Compact I/O Isolated Analog Modules

Catalog Number 1769-IF4I, 1769-OF4CI, 1769-OF4VI

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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

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

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

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

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.

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.

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

These labels may also be on or inside the equipment to provide specific precautions.

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.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

Table of Contents

Notes:

This manual describes how to install, configure, program, operate and troubleshoot the 1769 isolated analog I/O modules. Use this manual if you design, install, program, or troubleshoot control systems that use the Compact I/O™ system.

Summary of Changes

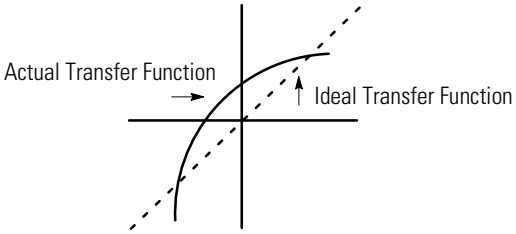
This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Moved the terms and abbreviations from the Glossary to the Preface	8
Updated the Additional Resources section	10
In the 1769-OF4VI Valid Output Data Table, updated these columns for the -10… +10V DC input value in the ±10V DC operating range: • Raw/Proportional Data • Scaled-for-PID	50
Removed the installation and wiring information See the installation instructions listed in the Additional Resources section and the Installation Considerations appendix.	61
Removed the Specification Appendix See the 1769 Compact I/O Modules Specifications, publication 1769-TD006	–

Terms and Abbreviations

The following terms and abbreviations are used throughout this manual.

Term	Meaning
A/D converter	Refers to the analog to digital converter inherent to the module. The converter produces a digital value whose magnitude is proportional to the magnitude of an analog input signal.
alternate last state	A configuration selection that instructs the module to convert a user-specified value from the channel fault or program/idle word to the output value when the module enters the fault or program mode.
analog input module	A module that contains circuits that convert analog voltage or current input signals to digital values that can be manipulated by the controller.
attenuation	The reduction in the magnitude of a signal as it passes through a system.
bus connector	A 16-pin plug and socket 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 that the controller reads, expressed in dB.
common mode rejection ratio (CMRR)	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 that a voltage common to its input terminals relative to ground causes. CMRR=20 $\text{Log}_{10\,(V1/V2)}$
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 that the module must configure and operate for each channel.
D/A Converter	Refers to the digital to analog converter inherent to the output module. The converter produces an analog DC voltage or current signal whose instantaneous magnitude is proportional to the magnitude of a digital value.
dB	(decibel) A logarithmic measure of the ratio of two signal levels.
data echo	The analog value currently being converted by the D/A converter and shown in words 2 and 3 of the output module's input data file. Under normal operating conditions, the data echo value is the same value that is being sent from the bus leader to the output module.
data word	A 16-bit integer that represents the value of the analog input or output channel. The channel data word is valid only when the channel is enabled and there are no channel errors. When the channel is disabled, the channel data word is cleared (0).
differential operation	The difference in voltage between a channel's positive terminal and negative terminal.
digital filter	A low-pass filter incorporated into the A/D converter. The digital filter provides very steep roll-off above its cutoff 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.

Term	Meaning
hold last state	A configuration selection that instructs the module to keep the outputs at the last converted value before the condition that caused the control system to enter the fault or program mode.
input image	The input from the module to the controller. The input image contains the module data words and status bits.
LSB	(Least Significant Bit) The bit that represents the smallest value within a string of bits. For analog modules, 16-bit, two's complement binary codes are used in the I/O image in the card. For analog inputs, the LSB is defined as the rightmost bit, bit 0, of the 16-bit field. For analog outputs, the three rightmost bits are not significant, and the LSB is defined as the third bit from the right, bit 2, of the 16-bit field.
linearity error	An analog input or output is composed of a series of voltage or current values that correspond to digital codes. For an ideal analog input or output, the values lie in a straight line that a voltage or current corresponding to 1 LSB spaces. Any deviation of the converted input or actual output from this line is the linearity error of the input or output. The linearity is expressed in percent of full-scale input or output. See the variation from the straight line due to linearity error (exaggerated) in the example below. 
number of significant bits	The power of two that represents the total number of completely different digital codes an analog signal can be converted into or generated from.
module scan time	same as module update time
module update time	For input modules, the time that is 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. For output modules, the time that is required for the module to receive the digital code from the controller, convert it to the analog output signal, and send it to the output channel.
multiplexer	A switching system that allows several signals to share a common A/D or D/A converter.
normal mode rejection	(differential mode rejection) A logarithmic measure, in dB, of a device's ability to reject noise signals between or among circuit signal conductors.
normal operating range	Input or output signals are within the configured range. See Normal and Full Ranges on page 12 for a list of input and output types/ranges.
overall accuracy	The worst-case deviation of the output voltage or current from the ideal over the full output range is the overall accuracy. For inputs, the worst-case deviation of the digital representation of the input signal from the ideal over the full input range is the overall accuracy. This is expressed in percent of full scale. Gain error, offset error, and linearity error all contribute to input and output channel accuracy.
output accuracy	The difference between the actual analog output value and what is expected when a given digital code is applied to the d/a converter. Expressed as a ± percent of full scale. The error includes gain, offset and drift elements, and is defined at 25 °C (77 °F), and also over the full operating temperature range of 0...60°C (32...140 °F).
output image	The output from the controller to the output module. The output image contains the analog output data.
analog output module	An I/O module that contains circuits that output an analog DC voltage or current signal proportional to a digital value transferred to the module from the controller.
repeatability	The closeness of agreement among repeated measurements of the same variable under the same conditions.

Term	Meaning
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 that is required for the channel data word signal to reach a specified percentage of its expected final value, which is given a large step change in the input signal.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation. You can view or download publications at rok.auto/literature.

Resource	Description
1769 Compact I/O Modules Specifications, publication 1769-TD006	Provides specifications and certification information for the Compact I/O modules.
Compact Isolated Analog Input Module Installation Instructions, publication 1769-IN074	Describes how to install and wire the 1769-IF4I module.
Compact 1769-OF4CI Isolated Analog Output Module Installation Instructions, publication 1769-IN075	Describes how to install and wire the 1769-OF4CI module.
Compact 1769-OF4VI Isolated Analog Output Module Installation Instructions, publication 1769-IN076	Describes how to install and wire the 1769-OF4VI module.
CompactLogix System User Manual, publication 1769-UM007	Describes how to install, use, and program the 1769-L20 and 1769-L30 CompactLogix® controllers.
CompactLogix System User Manual, publication 1769-UM011	Describes how to install, use and program the 1769-L31, 1769-L32C, 1769-L32E, 1769-L35CR, and 1769-L35E CompactLogix controllers.
MicroLogix 1500 Programmable Controllers User Manual, publication 1764-UM001	Describes how to install, use, and program the MicroLogix™ 1500 controllers and Compact I/O modules.
Compact I/O 1769-ADN DeviceNet Adapter User Manual, publication 1769-UM001	Describes how to install, use, and program the 1769-ADN DeviceNet® adapter.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.

Overview

This chapter explains how analog data is used, describes the 1769-IF4I isolated analog input module, and describes the 1769-OF4CI and 1769-OF4VI isolated analog output modules. Included is information about:

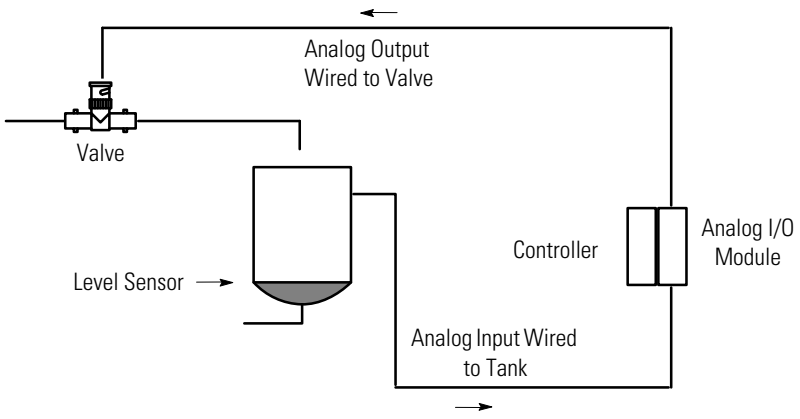
- the use of analog I/O.
- the modules' hardware and diagnostic features.
- an overview of the 1769 analog input system operation.
- an overview of the 1769 analog output system operation.

How to Use Analog I/O Data

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

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

Figure 1.1 Analog I/O Application Example



General Description

The 1769-IF4I isolated analog input module converts and digitally stores analog data for retrieval by controllers, such as the CompactLogix controller or the MicroLogix™ 1500 controller. The module supports connections from any combination of as many as four voltage or current analog sensors. The 1769-IF4I input module provides four, isolated-differential analog input channels.

The 1769-OF4CI and 1769-OF4VI isolated output modules each provide four, isolated differential analog output channels.

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

Table 1.1 Normal and Full Ranges

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

The data can be configured on board each module as:

- Engineering units.
- scaled-for-PID.
- percent.
- raw/proportional data.

Hardware Features

The modules contain removable terminal blocks. The modules' channels are isolated from each other and are normally wired as differential inputs or outputs. To support single-ended applications, wire the negative terminal of each channel to the other channel's negative terminals; however, this eliminates the channel-to-channel isolation that is provided by the modules.

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. See the controller's user manual for more information.

Figure 1.2 Isolated Analog Modules' Hardware Features

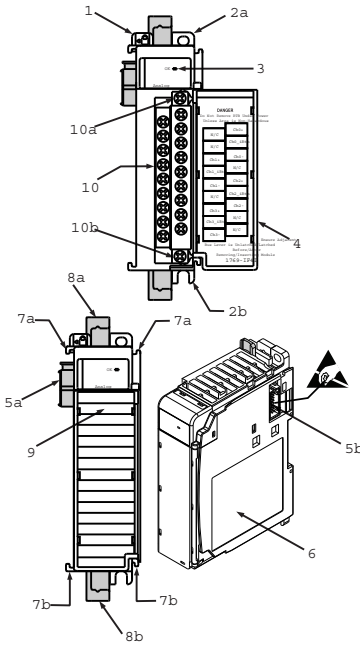


Table 1.2 Isolated Modules' Feature Descriptions

Item	Description
1	Bus lever (with lock)
2a	Upper-panel mounting tab
2b	Lower-panel mounting tab
3	Module 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 fingersafe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw

General Diagnostic Features

The analog modules contain diagnostic features that can help you identify the source of problems that occur when you cycle power or during normal channel operation.

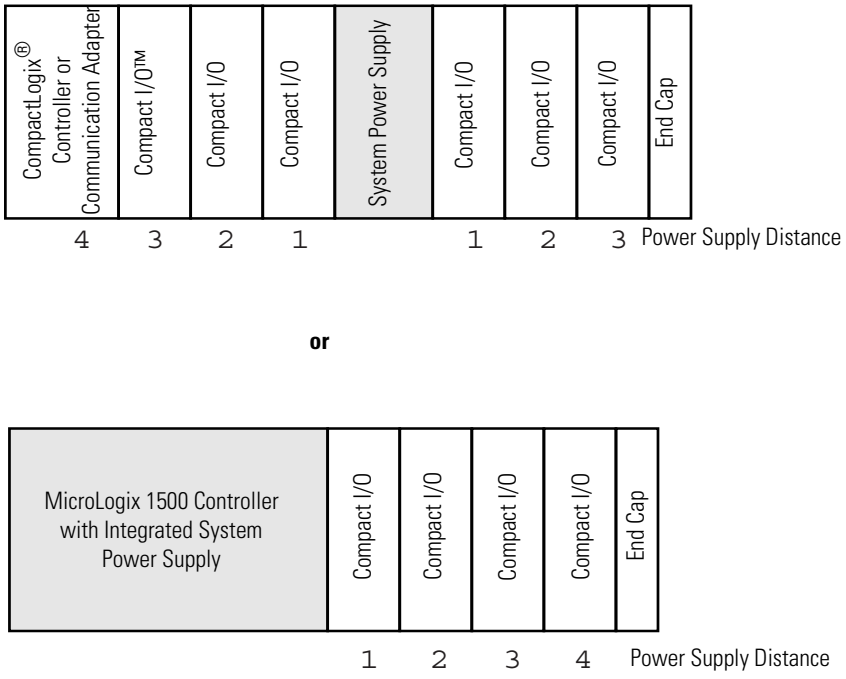
These power cycle and channel diagnostics are explained in Appendix A.

System Overview

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

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

Figure 1.3 Determine Power Supply Distance



System Operation

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

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

Input Modules

Each time a channel reads the input module, the module tests the analog data value for an overrange or underrange conditions. If any of these conditions are detected, unique bits are set in the channel status word.

The channel status word is described in the 1769-IF4I Input Data File on page 21.

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

Output Modules

The output modules monitor channels for overrange and underrange conditions and can also clamp the outputs at designated levels (if enabled by the user program). If such conditions are detected, a unique bit is set in the channel status word.

The channel status word is described in the 1769-OF4CI and 1769-OF4VI Output Data File on page 35.

The output modules receive two's complement binary values from the bus leader. The modules typically receive the values at the end of the program scan or when commanded by the control program. If the controller and the module determine that the bus transfer was completed without error, the output module converts the data to an analog output signal.

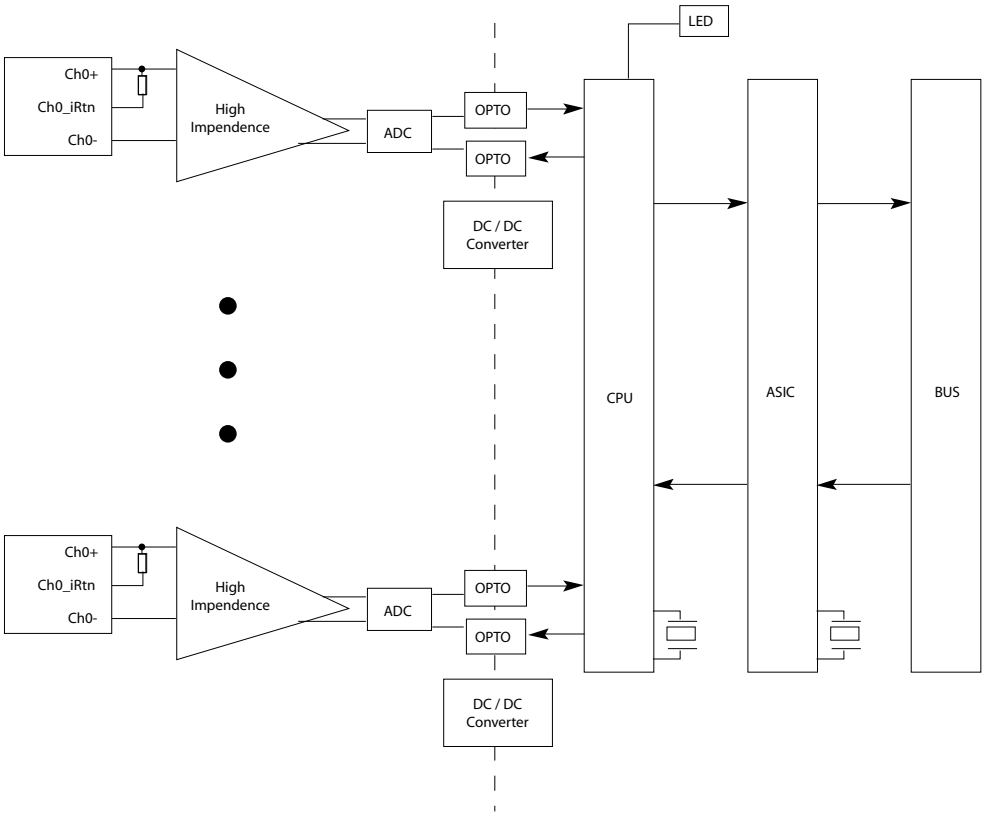
Module Operation

The following sections describe the input and output modules' block diagrams.

Input Module Block Diagram

The input module's input circuitry consists of four isolated-differential analog inputs each with its own analog-to-digital (A/D) converter. The A/D converter reads the selected input signal and converts it to a digital value that is presented to the controller.

Figure 1.4 1769-IF4I Block Diagram



Output Modules Block Diagram

The output modules use one digital-to-analog (D/A) converter per isolated output channel to convert the digital output data from the controller to an analog output signal.

Figure 1.5 1769-OF4CI Block Diagram

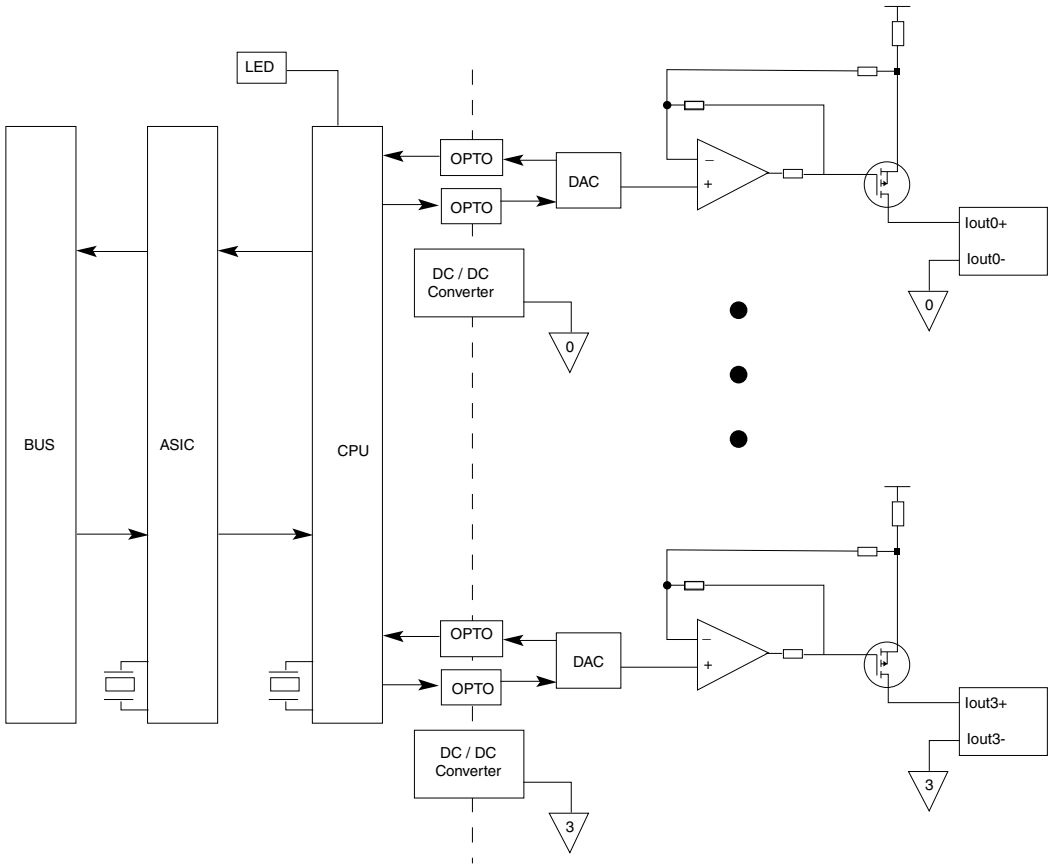
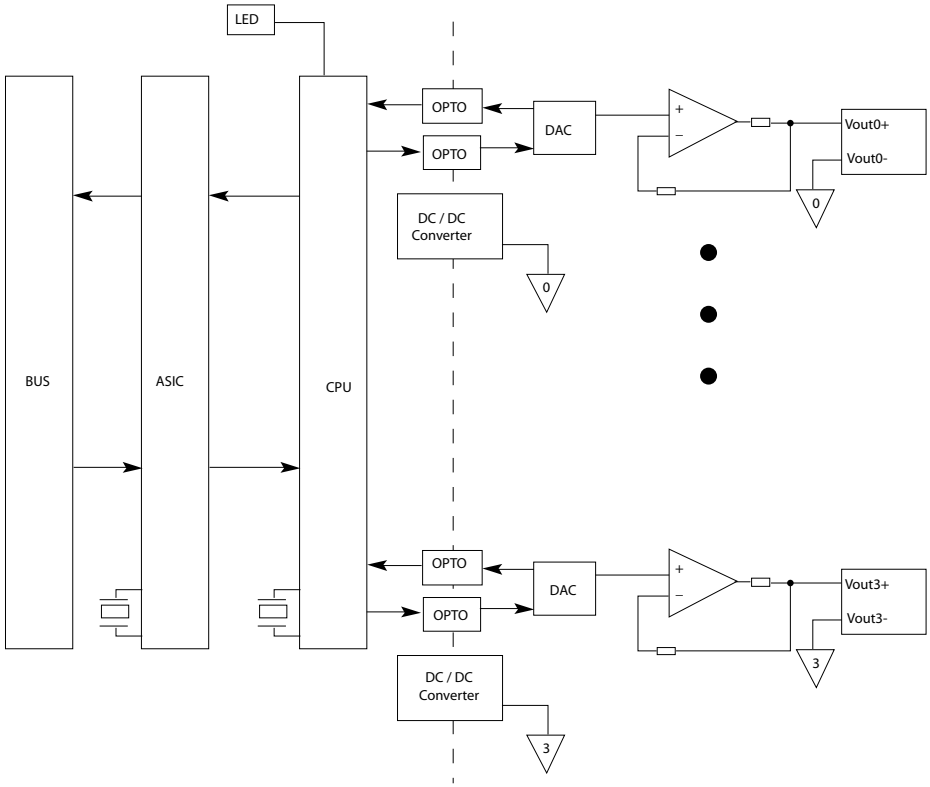


Figure 1.6 1769-OF4VI Block Diagram



Module Field Calibration

Each isolated analog module's design guarantees its calibration. No field calibration is required.

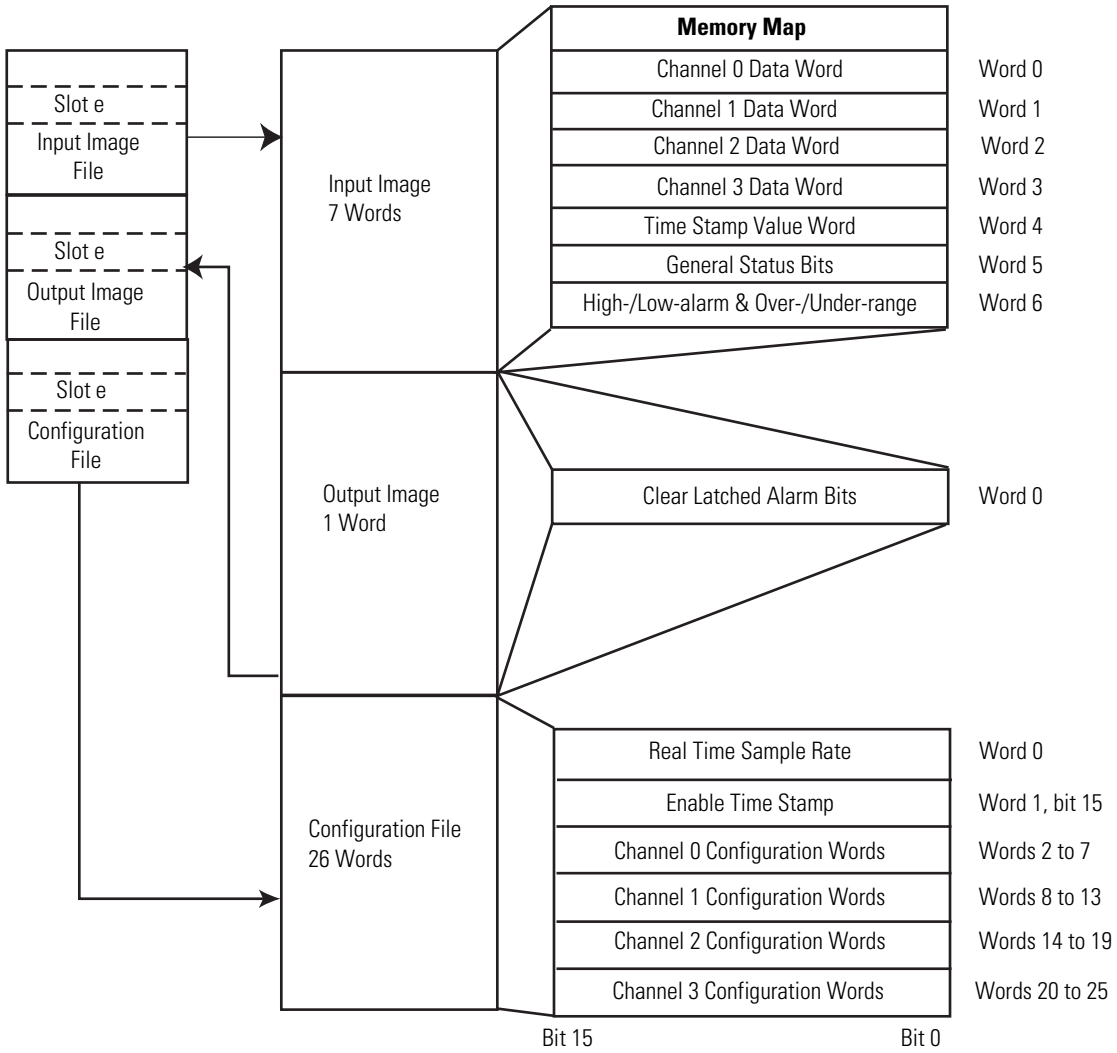
Module Data, Status, and Channel Configuration for the Input Module

This chapter examines the analog input module's data table, channel status, and channel configuration word.

1769-IF4I Input Module Addressing

The1769-IF4I memory map shows the output, input, and configuration tables for the 1769-IF4I module.

Figure 2.1 1769-IF4I Memory Map



1769-IF4I Input Image

The 1769-IF4I input image file represents data words and status bits. Input words 0 to 3 hold the input data that represents the value of the analog inputs for channels 0 to 3. These data words are valid only when the channel is enabled and there are no errors. Input words 5 and 6 hold the status bits. To receive valid status information, the channel must be enabled.

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

1769-IF4I Output Image

The 1769-IF4I output image file contains the clear alarm control bits for the high- and low-alarm bits on each input channel. These bits are used to clear alarms when alarms are latched.

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

1769-IF4I Configuration File

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

The configuration file is explained in more detail in 1769-IF4I Configuration Data File on page 24.

TIP Not all controllers support program access to the configuration file. For more information, see your controller's user manual.

1769-IF4I 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 to 3 in the input data file contain the analog values of the inputs.

Table 2.1 1769-IF4I Input Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	SGN	Analog Input Data Channel 0														
1	SGN	Analog Input Data Channel 1														
2	SGN	Analog Input Data Channel 2														
3	SGN	Analog Input Data Channel 3														
4	Nu	Time Stamp Value														
5	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	S3	S2	S1	S0
6	L3	H3	U3	O3	L2	H2	U2	O2	L1	H1	U1	O1	L0	H0	U0	O0

1769-IF4I Input Data Values

Words 0 to 3 contain the converted analog input data from the field device. The most significant bit (MSB) is the sign bit, which is in two's complement format. (Nu indicates not used with the bit set to 0.)

General Status Bits (S0 to S3)

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

Low Alarm Flag Bits (L0 to L3)

Word 6, bits 3, 7, 11, and 15 contain the low alarm flag bits for input channels 0 to 3. If set (1), these bits indicate that the input signal is outside the user-defined range. The module continues to convert analog data to minimum full-range values. The bit is automatically reset (0) when the low alarm condition clears, unless the channel's alarm bits are latched. If the channel's alarm bits are latched, a set (1) low alarm flag bit clears via the corresponding Clear Alarm Latch bit in your output data file.

High Alarm Flag Bits (H0 to H3)

Word 6, bits 2, 6, 10, 14 contain the high alarm flag bits for input channels 0 to 3 and applies to all input types. 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 Clear Alarm Latch bit in your output data file.

Overrange Flag Bits (O0 to O3)

Overrange bits for channels 0 to 3 are contained in Word 6, bits 0, 4, 8, 12. They apply to all input types. When set (1), this bit indicates input signals beyond the normal operating range. However, the module continues to convert analog data to the maximum full range value. The bit is automatically reset (0) by the module when the overrange condition is cleared and the data value is within the normal operating range.

Underrange Flag Bits (U0 to U3)

Underrange bits for channels 0 to 3 are contained in Word 6, bits 1, 5, 9, 13. They apply to all input types. When set (1), this bit indicates input signals below the normal operating range. It can also indicate an open circuit condition, when the module is configured for any voltage range or the 4...20 mA range. However, the module continues to convert analog data to the minimum full range value. The bit is automatically reset (0) by the module when the underrange condition is cleared and the data value is within the normal operating range.

Time Stamp Value (Word 4)

The 1769-IF4I supports a 15-bit rolling time stamp that is updated during each new update of the analog input values. The time stamp has a 1 ms resolution. The time stamp value is placed in the Input Data file, word 4, for each module input data update (if the time stamp function is enabled). Enable and/or disable this time stamp in word 1, bit 15 of the Configuration Data file.

1769-IF4I 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.

Table 2.2 1769-IF4I Output Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Nu[1]	Nu	Nu	Nu	Nu	Nu	Nu	Nu	UL3[2]	UH3[3]	UL2	UH2	UL1	UH1	UL0	UH0

(1) Nu = Not used. Bit must be set to 0.

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

(3) UHx = Unlatch High Process Alarm Latch x. This lets you individually cancel each high process alarm latch.

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

1769-IF4I Configuration Data File

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

Table 2.3 1769-IF8 Configuration Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Real Time Sample Value															
1	ETS	Reserved														
2	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Chl0			
3	Reserved					Inpt Dta Fm Chl0			Reserved				Inpt Tp/RngeSel Chl0			
4	S	Process Alarm High Data Value Channel 0														
5	S	Process Alarm Low Data Value Channel 0														
6	S	Alarm Dead Band Value Channel 0														
7	Reserved															
8	EC	Reserved				EA	AL	EI(1)	Reserved				Inpt Filter Sel Chl1			
9	Reserved					Inpt Dta Fm Chl1			Reserved				Inpt Tp/RngeSel Chl1			
10	S	Process Alarm High Data Value Channel 1														
11	S	Process Alarm Low Data Value Channel 1														
12	S	Alarm Dead Band Value Channel 1														
13	Reserved															
14	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Chl2			
15	Reserved					Inpt Dta Fm Chl2			Reserved				Inpt Tp/RngeSel Chl2			
16	S	Process Alarm High Data Value Channel 2														
17	S	Process Alarm Low Data Value Channel 2														
18	S	Alarm Dead Band Value Channel 2														
19	Reserved															
20	EC	Reserved				EA	AL	EI(1)	Reserved				Input Filter Sel Chl3			
21	Reserved					Inpt Dta Fm Chl3			Reserved				Inpt Tp/RngeSel Chl3			
22	S	Process Alarm High Data Value Channel 3														
23	S	Process Alarm Low Data Value Channel 3														
24	S	Alarm Dead Band Value Channel 3														
25	Reserved															

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

The configuration file is typically modified on the programming software configuration screen.

For information about how to configure the module with MicroLogix™ 1500 and RSLogix 500® software, see Appendix C; for CompactLogix® and RSLogix 5000® software, see Appendix D; for 1769-ADN DeviceNet® adapter and RSNetWorx™ software, see Appendix E.

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 25.

Channel Configuration

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

Table 2.4 Bit Definitions for Channel Configuration Words

Define	To Select	Make these bit settings												
		15	14	13	12	11	10	9	8	7…4	3	2	1	0
Input Filter Selection	60 Hz										0	0	0	0
	50 Hz										0	0	0	1
	28.5 Hz										0	0	1	0
	300 Hz										0	0	1	1
	360 Hz										0	1	0	0
Enable Interrupt	Enable[1]								1					
	Disable								0					
Enable Process Alarm Latch	Enable							1						
	Disable							0						
Enable Process Alarms	Enable						1							
	Disable						0							
Enable Channel	Enable	1												
	Disable	0												

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

Table 2.5 Bit Definitions for Input Range and Input Data

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

Enable/Disable Channel

This configuration selection lets each channel be enabled individually.

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

Input Filter Selection

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

Noise Rejection

The 1769-IF4I module uses 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 300 Hz) can provide better noise rejection but it increases channel update time. Transducer power supply noise, transducer circuit noise, or process variable irregularities can also be sources of normal mode noise.

Common Mode Rejection is better than 60 dB at 50 Hz and 60 Hz, with the 50 Hz and 60 Hz filters selected, respectively. The module performs well in the presence of common mode noise as long as the signals applied to the user plus and minus input terminals do not exceed the working voltage rating of the module. Improper earth ground can 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 that is 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, the channel filter attenuates a portion of that signal.

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 controller. For the 1769-IF4I, each input channels' selected filter setting determines the independent rate at which the channel is sampled continuously. The module's Input Data file updates on a channel-by-channel basis at a rate that corresponds to the sample rate for each enabled channel.

The Filter Frequency and Update Times table shows the channel update times that are associated with each input channel filter setting. When you select a filter setting for a channel, the indicated update time for that channel is set in the Input Data file.

The real-time sampling function can be used to set a pre-determined module update time. When you set a valid real-time sample rate, the module updates the Input Data file with the most recently sampled value from each input channel at the interval (module update time) set by the real-time sample rate. The Input Data file values are left unchanged between update times, but the input channels continue to be sampled at the fastest rate allowed by each channel's filter setting.

Table 2.6 Filter Frequency and Update Times

Filter Frequency	Update Time per Channel	Update Time per Module[1]
28.5 Hz	108 ms	Not applicable
50 Hz	62 ms	Not applicable
60 Hz	52 ms	Not applicable
300 Hz	12 ms	Not applicable
360 Hz	10 ms	Not applicable

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

Input Type/Range Selection

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

Input Data Selection Formats

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

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

Raw/Proportional Data

The value presented to the controller is proportional to the selected input and scaled into the maximum data range allowed by the bit resolution of the A/D converter and filter selected. The full range for a ±10V DC user input is -32767…+32767.

See Valid Input Data on page 29.

Engineering Units

The module scales the analog input data to the actual current or voltage values for the selected input range. The resolution of the engineering units is dependent on the range that is selected and the filter selected.

See Valid Input Data on page 29.

Scaled-for-PID

The value presented to the controller is a signed integer with zero representing the lower user range and 16383 representing the upper user range. Allen-Bradley® controllers, such as the MicroLogix 1500, use this range in their PID equations. The amount over and under user range (full-scale range -410…+16793) is also included.

See Valid Input Data on page 29.

Percent Range

The input data is presented as a percentage of the user range. For example, 0V…10V DC equals 0% to 100%.

See Valid Input Data on page 29.

Valid Input Data Word Formats/Ranges

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

Table 2.7 Valid Input Data

1769-IF4I Normal Operating Input Range	Full Range (includes amounts over and under normal operating range)	Raw/Pro-portional Data	Engineering Units	Scaled-for-PID		Percent	
		Full Range		Normal Operating Range	Full Range	Normal Operating Range	Full Range
-10…+10V DC	+10.5…-10.5V	-32767… +32767	-10500… +10500	0…16383	-410…+16793	-100… +100%	-105.00… 105.00%
0…5V DC	-0.5…5.25V	-32767… +32767	-500…+5250		-1638… 17202	0…100%	-10.00… 105.00%
0…10V DC	-0.5…10.5V	-32767… +32767	-500… 10500		-819…+17202		-5.00… 105.00%
4…20 mA	3.2…21 mA	-32767… +32767	3200… 21000		-819… +17407		-5.00… +106.25%
1.0…5V DC	0.5…5.25V		500…5250		-2048… 17407		-12.50… +106.25%
0…20 mA	0…21 mA		0…21000		0…17202		0.00…105.00%

1769-IF4I Real-time Sampling

This parameter instructs the module how often to place the most recently scanned data for each enabled input channel into the Input Data file. This feature is applied on a module-wide basis.

During module configuration, you specify a real-time sampling (RTS) period by entering a value into Word 0 of the Configuration Data file. This value that is entered in Word 0 can be in the range of 0 to 5000 and indicates the sampling rate that the module uses in 1 ms increments.

If you enter a 0 for the Real Time Sample Rate, the module places each input channel's most recently scanned data into the Input Data file at as fast a rate as possible, controlled by the filter setting selected for each enabled channel.

The module compares the Real Time Sample Rate value that is entered in Word 0 of the Configuration Data file with each input channel's calculated update time, again based on the filter setting selected for each enabled channel. If the value entered for the Real Time Sample Rate is smaller than any input channel's calculated update time, the module indicates a configuration error. The longest Real Time Sample Rate that the 1769-IF4I supports is 5 s, the maximum value for Word 0 of the Configuration Data file is 5000 decimal.

1769-IF4I Time Stamping

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

During module configuration, you enable time stamping with Word 1, bit 15 of the Configuration Data file: Enable Time Stamping (ETS). Set the ETS bit (1), to enable the module's time stamping function. Clear the ETS bit (0) to disable the function. The default condition of the ETS bit is disabled (0).

The 1769-IF4I provides (when enabled) a rolling time stamp value of 0 to +32767 where each count represents 1 ms. When the time stamp count reached +32767, the value is reset to 0 and the value continues to increment one count every ms.

When enabled, the time stamp value in the Input Data file is updated with the current time stamp value each time the module updates an input channel data value. In normal sampling mode, each input channel of the 1769-IF4I is sampled and its converted value is placed into the Input Data file at a rate set by the filter setting for the channel.

Since each input channel is sampled independently from the other input channels, the time stamp value is updated each time any channel's value is updated. If real-time sampling is used, the values of all enabled input channels are updated in the Input Data file simultaneously. In this case, the time stamp value is updated once per Real Time Sample period at the same time the channels' data values are updated.

1769-IF4I 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. (CompactLogix L43 controllers are able to support these interrupts.) Process alarms are set at two user-configurable alarm trigger points:

- Process Alarm High
- Process Alarm Low

Bits in the Configuration Data file control each input channel's process alarms. Set the EA bit (1) for the channel to enable alarms. 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.

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.

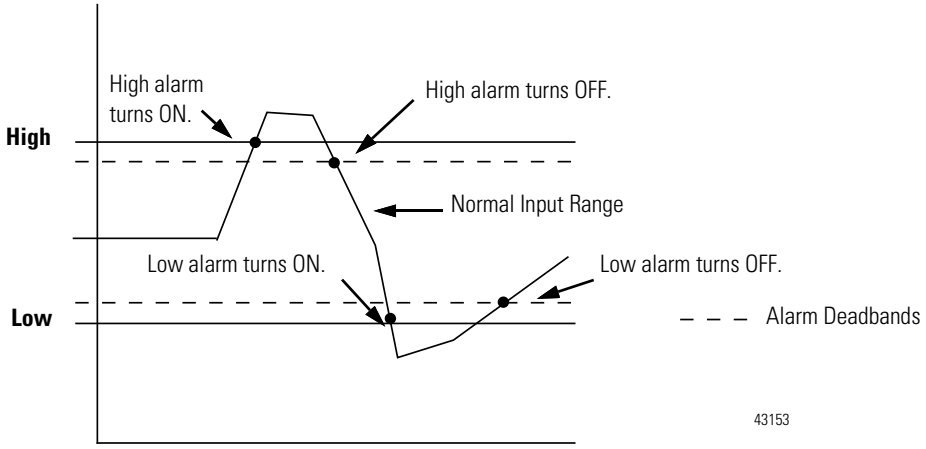
The values that are entered for a channel's process alarm data values must be within the normal operating data range as set by the input Data Format selected for that channel. If a process alarm data value is entered that is outside the normal operating data range set for a channel, the module indicates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

Alarm Deadband

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

Alarm Deadbands on page 32 shows input data that sets each of the two alarms at some point during module operation. In this example, latching is disabled; therefore, each alarm turns OFF when the condition that caused it to set ceases to exist.

Figure 2.2 Alarm Deadbands



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

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

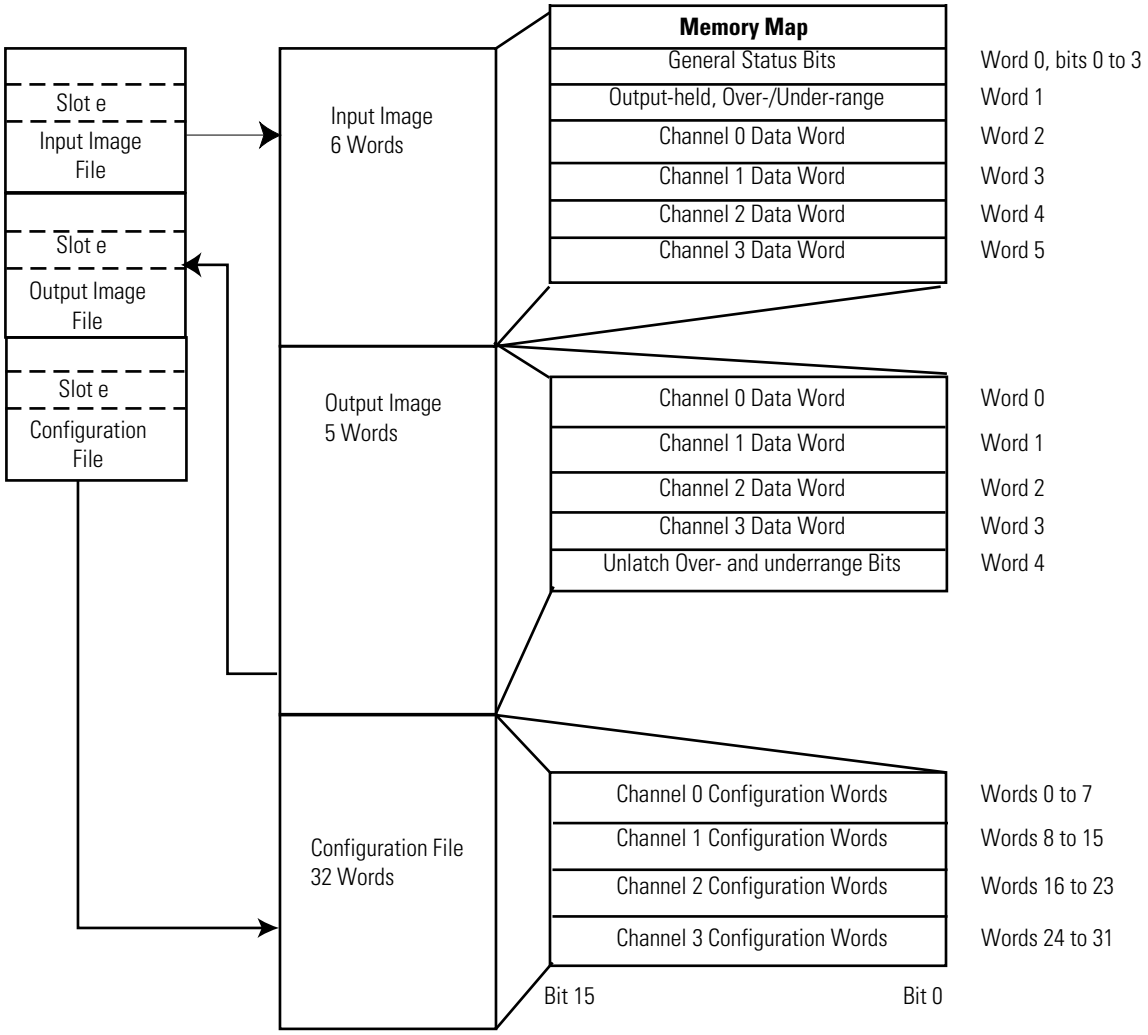
Module Data, Status, and Channel Configuration for the Output Modules

This chapter examines the analog output module's output data file, input data file, channel status, and channel configuration words.

1769-OF4CI Output Module Memory Map

The 1769-OF4CI memory map shows the output, input, and configuration tables for the 1769-OF4CI module.

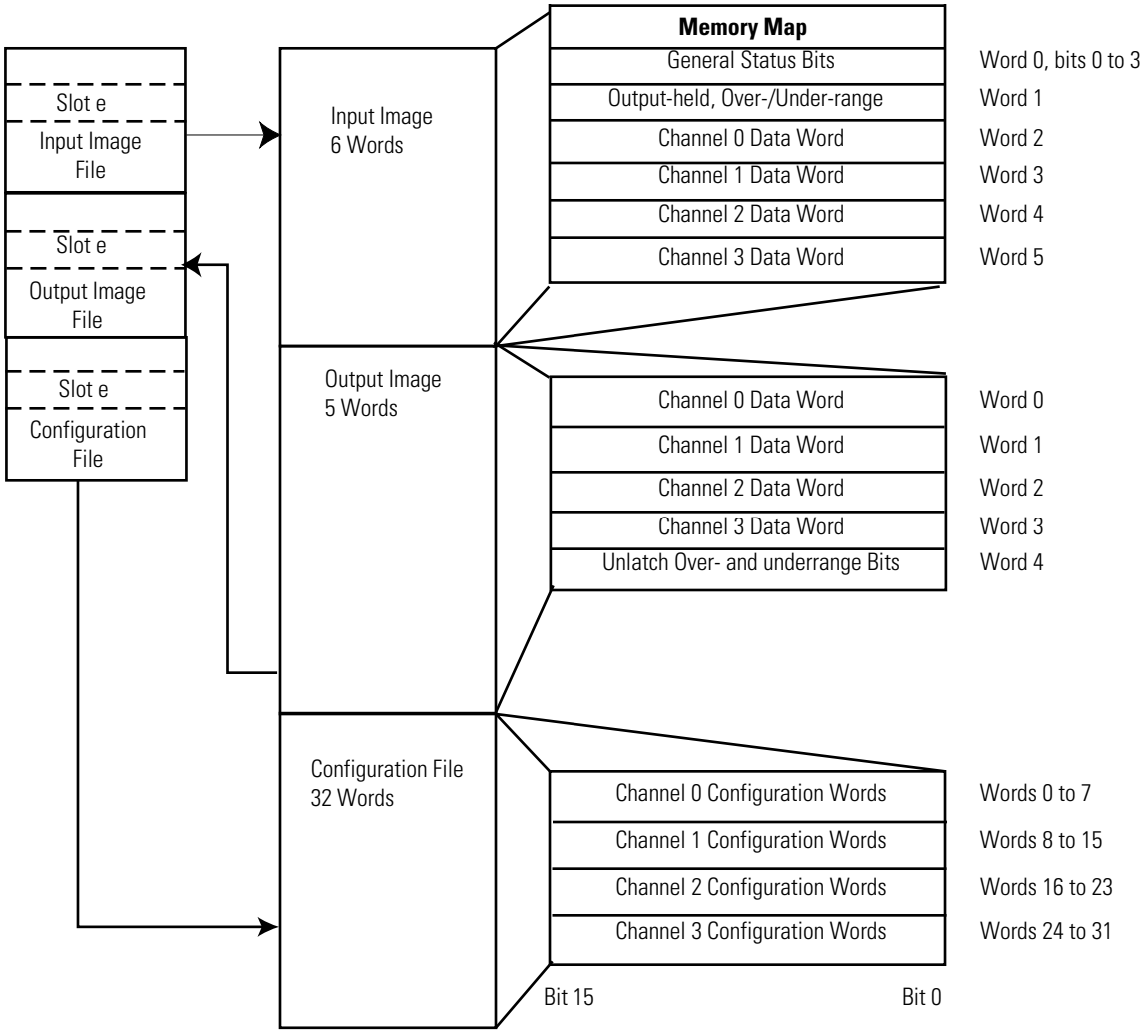
Figure 3.1 1769-OF4CI Memory Map



1769-OF4VI Output Module Memory Map

The 1769-OF4VI memory map shows the output, input, and configuration tables for the 1769-OF4VI module.

Figure 3.2 1769-OF4VI Memory Map



1769-OF4CI and 1769-OF4VI Output Data File

The structure of the output data file is shown in the table below. Words 0 to 3 contain the commanded analog output data for channels 0 to 3, respectively. The most significant bit is the sign bit. Word 4 contains the control bits for unlatching alarms.

Table 3.1 1769-OF4CI and 1769-OF4VI Output Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	SGN	Analog Output Data Channel 0														
1	SGN	Analog Output Data Channel 1														
2	SGN	Analog Output Data Channel 2														
3	SGN	Analog Output Data Channel 3														
4									UU3	UO3	UU2	UO2	UU1	UO1	UU0	UO0

Channel Alarm Unlatch

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

Table 3.2 Channel Alarm Unlatch

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Nu(1)	Nu	Nu	Nu	Nu	Nu	Nu	Nu	UU3(2)	UO3(3)	UU2	UO2	UU1	UO1	UU0	UO0

(1) Not used. Bit must be set to 0.

(2) Unlatch channel x underrange or low-clamp exceeded alarm.

(3) Unlatch channel x overrange or high-clamp exceeded alarm.

1769-OF4CI and 1769-OF4VI Input Data File

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

Table 3.3 1769-OF4CI and 1769-OF4VI Input Data Table

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0													S3	S2	S1	S0
1		H3	U3	O3		H2	U2	O2		H1	U1	O1		H0	U0	O0
2	Channel 0 Data Value															
3	Channel 1 Data Value															
4	Channel 2 Data Value															
5	Channel 3 Data Value															

1769-OF4CI and 1769-OF4VI Data Values

Words 2 to 5 contain the data echo of the analog data that the module commands for each output.

1769-OF4CI and 1769-OF4VI General Status Bits (S0 to S3)

Word 0, bits 0 to 3 contain the general status information for output channels 0 to 3. If set (1), these bits indicate an error that is associated with that channel. The overrange and underrange bits are logically ORed to this position.

1769-OF4CI and 1769-OF4VI Overrange Flag Bits (O0 to O3)

Word 1, bits 0, 4, 8, and 12 contain the overrange bits for channels 0 to 3. When set, the overrange bit indicates that the controller is attempting to drive the analog output above its normal operating range or above the channel's High Clamp level (if clamp limits are set for the channel). However, the module continues to convert analog output data to a maximum full range value if clamp levels are not set for the channel.

If alarm latching is not enabled for the channel, the bit is automatically reset (0) by the module when the overrange condition is cleared or the commanded value no longer exceeds the high clamp (the output is commanded to return to within the normal allowed range). The overrange bits apply to all output ranges.

To view the normal operating and overrange areas, see the 1769-OF4CI Valid Output Data Table on page 49 and the 1769-OF4VI Valid Output Data Table on page 50.

1769-OF4CI and 1769-OF4VI Underrange Flag Bits (U0 to U3)

Word 1, bits 1, 5, 9, and 13 contain the underrange bits for channels 0 to 3. When set (1), the underrange bit indicates that the controller is attempting to drive the analog output below its normal operating range or below the channel's Low Clamp level (if clamp limits are set for the channel). However, the module continues to convert analog output data to a minimum full range value if clamp levels are not set for the channel.

If alarm latching is not enabled for the channel, the bit is automatically reset (0) by the module when the underrange condition is cleared or the commanded value no longer exceeds the low clamp (the output is commanded to return to within the normal allowed range). The underrange bits apply to all output ranges.

To view the normal operating and underrange areas, see the 1769-OF4CI Valid Output Data Table on page 49 and 1769-OF4VI Valid Output Data Table on page 50.

1769-OF4CI and 1769-OF4VI Output Held Bits (H0 to H3)

Word 1, bits 2, 6, 10, and 14 contain the output held bits for input channels 0 to 3. When one of these bits is set (1), the corresponding channel is in the hold state. Output data will not change until the value that controller commands matches the value that is held by the module for any held output channel.

When the value commanded for a channel by the controller matches the value being held by the module, the Output Held bit for that channel is cleared (0). Then, the values that are commanded in the Output Data file by the controller can control the output channel directly. The control can determine the output value being held by the module for any channel whose Output Held bit is set (1) by reading words 2 to 5 of the Input Data file.

1769-OF4CI and 1769-OF4VI Output Data Loopback/Echo

Words 2 to 5 provide output loopback/data echo through the Input Data file for channels 0 to 3. The value of the data echo is the analog value currently being converted onboard the module by the D/A converter. This ensures that the logic-directed state of the output is true. Otherwise, the state of the output could vary depending on controller mode.

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

EXAMPLE

- During run mode, the control program could direct the module to a value over or under the defined full range. In that case, the module raises the over- or underrange flag and continues to convert and data echo up to the defined full range. However, upon reaching either the maximum upper or lower full range value, the module stops converting and echoes back that maximum upper or lower full range value, not the value being sent from the controller.
- During program or fault mode with Hold Last State or User-Defined Value selected, the module echoes the hold last value or alternate value you selected. For more information on the hold last and user-defined values, see 1769-OF4CI and 1769-OF4VI Fault Value on page 47 and 1769-OF4CI and 1769-OF4VI Program/Idle Value on page 48.
- When one or more of the output channel's Output Held bits are set (1). See 1769-OF4CI and 1769-OF4VI Output Held Bits (H0 to H3) on page 37.

1769-OF4CI and 1769-OF4VI Configuration Data File

The configuration file lets you determine how each individual output channel operates. Parameters such as the output type/range and data format are configured with this file. The configuration data file is writable and readable. The default value for the configuration data file is all zeros. The structure of the channel configuration file is explained below.

Table 3.4 1769-OF4CI and 1769-OF4VI Configuration Data File

Word	Description	Word	Description
0	Channel 0 Configuration Word 0	16	Channel 2 Configuration Word 0
1	Channel 0 Configuration Word 1	17	Channel 2 Configuration Word 1
2	Channel 0 Fault Value Word	18	Channel 2 Fault Value Word
3	Channel 0 Program Idle Mode Word	19	Channel 2 Program Idle Mode Word
4	Channel 0 Low Clamp	20	Channel 2 Low Clamp
5	Channel 0 High Clamp	21	Channel 2 High Clamp
6	Channel 0 Ramp Rate	22	Channel 2 Ramp Rate
7	Channel 0 Spare	23	Channel 2 Spare
8	Channel 1 Configuration Word 0	24	Channel 3 Configuration Word 0
9	Channel 1 Configuration Word 1	25	Channel 3 Configuration Word 1
10	Channel 1 Fault Value Word	26	Channel 3 Fault Value Word
11	Channel 1 Program Idle Mode Word	27	Channel 3 Program Idle Mode Word
12	Channel 1 Low Clamp	28	Channel 3 Low Clamp
13	Channel 1 High Clamp	29	Channel 3 High Clamp
14	Channel 1 Ramp Rate	30	Channel 3 Ramp Rate
15	Channel 1 Spare	31	Channel 3 Spare

Table 3.5 1769-OF4CI and 1769-OF4VI Configuration Words 0 and 1 Bit Descriptions

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

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

For information about how to configure the module with MicroLogix™ 1500 and RSLogix 500® software, see Appendix C; for CompactLogix® and RSLogix 5000® software, see Appendix D; for 1769-ADN DeviceNet® adapter and RSNetWorx™ software, see Appendix E.

If controller supports it, you can modify the configuration file through the control program.

The structure and bit settings are shown in 1769-OF4CI and 1769-OF4VI Channel Configuration on page 40.

1769-OF4CI and 1769-OF4VI Channel Configuration

The first two words of each eight word group in the configuration file allow you to change the parameters of each channel independently. For example, words 8 and 9 correspond to channel 1 while words 24 and 25 correspond to channel 3.

Table 3.6 1769-OF4CI and 1769-OF4VI Channel Configuration Word 0[1]

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

(1) See the 1769-OF4CI and 1769-OF4VI Output Channel Configuration Word 1 table.

(2) Hold Last State and User Defined Fault functionality is **only** supported when the analog module is used in a DeviceNet application via the 1769-ADN adapter No local configuration, that is, a MicroLogix or CompactLogix system, supports this

Table 3.7 1769-OF4CI and 1769-OF4VI Output Channel Configuration Word 1

	Define	Indicate	Bit Settings															
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1769-OF4CI	Output Range Select	0…20 mA dc														0	0	0
		4…20 mA dc														0	0	1
	Output Data Select	Raw/Proportional Counts						0	0	0								
		Engineering Units						0	0	1								
		Scaled for PID						0	1	0								
		Percent Range						0	1	1								
1769-OF4VI	Output Range Select	-10…+10V DC														0	0	0
		0…5V DC														0	0	1
		0…10V DC														0	1	0
		1…5V DC														0	1	1
	Output Data Select	Raw/Proportional Counts						0	0	0								
		Engineering Units						0	0	1								
		Scaled for PID						0	1	0								
		Percent Range						0	1	1								

1769-OF4CI and 1769-OF4VI Enable/Disable Channel

This configuration selection (bit 15 of Configuration Word 0) allows each channel to be individually enabled.

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

Clamping/Limiting

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

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

For example, an application sets the high clamp on a 1769-OF4CI module for 15 mA and the low clamp for 5 mA. If a controller sends a value to the module that corresponds to 16 mA, the module only applies 15 mA to its screw terminals.

Clamping is disabled on a per channel basis by entering a 0 value for both the high and low clamps in the Configuration Data file. Interrupts are generated on a high- or low-alarm by setting (1) the SIO bit (for high-clamp or overrange alarm) or setting (1) the SIU bit (for low-clamp or underrange), or you can set (1) a channel's LA bit on a per channel basis to latch the clamp limits.

Clamp/Limit Alarms

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

In the example from the Clamping/Limiting section, if a 1769-OF4CI module has clamping limits of 15 mA and 5 mA but then receives data to apply 16 mA, only 15 mA is applied to the screw terminals. The module sends a status bit back to the controller to report that the 16 mA value exceeds the module's clamping limits.

Ramping

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

Table 3.8 Ramping Types

Ramping Type	Description
Ramp to Fault Mode	This type of ramping occurs when the present output value changes to the Fault Value after a communications fault occurs. This is the only type of ramping for the 1769-OF4CI and 1769-OF4VI modules.

The ramp rate is defined in terms of the selected range/format in units per second. For example, in the 0...20 mA range and percent of full-scale format, a ramp rate of 1000 is 10%/second (since 1000 is 10% of the total number of counts in the full scale of the 0...20 mA range) or a maximum of 2 mA per second.

Table 3.9 and Table 3.10 describes how ramp rate is defined for all output range/types and output data formats.

Table 3.9 1769-OF4CI Output Range/Types and Output Data Formats

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

Table 3.10 1769-OF4VI Output Range/Types and Output Data Formats

Output Data Format Output Range/Type	Total Counts in Full Scale	Number of Counts for Every 1% of Ramp Rate	Real Units/Second for Every 1% of Ramp Rate
Proportional Counts			
-10…+10V	65534	655	0.2V/s
0…5V			0.05V/s
0…10V			0.1V/s
1…5V			0.04V/s
Engineering Units			
-10…+10V	21000	210	0.2V/s
0…5V	5750	58	0.05V/s
0…10V	11000	110	0.1V/s
1…5V	4750	48	0.04V/s
Scaled for PID			
-10…+10V	16383	164	0.2V/s
0…5V			0.05V/s
0…10V			0.1V/s
1…5V			0.04V/s
Percent of Full Scale			
-10…+10V	10000	100	0.2V/s
0…5V			0.05V/s
0…10V			0.1V/s
1…5V			0.04V/s

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

- the number of counts that are entered for a channel's ramp rate is greater than or equal to a minimum of 1% of the total number of full-scale counts for the channel's selected data format.

  See Ramping Types on page 43 and 1769-OF4CI Output Range/Types and Output Data Formats on page 43 for minimum values.

  or

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

Hold for Initialization

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

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

- Initial connection is established after power is cycled
- New connection is established after a communications fault occurs
- Transition to Run mode from Program state

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

1769-OF4CI and 1769-OF4VI Fault Mode (FM)

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

IMPORTANT Hold last state is the default condition for the 1769-OF4CI and 1769-OF4VI during a control system run-to-program mode change.

TIP The MicroLogix 1500 and CompactLogix controllers do not support Hold Last State. This functionality is **only** supported when the analog module is used on the DeviceNet network through the 1769-ADN adapter.

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

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

1769-OF4CI and 1769-OF4VI Program/Idle Mode (PM)

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

IMPORTANT Hold last state is the default condition for the 1769-OF4CI and 1769-OF4VI during a control system run-to-program mode change.

TIP The MicroLogix 1500 and CompactLogix controllers do not support Hold Last State. This functionality is **only** supported when the analog module is used on the DeviceNet network through the 1769-ADN adapter.

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

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

1769-OF4CI and 1769-OF4VI Program/Idle to Fault Enable (PFE)

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

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

1769-OF4CI and 1769-OF4VI Fault Value

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

For example, if you select engineering units for the 0...20 mA range and enter a fault value within the normal operating range (0...20000), the module configures and operates correctly. However, if you enter a value outside the normal operating range (for example 21,000), the module indicates a configuration error.

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

EXAMPLE

- If the default value, 0000, is used and the range that is selected is 0...20 mA, the module outputs 0 mA for all data formats.
- If the raw/proportional or engineering units format is selected and zero is entered as Fault Value in the 4...20 mA range (for 1769-OF4CI) or the 1…5V range (for 1769-OF4VI), a configuration error occurs.
- See 1769-OF4CI Valid Output Data Table on page 49 and 1769-OF4VI Valid Output Data Table on page 50 for more examples.

1769-OF4CI and 1769-OF4VI Program/Idle Value

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

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

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

EXAMPLE

- If the default value, 0000, is used and the range that is selected is 0...20 mA, the module outputs 0 mA for all data formats.
- If the raw/proportional or engineering units format is selected and zero is entered as Program/Idle mode word in the 4...20 mA range (for 1769-OF4CI) or the 1…5V range (for 1769-OF4VI), a configuration error occurs.
- See 1769-OF4CI Valid Output Data Table on page 49 and 1769-OF4VI Valid Output Data Table on page 50 for more examples.

1769-OF4CI Valid Output Data Word Formats/Ranges

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

Table 3.11 1769-OF4CI Valid Output Data Table

1769-OF4CI Normal Operating Range	Input Value	Example Data		Output Range State	Raw/ Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
					Decimal Range		Decimal Range		Decimal Range		Decimal Range	
		Controller Ordered	1769-OF8C Output		Controller Ordered	1769-OF8C Output and Echo	Controller Ordered	1769-OF8C Output and Echo	Controller Ordered	1769-OF8C Output and Echo	Controller Ordered	1769-OF8C Output and Echo
4…20 mA	Over 21.0 mA	+22.0 mA	+21.0 mA	Over	N/A	N/A	22000	21000	18431	17407	11250	10625
	21.0 mA	+21.0 mA	+21.0 mA	Over	32767	32767	21000	21000	17407	17407	10625	10625
	4.0…20.0 mA	+20.0 mA	+20.0 mA	Normal	29085	29085	20000	20000	16383	16383	10000	10000
		+4.0 mA	+4.0 mA	Normal	-29822	-29822	4000	4000	0	0	0	0
	3.2 mA	+3.2 mA	+3.2 mA	Under	-32767	-32767	3200	3200	-819	-819	-500	-500
	Under 3.2 mA	0.0 mA	+3.2 mA	Under	N/A	N/A	0	3200	-4096	-819	-2500	-500
0…20 mA	Over 21.0 mA	+22.0 mA	+21.0 mA	Over	N/A	N/A	22000	21000	18201	17202	11000	10500
	21.0 mA	21.0 mA	+21.0 mA	Over	32767	32767	21000	21000	17202	17202	10500	10500
	0.0…20.0 mA	20.0 mA	+20.0 mA	Normal	29646	29646	20000	20000	16383	16383	10000	10000
		0.0 mA	0.0 mA	Normal	-32767	-32767	0	0	0	0	0	0
	Under 0.0 mA	-1.0 mA	0.0 mA	Under	N/A	N/A	-1000	0	-819	0	-500	0

1769-OF4VI Valid Output Data Word Formats/Ranges

This table shows the valid formats and data ranges for the module.

Table 3.12 1769-OF4VI Valid Output Data Table

1769-OF4VI Normal Operating Output Range	Input Value	Example Data		Output Range State	Raw/ Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
					Decimal Range		Decimal Range		Decimal Range		Decimal Range	
		Controller Ordered	1769-OF8C Output		Controller Ordered	1769-OF8C Output and Echo	Controller Ordered	1769-OF8C Output and Echo	Controller Ordered	1769-OF8C Output and Echo	Controller Ordered	1769-OF8C Output and Echo
±10V DC	Over 10.5V DC	+11.0V DC	+10.5V DC	Over	N/A	N/A	11000	10500	17202	16793	11000	10500
	+10.5V DC	+10.5V DC	+10.5V DC	Over	32767	32767	10500	10500	16793	16793	10500	10500
	-10… +10V DC	+10.0V DC	+10.0V DC	Normal	29788	29788	10000	10000	16383	16383	10000	10000
		0.0V DC	0.0V DC	Normal	0	0	0	0	0	0	0	0
		-10.0V DC	-10.0V DC	Normal	-29788	-29788	-10000	-10000	0	0	-10000	-10000
	-10.5V DC	-10.5V DC	-10.5V DC	Under	-32767	-32767	-10500	-10500	-410	-410	-10500	-10500
	Under -0.5V DC	-11.0V DC	-11.0V DC	Under	N/A	N/A	-11000	-10500	-819	-410	-11000	-10500
0…5V DC	Over 5.25V DC	5.5V DC	+5.25V DC	Over	N/A	N/A	5500	5250	18021	17202	11000	10500
	5.25V DC	5.25V DC	+5.25V DC	Over	32767	32767	5250	5250	17202	17202	10500	10500
	0.0… 5.0V DC	5.0V DC	+5.0V DC	Normal	29918	29918	5000	5000	16383	16383	10000	10000
		0.0V DC	0.0V DC	Normal	-27068	-27068	0	0	0	0	0	0
	-0.5V DC	-0.5V DC	-0.5V DC	Under	-32767	-32767	-500	-500	-1638	-1638	-1000	-1000
	Under -0.5V DC	-1.0V DC	-0.5V DC	Under	N/A	N/A	-1000	-500	-3277	-1638	-2000	-1000
0…10V DC	Over 10.5V DC	11.0V DC	+10.5V DC	Over	N/A	N/A	11000	10500	18021	17202	11000	10500
	+10.5V DC	+10.5V DC	+10.5V DC	Over	32767	32767	10500	10500	17202	17202	10500	10500
	0.0… 10.0V DC	+10.0V DC	+10.0V DC	Normal	29788	29788	10000	10000	16383	16383	10000	10000
		0.0V DC	0.0V DC	Normal	-29788	-29788	0	0	0	0	0	0
	-0.5V DC	-0.5V DC	-0.5V DC	Under	-32767	-32767	-500	-500	-819	-819	-500	-500
	Under -5.0V DC	-1.0V DC	-0.5V DC	Under	N/A	N/A	-1000	-500	-1638	-819	-1000	-500
1.0…5V DC	Over 5.25V DC	+5.5V DC	+5.25V DC	Over	N/A	N/A	5500	5250	18431	17407	11250	10625
	+5.25V DC	+5.25V DC	+5.25V DC	Over	32767	32767	5250	5250	17407	17407	10625	10625
	1.0… 5.0V DC	+5.0V DC	+5.0V DC	Normal	29318	29318	5000	5000	16383	16383	10000	10000
		+1.0V DC	+1.0V DC	Normal	-25869	-25869	1000	1000	0	0	0	0
	0.5V DC	+0.5V DC	+0.5V DC	Under	-32767	-32767	500	500	-2048	-2048	-1250	-1250
	Under 0.5V DC	0.0V DC	0.0V DC	Under	N/A	N/A	0	500	-4096	-2048	-2500	-1250

Module Diagnostics and Troubleshooting

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

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

Safety Considerations

Safety considerations are an important element of proper troubleshooting. Consider the safety of yourself and others, and the condition of your equipment.

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

ATTENTION

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

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

Indicator Lights

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

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 overtravel limit switches, stop push buttons, and interlocks, must be hard-wired to the main control relay. These devices must be wired in series so that when any one device opens, the main control relay is de-energized, and power is removed from the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Module Operation Versus Channel Operation

The module performs operations at two levels:

- Module level
- Channel level

Module-level operations include functions such as power-up, configuration, and communication with a bus leader, such as a MicroLogix™ 1500 controller.

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

Internal diagnostics are performed at both levels of operation. When detected, the status indicator shows that a module error conditions immediately. Both module hardware and channel configuration error conditions are reported to the controller. Channel overrange or underrange conditions are reported in the module's input data table. Module hardware errors are typically reported in the controller's I/O status file. See your controller manual for details.

Power Cycle Diagnostics

When you cycle power to the module, a series of internal diagnostic tests is 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.

Table 1.1 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 or output module channel is enabled, the module performs a diagnostic check to see that the channel has been properly configured. In addition, the module checks each channel on every scan for configuration errors, overrange and underrange, open-circuit (input module in 4…20 mA current range and all voltage ranges).

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

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

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

Open-circuit Detection (1769-IF4I Module Only)

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

Possible causes of an open circuit include:

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

Non-critical vs. Critical Module Errors

Non-critical module errors are typically recoverable. Channel errors (overrange or underrange errors) are non-critical. Non-critical errors are indicated in the module input data table. Non-critical configuration errors are indicated in the extended error code.

See 1769-IF4I Extended Error Codes on page 56 and 1769-OF4CI and 1769-OF4VI Extended Error Codes on page 58.

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 1769-IF4I Extended Error Codes on page 56 and 1769-OF4CI and 1769-OF4VI Extended Error Codes on page 58.

Module Error Definition Table

Analog module errors are expressed in two fields as four-digit Hex format with the most significant digit as don't care and irrelevant. The two fields are Module Error and Extended Error Information.

Table 1.2 Module Error Table

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

Module Error Field

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

Table 1.3 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

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

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

Hardware Errors

Module error code 2 indicates general or module-specific hardware errors.

See 1769-IF4I Extended Error Codes on page 56 and 1769-OF4CI and 1769-OF4VI Extended Error Codes on page 58.

Configuration Errors

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

Each type of analog module has different features and different error codes. See 1769-IF4I Extended Error Codes on page 56 and 1769-OF4CI and 1769-OF4VI Extended Error Codes on page 58.

Error Codes

Error codes can help troubleshoot your module.

Table 1.4 1769-IF4I Extended Error Codes

Error Type	Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
No Error	X000	000	0 0000 0000	No Error
General Common Hardware Error	X200	001	0 0000 0000	General hardware error; no additional information
	X201	001	0 0000 0001	Power-up reset state
Hardware-Specific Error	X300	001	0 1000 0000	General hardware error
	X301	001	0 1000 0001	Microprocessor hardware error
	X302	001	1 0000 0010	A/D converter communication error

Table 1.4 1769-IF4I Extended Error Codes

Error Type	Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
1769-IF4I Specific Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X403	010	0 0000 0011	Invalid real time sample rate value
	X404	010	0 0000 0100	Invalid input filter selected (channel 0)
	X405	010	0 0000 0101	Invalid input filter selected (channel 1)
	X406	010	0 0000 0110	Invalid input filter selected (channel 2)
	X407	010	0 0000 0111	Invalid input filter selected (channel 3)
	X408	010	0 0000 1000	Invalid input range selected (channel 0)
	X409	010	0 0000 1001	Invalid input range selected (channel 1)
	X40A	010	0 0000 1010	Invalid input range selected (channel 2)
	X40B	010	0 0000 1011	Invalid input range selected (channel 3)
	X40C	010	0 0000 1100	Invalid input format selected (channel 0)
	X40D	010	0 0000 1101	Invalid input format selected (channel 1)
	X40E	010	0 0000 1110	Invalid input format selected (channel 2)
	X40F	010	0 0000 1111	Invalid input format selected (channel 3)
	X410	010	0 0001 0000	Invalid low alarm data value (channel 0)
	X411	010	0 0001 0001	Invalid low alarm data value (channel 1)
	X412	010	0 0001 0010	Invalid low alarm data value (channel 2)
	X413	010	0 0001 0011	Invalid low alarm data value (channel 3)
	X414	010	0 0001 0100	Invalid high alarm data value (channel 0)
	X415	010	0 0001 0101	Invalid high alarm data value (channel 1)
	X416	010	0 0001 0110	Invalid high alarm data value (channel 2)
	X417	010	0 0001 0111	Invalid high alarm data value (channel 3)
	X418	010	0 0001 1000	Invalid alarm deadband value (channel 0)
	X419	010	0 0001 1001	Invalid alarm deadband value (channel 1)
	X41A	010	0 0001 1010	Invalid alarm deadband value (channel 2)
	X41B	010	0 0001 1011	Invalid alarm deadband value (channel 3)
	X41C	010	0 0001 1100	Alarm not enabled (channel 0)
	X41D	010	0 0001 1101	Alarm not enabled (channel 1)
	X41E	010	0 0001 1110	Alarm not enabled (channel 2)
	X41F	010	0 0001 1111	Alarm not enabled (channel 3)

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

Table 1.5 1769-OF4CI and 1769-OF4VI Extended Error Codes

Error Type	Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
No Error	X000	000	0 0000 0000	No Error
General Common Hardware Error	X200	001	0 0000 0000	General hardware error; no additional information
	X201	001	0 0000 0001	Power cycle reset state
	X216	001	0 0001 0110	Microprocessor watchdog error
	X220	001	0 0010 0000	Firmware corrupt (checksum failure)
	X221	001	0 0010 0001	Firmware checksum error in NVRAM (calibration data checksum failure)
Hardware-Specific Error	X300	001	1 0000 0000	General hardware error (ASIC)
1769-OF4CI and 1769-OF4VI Specific Configuration Error	X401	010	0 0000 0001	Invalid input range selected (channel 0)
	X402	010	0 0000 0010	Invalid input range selected (channel 1)
	X403	010	0 0000 0011	Invalid input range selected (channel 2)
	X404	010	0 0000 0100	Invalid input range selected (channel 3)
	X409	010	0 0000 1001	Invalid data format selected (channel 0)
	X40A	010	0 0000 1010	Invalid data format selected (channel 1)
	X40B	010	0 0000 1011	Invalid data format selected (channel 2)
	X40C	010	0 0000 1100	Invalid data format selected (channel 3)
	X411	010	0 0001 0001	Invalid fault value (channel 0)
	X412	010	0 0001 0010	Invalid fault value (channel 1)
	X413	010	0 0001 0011	Invalid fault value (channel 2)
	X414	010	0 0001 0100	Invalid fault value (channel 3)
	X419	010	0 0001 1001	Invalid idle value (channel 0)
	X41A	010	0 0001 1010	Invalid idle value (channel 1)
	X41B	010	0 0001 1011	Invalid idle value (channel 2)
	X41C	010	0 0001 1100	Invalid idle value (channel 3)
	X421	010	0 0010 0001	Invalid clamps (channel 0)
	X422	010	0 0010 0010	Invalid clamps (channel 1)
	X423	010	0 0010 0011	Invalid clamps (channel 2)
	X424	010	0 0010 0100	Invalid clamps (channel 3)
	X429	010	0 0010 1001	Invalid ramp rate (channel 0)
	X42A	010	0 0010 1010	Invalid ramp rate (channel 1)
	X42B	010	0 0010 1011	Invalid ramp rate (channel 2)
	X42C	010	0 0010 1100	Invalid ramp rate (channel 3)

Table 1.5 1769-OF4CI and 1769-OF4VI Extended Error Codes

Error Type	Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
1769-OF4CI and 1769-OF4VI Specific Configuration Error	X431	010	0 0011 0001	Configuration word 0 illegal bits set (channel 0)
	X432	010	0 0011 0010	Configuration word 0 illegal bits set (channel 1)
	X433	010	0 0011 0011	Configuration word 0 illegal bits set (channel 2)
	X434	010	0 0011 0100	Configuration word 0 illegal bits set (channel 3)
	X439	010	0 0011 1001	Configuration word 1 illegal bits set (channel 0)
	X43A	010	0 0011 1010	Configuration word 1 illegal bits set (channel 1)
	X43B	010	0 0011 1011	Configuration word 1 illegal bits set (channel 2)
	X43C	010	0 0011 1100	Configuration word 1 illegal bits set (channel 3)

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

Module Inhibit Function

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

Whenever the output modules are inhibited, the modules enter the program mode and the output channel is changed to the state configured for the program mode. Whenever the input modules are inhibited, the modules continue to provide information about changes at its inputs to the 1769 CompactBus leader (for example, a CompactLogix controller).

Notes:

Installation Considerations

For the latest installation, specification and certification information, see the manuals listed in the Additional Resources on page 10.

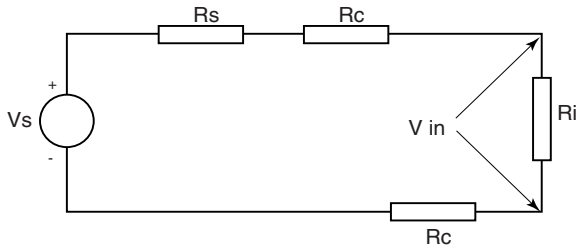
Consider the following when you wire your system.

Impedance and Accuracy

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

For voltage inputs, the length of the cable used between the transducer/sensor and the 1769-IF4I module can affect the accuracy of the data provided by the module.

Figure 2.1 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-IF4I)

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.

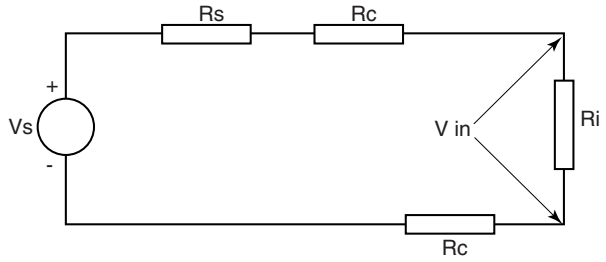
$$Vs = Vin \times \frac{[Rs + (2 \times Rc) + Ri]}{Ri}$$

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

Effect of Device and Cable Output Impedance on Output Module Accuracy

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

Figure 2.2 Output Module Accuracy



Where:

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

Rs = Source impedance (1 Ω for 1769-OF4VI)

Ri = Impedance of the voltage input (220 kΩ for 1769-IF4I)

Vs = Voltage at the output of 1769-OF4VI

Vin = Measured potential at the module input

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

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

For example, for Belden 8761 two conductor, shielded cable and a 1769-OF4CI output module:

Rc = 16 Ω/1000 ft
Rs = 15 Ω
Ri = 220 kΩ

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

Table 2.2 Effect of Output Impedance and Cable Length on Accuracy

Length of Cable (m)	dc Resistance of the Cable Rc (Ω)	Accuracy Impact at the Input Module
50	2.625	0.00919%
100	5.25	0.01157%
200	10.50	0.01634%
300	15.75	0.02111%

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

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

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

Module Addressing and Configuration with MicroLogix 1500

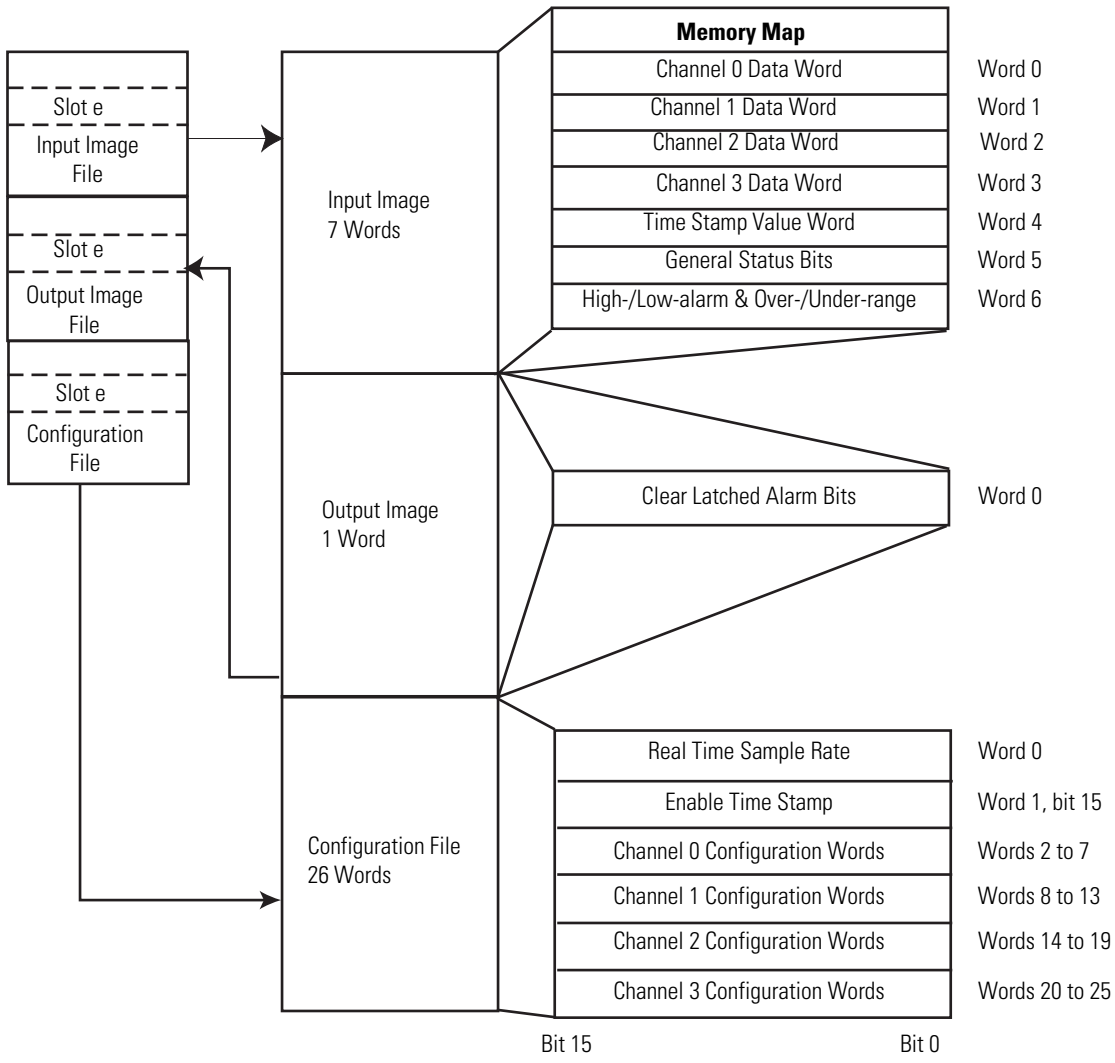
This appendix examines the analog modules' addressing scheme and describes module configuration using RSLogix 500® and MicroLogix™ 1500 software.

Input Module Addressing

In the following example, the 1769-IF4I module is used.

Detailed information on the input image table can be found in 1769-IF4I Input Data Table on page 21.

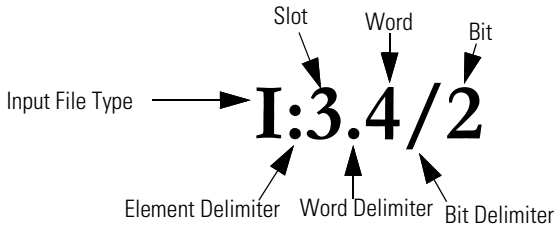
Figure C.1 1769-IF4I Memory Map

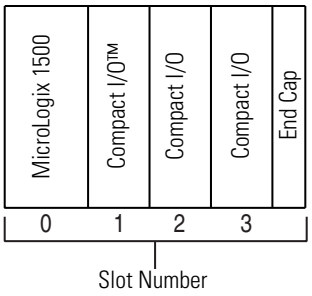


Input Module's Input Image

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

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





TIP The end cap does not use a slot address.

Input Module's 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 on page 68.

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

Table C.1 Software Configuration Channel Defaults

1769-IF4I		1769-OF4CI and 1769-OF4VI	
Parameter	**Default Setting**	**Parameter**	**Default Setting**
Enable/Disable Channel[1]	Disabled	Enable/Disable Channel	Disabled
Filter Selection	60 Hz	Output Range Selection	0…20 mA
Input Range	±10V DC	Data Format	Raw/Proportional
Data Format	Raw/Proportional		

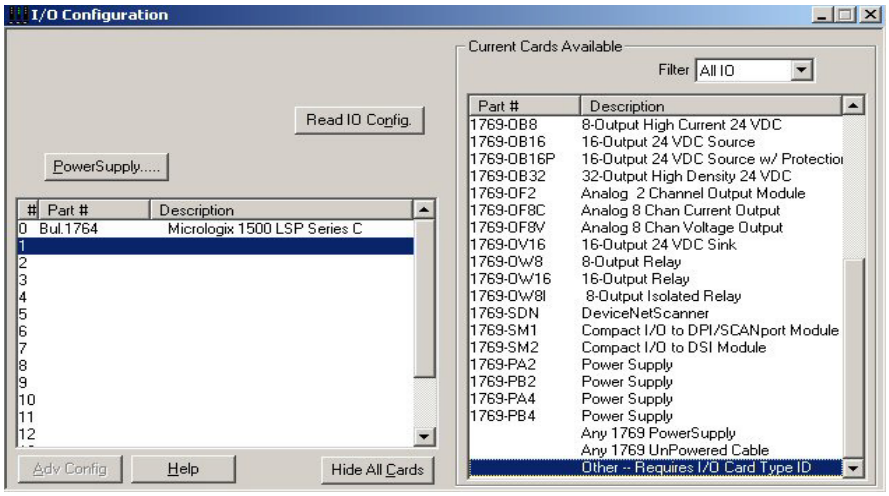
(1) The 1769-IF4I, 1769-OF4CI, and 1769-OF4VI modules are disabled by default.

Configure Analog I/O Modules in a MicroLogix 1500 System

This is an example of how to configure your 1769 analog input and output modules with RSLogix 500 programming software. This application example assumes that your input and output modules are installed as expansion I/O in a MicroLogix 1500 system, and that RSLinx® software is properly configured and a communications link has been established between the MicroLogix controller and RSLogix 500 software.

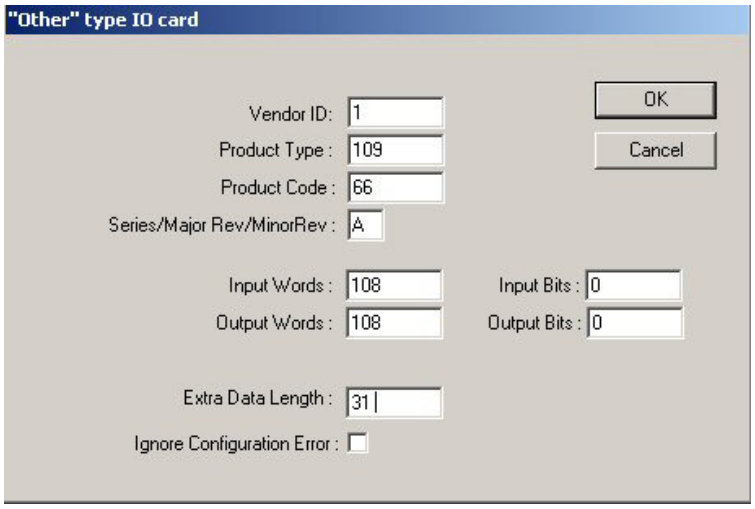
If you have RSLogix 500, version 6 or earlier, follow this procedure to configure your module.

1. From the list, choose Other:Requires I/O Card Type ID.



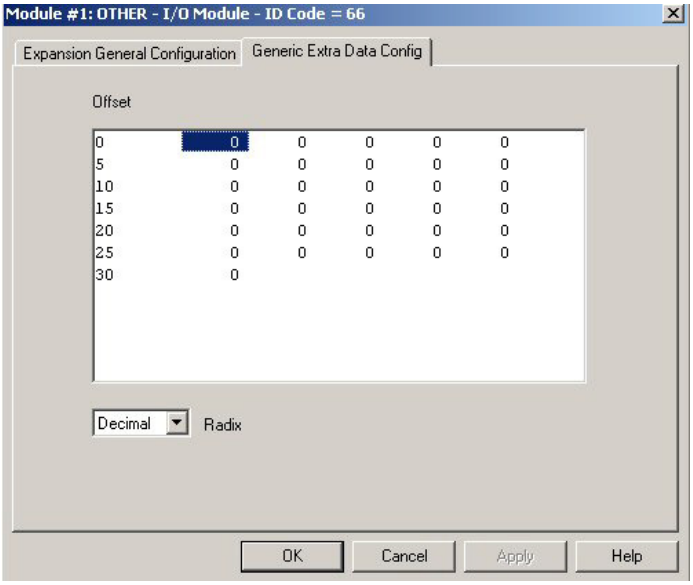
2. Enter the appropriate values as listed below.

Vendor ID = 1
Product Type = 109
Product Code = 66
Series/Major Rev/Minor Rev = A
Input Words = 108
Input Bits = 0
Output Words = 108
Output Bits = 0
Extra Data Length = 31



3. Choose OK.

4. From the Generic Extra Data Config tab, enter your configuration data.



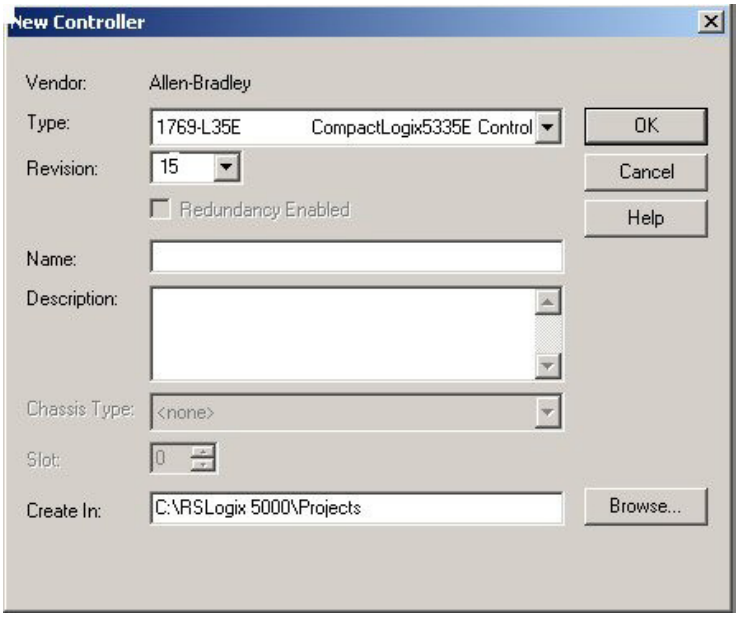
Notes:

Configuration with the RSLogix 5000 Generic Profile for CompactLogix Controllers

To configure a 1769 analog I/O module for a CompactLogix® controller in RSLogix 5000® software with the Generic Profile, you must start a new project in RSLogix 5000 software.

1. Click the new project icon or on the FILE dropdown menu and select NEW.

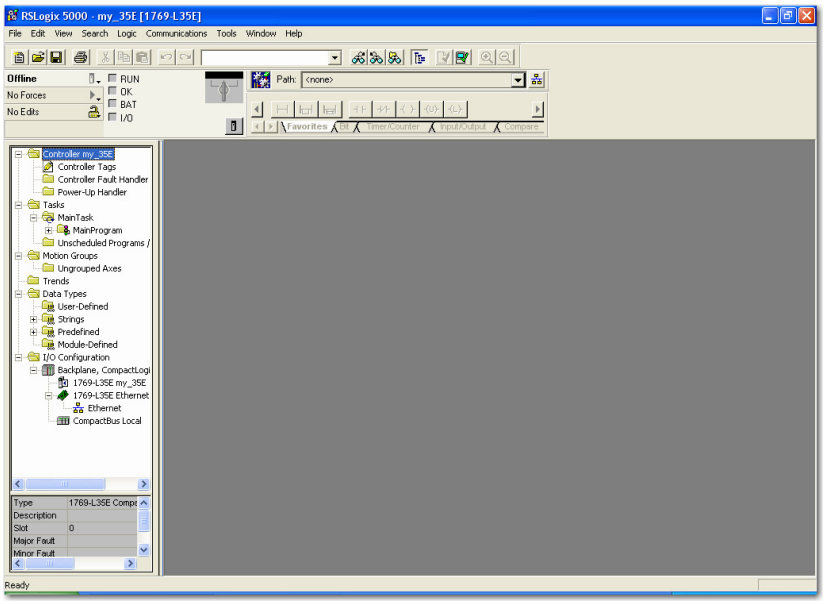
   The following screen appears.



2. Choose your controller type and enter a name for your project.

3. Click OK.

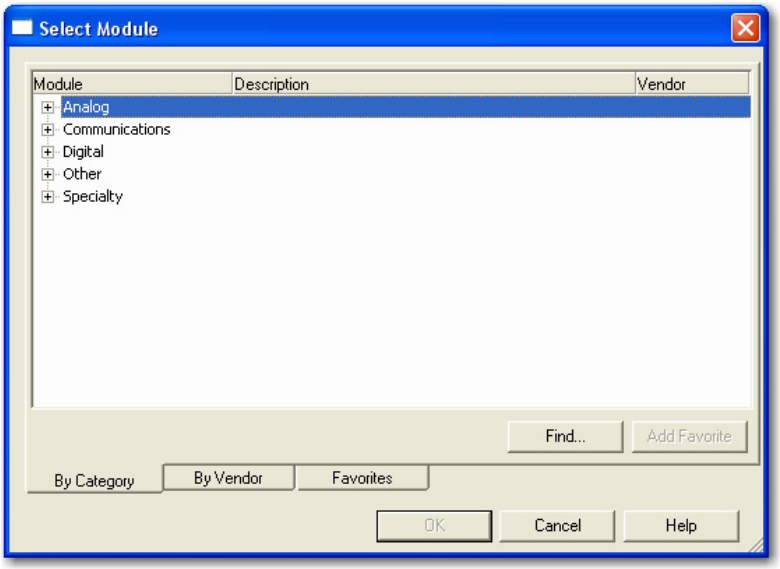
   The following main RSLogix 5000 screen appears.



   The last entry in the controller organizer on the left of the screen that is shown above is a line that is labeled [0] CompactBus Local.

4. Right-click this line, select New Module.

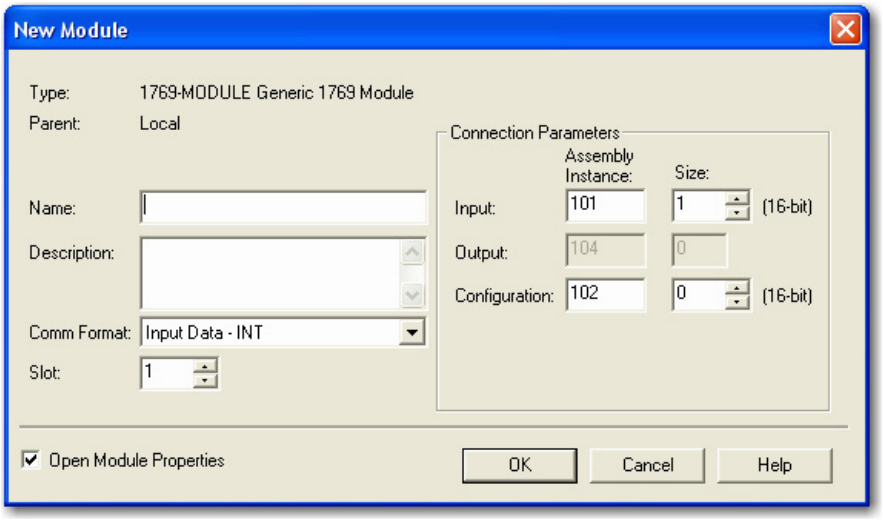
   The following screen appears.



   This screen narrows your search for I/O modules to configure into your system.

5. Click OK.

   The following default Generic Profile screen appears.



   This is the default Generic Profile screen.

   Enter a name for the module. This helps to identify the module type configured on your local CompactBus. The Description field is optional and you can use it to provide more details about this I/O module in your application.

   The next parameter to configure is the Comm Format.

6. Click the down arrow for the Comm Format parameter to reveal the choices.

   For the 1769-OF4CI and 1769-OF4VI modules, Data – INT is used. Input Data –INT is used for the 1769-IF4I module.

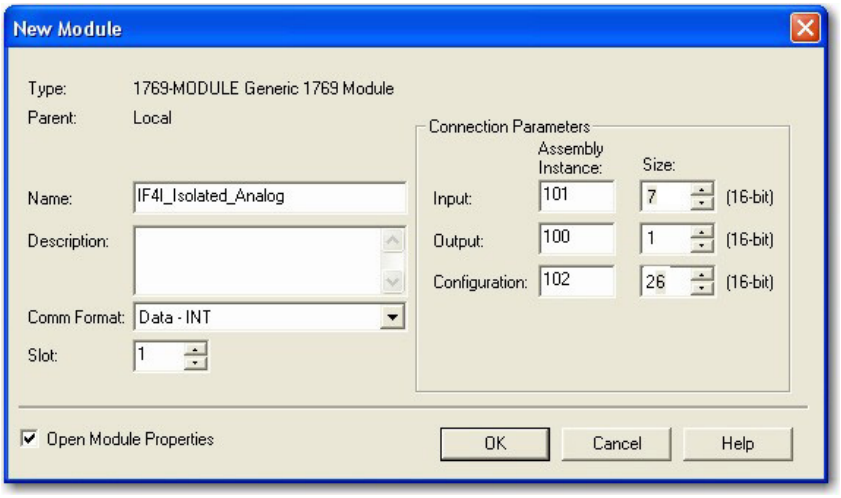
7. Select the slot number.

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

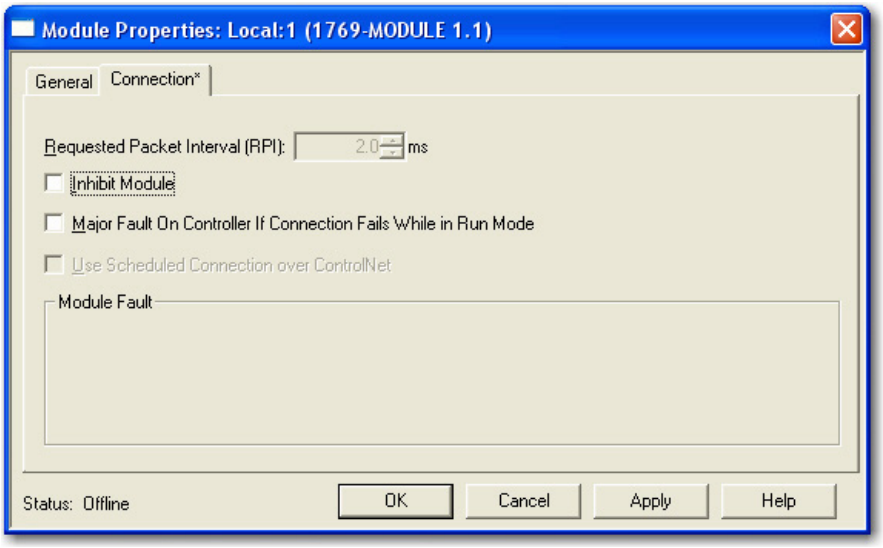
Use the following table for the Comm Format, Assembly Instance and Size values for the 1769-IF4I, 1769-OF4CI, and 1769-OF4VI modules if you have an earlier version of RSLogix 5000 software, version 15.

1769 I/O Modules	Comm Format	Parameter	Assembly Instance	Size (16-bit)
IF4I	Input Data – INT	Input	101	7
		Output	100	1
		Config	102	26
OF4CI and OF4VI	Data – INT	Input	101	6
		Output	100	5
		Config	102	32

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



9. To complete the configuration of your I/O module, click OK.



You can choose to inhibit the module or have the controller fault if the connection to this I/O module fails. These options are not selected by default.

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

To complete the configuration of your analog output module, click Finish. If you click Next, the Module Information screen opens. The values on this screen are populated only when you are online with your controller. If you clicked Next to get the Module Information screen, click Finish to complete the configuration of your I/O module.

Configure each analog I/O module in this manner.

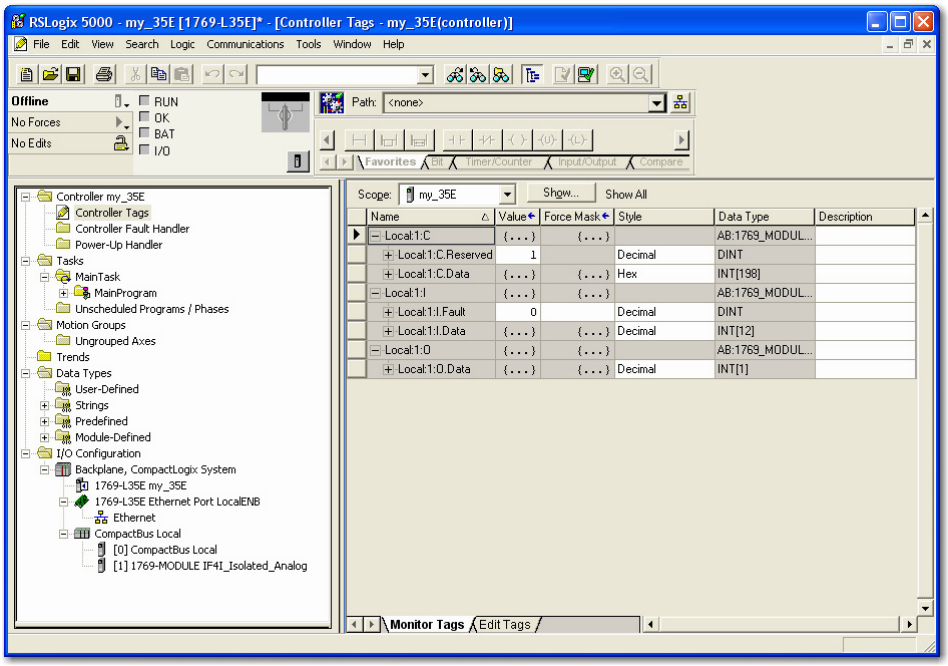
Configure I/O Modules

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

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

You must first enter the Controller Tag database, by double-clicking Controller Tags in the upper portion of the controller organizer. This example shows how to enter configuration data for 1769-OF4I module.

For demonstration purposes, Generic Profiles have been created for 1769-IF4I, 1769-OF4CI, and 1769-OF4VI modules. The Controller Tags screen looks like the following:



Tag addresses are automatically created for configured I/O modules. The word Local follows all local I/O addresses. 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.

To configure an I/O module, you must open up the configuration tag for that module. To do so, click the plus sign to the left of its configuration tag in the tag database.

Configure Analog Output Modules

To configure the 1769-OF4CI or 1769-OF4VI module in slot 1, click the plus sign to the left of Local:1.C. Click the plus sign to the left of Local:1.C.Data to reveal the 32 integer data words where you can enter configuration data for the 1769-OF4CI or 1769-OF4VI module.

Configure Analog Input Modules

To configure the input modules in slot 2, click the plus sign to the left of Local:2.C. Click the plus sign to the left of Local:2.C.Data to reveal the 26 integer data words where you can enter configuration data for the module. The tag addresses for these four words are Local:2.C.Data[0] through Local:2.C.Data[3].

Notes:

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

Overview

In this example, a 1769-ADN DeviceNet® adapter connects the 1769-IF4I and 1769-OF4CI modules to a remote DeviceNet system. Use RSNetWorx™ for DeviceNet software, version 2.23 or later, to configure the network and the I/O modules.

The configuration method that is described here must be done before you configure the DeviceNet adapter in the DeviceNet scanner's scanlist. This applies if you configure an I/O module offline, then download to the adapter, or if you do the configuration online. After the adapter is placed in the scanner's scanlist, you can only configure or reconfigure the I/O module with explicit messages or if you remove the adapter from the scanner's scanlist, modify the configuration of the I/O module, and then add the adapter back into the scanner's scanlist.

For additional information on how to configure DeviceNet scanners and adapters, see to the documentation for those products. For examples on how to modify I/O module configurations with explicit messages while the system is running, see the Compact I/O 1769-ADN DeviceNet Adapter User Manual, publication 1769-UM001.

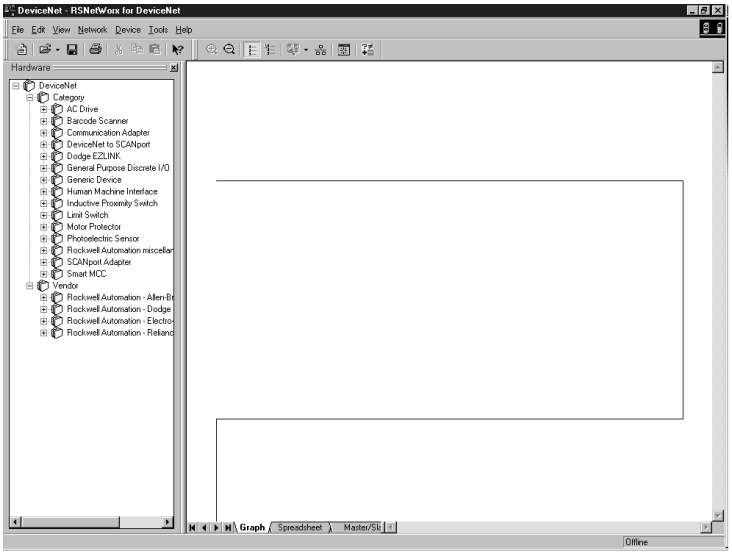
IMPORTANT You must use a Series B 1769-ADN adapter with the Compact I/O™ analog isolated modules.

TIP After you configure each slot, be sure to click Apply.

Add the DeviceNet Adapter to the Scanlist

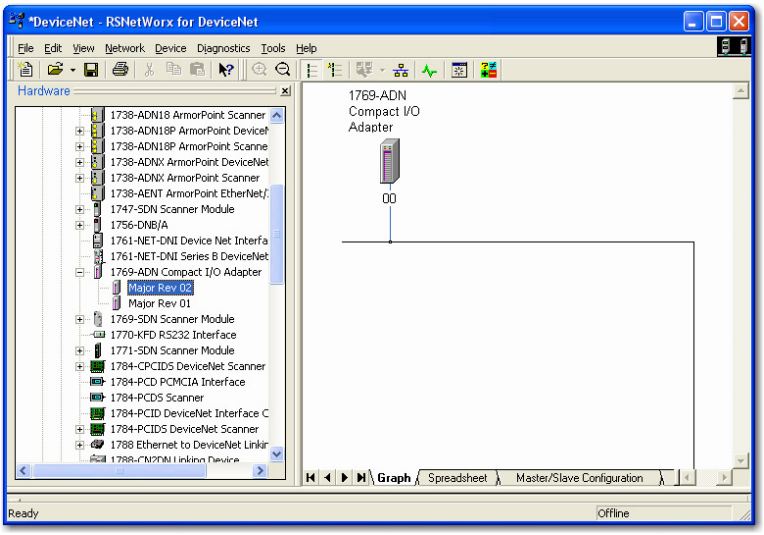
In this part of the example, the 1769-ADN adapter is added to the DeviceNet scanner's scanlist.

1. Start the RSNetWorx for DeviceNet software.



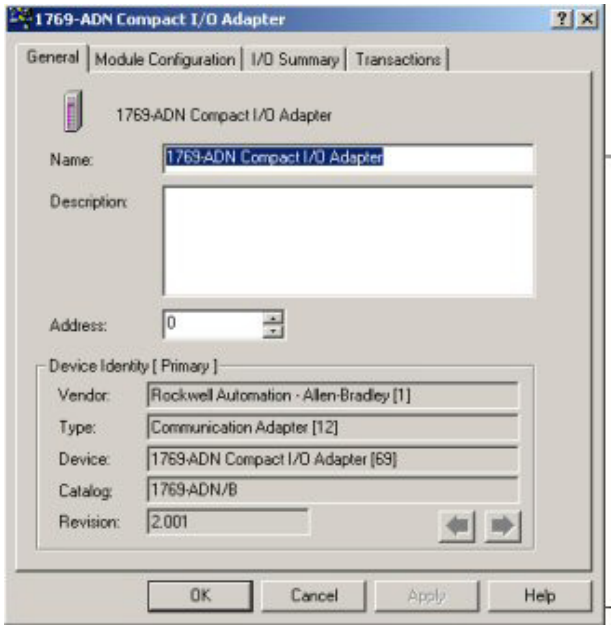
2. In the left column under Category, click the + sign next to Communication Adapters.

3. In the list of products, double-click the 1769-ADN to place it on the network.

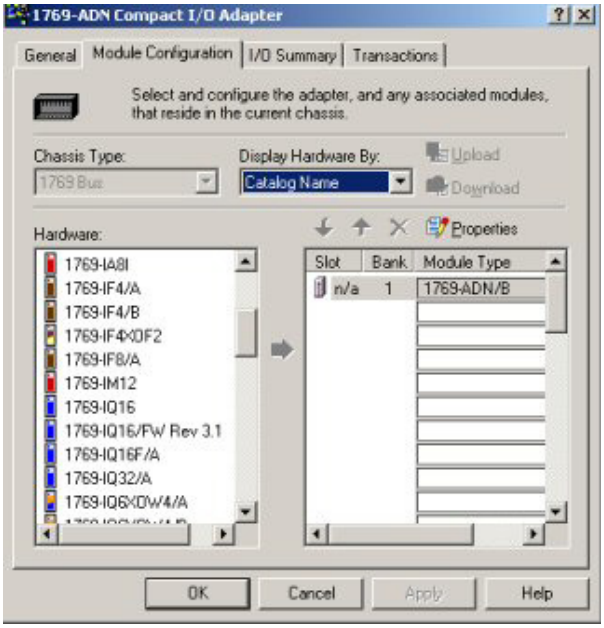


TIP If 1769-ADN is not an option, you have an earlier version of RSNetWorx for DeviceNet software.

4. To configure I/O for the adapter, double-click the adapter icon that appears on the network.



5. Click the Module Configuration tab.



TIP

The I/O Summary tab provides the configured sized and format of the I/O data.

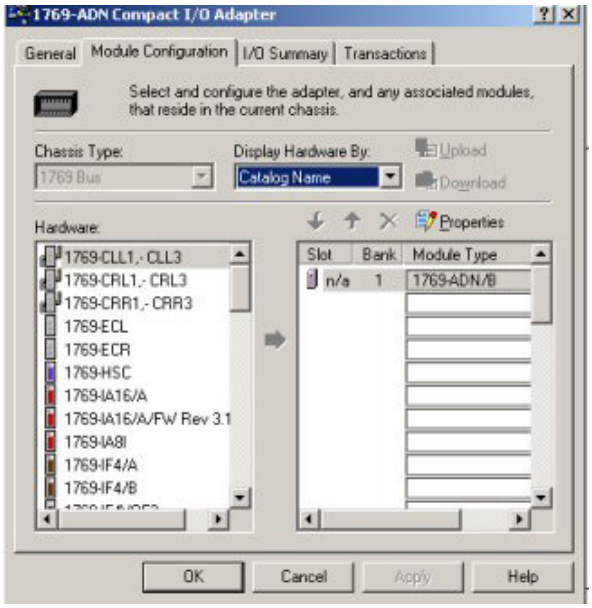
The Transaction tab lets you send services that the device supports. The Clear/Reset Memory transaction returns the module's configuration to the factory defaults, that is, empty. This operation cannot be undone.

Configure the 1769-IF4I Input Module Example

The 1769-ADN adapter appears in slot 0. Your I/O modules, power supplies, end caps, and interconnect cables must be entered in the proper order, following the 1769 I/O rules contained in the Compact I/O 1769-ADN DeviceNet Adapter User Manual, publication 1769-UM001. To simplify this example, we placed the 1769-IF4I in slot 1 to show how it is configured.

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

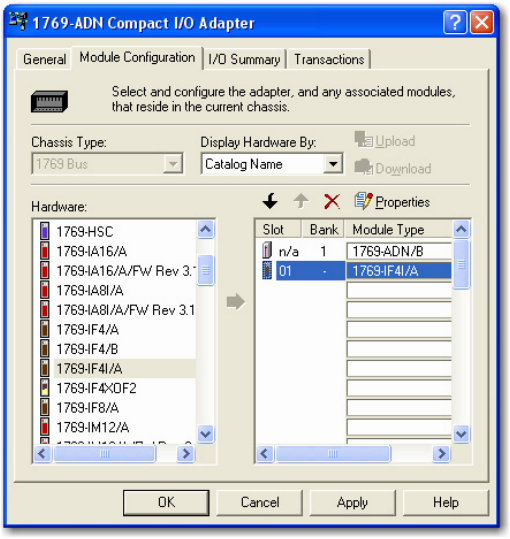
   A list of all possible 1769 products appears.



2. Select the 1769-IF4I module from the Hardware tree on the left and click the arrow to move it to the right.

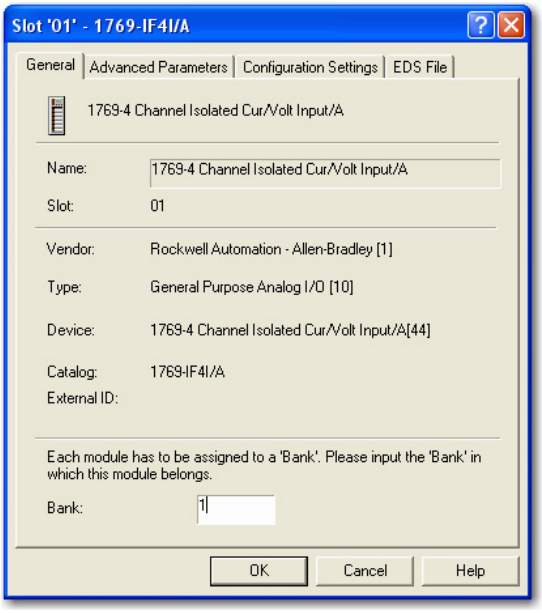
   Slot 1 appears to the right of the 1769-IF4I module.

3. Double-click the 1769-IF4I.

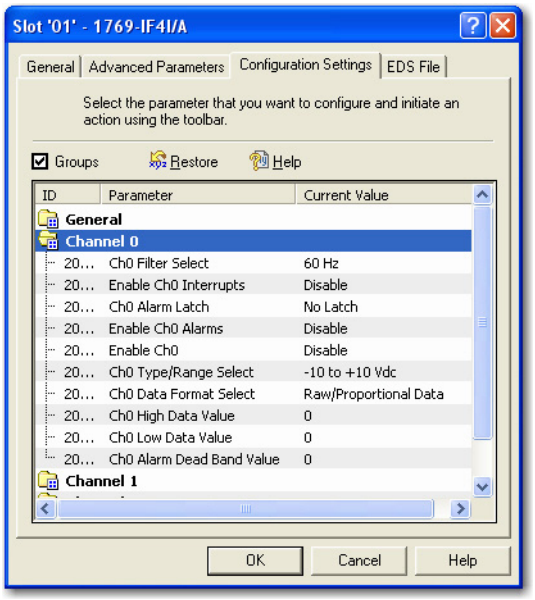


4. Under the General tab, select the appropriate bank.

   Bank 1 was selected in this example.



5. Under the Configuration Settings tab, you can select the parameter that you want to configure and initiate an action with the toolbar.



By default, the 1769-IF4I module contains six input words and no output words.

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

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

7. Click OK or Cancel to exit this screen and return to the Configuration screen.

8. If your application requires only four data words and not the status information, click the Set for I/O only button

   The input size changes to four words. The revision number for the 1769-IF4I module is two. With this setting, you can leave the electronic keying to Exact Match. It is not recommended to disable keying, but if you are not sure of the exact revision of your module, select Compatible Module to allow your system to operate, while still requiring a 1769-IF4I module in slot 1.

The 1769-IF4I module allows external 24V DC power. If your 1769 power supply does not provide enough 24V DC power for your particular set of 1769 I/O modules, the external power connection allows you to draw 24V DC power for the module from your external source.

If you are using external 24V DC power for your 1769-IF4I module, you must select the checkbox to the left of Using External +24v Power Source. Do not select the box if you are not using external 24V DC power.

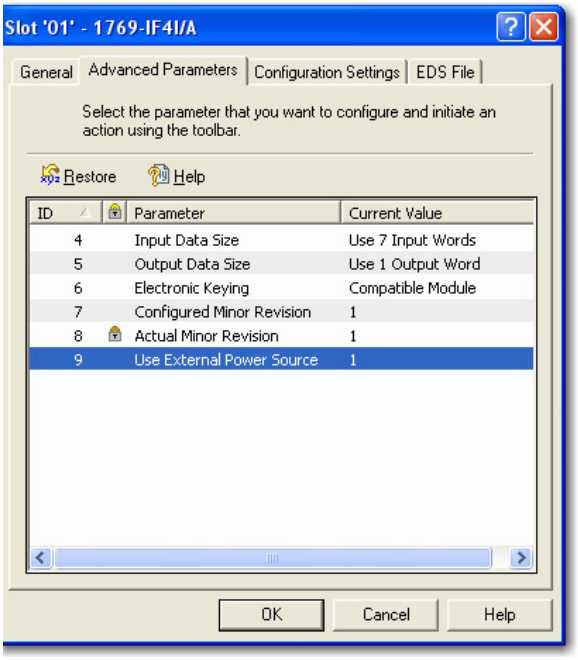
Each of the four analog input channels is disabled by default. To enable a channel, click its Enable box, so that a check mark appears in it. Then, choose your Filter frequency, Input Range, and Data Format for each channel.

See Chapter 3 for a complete description of each of these configuration categories.

1769-IF4I External Power Example

In this example, channels 0...4 are used and external power is being supplied from an external 24V DC power source. In addition, 4...20 mA transducers drive channels 0 and 1, while devices that generate 0...10V DC analog signals drive channels 2 and 3.

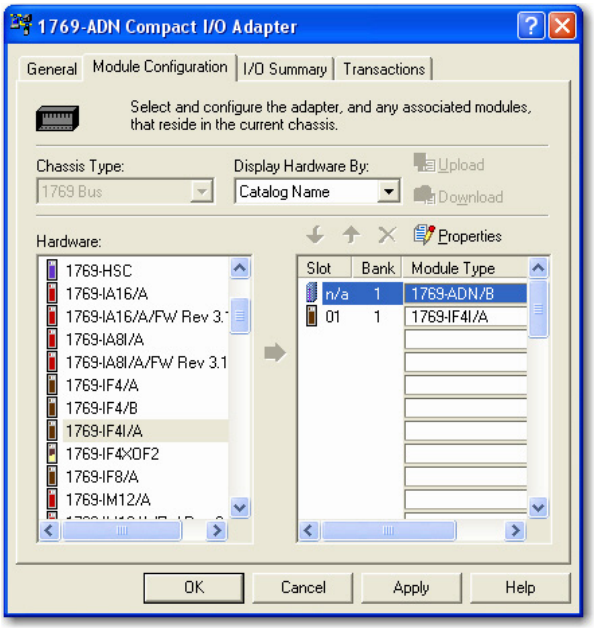
Throughput is not a concern for this application. However, noise immunity is. Therefore, the filter frequency for maximum noise immunity, 50 Hz, has been chosen. The analog input on channel 0 is used as the PV (input) value for a PID loop. Therefore, the Data Format for this channel is Scaled-for-PID.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



Click OK, and your configuration for the 1769-IF4I analog input module is complete.

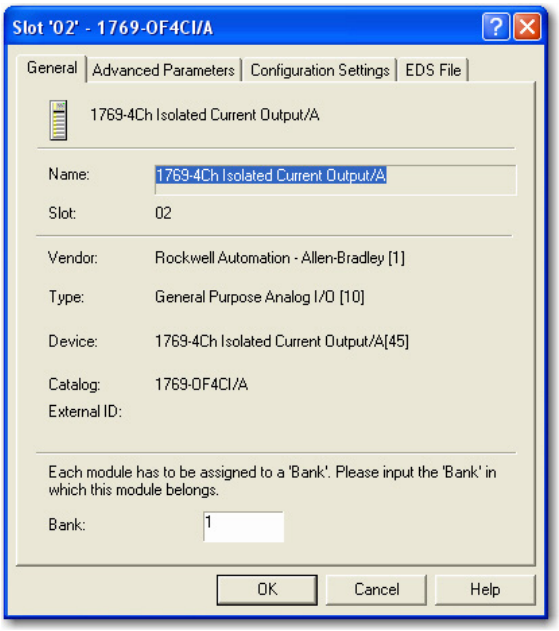
Configure the 1769-OF4CI Output Module Example

After leaving the 1769-IF4I configuration screen, the I/O Bank 1 screen for the 1769-ADN adapter looks like the following:



1. Click the dropdown arrow next to the empty slot and this time choose the 1769-OF4CI module.

2. Click the Slot 2 button that appears to the right of the 1769-OF4CI module.



By default, the 1769-OF4CI module contains 11 input words and nine output words.

3. Click the Configuration Settings button to see what the 11 input and nine output words represent.

   The 11 input words contain channel diagnostic data for the eight channels. The nine output words contain the actual analog output data for the eight channels along with one additional word that contains the control bits for unlatching alarms.

4. Click OK or Cancel to exit this screen and return to the Configuration screen.

5. Select No Input Data under Input Data Size if your application requires only the data words and not the status information.

   The Input Size changes to 0, while the Output Size remains at nine words. The Revision number for 1769-OF4CI module is two. With this, you can leave the Electronic Keying to Exact Match. We do not recommend that you disable keying, but if you are unsure of the exact revision of your module, select Compatible Module to allow your system to operate, while still requiring a 1769-OF4CI module in slot 2.

1769-OF4CI External Power Example

The 1769-OF4CI module allows external 24V DC power. If your 1769 power supply does not provide enough 24V DC power for your particular set of 1769 I/O modules, the external power connection allows you to draw 24V DC power for the module from your external source.

If you are using external 24V DC power for your 1769-OF4CI module, you must select the white box to the left of Using External +24v Power Source. Do not select the box if you are not using external 24V DC power.

1769-OF4CI Output Channels Example

Each of the two analog output channels is disabled by default. To enable a channel, select the Enable checkbox. Then, choose your Output Range, Data Format, and the state of your outputs if the controlling controller is placed into the program mode, fault, or lose communications.

Program State and Fault State each have two options:

- Hold Last State

  Hold last state holds the analog output at the last value that is received before the controller was placed in program mode or before it faulted.

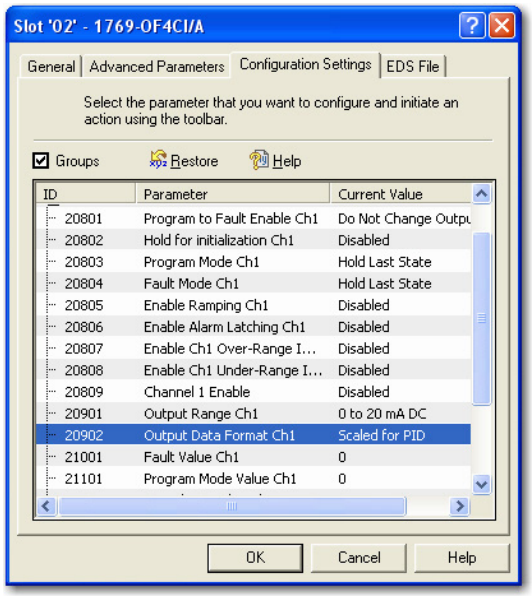
- User-defined State

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

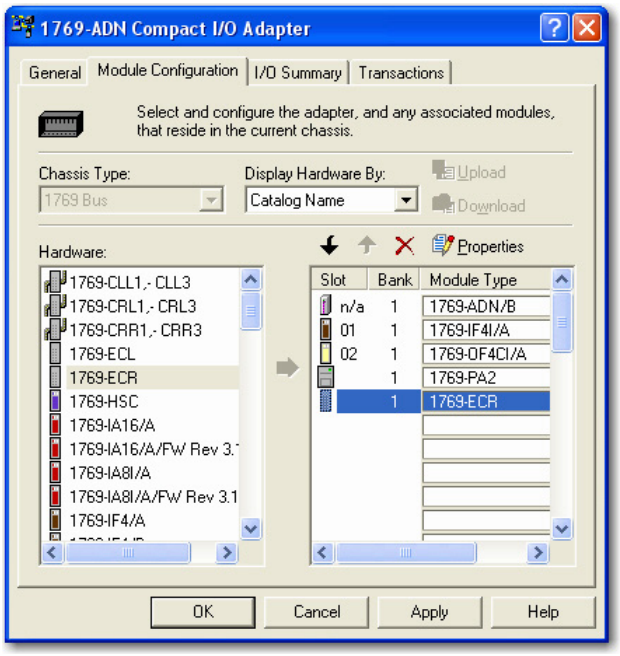
In this example, channels 0 and 1 are enabled and configured for 4…20 mA Output Ranges. The Data Format for channel 0 is Scaled-for-PID, because it is the CV (output) value from your PID instruction. Hold last state was chosen for all possible conditions other than Run mode for channel 0.

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

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



Click OK, and your configuration for the 1769-OF4CI analog output module is complete.



IMPORTANT Be sure to add appropriate power supplies and end caps.

Two's Complement Binary Numbers

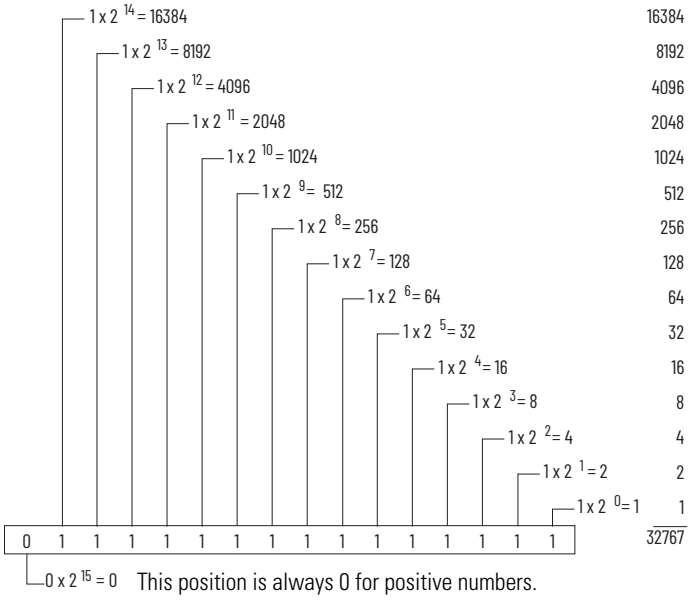
The controller memory stores 16-bit binary numbers. Two's complement binary is used when performing mathematical calculations internal to the controller. Analog input values from the analog modules are returned to the controller in 16-bit two's complement binary format. For positive numbers, the binary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

Figure F.1 Positive Decimal Values



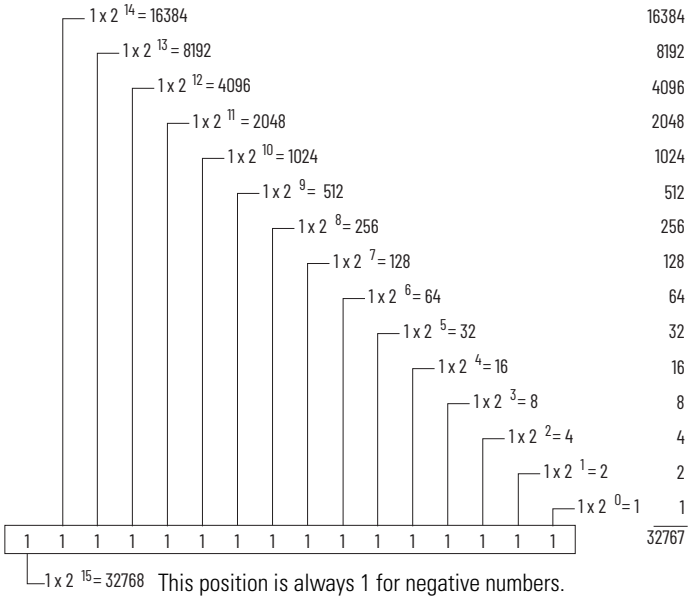
EXAMPLE 0000 1001 0000 1110 = $2^{11}+2^8+2^3+2^2+2^1$ = 2048+256+8+4+2 = 2318

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

Negative Decimal Values

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

Figure F.2 Negative Decimal Values



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

Numerics

A

B

C

D

E

F

R

S

T

U

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

Documentation Feedback

Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

Rockwell Otomasyon Ticaret A.Ş. Kar Plaza İş Merkezi E Blok Kat:6 34752, İçerenköy, İstanbul, Tel: +90 (216) 5698400 EEE Yönetmeliğine Uygundur

Connect with us.

rockwellautomation.com — expanding **human possibility**®

AMERICAS: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000
EUROPE/MIDDLE EAST/AFRICA: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2663 0600
ASIA PACIFIC: Rockwell Automation SEA Pte Ltd, 2 Corporation Road, #04-05, Main Lobby, Corporation Place, Singapore 618494, Tel: (65) 6510 6608
UNITED KINGDOM: Rockwell Automation Ltd., Pitfield, Kiln Farm, Milton Keynes, MK11 3DR, United Kingdom, Tel: (44)(1908) 838-800

Publication 1769-UM014C-EN-P - December 2025
Supercedes Publication 1769-UM014B-EN-P - May 2010