X41E	010	0 0001 1110	Invalid input filter selected (channel 13)
X41F	010	0 0001 1111	Invalid input filter selected (channel 14)
X420	010	0 0010 0000	Invalid input filter selected (channel 15)
X421	010	0 0010 0001	Invalid input format selected (channel 0)
X422	010	0 0010 0010	Invalid input format selected (channel 1)
X423	010	0 0010 0011	Invalid input format selected (channel 2)
X424	010	0 0010 0100	Invalid input format selected (channel 3)
X425	010	0 0010 0101	Invalid input format selected (channel 4)

Extended Error Codes for Configuration Errors

Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
	Binary	Binary	
X404	010	0 0000 0100	Invalid input range selected (channel 3)
X405	010	0 0000 0101	Invalid input range selected (channel 4)
X406	010	0 0000 0110	Invalid input range selected (channel 5)
X407	010	0 0000 0111	Invalid input range selected (channel 6)
X408	010	0 0000 1000	Invalid input range selected (channel 7)
X409	010	0 0000 1001	Invalid input range selected (channel 8)
X40A	010	0 0000 1010	Invalid input range selected (channel 9)
X40B	010	0 0000 1011	Invalid input range selected (channel 10)
X40C	010	0 0000 1100	Invalid input range selected (channel 11)
X40D	010	0 0000 1101	Invalid input range selected (channel 12)
X40E	010	0 0000 1110	Invalid input range selected (channel 13)
X40F	010	0 0000 1111	Invalid input range selected (channel 14)
X410	010	0 0001 0000	Invalid input range selected (channel 15)
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 input filter selected (channel 4)
X416	010	0 0001 0110	Invalid input filter selected (channel 5)
X417	010	0 0001 0111	Invalid input filter selected (channel 6)
X418	010	0 0001 1000	Invalid input filter selected (channel 7)
X419	010	0 0001 1001	Invalid input filter selected (channel 8)
X41A	010	0 0001 1010	Invalid input filter selected (channel 9)
X41B	010	0 0001 1011	Invalid input filter selected (channel 10)
X41C	010	0 0001 1100	Invalid input filter selected (channel 11)
X41D	010	0 0001 1101	Invalid input filter selected (channel 12)
X41E	010	0 0001 1110	Invalid input filter selected (channel 13)
X41F	010	0 0001 1111	Invalid input filter selected (channel 14)
X420	010	0 0010 0000	Invalid input filter selected (channel 15)
X421	010	0 0010 0001	Invalid input format selected (channel 0)
X422	010	0 0010 0010	Invalid input format selected (channel 1)
X423	010	0 0010 0011	Invalid input format selected (channel 2)
X424	010	0 0010 0100	Invalid input format selected (channel 3)
X425	010	0 0010 0101	Invalid input format selected (channel 4)

Extended Error Codes for Configuration Errors

Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
	Binary	Binary	
X426	010	0 0010 0110	Invalid input format selected (channel 5)
X427	010	0 0010 0111	Invalid input format selected (channel 6)
X428	010	0 0010 1000	Invalid input format selected (channel 7)
X429	010	0 0010 1001	Invalid input format selected (channel 8)
X42A	010	0 0010 1010	Invalid input format selected (channel 9)
X42B	010	0 0010 1011	Invalid input format selected (channel 10)
X42C	010	0 0010 1100	Invalid input format selected (channel 11)
X42D	010	0 0010 1101	Invalid input format selected (channel 12)
X42E	010	0 0010 1110	Invalid input format selected (channel 13)
X42F	010	0 0010 1111	Invalid input format selected (channel 14)
X430	010	0 0011 0000	Invalid input format selected (channel 15)
X431	010	0 0011 0001	Alarm not enabled (channel 0)
X432	010	0 0011 0010	Alarm not enabled (channel 1)
X433	010	0 0011 0011	Alarm not enabled (channel 2)
X434	010	0 0011 0100	Alarm not enabled (channel 3)
X435	010	0 0011 0101	Alarm not enabled (channel 4)
X436	010	0 0011 0110	Alarm not enabled (channel 5)
X437	010	0 0011 0111	Alarm not enabled (channel 6)
X438	010	0 0011 1000	Alarm not enabled (channel 7)
X439	010	0 0011 1001	Alarm not enabled (channel 8)
X43A	010	0 0011 1010	Alarm not enabled (channel 9)
X43B	010	0 0011 1011	Alarm not enabled (channel 10)
X43C	010	0 0011 1100	Alarm not enabled (channel 11)
X43D	010	0 0011 1101	Alarm not enabled (channel 12)
X43E	010	0 0011 1110	Alarm not enabled (channel 13)
X43F	010	0 0011 1111	Alarm not enabled (channel 14)
X440	010	0 0100 0000	Alarm not enabled (channel 15)
X441	010	0 0100 0001	Invalid alarm data (channel 0)
X442	010	0 0100 0010	Invalid alarm data (channel 1)
X443	010	0 0100 0011	Invalid alarm data (channel 2)
X444	010	0 0100 0100	Invalid alarm data (channel 3)
X445	010	0 0100 0101	Invalid alarm data (channel 4)
X446	010	0 0100 0110	Invalid alarm data (channel 5)
X447	010	0 0100 0111	Invalid alarm data (channel 6)

Extended Error Codes for Configuration Errors

Hex Equivalent(1)	Module Error Code	Extended Error Information Code	Error Description
	Binary	Binary	
X448	010	0 0100 1000	Invalid alarm data (channel 7)
X449	010	0 0100 1001	Invalid alarm data (channel 8)
X44A	010	0 0100 1010	Invalid alarm data (channel 9)
X44B	010	0 0100 1011	Invalid alarm data (channel 10)
X44C	010	0 0100 1100	Invalid alarm data (channel 11)
X44D	010	0 0100 1101	Invalid alarm data (channel 12)
X44E	010	0 0100 1110	Invalid alarm data (channel 13)
X44F	010	0 0100 1111	Invalid alarm data (channel 14)
X450	010	0 0101 0000	Invalid alarm data (channel 15)
X451	010	0 0101 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.

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 1769-IF16C Module: Bit Definitions for Input Range and Input Data Configuration Words on page 38 or 1769-IF16V Module: Bit Definitions for Input Range and Input Data Configuration Words on page 39 for details on the assigned input range codes for each module.

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 Channel Configuration Words on page 38 for details on the assigned input filter codes for the modules.

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 1769-IF16C Module: Bit Definitions for Input Range and Input Data Configuration Words on page 38 or 1769-IF16V Module: Bit Definitions for Input Range and Input Data Configuration Words on page 39 for details on the assigned input format codes for each 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 Channel Configuration Words on page 38 for details on setting the process alarm control bits for the modules.

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 42 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 Real Time Sample Value

This error code occurs when the data entered for the Real Time Sample value is less than 0, is greater than 5000 (decimal) or, if non-zero, is less than the calculated module update time.

See Real Time Sampling on page 43 for details on how the calculated module update time can affect the minimum allowed real time sample value.

Module Inhibit Function

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

Whenever the input modules are inhibited, the modules continue to provide information about changes at its inputs to the 1769 Compact Bus Master (for example, a CompactLogix controller).

Contacting Rockwell Automation

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

- 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

General Specifications

Attribute	Value
Dimensions (HxWxD), approx.	118 mm x 87 mm x 35 mm (4.65 in. x 3.43 in. x 1.38 in.) Height including mounting tabs is 138 mm (5.43 in.)
Shipping weight, approx. (with carton)	281 g (0.62 lb)
Temperature, storage	-40 °C…85 °C (-40 °F…185 °F)
Temperature, operating	0 °C…60 °C (32 °F…140 °F)
Operating humidity	5% …95% non-condensing
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) Non-operating: 40 g panel-mounted (30 g DIN rail-mounted)
Bus current draw, max	190 mA @ 5V DC 70 mA @ 24V DC
Heat dissipation	1769-IF16C: 4 total Watts 1769-IF16V: 2.4 total Watts *(Watts per point plus the minimum Watts with all points energized.)*
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	1769-IF16C: 47 1769-IF16V: 46
Input words	22
Output words	2
Configuration words	98

Input Specifications

Attribute	1769-IF16C	1769-IF16V
Analog normal operating ranges(1)	0…20 mA, 4…20 mA	±10V DC, 0 …10V DC, 0…5V DC, 1…5V DC
Full scale analog ranges(1)	0…21 mA, 3.2…21 mA	±10.5V DC, -0.5…10.5V DC, -0.5…5.25V DC, 0.5…5.25V DC
Number of inputs	16 single-ended	
Converter type	Sigma Delta	
Response speed per channel	Input filter and configuration dependent.	
Resolution, max(2)	16 bits (unipolar) 15 bits plus sign (bipolar)	
Rated working voltage(3)	30V AC/30V DC	
Common mode voltage range(4)	±10V DC maximum per channel	
Common mode rejection	greater than 60 dB at 50 and 60 Hz with the 16 Hz filter selected, respectively.	
Input impedance	249 Ω	Greater than 1 MΩ(typical)
Overall accuracy(5)	0.5% full scale at 25 °C (77 °F) for 16 Hz, 50 Hz, and 60 Hz filters	0.35% full scale at 25 °C (77°F) for 16 Hz, 50 Hz, and 60 Hz filters
Accuracy drift with temperature	±0.0045% per °C	±0.003% per °C
Calibration	None required	None required
Non-linearity (in percent full scale)	±0.03%	±0.03%
Repeatability(6)	±0.03% for 16 Hz filter	±0.06% for 16 Hz filter
Module error over full temperature range (0…60 °C [32 °F…140 °F])	1.25% for 16 Hz filter	1.0% for 16 Hz, 50 Hz, and 60 Hz filters
Channel diagnostics	Over- or under-range by bit reporting, process alarms	
Maximum overload at input terminals(7)	±28 mA continuous, 7.0 V DC	±30V DC continuous, 0.03 mA
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.

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 MHz…1000 MHz.

Replacement Parts

The module has the following replacement parts:

- Terminal block, catalog number 1769-RTBN18 (1 per kit)
- Door, catalog number 1769-RD (2 per kit)

Module Addressing and Configuration with MicroLogix 1500 Controller

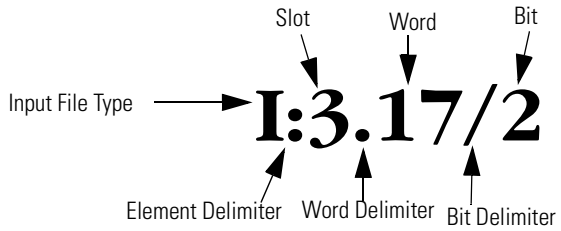
Introduction

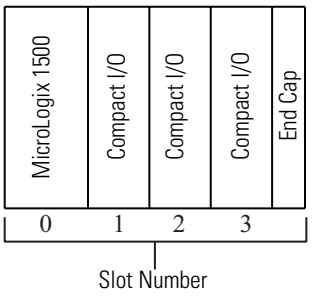
This appendix examines the modules' addressing scheme and describes module configuration using RSLogix 500 software and a MicroLogix 1500 controller.

Module Input Image

The modules' input image file represents data words and status bits. Input words 0…15 hold the input data that represents the value of the analog inputs for channels 0…15. These data words are valid only when the channel is enabled and there are no errors. Input words 17…21 hold the status bits. To receive valid status information, the channel must be enabled.

For example, to obtain the general status of channel 2 of the analog module located in slot 3, use address I:3.17/2.





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 channel. For improved analog input module performance, disable any **unused** channels.

Software Configuration Channel Defaults

Parameter	Default Setting
Enable/Disable Channel	Disabled
Filter Selection	60 Hz
Input Range	1769-IF16C: 4…20 mA 1769-IF16V: ±10V DC
Data Format	Raw/Proportional

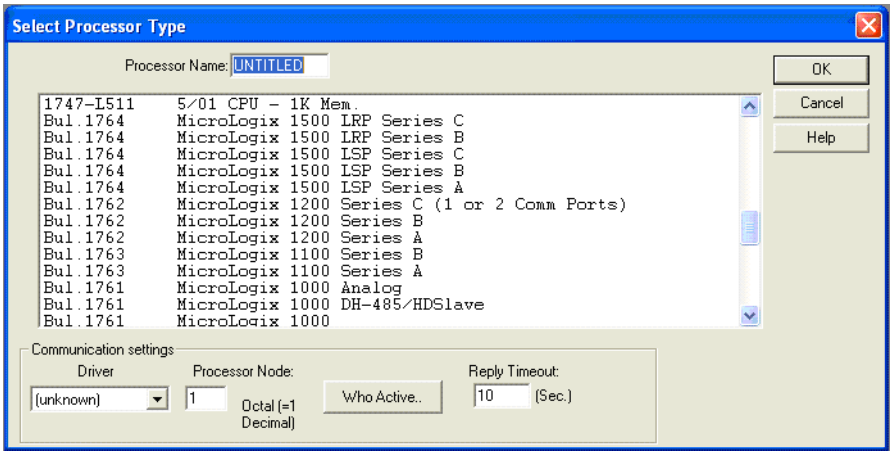
Configure Analog I/O Modules in a MicroLogix 1500 System

This example takes you through configuring your 1769 16-point analog input modules with RSLogix 500 programming software. This application example assumes your input modules are installed as expansion I/O in a MicroLogix 1500 system, and that RSLinx software is properly configured and a communication link has been established between the MicroLogix controller and RSLogix 500 software.

If you have a version of RSLogix 500 software that does not include the 1769-IF16C or 1769-IF16V modules, follow this procedure to configure your module.

1. Choose File>New to create a new project.

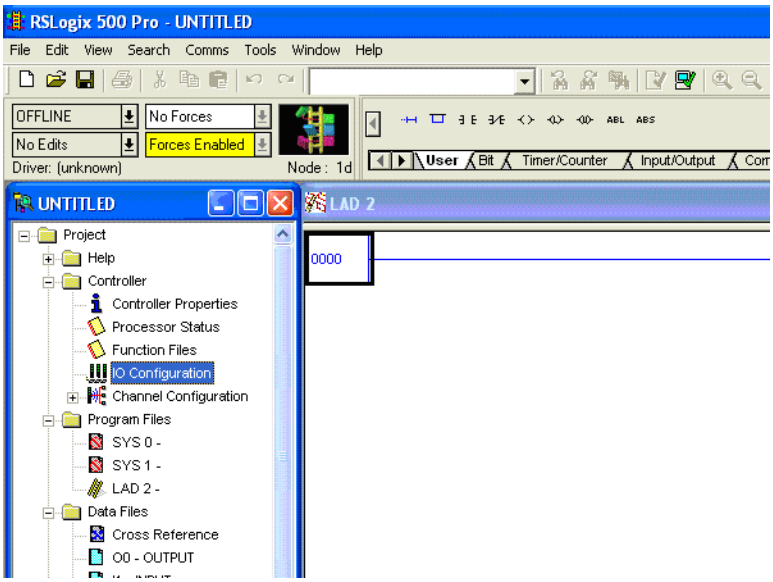
   The Select Processor Type dialog box opens.



2. Type a name for the project in the Processor Name field.

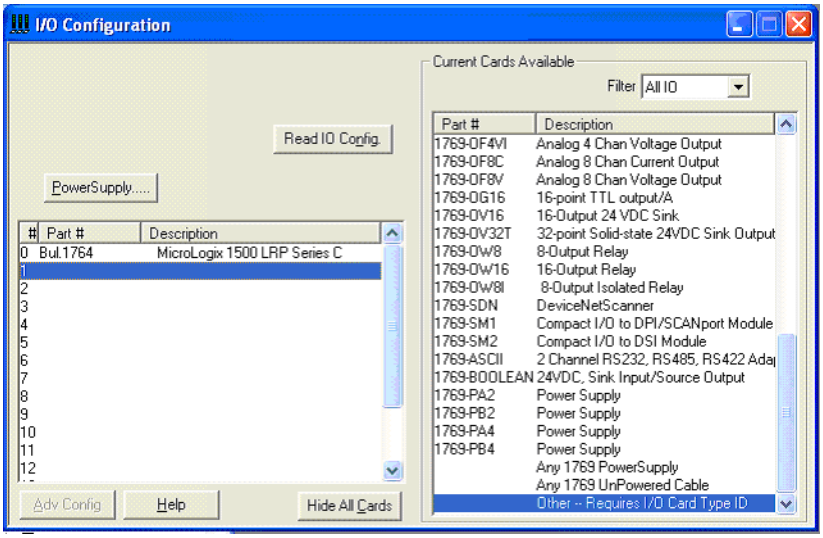
3. Select Your MicroLogix 1500 controller from the list and click OK.

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



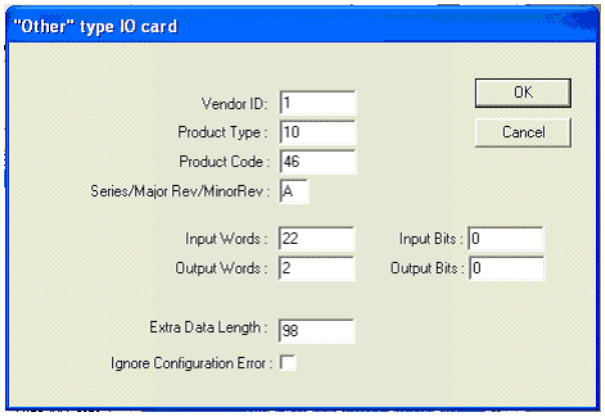
5. On the I/O Configuration dialog box, select the slot position where you want to add your module.

6. In the Current Cards Available list, double-click Other – Requires I/O Card Type to add a generic module to the project in the indicated slot position.

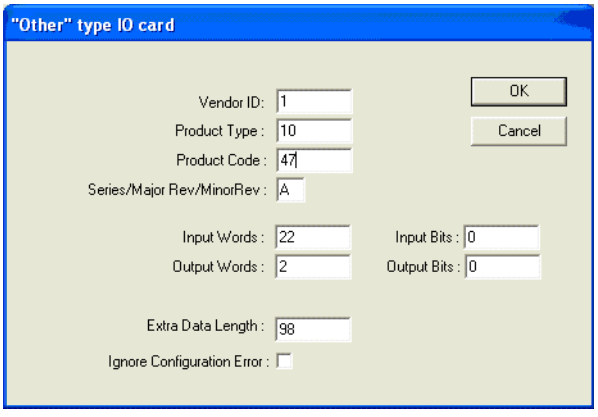


7. To add a module to the project, complete the fields on the Other Type I/O Card dialog box as shown.

For a 1769-IF16V module:

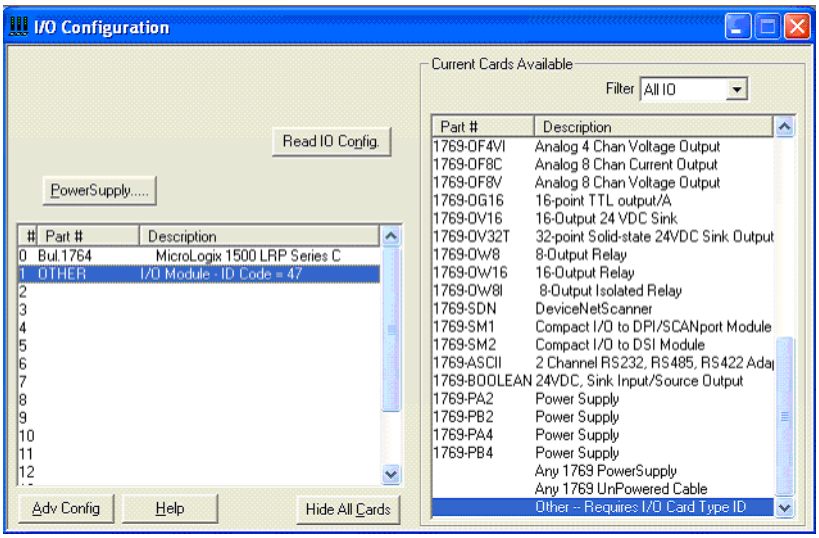


For a 1769-IF16C module:



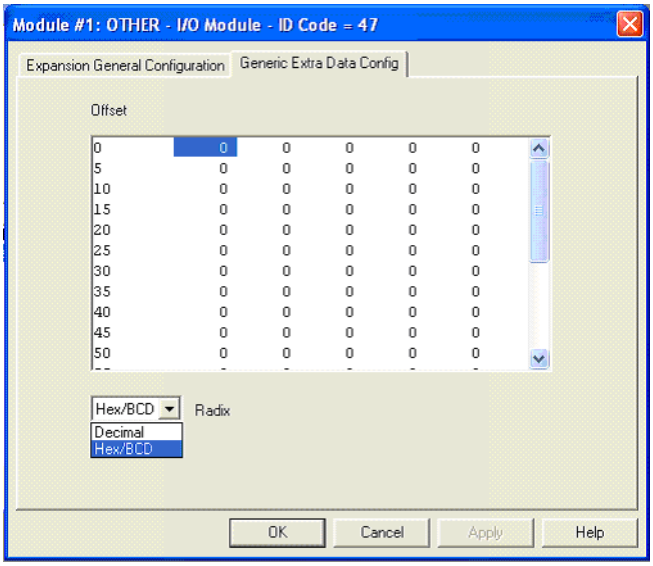
8. Click OK to add the generic module to the project.

9. Double-click the newly-added generic module.



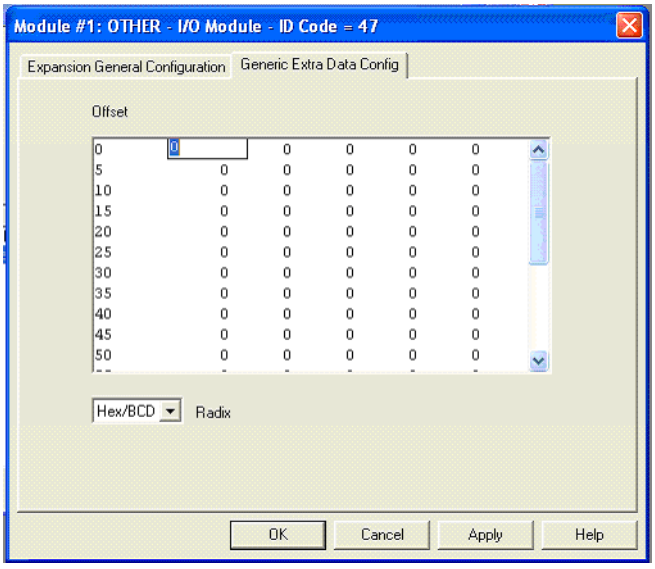
10. Click the Generic Extra Data Config tab to access the Configuration Data File.

11. Change the Radix to Hex/BCD to enter data in hexidecimal format in the Configuration Data file words.



The Configuration Data File words are shown in order from zero to one less than the total number of words in the Configuration Data File.

12. To enter data, double-click the configuration word, type the hexidecimal value, and click Apply.



13. When you are finished entering all the data, click Apply and then OK.

14. Download the project to the MicroLogix 1500 controller.

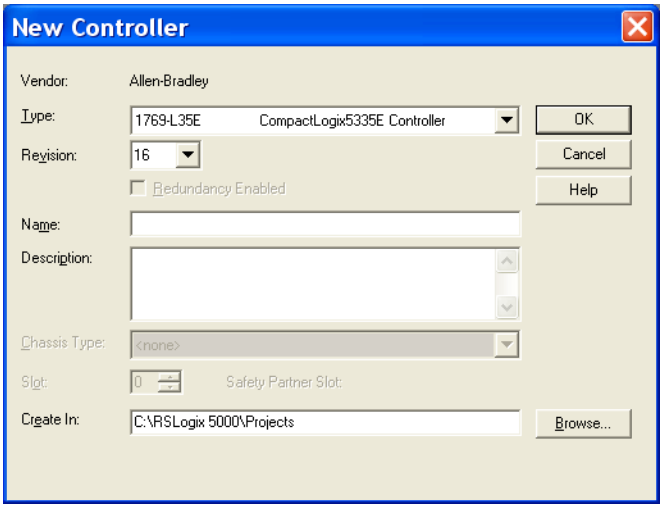
Configuration Using the RSLogix 5000 Generic Profile for CompactLogix Controllers

Introduction

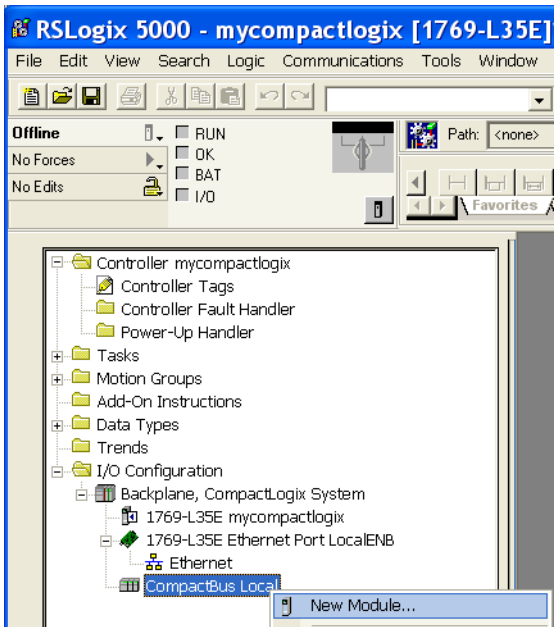
If the Add-on Profile for the 1769-IF16C or 1769-IF16V module is not yet available, follow this procedure to configure your module using a generic profile.

Add the Module to Your Project

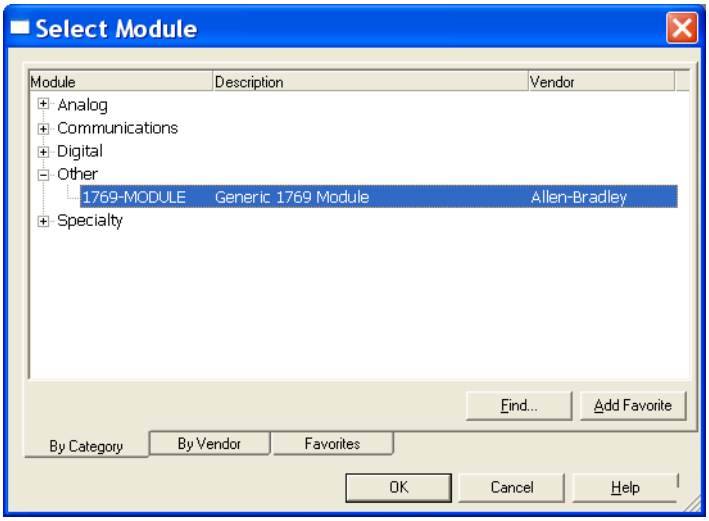
1. Open an existing project in RSLogix 5000 software or start a new project by choosing File>New.
2. If this is a new project select a CompactLogix controller, type a name for the controller, and click OK.



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

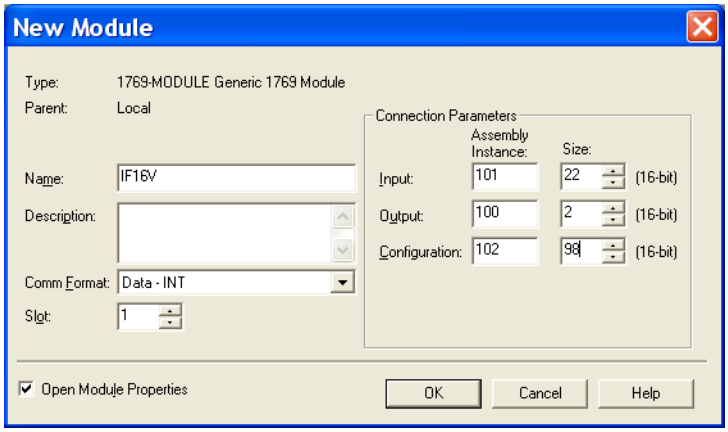


4. Expand the Other group and select the 1769-MODULE Generic Profile.



5. Click OK.

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



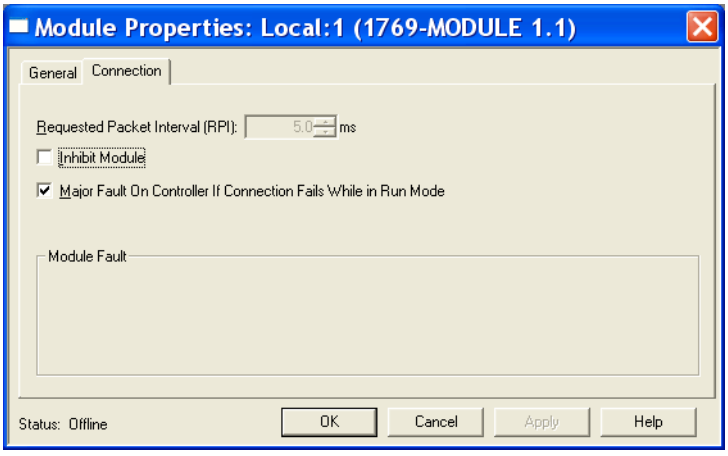
7. Select the slot number.

   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 for each analog I/O module type into the Generic Profile.

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

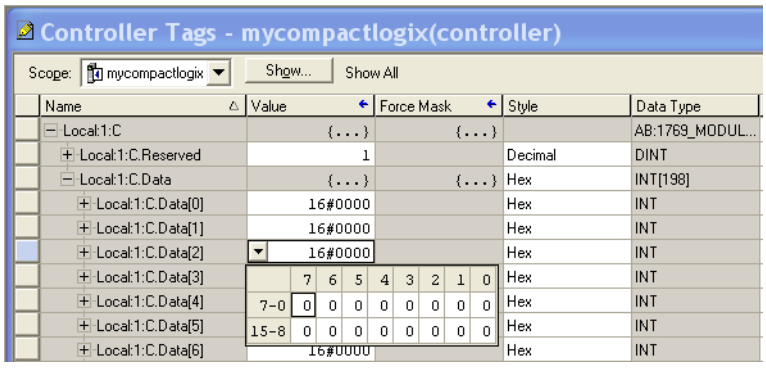
  where *s* is the slot number assigned the I/O modules in the Generic Profiles.

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.



Two's Complement Binary Numbers

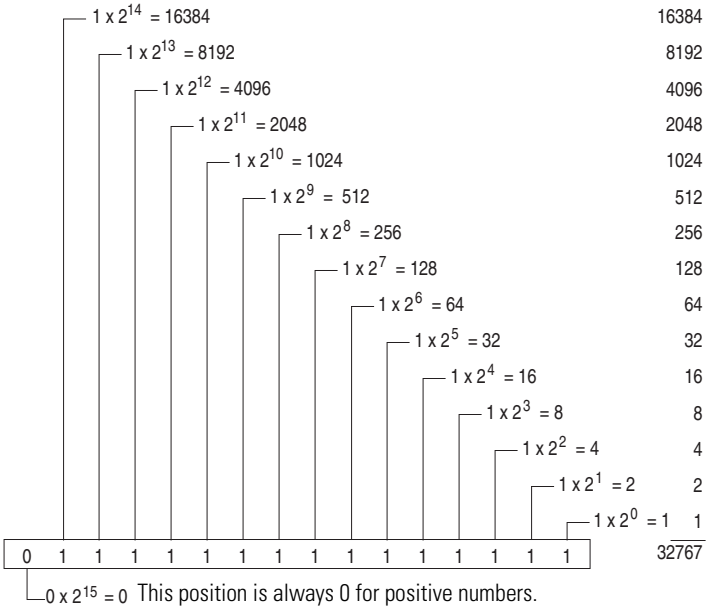
The controller memory stores 16-bit binary numbers. Two's complement binary is used when performing mathematical calculations internal to the controller. Analog input values from the analog modules are returned to the controller in 16-bit two's complement binary format. For positive numbers, the binary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



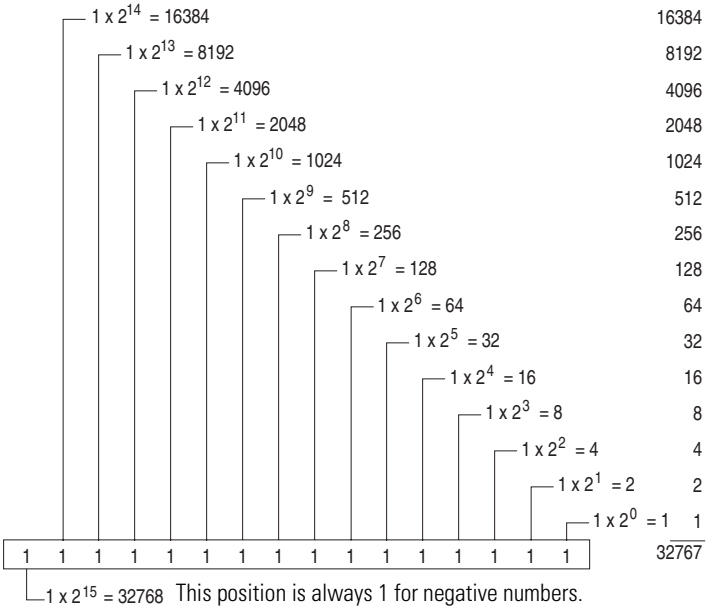
EXAMPLE 0000 1001 0000 1110 = $2^{11}+2^8+2^3+2^2+2^1$ = 2048+256+8+4+2 = 2318

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 far left position is always 1 for negative values. The equivalent decimal value of the binary number is obtained by subtracting the value of the far left position, 32,768, from the sum of the values of the other positions. In 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.

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. CMRR=20 Log_{10} (V1/V2)

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

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

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

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

data word – A 16-bit integer that represents the value of the analog input 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).

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

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

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

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

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

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

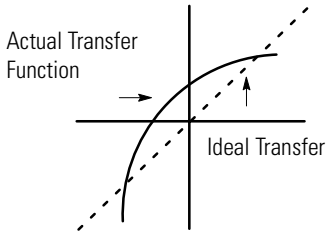
input image – The input from the module to the controller. The input image contains the module data words and status bits.

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 – 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.

multiplexer – A switching system that allows several signals to share a common A/D 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 ± 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).

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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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Installation Assistance

If you experience a problem within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your product up and running.

United States	1.440.646.3434 Monday – Friday, 8 a.m. – 5 p.m. EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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