Allen-Bradley

ControlLogix Analog I/O Modules

(Cat. No. 1756-IF16, IF6I, IF8, IR6I, IT6I, OF4, OF6CI, OF6VI, OF8)

User Manual

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. “Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls” (Publication SGI-1.1) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will the Allen-Bradley Company 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, the Allen-Bradley Company cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Allen-Bradley Company with respect to use of information, circuits, equipment, or software described in this manual.

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

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

Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

Important: Identifies information that is especially important for successful application and understanding of the product.

Summary of Changes

Introduction

This release of this document contains new information.

New Information

Chapter 4 contains information on ControlLogix non-isolated analog input modules.

Chapter 7 contains information on ControlLogix non-isolated analog output modules.

Appendix B now contains ladder logic that provide examples of how to do the following:

- Unlatch low and high limit alarms on analog input modules
- Unlatch low, high limit and ramp alarms on analog output modules

Notes:

About This User Manual

What This Preface Contains

This preface describes how to use this manual. The following table describes what this preface contains and its location.

For information about:	See page:
Who Should Use This Manual	P-1
Purpose of This Manual	P-1
Conventions and Related Terms	P-2
Related Products and Documentation	P-4
Rockwell Automation Support	P-4

Who Should Use This Manual

You must be able to program and operate an Allen-Bradley Control**Logix**™ Logix5550 Controller to efficiently use your analog I/O modules.

We assume that you know how to do this in this manual.
If you do not, refer to the Logix5550 Controller user manual, publication 1756-6.5.12, before you attempt to use these modules.

Purpose of This Manual

This manual describes how to install, configure, and troubleshoot your ControlLogix analog I/O module.

Conventions and Related Terms

This manual uses the following conventions:

This icon:	Calls attention to:
TIP	helpful, time-saving information
Example	an example
 For more information . . .	additional information in the publication referenced

Terms

This term:	Means:
Broadcast	Data transmissions to all addresses
Communications format	Format that defines the type of information transferred between an I/O module and its owner controller. This format also defines the tags created for each I/O module
Compatible match	An electronic keying protection mode that requires the physical module and the module configured in the software to match according to vendor, catalog number and major revision. In this case, the minor revision of the module must be greater than or equal to that of the configured slot
Connection	The communication mechanism from the controller to another module in the control system
ControlBus	The backplane used by the 1756 chassis
Coordinated System Time (CST)	Timer value which is kept synchronized for all modules within a single ControlBus chassis. The CST is a 64 bit number with µs resolution
Direct Connection	An I/O connection where the controller establishes an individual connection with I/O modules
Disable keying	Option that turns off all electronic keying to the module. Requires no attributes of the physical module and the module configured in the software to match
Download	The process of transferring the contents of a project on the workstation into the controller
Electronic keying	A system feature which makes sure that the physical module attributes are consistent with what was configured in the software
Exact match	An electronic keying protection mode that requires the physical module and the module configured in the software to match identically, according to vendor, catalog number, major revision and minor revision

Field side	Interface between user field wiring and I/O module
Inhibit	A ControlLogix process that allows you to configure an I/O module but prevent it from communicating with the owner controller. In this case, the controller does not establish a connection
Interface module (IFM)	A prewired removable terminal block (RTB)
Listen-only connection	An I/O connection that allows a controller to monitor I/O module data without owning the module
Major revision	A module revision that is updated any time there is a functional change to the module resulting in an interface change with software
Minor revision	A module revision that is updated any time there is a change to the module that does not affect its function or software user interface (e.g. bug fix)
Multicast	Data transmissions which reach a specific group of one or more destinations
Multiple owners	A configuration set-up where multiple owner controllers use exactly the same configuration information to simultaneously own an input module
Network update time (NUT)	The smallest repetitive time interval in which the data can be sent on a ControlNet network. The NUT may be configured over the range from 2ms to 100ms using RSNetWorx
Owner controller	The controller that creates and stores the primary configuration and communication connection to a module
Program mode	In this mode, the controller program is not executing. Inputs are actively producing data. Outputs are not actively controlled and go to their configured program mode state
Remote connection	An I/O connection where the controller establishes an individual connection with I/O modules in a remote chassis
Removable terminal block (RTB)	Field wiring connector for I/O modules
Removal and insertion under power (RIUP)	ControlLogix feature that allows a user to install or remove a module or RTB while power is applied
Requested packet interval (RPI)	A configurable parameter which defines when the module will multicast data
Run mode	In this mode, the controller program is executing Inputs are actively producing data. Outputs are actively controlled
Service	A system feature that is performed on user demand
System side	Backplane side of the interface to the I/O module
Tag	A named area of the controller's memory where data is stored like a variable
Timestamping	ControlLogix process that stamps a change in input, output, or diagnostic data with a time reference indicating when that change occurred

Related Products and Documentation

The following table lists related ControlLogix products and documentation:

Cat. number:	Document title:	Pub. number:
1756-PA72, -PB72	ControlLogix Power Supply Installation Instructions	1756-5.1
1756-A4, -A7, -A10, -A13, -A17	ControlLogix Chassis Installation Instructions	1756-5.2
1756 Series	ControlLogix Module Installation Instructions (Each module has separate document for installation)	1756-5.5, -5.42
1756-L1, -L1M1, -L1M2	Logix5550 Controller User Manual	1756-6.5.12
1756-DHRIO	ControlLogix Data Highway Plus Communication Interface Module User Manual	1756-6.5.2
1756-ENET	ControlLogix Ethernet Communication Interface Module User Manual	1756-6.5.1

If you need more information on these products, contact your local Allen-Bradley integrator or sales office for assistance. For more information on the documentation, refer to the Allen-Bradley Publication Index, publication SD499.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with over 75 sales/support offices, 512 authorized distributors and 260 authorized systems integrators located throughout the United States alone, as well as Rockwell Automation representatives in every major country in the world.

Local Product Support

Contact your local Rockwell Automation representative for:

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

Technical Product Assistance

If you need to contact Rockwell Automation for technical assistance, please review the troubleshooting information in Appendix A first. If the problem persists, then call your local Rockwell Automation representative.

Your Questions or Comments on this Manual

If you find a problem with this manual, please notify us of it on the enclosed Publication Problem Report.

ControlLogix Analog I/O Module Features

Chapter 3

Non-Isolated Analog Voltage/ Current Input Modules (1756-IF16, -IF8)

Chapter 4

Isolated Analog Voltage/ Current Input Module (1756-IF6I)

Chapter 5

Temperature Measuring Analog Modules (1756-IR6I & 1756-IT6I)

Chapter 6

Non-Isolated Analog Output Modules (1756-OF4 & 1756-OF8)

Chapter 7

Isolated Analog Output Modules (1756-OF6CI & 1756-OF6VI)

Chapter 8

Installing the ControlLogix I/O Module

Chapter 9

Configuring the ControlLogix Analog I/O Module

Chapter 10

Calibrating the ControlLogix Analog I/O Modules

Chapter 11

Troubleshooting

Chapter 12

Module Specifications

Appendix A

Using Software Configuration Tags

Appendix B

Using Ladder Logic To Perform Run Time Services and Reconfiguration

Appendix C

Power Supply Sizing Chart

Appendix D

What Are ControlLogix Analog I/O Modules?

What This Chapter Contains

This chapter describes the ControlLogix analog modules and what you must know and do before you begin to use them. The following table describes what this chapter contains and its location.

What are ControlLogix Analog I/O Modules?

ControlLogix analog I/O modules are interface modules that convert analog signals to digital values for inputs and convert digital values to analog signals for outputs.

Using the producer/consumer network model, they can produce information when needed while providing additional system functions.

The following is a list of the features available on ControlLogix Analog I/O modules that allow their use in a wide variety of applications.

- Removal and insertion under power (RIUP) - a system feature that allows you to remove and insert modules while chassis power is applied
- Producer/consumer communications - an intelligent data exchange between modules and other system devices in which each module produces data without having been polled
- Rolling timestamp of data - 15 bit module-specific rolling timestamp with millisecond resolution which indicates when data was sampled/applied. This timestamp may be used to calculate the interval between channel or field side updates

- System timestamp of data - 64 bit system clock places a timestamp on the transfer of data between the module and its owner controller within the local chassis
- IEEE 32 bit floating point or 16 bit integer data formats
- 16 bit input and 13-16 bit output resolution, depending on the output module type
- On-Board Features, such as Scaling to Engineering Units, Alarming, and Under/Overrange Detection
- Calibration - analog I/O modules allow calibration on a channel-by-channel or module-wide basis
- Class I/Division 2, UL, CSA, CE, and FM Agency Certification

Using An Analog Module in the ControlLogix System

An analog I/O module translates an analog signal into, or from, a corresponding digital representation which controllers can easily operate on for control purposes.

A ControlLogix I/O module mounts in a ControlLogix chassis and uses a Removable Terminal Block (RTB) or Interface Module (IFM) to connect all field-side wiring.

Before you install and use your module you should have already:

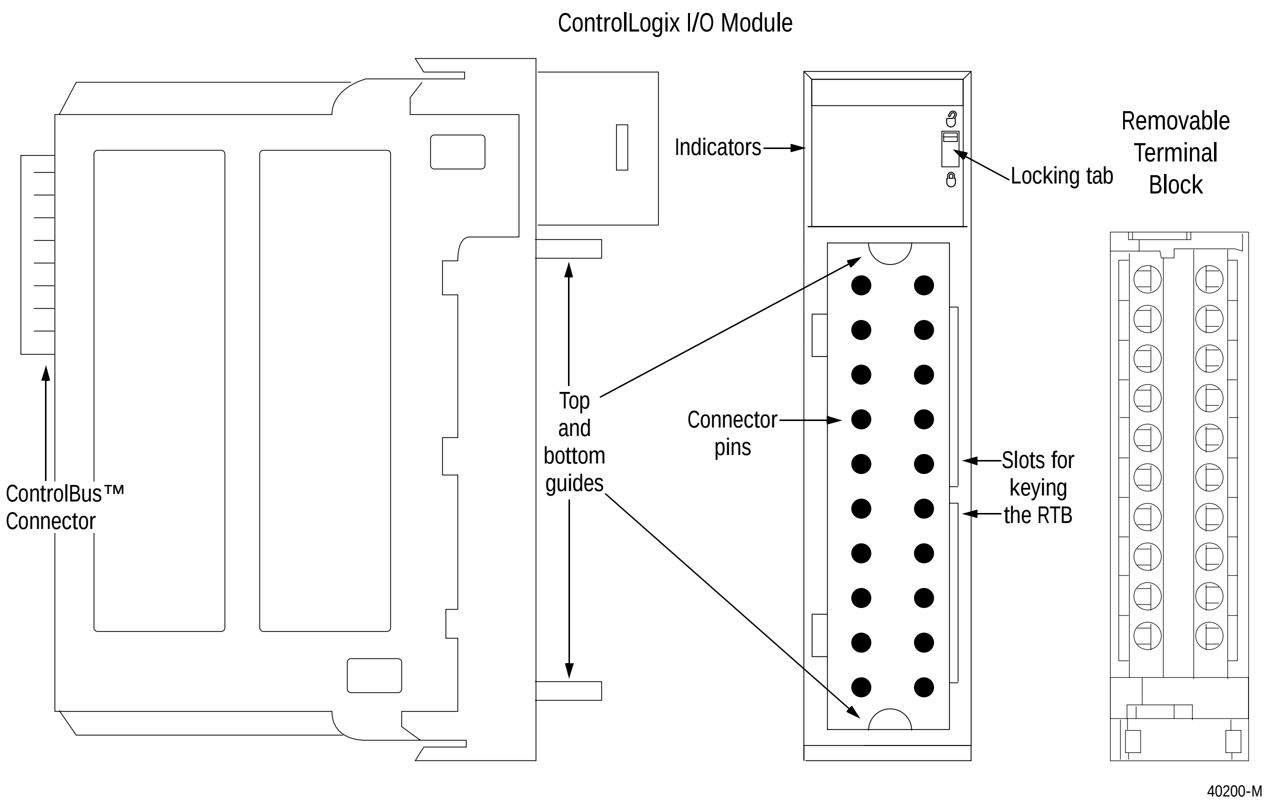
- installed and grounded a 1756 chassis and power supply. To install these products, refer to publications 1756-5.1 and 1756-5.2.
- ordered and received an RTB or IFM and their components for your application.

Important: RTBs are not included with your module purchase.

Table 1.A
Types of ControlLogix Analog I/O

Catalog number:	Description:	RTB:
1756-IF16	16 pt non-isolated analog current/voltage input module	36 pin
1756-IF6I	6 pt isolated analog current/voltage input module	20 pin
1756-IF8	8 pt non-isolated analog current/voltage input module	36 pin
1756-IR6I	6 pt isolated RTD input module	20 pin
1756-IT6I	6 pt isolated Thermocouple/mV input module	20 pin
1756-OF4	4 pt non-isolated analog current/voltage output module	20 pin
1756-OF6CI	6 pt isolated analog current output module	20 pin
1756-OF6VI	6 pt isolated analog voltage output module	20 pin
1756-OF8	8 pt non-isolated analog current/voltage output module	20 pin

Features of the ControlLogix Analog I/O Modules



ControlBus connector - The backplane interface for the ControlLogix system connects the module to the ControlBus backplane.

Connectors pins - Input/output, power and grounding connections are made to the module through these pins with the use of an RTB.

Locking tab - The locking tab anchors the RTB on the module, maintaining wiring connections.

Slots for keying - Mechanically keys the RTB to prevent inadvertently making the wrong wire connections to your module.

Status indicators - Indicators display the status of communication, module health and presence of input/output devices. Use these indicators to help in troubleshooting.

Top and bottom guides - Guides provide assistance in seating the RTB onto the module.

Preventing Electrostatic Discharge

This module is sensitive to electrostatic discharge.

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

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

Removal and Insertion Under Power

These modules are designed to be installed or removed while chassis power is applied.

ATTENTION: When you insert or remove a module while backplane power is applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices causing unintended machine motion or loss of process control.
- causing an explosion in a hazardous environment.

Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connectors. Worn contacts may create electrical resistance that can affect module operation.

Compliance to European Union Directives

If this product bears the CE marking, it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documeNovember 1998nted in a technical construction file:

- EN 50081-2EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, publication 1770-4.1
- Automation Systems Catalog, publication B111

This equipment is classified as open equipment and must be installed (mounted) in an enclosure during operation as a means of providing safety protection.

Chapter Summary and What's Next

In this chapter you learned about:

- what ControlLogix analog I/O modules are
- types of ControlLogix analog I/O modules

Move on to Chapter 2 to learn about analog I/O operation within the ControlLogix system.

Analog I/O Operation Within the ControlLogix System

What This Chapter Contains

This chapter describes how analog I/O modules work within the ControlLogix system. The following table describes what this chapter contains and its location.

Ownership and Connections

Every I/O module in the ControlLogix system must be owned by a Logix5550 Controller to be useful. This owner-controller stores configuration data for every module that it owns and can be local or remote in regard to the I/O module's position. The owner sends the I/O module configuration data to define the module's behavior and begin operation within the control system. Each ControlLogix I/O module must continuously maintain communication with its owner to operate normally.

Typically, each module in the system will have only 1 owner. Input modules can have more than 1 owner. Output modules, however, are limited to a single owner. For more information on the increased flexibility provided by multiple owners and the ramifications of using multiple owners, see page 2-10.

Using RSNetWorx and RSLogix 5000

The I/O configuration portion of RSLogix5000 generates the configuration data for each I/O module in the control system, whether the module is located in a local or remote chassis. A remote chassis, also known as networked, contains the I/O module but not the module's owner controller.

Configuration data is transferred to the controller during the program download and subsequently transferred to the appropriate I/O modules.

I/O modules in the same chassis as the controller are ready to run as soon as the configuration data has been downloaded. You must run RSNetWorx to enable I/O modules in the networked chassis.

Running RSNetWorx transfers configuration data to networked modules and establishes a Network Update Time (NUT) for ControlNet that is compliant with the desired communications options specified for each module during configuration.

If you are not using I/O modules in a networked chassis, running RSNetWorx is not necessary. However, anytime a controller references an I/O module in a networked chassis, RSNetWorx must be run to configure ControlNet. Follow these general guidelines when configuring I/O modules:

1. Configure all I/O modules for a given controller using RSLogix 5000 and download that information to the controller.

2. If the I/O configuration data references a module in a remote chassis, run RSNetWorx.

Important: RSNetWorx **must** be run whenever a new module is added to a networked chassis. When a module is permanently removed from a remote chassis, we recommend that RSNetWorx be run to optimize the allocation of network bandwidth.

Direct Connections

A **direct connection** is a real-time data transfer link between the controller and the device that occupies the slot that the configuration data references. When module configuration data is downloaded to an owner-controller, the controller attempts to establish a direct connection to each of the modules referenced by the data.

If a controller has configuration data referencing a slot in the control system, the controller periodically checks for the presence of a device there. When a device's presence is detected there, the controller automatically sends the configuration data.

If the data is appropriate to the module found in the slot, a connection is made and operation begins. If the configuration data is not appropriate, the data is rejected and an error message displays in the software. In this case, the configuration data can be inappropriate for any of a number of reasons. For example, a module's configuration data may be appropriate except for a mismatch in electronic keying that prevents normal operation.

The controller maintains and monitors its connection with a module. Any break in the connection, such as removal of the module from the chassis while under power, causes the controller to set fault status bits in the data area associated with the module. The RSLogix 5000 software may monitor this data area to announce the modules' failures.

Input Module Operation

In traditional I/O systems, controllers poll input modules to obtain their input status. Analog input modules in the ControlLogix system are not polled by a controller once a connection is established. The modules multicast their data periodically. Multicast frequency depends on the options chosen during configuration and where in the control system that input module physically resides.

An input module's communication, or multicasting, behavior varies depending upon whether it operates in the local chassis or in a remote chassis. The following sections detail the differences in data transfers between these set-ups.

Input Modules in a Local Chassis

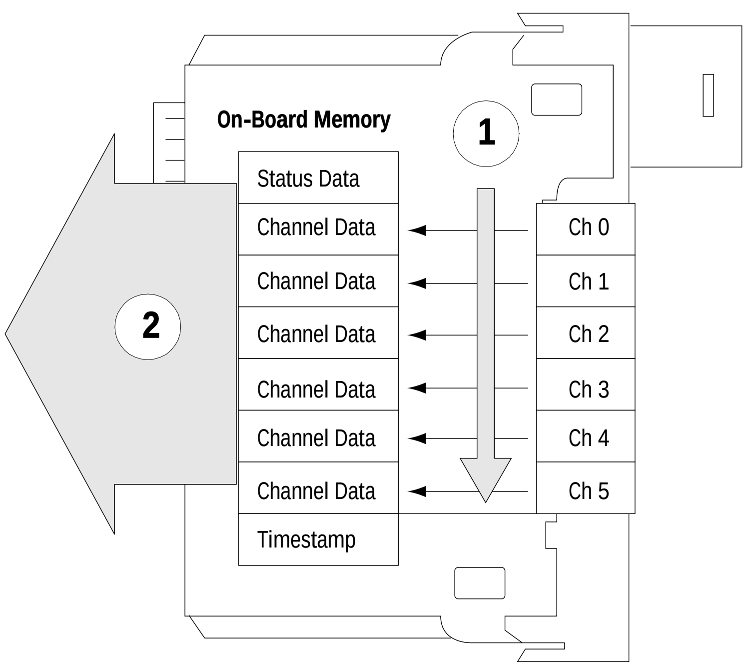
When a module resides in the same chassis as the owner controller, the following two configuration parameters will affect how and when the input module multicasts data:

- Real Time Sample (RTS)
- Requested Packet Interval (RPI)

Real Time Sample (RTS)

This configurable parameter instructs the module to perform the following operations:

1. **scan all** of its input channels and store the data into on-board memory
2. multicast the updated channel data (as well as other status data) to the backplane of the local chassis

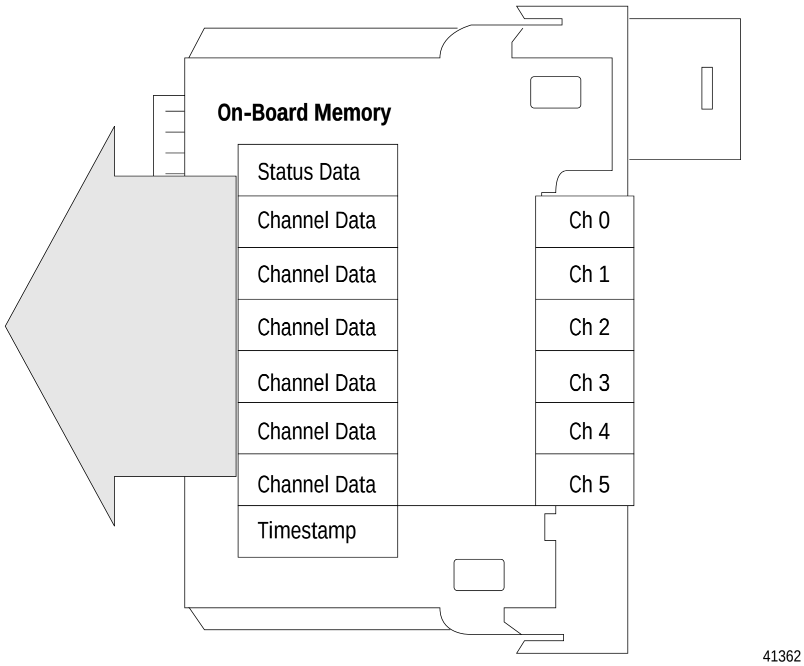


Important: The RTS value is set during the initial configuration using RSLogix 5000. This value can be adjusted anytime.

Requested Packet Interval (RPI)

This configurable parameter also instructs the module to multicast its channel and status data to the local chassis backplane.

The RPI instructs the module to multicast the **current contents** of its on-board memory when the RPI expires, (i.e. the module does not update its channels prior to the multicast).



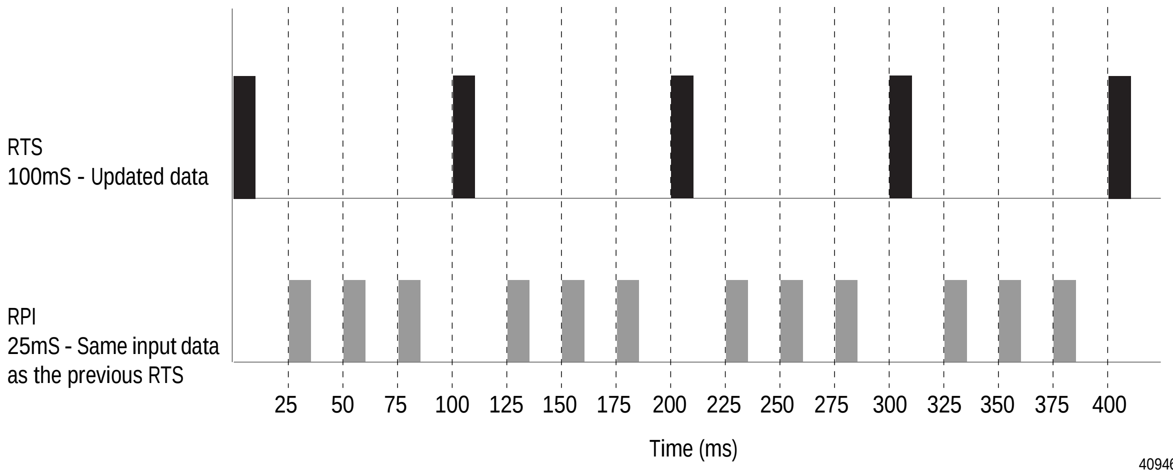
Important: The RPI value is set during the initial module configuration using RSLogix 5000. This value can be adjusted when the controller is in Program mode.

It is important to note that the module will reset the RPI timer each time an RTS is performed. This operation dictates how and when the owner controller in the local chassis will receive updated channel data, depending on the values given to these parameters.

If the RTS value is less than or equal to the RPI, each multicast of data from the module will have updated channel information. In effect, the module is only multicasting at the RTS rate.

If the RTS value is greater than the RPI, the module will multicast at both the RTS rate and the RPI rate. Their respective values will dictate how often the owner controller will receive data and how many multicasts from the module contain updated channel data.

In the example below, the RTS value is 100mS and the RPI value is 25mS. Only every fourth multicast from the module will contain updated channel data.



Input Modules in a Remote Chassis

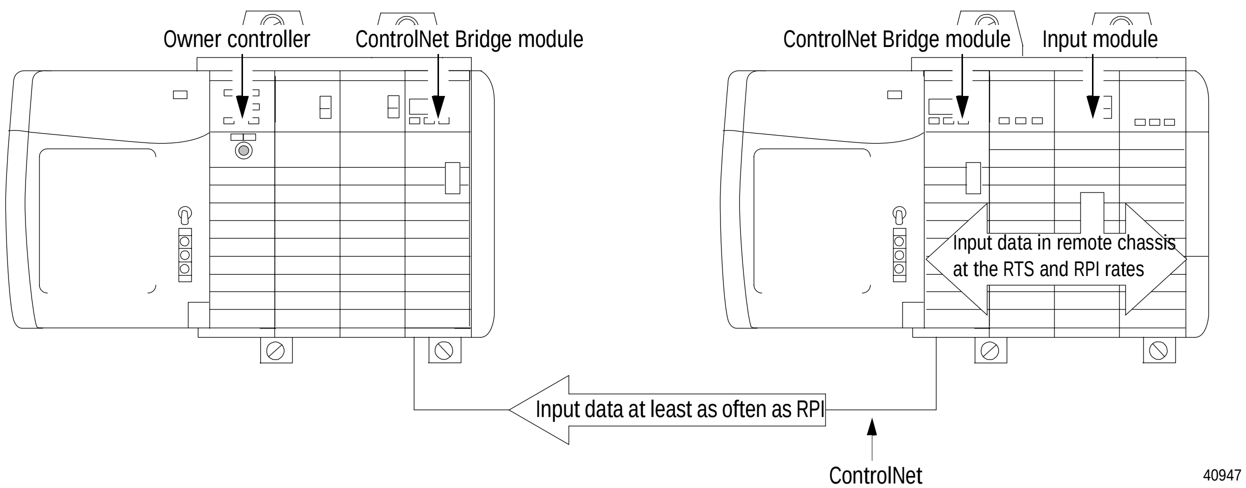
If an input module resides in a networked chassis, the role of the RPI and the module's RTS behavior change slightly with respect to getting data to the owner.

The RPI and RTS intervals still define when the module will multicast data **within its own chassis** (as described in the previous section), but only the value of the RPI determines how often the owner controller will receive it over the network.

When an RPI value is specified for an input module in a remote chassis, in addition to instructing the module to multicast data within its own chassis, the RPI also "reserves" a spot in the stream of data flowing across the ControlNet network.

The timing of this “reserved” spot may or may not coincide with the exact value of the RPI, but the control system will guarantee that the owner controller will receive data **at least as often** as the specified RPI.

Input Module in Remote Chassis with RPI Reserving a Spot in Flow of Data



The “reserved” spot on the network and the module’s RTS are asynchronous to each other. This means there are Best and Worst Case scenarios as to when the owner controller will receive updated channel data from the module in a networked chassis.

Best Case RTS Scenario

In the Best Case scenario, the module performs an RTS multicast with updated channel data just before the “reserved” network slot is made available. In this case, the remotely located owner receives the data almost immediately.

Worst Case RTS Scenario

In the Worst Case scenario, the module performs an RTS multicast just after the “reserved” network slot has passed. In this case, the owner-controller will not receive data until the next scheduled network slot.

TIP

Because it is the RPI and NOT the RTS which dictates when the module’s data will be sent over the network, we recommend the RPI value be set LESS THAN OR EQUAL TO the RTS to make sure that updated channel data is received by the owner controller with each receipt of data.

Output Module Operation

The RPI parameter governs exactly when an analog output module receives data from the owner controller and when the output module echoes data. For more information on data echo, see the feature description in each module-specific chapter.

An owner controller sends data to an analog output module **only at the period specified in the RPI**. Data is NOT sent to the module at the end of the controller's program scan.

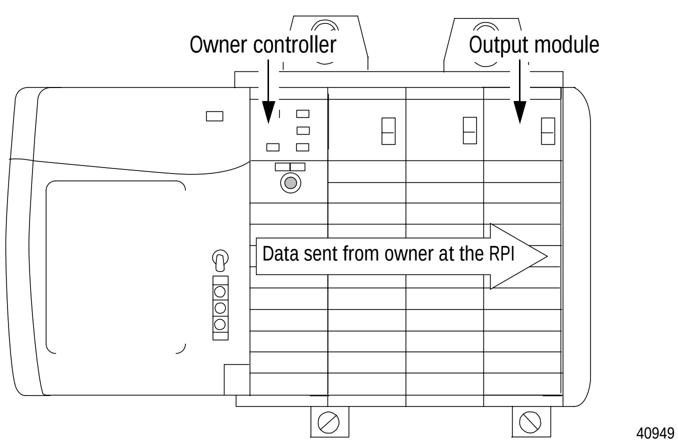
When an analog output module receives **new data** from an owner controller (i.e. every RPI), the module will automatically multicast or "echo" a data value which corresponds to the analog signal present at the output terminals to the rest of the control system. This feature, called **Output Data Echo**, occurs whether the output module is located locally or in a networked chassis with respect to the controller.

Depending on the value of the RPI, with respect to the length of the controller program scan, the output module can receive and "echo" data multiple times during one program scan.

Because it is not dependent on reaching the end of the program to send data, the controller effectively allows the module's output channels to change values multiple times during a single program scan when the RPI is less than the program scan length.

Output Modules in a Local Chassis

When specifying an RPI value for an analog output module, you instruct the controller when to broadcast the output data to the module. If the module resides in the same chassis as the owner controller, the module will receive the data almost immediately after the controller sends it.



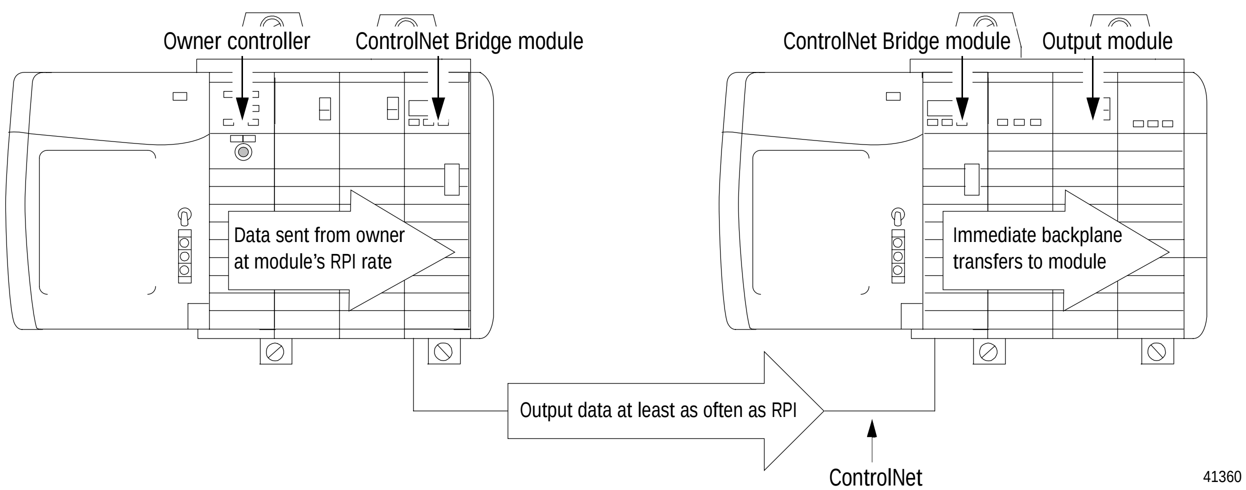
Output Modules in a Remote Chassis

If an output module physically resides in a chassis other than that of the owner controller (i.e. a remote chassis connected via ControlNet), the role of the RPI changes slightly with respect to getting data from the owner controller.

When an RPI value is specified for an output module in a remote chassis, in addition to instructing the controller to multicast the output data within its own chassis, the RPI also “reserves” a spot in the stream of data flowing across the ControlNet network.

The timing of this “reserved” spot may or may not coincide with the exact value of the RPI, but the control system will guarantee that the output module will receive data **at least as often** as the specified RPI.

Output Module in Remote Chassis with RPI Reserving a Spot in Flow of Data



The “reserved” spot on the network and when the controller sends the output data are asynchronous to each other. This means there are Best and Worst Case scenarios as to when the module will receive the output data from the controller in a networked chassis.

Best Case RPI Scenario

In the Best Case scenario, the controller sends the output data just BEFORE the “reserved” network slot is available. In this case, the remotely located output module receives the data almost immediately.

Worst Case RPI Scenario

In the Worst Case scenario, the controller sends the data just AFTER the "reserved" network slot has passed. In this case, the data will not be received by the module until the next scheduled network slot.

Important: These Best and Worst Case scenarios indicate the time required for output data to transfer from the controller to the module **once the controller has produced it**.

They do not take into account when the module will receive NEW data (updated by the user program) from the controller. That is a function of the length of the user program and its asynchronous relationship with the RPI.

Listen-Only Mode

Any controller in the system can **listen** to the data from any I/O module (e.g. input data or "echoed" output data) even if the controller does not own the module (i.e. it does not have to hold the module's configuration data to listen to the module).

During the I/O configuration process, you can specify one of several 'Listen-Only' modes in the Communication Format field. For more information on Communication Format, see page 10-6.

Choosing a 'Listen-Only' mode option allows the controller and module to establish communications without the controller sending any configuration data. In this instance, another controller owns the module being listened to.

Important: Controllers using the Listen-Only mode continue to receive data multicast from the I/O module as long as a connection between an owner and I/O module is maintained.

If the connection between all owners and the module is broken, the module stops multicasting data and connections to all 'Listening controllers' are also broken.

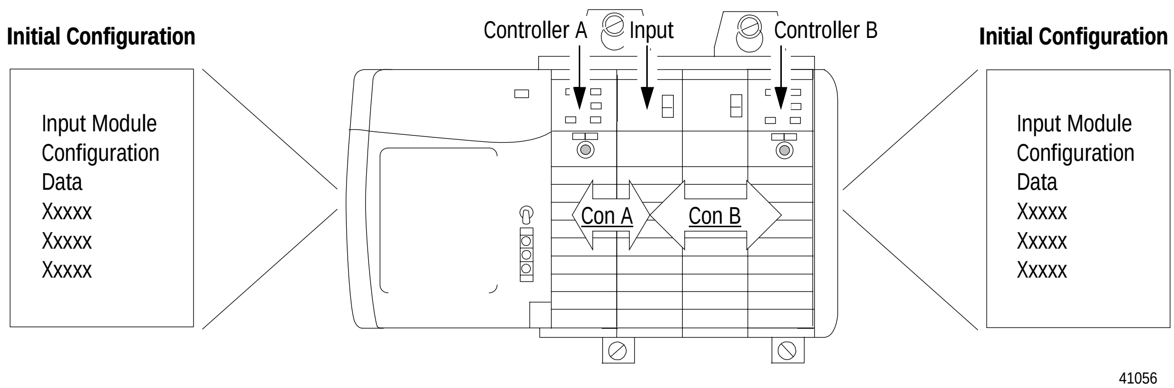
Multiple Owners of Input Modules

Because 'Listening controllers' lose their connections to modules when communications with the owner stop, the ControlLogix system will allow you to define more than one owner for input modules.

Important: Only input modules can have multiple owners. If multiple owners are connected to the same input module, they **must maintain identical configuration** for that module.

In the example below, Controller A and Controller B have both been configured to be the owner of the input module.

Multiple Owners with Identical Configuration Data



When the controllers begin downloading configuration data, both try to establish a connection with the input module. Whichever controller's data arrives first establishes a connection. When the second controller's data arrives, the module compares it to its current configuration data (the data received and accepted from the first controller).

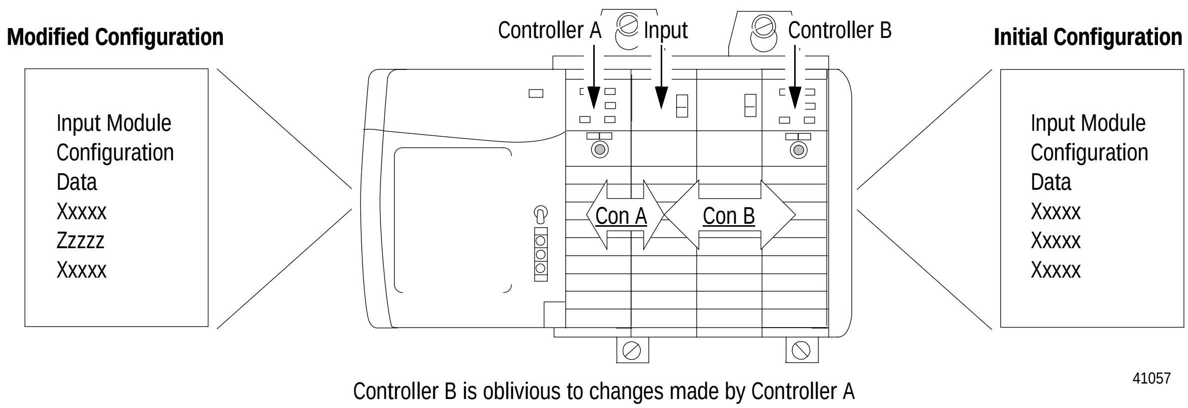
If the configuration data sent by the second controller matches the configuration data sent by the first controller the connection is also accepted. If any parameter of the second configuration data is different from the first, the module rejects the connection and the user is informed by an error in the software.

The advantage of multiple owners over a 'Listen-only' connection is that now either of the controllers can lose the connection to the module and the module will continue to operate and multicast data to the system because of the connection maintained by the other owner controller.

Configuration Changes in an Input Module with Multiple Owners

You must be careful when changing an input module's configuration data in a multiple owner scenario. When the configuration data is changed in one of the owners, for example, Controller A, and sent to the module, that configuration data is accepted as the new configuration for the module. Controller B will continue to listen, unaware that any changes have been made in the module's behavior.

Multiple Owners with Changed Configuration Data



Controller B is oblivious to changes made by Controller A

Important: A pop-up screen in RSLogix 5000 alerts you to the possibility of a multiple owner situation and allows you to inhibit the connection before changing the module's configuration. When changing configuration for a module with multiple owners, we recommend the connection be inhibited.

To prevent other owners from receiving potentially erroneous data, as described above, the following steps **must be followed** when changing a module's configuration in a multiple owner scenario when online:

1. For each owner controller, inhibit the controller's connection to the module, either in the software on the Connection tab or the pop-up screen warning of the multiple owner condition. For detailed information on using RSLogix 5000 to change configuration, see chapter 10.

2. Make the appropriate configuration data changes in the software.

3. Repeat steps 1 and 2 for all owner controllers, making the **exact same changes** in all controllers.

4. Disable the Inhibit box in each owner's configuration.

Chapter Summary and What's Next

In this chapter you learned about:

- ownership and connections
- direct connections
- input module operation
- output module operation

Move to Chapter 3 to learn about ControlLogix Analog I/O Interface and System Design.

Chapter 3

ControlLogix Analog I/O Module Features

What This Chapter Contains

This chapter describes features that are common to all ControlLogix analog I/O modules. The following table describes what this chapter contains and its location.

Determining Input Module Compatibility

ControlLogix analog input modules convert an analog signal of either volts, millivolts, milliamps or ohms that is connected to the module's screw terminals into a digital value.

The digital value which represents the magnitude of the analog signal is then transmitted on the backplane to either a controller or other control entities.

For more information . . .

For more information on compatibility of other Allen-Bradley Company products to ControlLogix analog input modules, see the I/O Systems Overview, publication CIG-2.1.

Determining Output Module Compatibility

ControlLogix output modules convert a digital value that is delivered to the module via the backplane into an analog signal of -10.5 to +10.5 volts or 0 to 21 milliamps.

The digital value represents the magnitude of the desired analog signal. The module converts the digital value into an analog signal and provides this signal on the module's screw terminals.

For more information . . .

For more information on compatibility of other Allen-Bradley Company products to ControlLogix analog output modules, see the I/O Systems Overview, publication CIG-2.1.

Features Common to All Analog I/O Modules

The following features are common to all ControlLogix analog I/O modules:

Removal and Insertion Under Power (RIUP)

All ControlLogix I/O modules may be inserted and removed from the chassis while power is applied. This feature allows greater availability of the overall control system because, while the module is being removed or inserted, there is no additional disruption to the rest of the controlled process.

Module Fault Reporting

ControlLogix analog I/O modules provide both hardware and software indication when a module fault has occurred. Each module has an LED fault indicator and RSLogix 5000 will graphically display this fault and include a fault message describing the nature of the fault. This feature allows you to determine how your module has been affected and what action should be taken to resume normal operation.

For more information on module fault reporting as it relates to specific modules, see the chapter describing that module, either chapter 4, 5, 6, 7 or 8.

Fully Software Configurable

The software uses a custom, easily understood interface to configure the module. All module features are enabled or disabled through the I/O configuration portion of RSLogix 5000.

The user can also use the software to interrogate any module in the system to retrieve serial number, revision information, catalog number, vendor identification, error/fault information, and diagnostic counters.

By eliminating such tasks as setting hardware switches and jumpers, the software makes module configuration easier and more reliable.

Electronic Keying

Instead of using plastic mechanical backplane keys, electronic keying allows the ControlLogix system to control what modules belong in the various slots of a configured system.

During module configuration, you must choose one of the following keying options for your I/O module:

- **Exact match -** all of the parameters described below must match or the inserted module will reject a connection to the controller
- **Compatible module -** all of the parameters described below, except minor revision must match or the inserted module will reject a connection to the controller.
  The minor revision of the physical module must be greater than or equal to that of the configured slot.
- **Disable keying -** the inserted module will not reject a connection to the controller

ATTENTION: Be extremely cautious when using the disable keying option; if used incorrectly, this option can lead to personal injury or death, property damage or economic loss.

When an I/O module is inserted into a slot in a ControlLogix chassis, the module compares the following information for itself to that of the configured slot it is entering:

- Vendor
- Product Type
- Catalog Number
- Major Revision
- Minor Revision

This feature can prevent the inadvertent operation of a control system with the wrong module in the wrong slot.

Access to System Clock for Timestamping Functions

Controllers within the ControlLogix chassis maintain a system clock. You can configure your analog I/O modules to access this clock and timestamp input data or output echo data when the module multicasts to the system. You decide how to timestamp data when you choose a communications format. For more information on choosing a communications format, see page 10-6.

This feature allows for accurate calculations between events to help you identify the sequence of events in either fault conditions or in the course of normal I/O operations. The system clock can be used between multiple modules in the same chassis.

Rolling Timestamp

Each module maintains a rolling timestamp that is unrelated to the CST. The rolling timestamp is a continuously running 15 bit timer that counts in milliseconds.

For input modules, whenever a module scans its channels, it also records the value of the rolling timestamp at that time. The user program can then use the last two rolling timestamp values and calculate the interval between receipt of data or the time when new data has been received.

For output modules, the rolling timestamp value is only updated when new values are applied to the Digital to Analog Converter (DAC).

Producer/Consumer Model

By using the Producer/Consumer model, ControlLogix I/O modules can produce data without having been polled by a controller first. The modules produce the data and any owner or listen-only controller device can decide to consume it.

For example, an input module produces data and any number of processors can consume the data at the same time. This eliminates the need for one processor to send the data to another processor. For a more detailed explanation of this process, see chapter 2.

LED Status Information

Each ControlLogix analog I/O module has LED indicators on the front of the module that allows you to check the module health and operational status of a module.

The following status can be checked with the LED indicators:

- **Calibration status -** display indicates when your module is in the calibration mode.
- **Module status -** display indicates the module's communication status.

For examples of LED indicators on ControlLogix analog I/O modules, see chapter 12.

Full Class I Division 2 Compliance

All ControlLogix analog I/O modules maintain CSA Class I Division 2 system certification. This allows the ControlLogix system to be placed in an environment other than only a 100% hazard free.

Important: Modules should not be pulled under power, nor should a powered RTB be removed, when a hazardous environment is present.

CE/CSA/UL/FM Agency Certification

Any ControlLogix analog I/O modules that have obtained CE/CSA/UL/FM agency certification are marked as such. Ultimately, all analog modules will have these agency approvals and be marked accordingly.

Field Calibration

ControlLogix analog I/O modules allow you to calibrate on a channel-by-channel or module-wide basis. RSLogix 5000 provides a software interface to perform calibration.

To see how to calibrate your module, see chapter 11.

Calibration Bias

You can add this offset directly to the input or output during calibration calculation. The purpose of this feature is to allow you to compensate for any sensor offset errors which may exist, such offset errors are common in thermocouple sensors.

To see how to set the calibration bias, see page 10-10.

Latching of Alarms

The latching feature allows analog I/O modules to latch an alarm in the set position once it has been triggered, even if the condition causing the alarm to occur disappears.

Data Format

Your analog I/O module will multicast data in one of two formats:

- integer - mode uses a 16 bit signed format and allows faster sampling rates while using less memory in the controller but also limits the availability of features on your module
- floating point - mode uses a 32 bit IEEE floating point format

During initial configuration, you must choose a Communications Format. This selection determines what data type you receive from the module. For more information on Communications Formats, see page 10-6.

For a more detailed explanation of Data Formats, as they relate to module resolution and scaling, see the next section.

Module Inhibiting

Inhibiting allows you to write configuration for an I/O module but prevent the module from communicating with the owner controller. In this case, the owner does not establish a connection and configuration is not sent to the module until the connection is uninhibited.

Important: Whenever you inhibit an output module, it enters the program mode and all outputs change to the state configured for the program mode. For example, if an output module is configured so that the state of the outputs got to zero (0) during program mode, whenever that module is inhibited, the outputs will go to zero (0).

Understanding the Relationship Between Module Resolution, Scaling and Data Format

The following three concepts are closely related and must be explained in conjunction with each other:

- Module Resolution
- Scaling
- Data Formats

Module Resolution

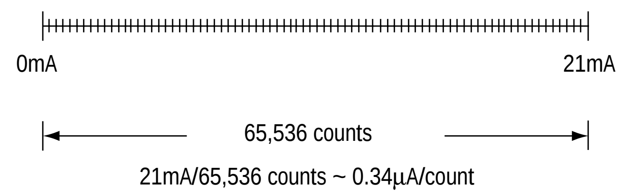
Resolution is the smallest amount of change that the module can detect. Analog input modules are capable of 16 bit resolution. Output modules are capable of 13-16 bit resolution, depending on the module type.

The 16 bits represent 65,536 counts. This total is fixed but the value of each count is determined by the operational range you choose for your module.

For example, if you are using the 1756-IF6I module, your module’s available current range equals 21mA. Divide your range by the number of counts to figure out the value of each count. In this case, one count is approximately 0.34µA.

Important: A module’s resolution is fixed. It will not change regardless of what data format you choose or how you decide to scale your module in floating point mode.

Module resolution



Use the following table to see the resolution for each module’s range.

Table 3.A
Current Values Represented in Engineering Units

Module:	Range:	Number of significant bits:	Resolution:
1756-IF16/IF8	+/- 10.25V 0V - 10.25V 0V - 5.125V 0mA - 20.5mA	16 bits	320µV/count 160µV/count 80µV/count 0.32µA/count
1756-IF6I	+/- 10.5V 0V - 10.5V 0V - 5.25V 0mA - 21mA	16 bits	343µV/count 171µV/count 86µV/count 0.34µA/count
1756-IR6I	1Ω - 487Ω 2Ω - 1000Ω 4Ω - 2000Ω 8Ω - 4020Ω	16 bits	7.7mΩ/count 15mΩ/count 30mΩ/count 60mΩ/count
1756-IT6I	-12mV - 30mV -12mV - 78mV	16 bits	0.7µV/count 1.5µV/count
1756-OF4/OF8	+/- 10.4V 0mA - 21mA	16 bits 15 bits	320µV/count 0.65µA/count
1756-OF6VI	+/- 10.5V	14 bits	1.3mV
1756-OF6CI	0mA - 21mA	13 bits	2.7µA

Important: Because these modules must allow for possible calibration inaccuracies, resolution values represent the available Analog to Digital or Digital to Analog counts over the specified range.

Scaling

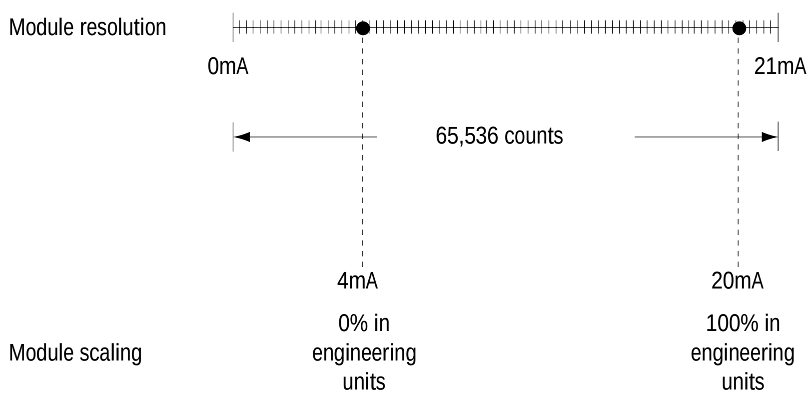
With scaling, you change a quantity from one notation to another. For ControlLogix analog I/O modules, scaling is **only available with the floating point data format**.

When you scale a module, you must choose two points along the module's operating range and apply low and high values to those points.

For example, if you are using the 1756-IF6I module in current mode, the module maintains a 0mA to 21mA range capability. But your application may use a 4mA to 20mA transmitter. You can scale the module to represent 4mA as the low signal and 20mA as the high signal.

Scaling causes the module to return data to the controller so that 4mA returns a value of 0% in engineering units and 20mA returns a value of 100% in engineering units.

Module Resolution Compared to Module Scaling



Module scaling represents the data returned from the module to the controller

Important: In choosing two points for the low and high value of your application, you do not limit the range of the module. The module's range and its resolution remain constant regardless of how you scale it for your application.

The module may operate with values beyond the 4mA to 20mA range. If an input signal beyond the low and high signals is present at the module (e.g. 3mA), that data will be represented in terms of the engineering units set during scaling. The table below shows example values that may appear based the example mentioned above.

Table 3.B
Current Values Represented in Engineering Units

Current:	Engineering units value:
3mA	-6.25%
4mA	0%
12mA	50%
20mA	100%
21mA	106.25%

Data Format as Related to Resolution and Scaling

You can choose one of the following data formats for your application:

- Integer mode
- Floating point mode

Integer mode

This mode provides the most basic representation of analog data. When a module multicasts data in the integer mode, the low and high signals of the input range are fixed.

Important: Scaling is not available in integer mode. The low signal of your application range equals -32,768 counts of resolution while the high signal equals 32,767 counts of resolution.

In integer mode, input modules generate digital signal values that correspond to a range from -32,768 to 32,767 counts of resolution.

Use the following table to convert a generated digital signal to the number of counts.

Table 3.C
Input Signal to User Count Conversion

Input module:	Available range:	Low signal and user counts:	High signal and user counts:
1756-IF16/IF8	+/- 10V	-10.25V -32768 counts	10.25V 32767 counts
	0V - 10V	0V -32768 counts	10.25V 32767 counts
	0V - 5V	0V -32768 counts	5.125V 32767 counts
	0mA - 20mA	0mA -32768 counts	20.58mA 32767 counts
1756-IF6I	+/- 10V	-10.54688V -32768 counts	10.54688V 32767 counts
	0V - 10V	0V -32768 counts	10.54688V 32767 counts
	0V - 5V	0V -32768 counts	5.27344V 32767 counts
	0mA - 20mA	0mA -32768 counts	21.09376mA 32767 counts

Table 3.C
Input Signal to User Count Conversion

Input module:	Available range:	Low signal and user counts:	High signal and user counts:
1756-IR6I	1Ω – 487Ω	0.859068653Ω -32768 counts	507.862Ω 32767 counts
	2Ω – 1000Ω	2Ω -32768 counts	1016.502Ω 32767 counts
	4Ω – 2000Ω	4Ω -32768 counts	2033.780Ω 32767 counts
	8Ω – 4020Ω	8Ω -32768 counts	4068.392Ω 32767 counts
1756-IT6I	-12mV - 30mV	-15.80323mV -32768 counts	31.396mV 32767 counts
	-12mV - 78mV	-15.15836mV -32768 counts	79.241mV 32767 counts

Output modules allow you to generate a analog signal at the screw terminals that correspond to a range from -32, 768 to 32, 767 counts of resolution.

Use the following table to convert a generated digital signal to the number of counts.

Table 3.D
Output Signal to User Count Conversion

Input module:	Available range:	Low signal and user counts:	High signal and user counts:
1756-OF4/OF8	0mA - 20mA	0mA -32768 counts	21.2916mA 32767 counts
	+/- 10V	-10.4336V -32768 counts	10.4336V 32767 counts
1756-OF6CI	0mA - 20mA	0mA -32768 counts	21.074mA 32767 counts
1756-OF6VI	+/- 10V	-10.517V -32768 counts	10.517V 32767 counts

Floating point mode

This data type mode allows you to change the data representation of the selected module. Although the full range of the module does not change, you can **scale** your module to represent I/O data in terms specific for your application.

For example, if you are using the 1756-IF6I module in floating point mode and choose an input range of 0mA to 20mA, the module can use signals within the range of 0mA to 21mA but you can scale the module to represent data between 4mA to 20mA as the low and high signals in engineering units as shown on page 3-8.

For an example of how to define data representation in engineering units through RSLogix 5000, see page 10-10.

Difference Between Integer and Floating Point

The key difference between choosing integer mode or floating point mode is that integer is fixed between -32, 768 and 32, 767 counts and floating point mode provides scaling to represent I/O data in specific engineering units for your application.

For example, the table below shows the difference in the data returned from the 1756-IF6I module to the controller between data formats. In this case, the module uses the 0mA-20mA input range with 0mA scaled to 0% and 20mA scaled to 100%, as shown in the graphic on page 3-8.

Table 3.E
Difference Between Data Formats in Applications Using the 1756-IF6I Module and An Input Range of 0mA to 20mA

Signal value:	Fixed number of counts in integer mode:	Data representation in floating point mode (Eng. units):
0mA	-32768 counts	-25%
4mA	-21003 counts	0%
12mA	2526 counts	50%
20mA	29369 counts	100%
21mA	32767 counts	106.25%

Chapter Summary and What's Next

In this chapter you learned about using features common to all ControlLogix analog I/O modules

Move to Chapter 4 to learn about non-isolated analog input modules.

Non-Isolated Analog Voltage/Current Input Modules (1756-IF16, -IF8)

What This Chapter Contains

This chapter describes features specific to ControlLogix non-isolated analog voltage/current input modules. The following table describes what this chapter contains and its location.

The 1756-IF16 and -IF8 modules support the features described in this chapter.

In addition to the features described in this chapter, the non-isolated analog voltage/current input modules support all features described in chapter 3.

The following table lists which additional features your non-isolated analog voltage/current input modules support and the page of the description of each feature.

Table 4.A
Additional Features Supported by the 1756-IF16 and 1756-IF8 Modules

Feature:	Page of description:
Removal and Insertion Under Power (RIUP)	3-2
Module Fault Reporting	3-2
Fully Software Configurable	3-2
Electronic Keying	3-3
Timestamping	3-4
Producer/Consumer Model	3-4
LED Status Information	3-5
Full Class I Division 2 Compliance	3-5
Multiple Choices of Data Format	3-6
On-Board Calibration	3-5
Alarm Latching	3-6
Scaling	3-9

Choosing a Wiring Method

The 1756-IF16 and 1756-IF8 modules support the following three wiring methods:

- Single-ended mode
- Differential mode
- High speed differential mode

After determining which wiring method you will use on your module, you must inform the system of that choice when you choose a Communications Format, as described on page 10-5.

For examples of each wiring format on the 1756-IF16 and 1756-IF8, see page 4-20 and page 4-25.

Single-Ended Wiring Method

Single-ended wiring compares one side of the signal input to signal ground. This difference is used by the module in generating digital data for the controller.

When using the single-ended wiring method, all input devices are tied to a common ground. In addition to the common ground, the use of single-ended wiring maximizes the number of usable channels on the module (8 channels for 1756-IF8 module & 16 channels for the 1756-IF16).

Differential Wiring Method

The differential wiring method is recommended for applications in which it is advantageous or required to have separate signal pairs or a common ground is not available. Differential wiring is recommended for environments where improved noise immunity is needed.

Important: This wiring method allows use of only half a module's channels. For example, you can only use 8 channels on the 1756-IF16 module and 4 channels on the 1756-IF8 module.

High Speed Mode Differential Wiring Method

You can configure the 1756-IF16 and 1756-IF8 modules for a high speed mode that will give you the fastest data updates possible. When using the high speed mode, remember the following conditions:

- This mode uses the differential wiring method
- This mode only allows use of 1 out of every 4 channels on the module

Update times for applications using the high speed mode can be found in the table on page 4-5.

Choosing a Data Format

Data format determines the format of the data returned from the module to the owner-controller and the features that are available to your application.

You can choose one of the two following data formats:

- Integer mode
- Floating point mode

The following table shows which features are available in each format.

Table 4.B
Features Available in Each Data Format

Data format:	Features available:	Features not available:
Integer mode	Multiple input ranges Module filter Real time sampling	Process alarms Digital filtering Rate alarms Scaling
Floating point mode	All features	See below

Important: When using the **1756-IF16** module in **single-ended** mode (i.e. 16 channel mode) with floating point data format, **process alarms and rate alarms** are **not available**.

This condition exists only when the 1756-IF16 is wired for single-ended mode. The 1756-IF8 is not affected.

Features Specific to Non-Isolated Analog Input Modules

The following features are available on ControlLogix non-isolated input modules.

Multiple Input Ranges

You can select from a series of operational ranges for **each channel** on your module. The range designates the minimum and maximum signals that are detectable by the module.

Table 4.C
Possible Input Ranges

Module:	Possible ranges:
1756-IF16 and 1756-IF8	-10 to 10V 0 to 5V 0 to 10V 0 to 20mA

For an example of how to choose an input range for your module, see chapter 10.

Module Filter

The module filter is a built-in feature of the Analog-to-Digital convertor which attenuates the input signal beginning at the specified frequency. This feature is used on a module-wide basis.

The module will attenuate the selected frequency by approximately -3dB or 0.707 of the applied amplitude. This selected frequency is also called the bandwidth of the module.

An input signal with frequencies above the selected frequency will be attenuated more while frequencies below the selection will receive no attenuation.

In addition to frequency rejection, a by-product of the filter selection is the minimum sample rate (RTS) that is available. For example, the 1000Hz selection will not attenuate any frequencies less than 1000Hz but will allow sampling of all 16 channels within 18ms. But the 10Hz selection will reject all frequencies above 10Hz and will only allow sampling all 16 channels within 488ms.

Important: 60Hz is the default setting for the module filter.

Use the table below to choose a module filter setting.

Table 4.D
Module Filter Selections with Associated Performance Data

Module Filter Setting (-3dB)[1, 2]	Wiring Mode	10Hz	50Hz	60Hz (Default)	100Hz	250Hz	1000Hz
Minimum Sample Time (RTS) Integer Mode	SE Diff. HS Diff.	488ms 244ms 122ms	88ms 44ms 22ms	88ms 44ms 22ms	56ms 28ms 14ms	28ms 14ms 7ms	16ms 8ms 5ms
Minimum Sample Time (RTS) Floating Point Mode	SE Diff. HS Diff.	488ms 244ms 122ms	88ms 44ms 22ms	88ms 44ms 22ms	56ms 28ms 14ms	28ms 14ms 7ms	18ms 11ms 6ms
Effective Resolution		16 bits	16 bits	16 bits	16 bits	14 bits	12 bits

1 For optimal 50/60Hz noise rejection (>80dB), choose the 10Hz filter.
2 Worst case settling time to 100% of a step change is double the RTS sample times.

To see how to choose a Module Filter, see page 10-10.

Real Time Sampling

This parameter instructs the module to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data. This feature is used on a module-wide basis.

During module configuration, you specify a Real Time Sampling (RTS) period and a Requested Packet Interval (RPI) period. Both of these features instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For more information on Real Time Sampling, see chapter 2. For an example of how to set the RTS rate, see page 10-10.

Underrange/Overrange Detection

This feature detects when the non-isolated input module is operating beyond limits set by the input range. For example, If you are using the 1756-IF16 module in the 0V-10V input range and the module voltage increases to 11V, the Overrange detection detects this condition.

Use the following table to see the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition:

Table 4.E
Low and High Signal Limits on Non-Isolated Input Modules

Input module:	Available range:	Lowest signal in range:	Highest signal in range:
1756-IF16 & 1756-IF8	+/- 10V 0V-10V 0V-5V 0mA-20mA	-10.25V 0V 0V 0mA	10.25V 10.25V 5.125V 20.58mA

Digital Filter

The digital filter smooths input data noise transients for all channels on the module. This feature is used on a **per channel** basis.

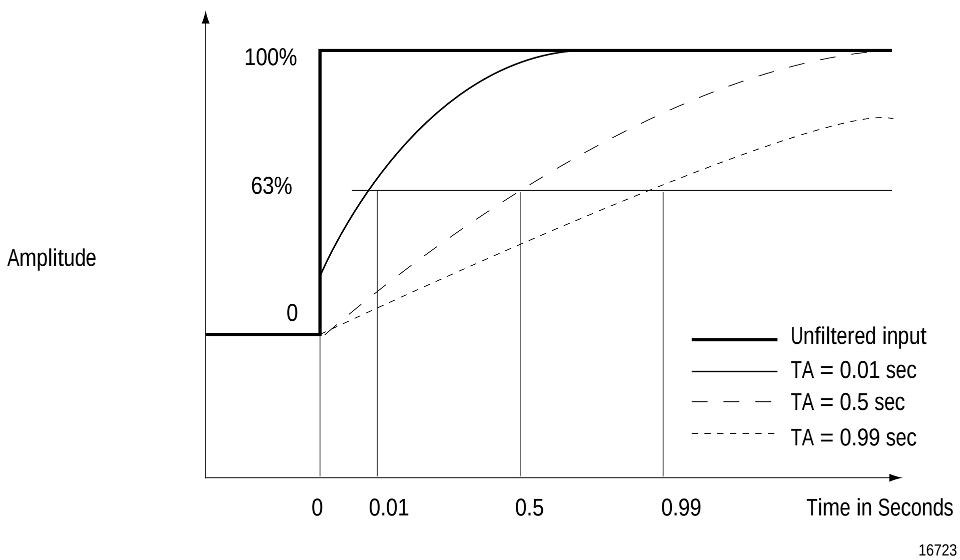
The digital filter value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA}(X_n - Y_n\text{-}1)$$

Yn = present output, filtered peak voltage (PV)
Yn-1 = previous output, filtered PV
Δt = module channel update time (seconds)
TA = digital filter time constant (seconds)
Xn = present input, unfiltered PV

Using a step input change to illustrate the filter response, as shown below, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.



Process Alarms

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

- High high
- High
- Low
- Low low

Important: Process alarms are not available in integer mode or in applications using 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

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

To see how to set Process Alarms, see page 10-10.

Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel.

Important: Rate alarms are not available in integer mode or in applications using 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

For example, if you set the 1756-IF16 (with normal scaling in Volts) to a rate alarm of 1.0 V/S, the rate alarm will only trigger if the difference between measured input samples changes at a rate > 1.0 V/S.

If the module's RTS is 100 ms (i.e. sampling new input data every 100ms) and at time 0, the module measures 5.0 volts and at time 100ms measures 5.08 V, the rate of change is (5.08V - 5.0V) / (100mS) = 0.8 V/S. The rate alarm would not set as the change is less than the trigger point of 1.0V/s.

If the next sample taken is 4.9V, the rate of change is (4.9V-5.08V)/(100mS)=-1.8V/S. The absolute value of this result is > 1.0V/S, so the rate alarm will set. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the Rate Alarm, see page 10-10.

Wire Off Detection

The 1756-IF16 and 1756-IF8 modules will alert you when a **signal wire only** has been disconnected from one of its channels or the RTB has been removed from the module. When a wire off condition occurs for this module, two events occur:

- Input data for that channel changes to a specific scaled value
- A fault bit is set in the owner controller which may indicate the presence of a wire off condition

Because the 1756-IF16 and 1756-IF8 modules can be used in voltage or current applications, differences exist as to how a wire off condition is detected in each application.

Wire Off in Single-Ended Voltage Applications

When a wire off condition occurs for a channel wired for single-ended voltage applications, the following occurs:

- Input data for **odd numbered channels** changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,767 counts in integer mode
- The ChxUnderrange (x=channel number) tag is set to 1
- Input data for **even numbered channels** changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode
- The ChxOverrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix B.

Wire Off in Single-Ended Current Applications

When a wire off condition occurs for a channel wired for single-ended current applications, the following occurs:

- Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode
- The ChxUnderrange (x=channel number) tag is set to 1

Wire Off in Differential Voltage Applications

When a wire off condition occurs for a module channel wired for differential voltage applications, the following occurs:

- Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,768 counts in integer mode
- The ChxOverrange (x=channel number) tag is set to 1

Wire Off in Differential Current Applications

When a wire off condition occurs for a module channel wired for differential current applications, the following occurs:

- Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode
- The ChxUnderrange (x=channel number) tag is set to 1

Important: In current applications, if wire off detection occurs for one of the following reasons:

- because the RTB has been disconnected from the module
- both the signal wire and the jumper wire have been disconnected

the module reacts with the same conditions as described in voltage applications.

For more information about tags in the tag editor, see Appendix B.

Fault and Status Reporting Between the 1756-IF16 Module and Controllers

The 1756-IF16 module multicasts status/fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide an increasing degree of detail as to the specific cause of faults on the module.

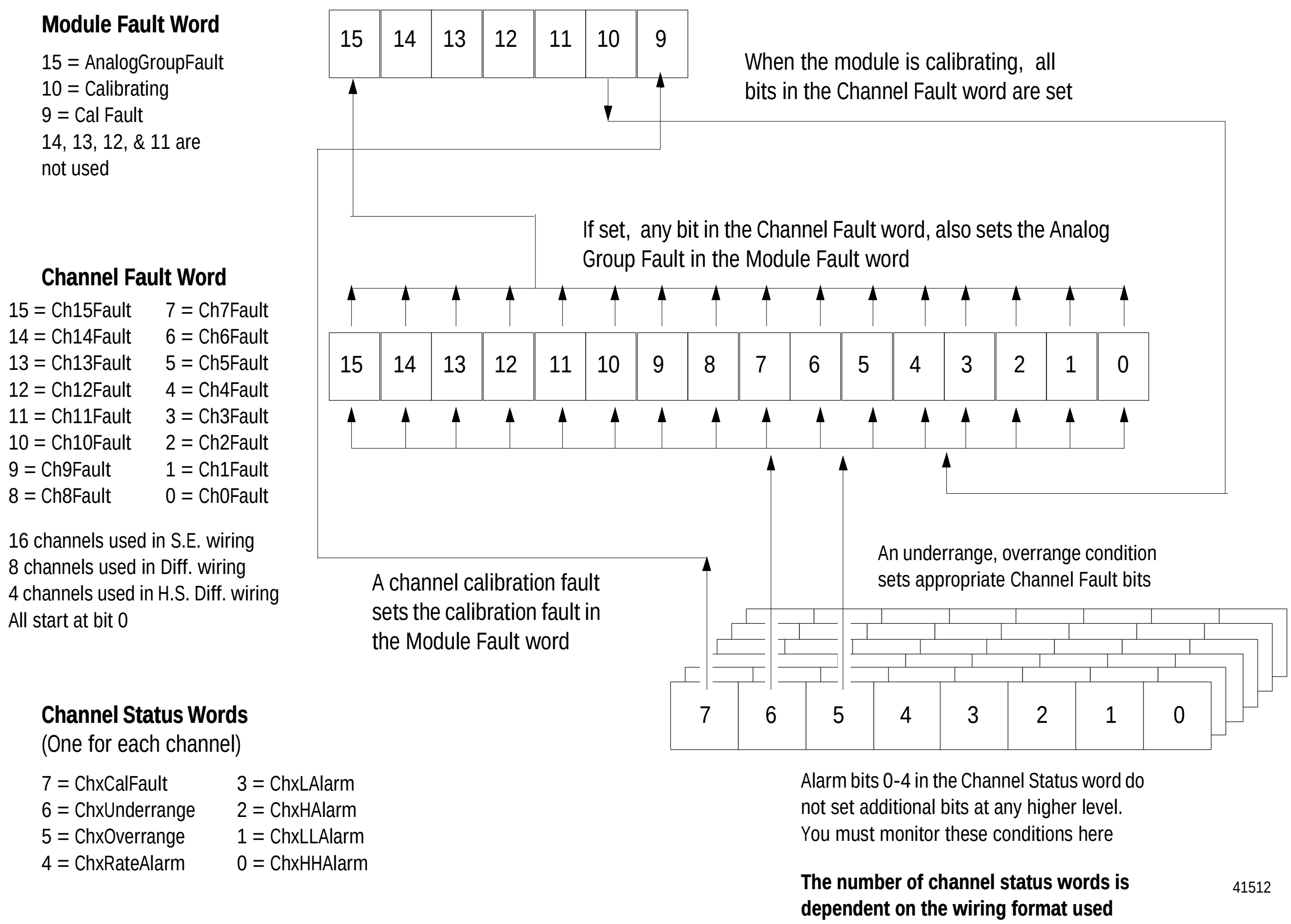
The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Module Fault Word -** This word provides fault summary reporting. Its tag name is ModuleFaults.
- **Channel Fault Word -** This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. When examining the Channel Fault Word for faults, remember the following:
  - 16 channels are used in single-ended wiring
  - 8 channels are used in differential wiring
  - 4 channels are used in high speed differential wiring
  - All bits start with bit 0
- **Channel Status Words -** These words, one per channel, provide individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus.

Important: Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

1756-IF16 Fault Reporting in Floating Point Mode

The following graphic provides an overview of the fault reporting process for the 1756-IF16 module in floating point mode.



1756-IF16 Module Fault Word Bits in Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Analog Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
- **Calibrating -** This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
- **Calibration Fault -** This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

1756-IF16 Channel Fault Word Bits in Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition.

Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

The following conditions set **all** Channel Fault word bits:

- A channel is being calibrated - in this case, the module sets the bits to display the following:
  "FFFF" for single-ended wiring applications
  "00FF" for differential wiring applications
  "000F" for high speed differential wiring applications
- A communications fault occurred between the module and its owner controller. In this case, the bits are set by the controller and set to display "FFFF".

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

1756-IF16 Channel Status Word Bits in Floating Point Mode

Any of the Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

When the Underrange or Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word.

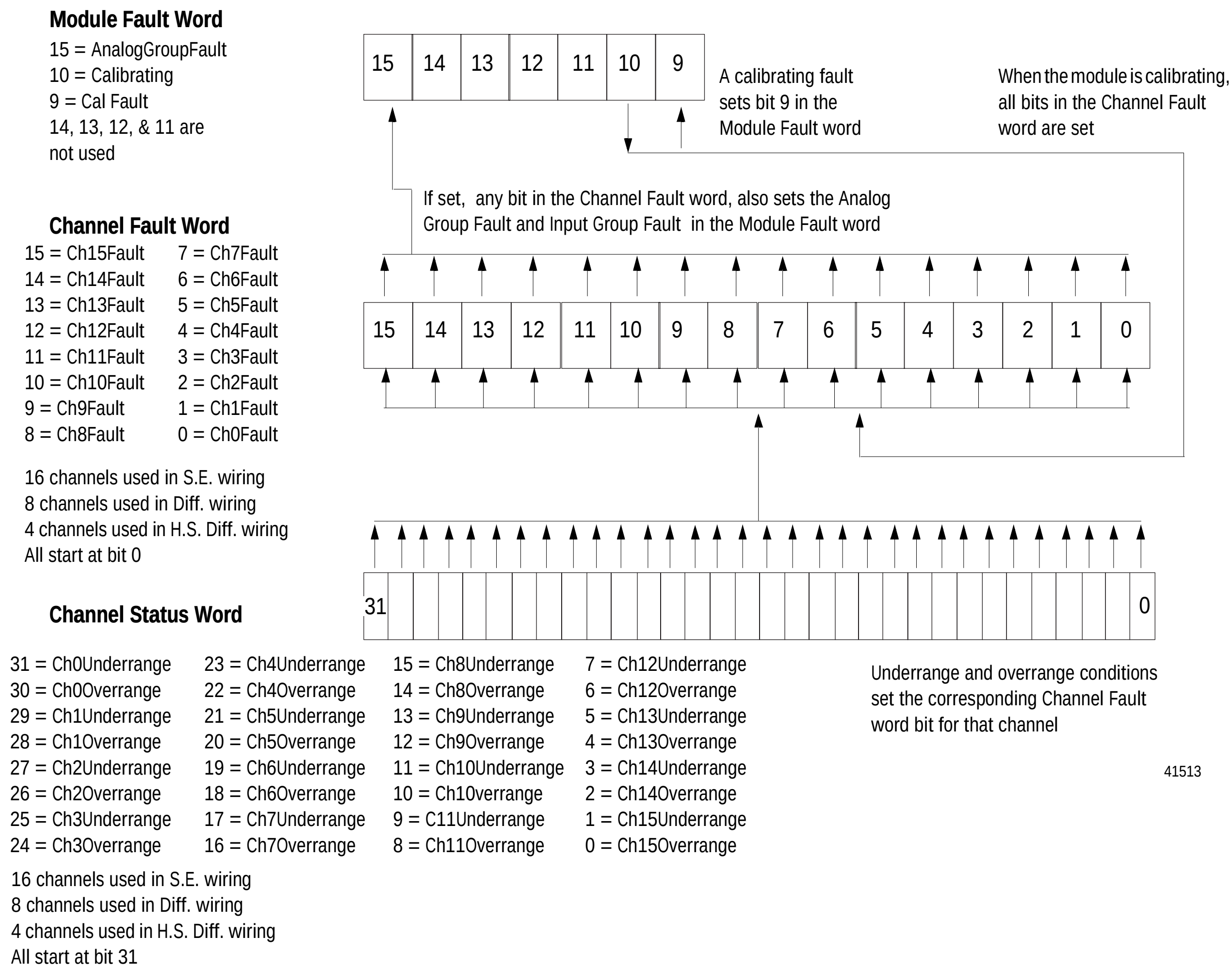
- **ChxCalFault - Bit 7 -** This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 11 in the Module Fault word.
- **UnderRange - Bit 6 -** This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 4.E on page 4-5. This bit also sets the appropriate bit in the Channel Fault word.
- **OverRange - Bit 5 -** This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 4.E on page 4-5. This bit also sets the appropriate bit in the Channel Fault word.

Important: Bits 0-4 are **not available** in floating point single-ended mode.

- **ChxRateAlarm - Bit 4 -** This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched.
- **ChxLAlarm - Bit 3 -** This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxHAlarm - Bit 2 -** This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxLLAlarm - Bit 1 -** This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.
- **ChxHHAlarm - Bit 0 -** This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.

1756-IF16 Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process for the 1756-IF16 module in integer mode.



1756-IF16 Module Fault Word Bits in Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode, see page 4-11.

1756-IF16 Channel Fault Word Bits in Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode, see page 4-12.

1756-IF16 Channel Status Word Bits in Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.

  Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word will activate if a channel is not properly calibrated.
- There is one 32 bit Channel Status word for all IF16 channels.

Fault and Status Reporting Between the 1756-IF8 Module and Controllers

The 1756-IF8 module multicasts status/fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide an increasing degree of detail as to the specific cause of faults on the module.

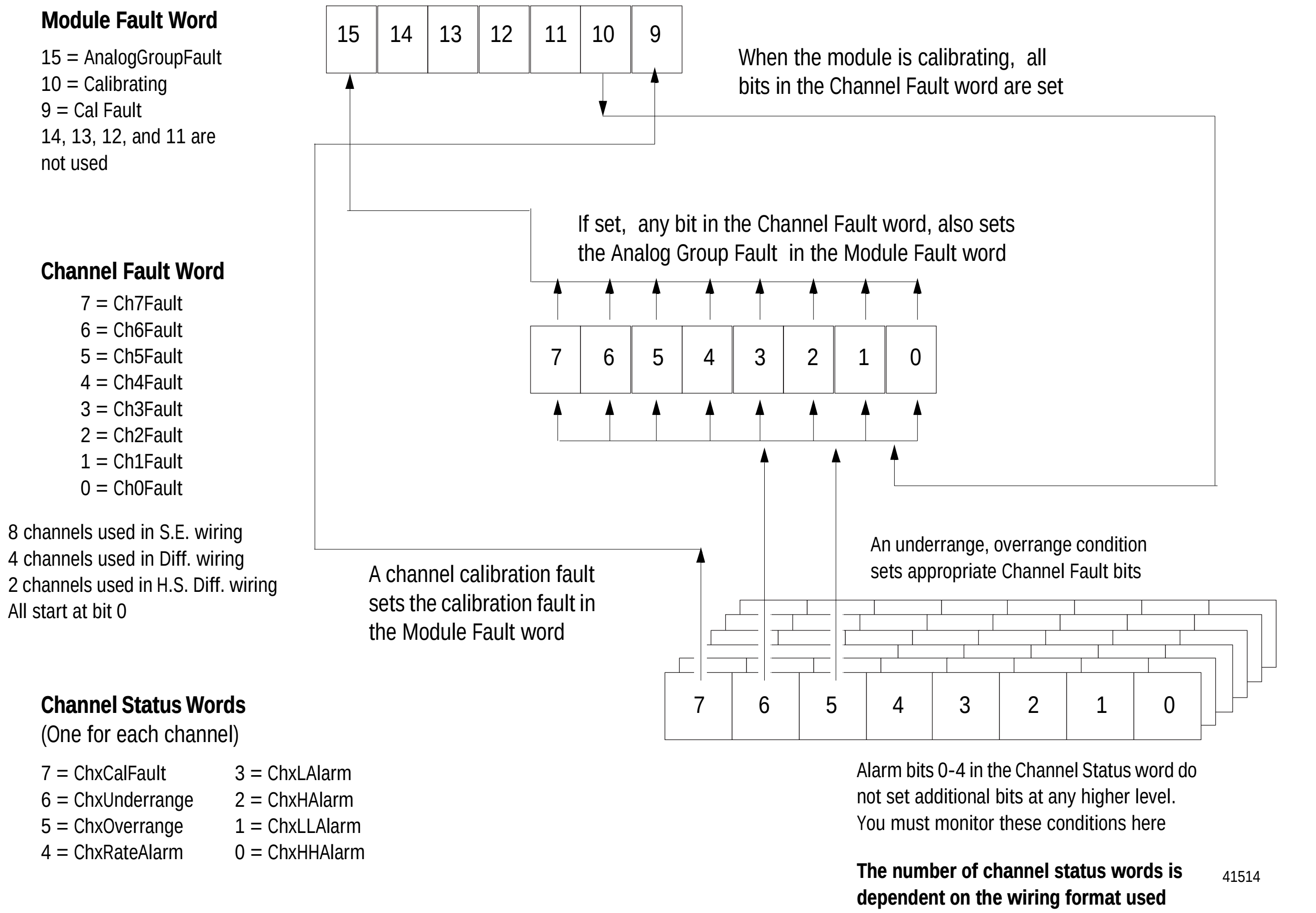
The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Module Fault Word -** This word provides fault summary reporting. Its tag name is ModuleFaults.
- **Channel Fault Word -** This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. When examining the Channel Fault Word for faults, remember the following:
  8 channels are used in single-ended wiring
  4 channels are used in differential wiring
  2 channels are used in high speed differential wiring
  All bits start with bit 0
- **Channel Status Words -** This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus.

Important: Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

1756-IF8 Fault Reporting in Floating Point Mode

The following graphic provides an overview of the fault reporting process for the 1756-IF8 module in floating point mode.


Module Fault Word
15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, and 11 are not used
15 14 13 12 11 10 9
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault in the Module Fault word
Channel Fault Word
7 = Ch7Fault
6 = Ch6Fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
7 6 5 4 3 2 1 0
8 channels used in S.E. wiring
4 channels used in Diff. wiring
2 channels used in H.S. Diff. wiring
All start at bit 0
A channel calibration fault sets the calibration fault in the Module Fault word
An underrange, overrange condition sets appropriate Channel Fault bits
Channel Status Words
(One for each channel)
7 = ChxCalFault
6 = ChxUnderrange
5 = ChxOverrange
4 = ChxRateAlarm
3 = ChxLAlarm
2 = ChxHAlarm
1 = ChxLLAlarm
0 = ChxHHAlarm
7 6 5 4 3 2 1 0
Alarm bits 0-4 in the Channel Status word do not set additional bits at any higher level. You must monitor these conditions here
The number of channel status words is dependent on the wiring format used
41514

1756-IF8 Module Fault Word Bits in Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Analog Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
- **Calibrating -** This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault
  word are set. Its tag name is Calibrating.
- **Calibration Fault -** This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

1756-IF8 Channel Fault Word Bits in Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition.

Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

The following conditions set **all** Channel Fault word bits:

- A channel is being calibrated - in this case, the module sets the bits to display the following:
  "00FF" for single-ended wiring applications
  "000F" for differential wiring applications
  "0003" for high speed differential wiring applications
- A communications fault occurred between the module and its owner controller. In this case, the bits are set by the controller and set to display "FFFF".

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

1756-IF8 Channel Status Word Bits in Floating Point Mode

Any of the Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

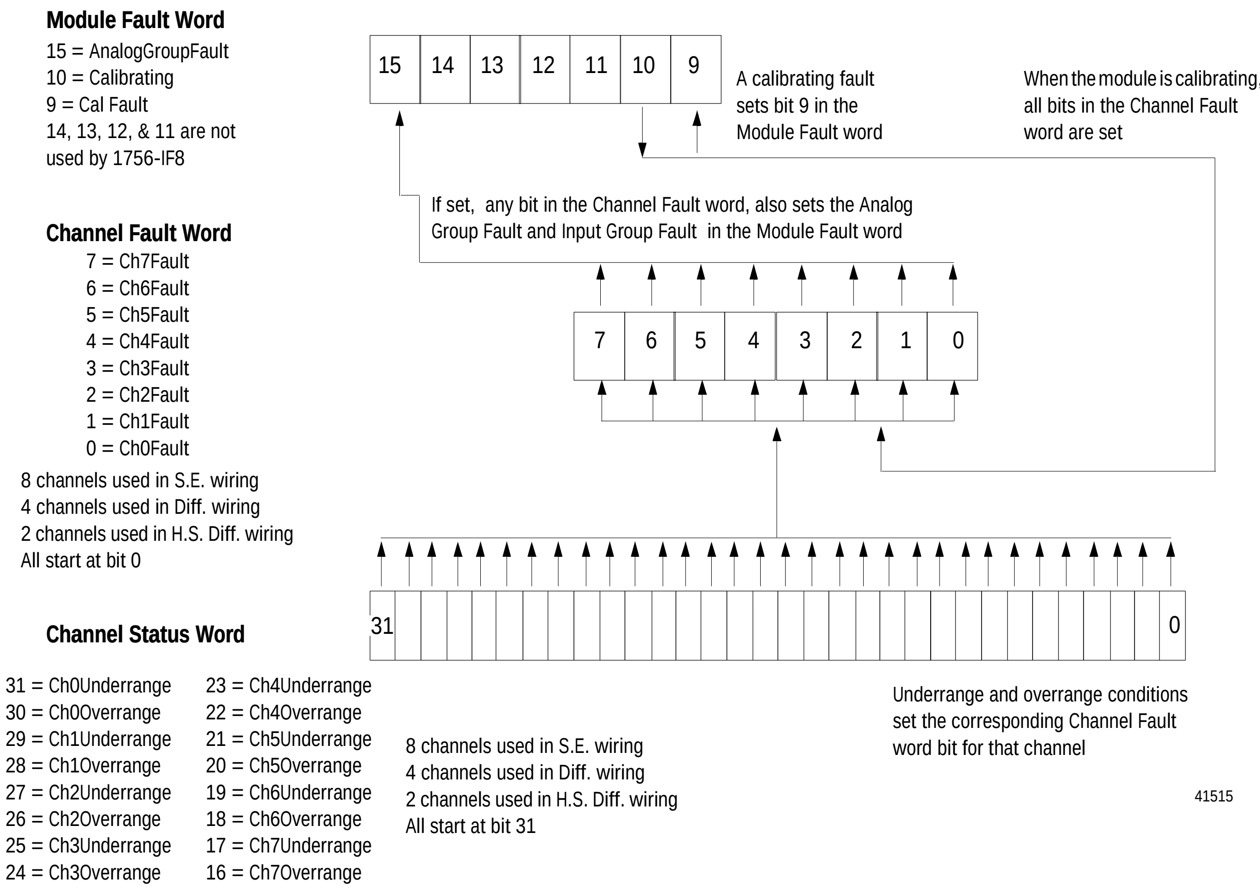
When the Underrange and Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word.

- **ChxCalFault - Bit 7 -** This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 11 in the Module Fault word
- UnderRange - Bit 6 - This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 3.3 on page 3-9. This bit also sets the appropriate bit in the Channel Fault word.
- **OverRange - Bit 5 -** This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 3.3 on page 3-9. This bit also sets the appropriate bit in the Channel Fault word.
- **ChxRateAlarm - Bit 4 -** This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched.
- **ChxLAlarm - Bit 3 -** This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxHAlarm - Bit 2 -** This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxLLAlarm - Bit 1 -** This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.
- **ChxHHAlarm - Bit 0 -** This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.

1756-IF8 Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process for the 1756-IF8 module in integer mode.



1756-IF8 Module Fault Word Bits in Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode, see page 4-17.

1756-IF8 Channel Fault Word Bits in Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode, see page 4-17.

1756-IF8 Channel Status Word Bits in Integer Mode

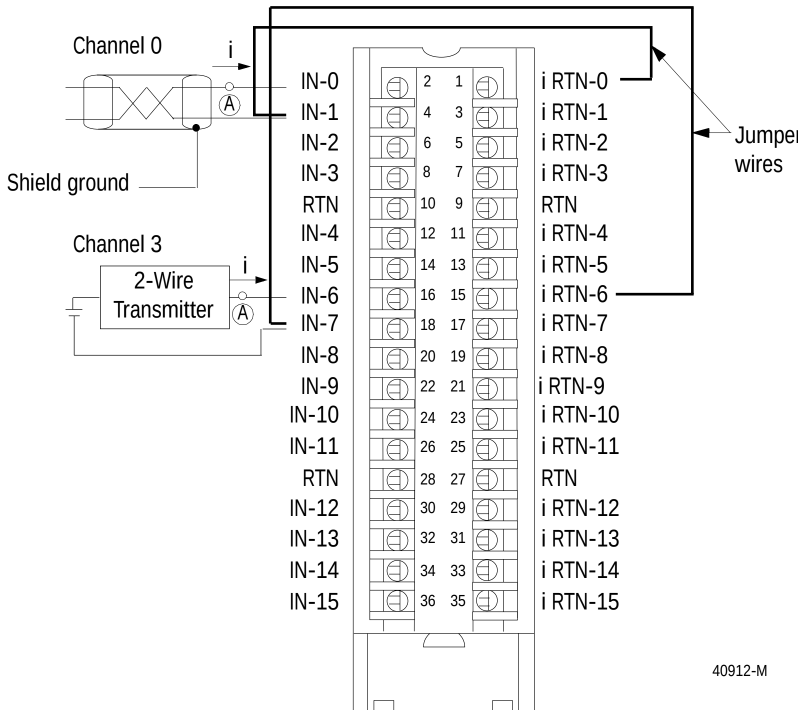
The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.

  Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word will activate if a channel is not properly calibrated.
- There is only one 32 bit Channel Status word for all 8 channels.

1756-IF16 Module Wiring Examples and Specifications

1756-IF16 Differential Current Wiring Example



NOTES: Use the following chart when wiring your module in differential mode

This channel:	Uses these terminals:	This channel:	Uses these terminals:
Channel 0	IN-0 (+), IN-1 (-) & i RTN-0	Channel 4	IN-8 (+), IN-9 (-) & i RTN-8
Channel 1	IN-2 (+), IN-3 (-) & i RTN-2	Channel 5	IN-10 (+), IN-11 (-) & i RTN-10
Channel 2	IN-4 (+), IN-5 (-) & i RTN-4	Channel 6	IN-12 (+), IN-13 (-) & i RTN-12
Channel 3	IN-6 (+), IN-7 (-) & i RTN-6	Channel 7	IN-14 (+), IN-15 (-) & i RTN-14

All terminals marked RTN are connected internally.

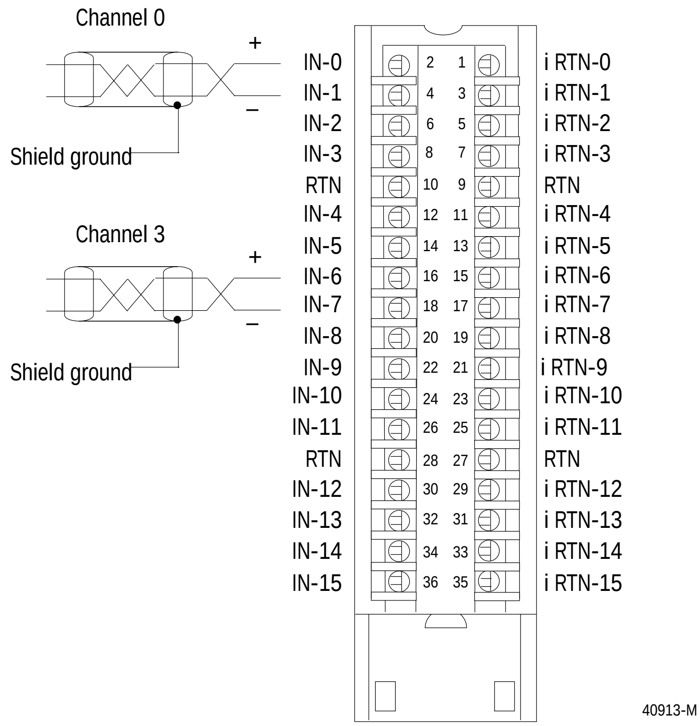
A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.

If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

Place additional loop devices (e.g. strip chart recorders, etc.) at either A location.

Important: When operating in 4 channel, **high speed mode**, only use channels 0, 2, 4 and 6.

1756-IF16 Differential Voltage Wiring Example



NOTES: Use the following chart when wiring your module in differential mode

This channel:	Uses these terminals:	This channel:	Uses these terminals:
Channel 0	IN-0 (+) & IN-1 (-)	Channel 4	IN-8 (+) & IN-9 (-)
Channel 1	IN-2 (+) & IN-3 (-)	Channel 5	IN-10 (+) & IN-11 (-)
Channel 2	IN-4 (+) & IN-5 (-)	Channel 6	IN-12 (+) & IN-13 (-)
Channel 3	IN-6 (+) & IN-7 (-)	Channel 7	IN-14 (+) & IN-15 (-)

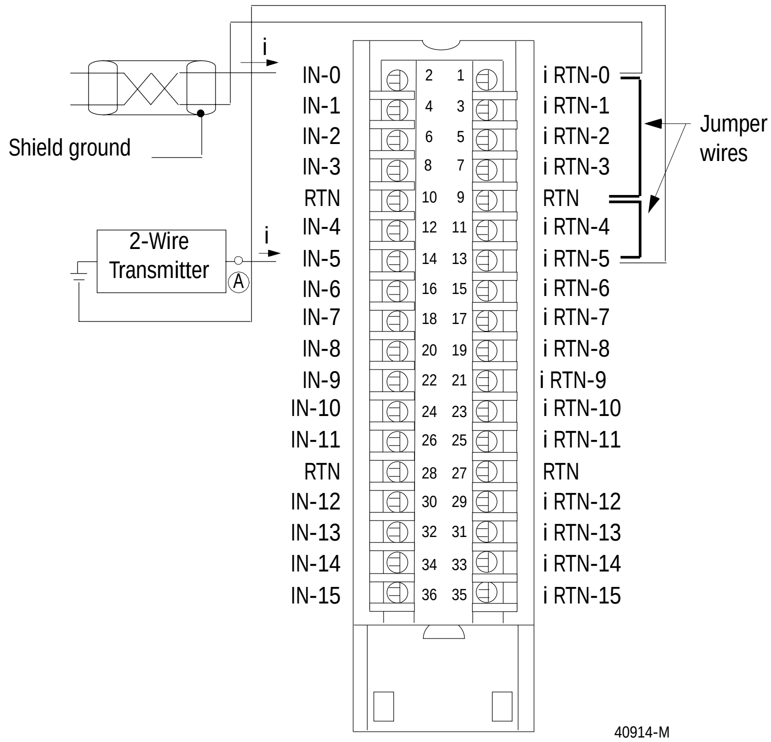
All terminals marked RTN are connected internally

If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module’s accuracy.

Terminals marked RTN or iRTN are not used for differential voltage wiring.

Important: When operating in 4 channel, **high speed mode**, only use channels 0, 2, 4 and 6.

1756-IF16 Single-Ended Current Wiring Example



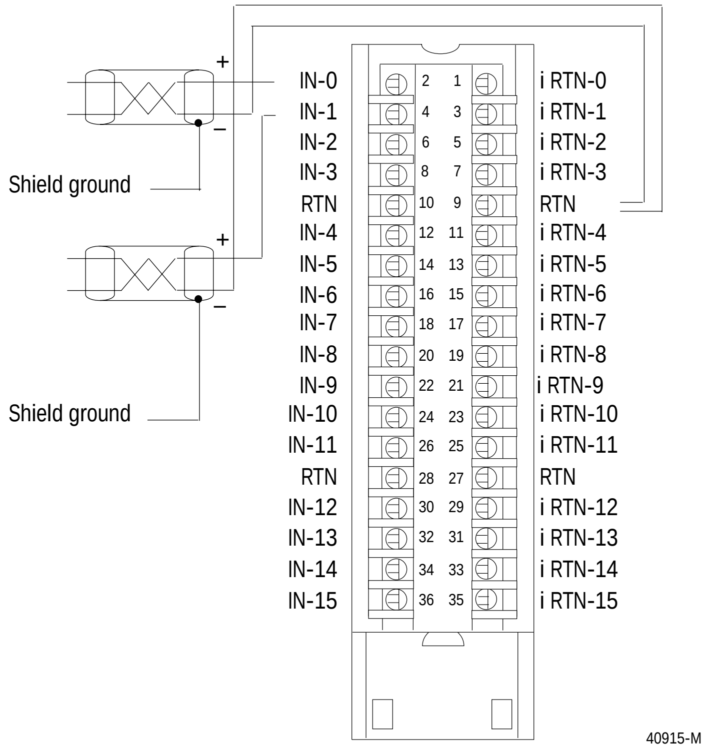
NOTES: All terminals marked RTN are connected internally.

For current applications, all terminals marked iRTN must be wired to terminals marked RTN.

A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.

Place additional loop devices (e.g. strip chart recorders, etc.) at the A location.

1756-IF16 Single-Ended Voltage Wiring Example



NOTES: All terminals marked RTN are connected internally.

Terminals marked iRTN are not used for single-ended voltage wiring.

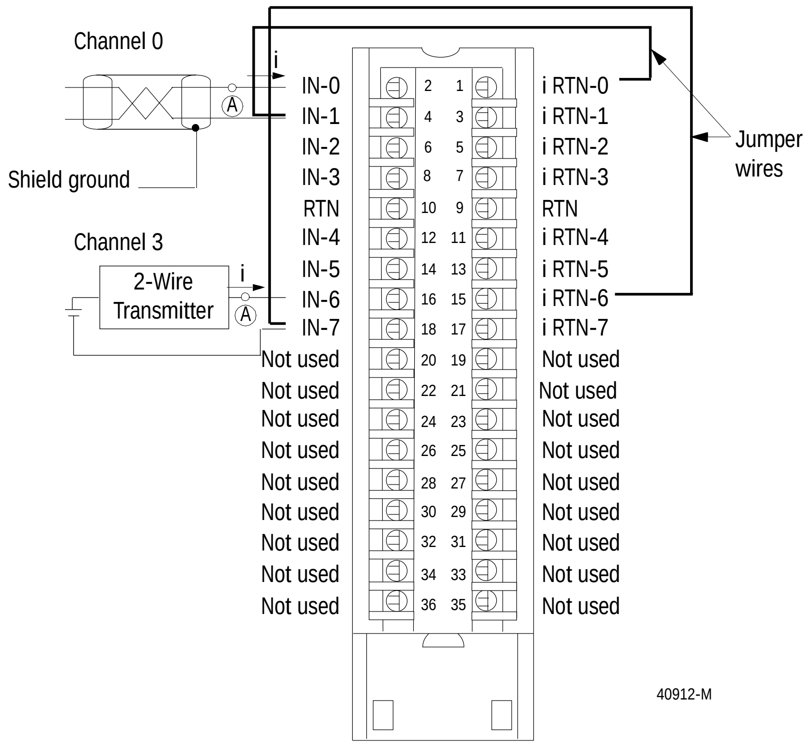
1756-IF16 Specifications

Number of Inputs	16 single ended, 8 differential or 4 differential (high speed)
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 65mA @ 24V dc (2.33W)
Power Dissipation within Module Thermal Dissipation	2.3W voltage 3.9W current 7.84 BTU/hr voltage 13.30 BTU/hr current
Input Range and Resolution	+/-10.25V – 320µV/cnt (15 bits plus sign bipolar) 0-10.25V – 160µV/cnt (16 bits) 0-5.125V – 80µV/cnt (16 bits) 0-20.5mA – 0.32µA/cnt (16 bits)
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance Voltage Current	 >1megΩ 249Ω
Open Circuit Detection Time	Differential voltage - Positive full scale reading within 5s Single Ended/Diff. current - Negative full scale reading within 5s Single Ended voltage - Even numbered channels go to positive full scale reading within 5s, odd numbered channels go to negative full scale reading within 5s
Overvoltage Protection	30V dc voltage 8V dc current
Normal Mode Noise Rejection[1]	>80dB at 50/60Hz
Common Mode Noise Rejection	>100dB at 50/60Hz
Calibrated Accuracy at 25°C	Better than 0.05% of range - voltage Better than 0.15% of range - current
Input Offset Drift with Temperature	90µV/degree C
Gain Drift with Temperature	15 ppm/degree C - voltage 20 ppm/degree C - current
Module Error over Full Temp. Range	0.1% of range - voltage 0.3% of range - current
Module Scan Time for All Channels (Sample Rate Module Filter Dependent)	16 pt single ended - 16-488ms 8 pt differential - 8-244ms 4 pt differential - 5-122ms
Module Conversion Method	Sigma-Delta
Isolation Voltage User to system	 100% tested at 2550 dc for 1s
RTB Screw Torque (Cage clamp)	4.4 inch-pounds (0.4Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
Field Wiring Arm and Housing	36 Position RTB (1756-TBCH or TBS6H)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded [2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	1/8 inch (3.2mm) maximum
Agency Certification (when product or packaging is marked)	Class I Div 2 Hazardous[5] Class I Div 2 Hazardous[5] marked for all applicable directives[6]

1 This specification is module filter dependent.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use this conductor category information for planning conductor routing as described in the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

1756-IF8 Module Wiring Examples and Specifications

1756-IF8 Differential Current Wiring Example - 4 Channels



NOTES: Use the following chart when wiring your module in differential mode

This channel:	Uses these terminals:
Channel 0	IN-0, IN-1 & i RTN-0
Channel 1	IN-2, IN-3 & i RTN-2
Channel 2	IN-4, IN-5 & i RTN-4
Channel 3	IN-6, IN-7 & i RTN-6

All terminals marked RTN are connected internally.

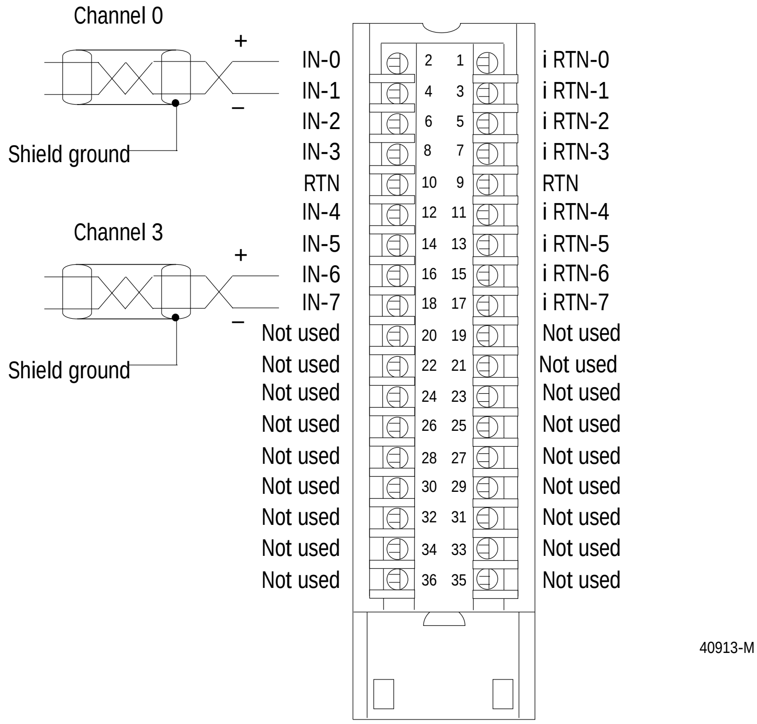
A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.

If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

Place additional loop devices (e.g. strip chart recorders, etc.) at either A location.

Important: When operating in 2 channel, **high speed mode**, only use channels 0, 2.

1756-IF8 Differential Voltage Wiring Example - 4 Channels



NOTES: Use the following chart when wiring your module in differential mode

This channel:	Uses these terminals:
Channel 0	IN-0 & IN-1
Channel 1	IN-2 & IN-3
Channel 2	IN-4 & IN-5
Channel 3	IN-6 & IN-7

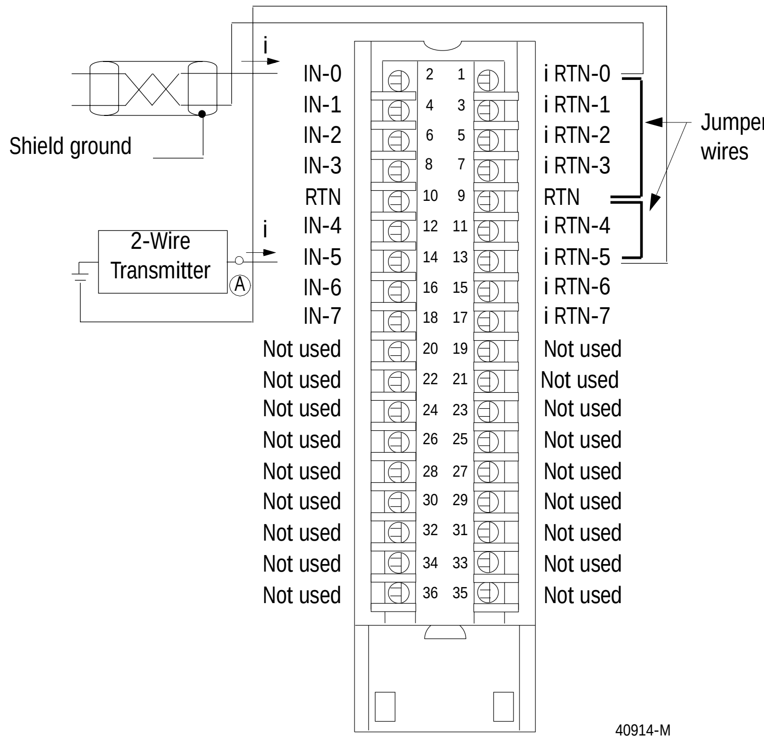
All terminals marked RTN are connected internally

If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

Terminals marked RTN or iRTN are not used for differential voltage wiring.

Important: When operating in 2 channel, **high speed mode**, only use channels 0, 2.

1756-IF8 Single-Ended Current Wiring Example



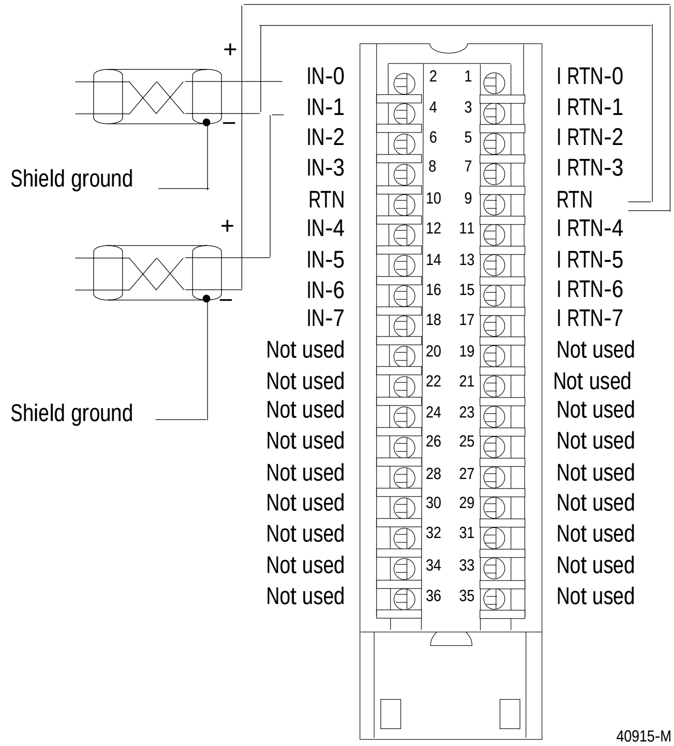
NOTES: All terminals marked RTN are connected internally.

For current applications, all terminals marked iRTN must be wired to terminals marked RTN.

A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.

Place additional loop devices (e.g. strip chart recorders, etc.) at the A location.

1756-IF8 Single-Ended Voltage Wiring Example



NOTES: All terminals marked RTN are connected internally.

Terminals marked iRTN are not used for single-ended voltage wiring.

1756-IF8 Specifications

Number of Inputs	8 single ended, 4 differential or 2 differential (high speed)
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 40mA @ 24V dc (1.73W)
Power Dissipation within Module Thermal Dissipation	1.73W voltage 2.53W current 5.9 BTU/hr voltage 8.6 BTU/hr current
Input Range and Resolution	+/-10.25V - 320µV/cnt (15 bits plus sign bipolar) 0-10.25V - 160µV/cnt (16 bits) 0-5.125V - 80V/µcnt (16 bits) 0-20.5mA - 0.32µA/cnt (16 bits)
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance Voltage Current	 >1megΩ 249Ω
Open Circuit Detection Time	Differential voltage - Positive full scale reading within 5s Single Ended/Diff. current - Negative full scale reading within 5s Single Ended voltage -Even numbered channels go to positive full scale reading within 5s, odd numbered channels go to negative full scale reading within 5s
Overvoltage Protection	30V dc voltage 8V dc current
Normal Mode Noise Rejection[1]	>80dB at 50/60Hz
Common Mode Noise Rejection	>100dB at 50/60Hz
Calibrated Accuracy at 25°C	Better than 0.05% of range - voltage Better than 0.15% of range - current
Input Offset Drift with Temperature	90µV/degree C
Gain Drift with Temperature	15 ppm/degree C - voltage 20 ppm/degree C - current
Module Error over Full Temp. Range	0.1% of range - voltage 0.3% of range - current
Module Scan Time for All Channels (Sample Rate Module Filter Dependent)	8 pt single ended - 16-488ms 4 pt differential - 8-244ms 2 pt differential - 5-122ms
Module Conversion Method	Sigma-Delta
Isolation Voltage User to system	 100% tested at 2550 dc for 1s
RTB Screw Torque (Cage clamp)	4.4 inch-pounds (0.4Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
Field Wiring Arm and Housing	36 Position RTB (1756-TBCH or TBS6H)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge (2mm^2) stranded [2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	1/8 inch (3.2mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[5] FM Class I Div 2 Hazardous[5] CE marked for all applicable directives[6]

1 These specifications are module filter dependent.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use this conductor category information for planning conductor routing as described in the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

Chapter Summary and What's Next

In this chapter you learned about features specific to the 1756-IF16 and -IF8 modules.

Move on to chapter 5 to learn about features specific to isolated analog input module.

Isolated Analog Voltage/Current Input Module (1756-IF6I)

What This Chapter Contains

This chapter describes features specific to ControlLogix isolated analog voltage/current input module. The following table describes what this chapter contains and its location.

The 1756-IF6I module supports the features described in this chapter.

In addition to the features described in this chapter, the isolated analog voltage/current input module supports all features described in chapter 3.

The following table lists which additional features your isolated analog voltage/current input module supports and the page of the description of each feature.

Table 5.A
Additional Features Supported by the 1756-IF6I Module

Feature:	Page of description:
Removal and Insertion Under Power (RIUP)	3-2
Module Fault Reporting	3-2
Fully Software Configurable	3-2
Electronic Keying	3-3
Timestamping	3-4
Producer/Consumer Model	3-4
LED Status Information	3-5
Full Class I Division 2 Compliance	3-5
Multiple Choices of Data Format	3-6
On-Board Calibration	3-5
Alarm Latching	3-6
Scaling	3-9

Choosing a Data Format

Data format determines the format of the data returned from the module to the owner-controller and the features that are available to your application.

You can choose one of the two following data formats:

- Integer mode
- Floating point mode

The following table shows which features are available in each format.

Table 5.B
Features Available in Each Data Format

Data format:	Features available:	Features not available:
Integer mode	Multiple input ranges Notch filter Real time sampling	Digital filtering Process alarms Rate alarms Scaling
Floating point mode	All features	N/A

Features Specific to Isolated Analog Input Modules

The following features are available on ControlLogix isolated input modules.

Multiple Input Ranges

You can select from a series of operational ranges for **each channel** on your module. The range designates the minimum and maximum signals that are detectable by the module.

Table 5.C
Possible Input Ranges

Module:	Possible ranges:
1756-IF6I	-10 to 10V 0 to 5V 0 to 10V 0 to 20mA

For an example of how to choose an input range for your module, see chapter 10.

Notch Filter

An Analog-to-Digital Convertor (ADC) filter removes line noise in your application for **each channel**.

Choose a notch filter that most closely matches the anticipated noise frequency in your application. Remember that each filter time affects the response time of your module. Also, the highest frequency notch filter settings also limit the effective resolution of the channel.

Important: 60Hz is the default setting for the notch filter.

Use the table below to choose a notch filter setting.

Table 5.D
Notch Filter Settings

Notch setting:	10Hz	50Hz	60Hz (Default)	100Hz	250Hz	1000Hz
Minimum Sample Time (RTS)[1] (Integer mode)	102mS	22mS	19mS	12mS	10mS	10mS
Minimum Sample Time (RTS)[2] (Floating point mode)	102mS	25mS	25mS	25mS	25mS	25mS
0-100% Step Response Time[2]	400mS + RTS	80mS + RTS	68mS + RTS	40mS + RTS	16mS + RTS	4mS + RTS
-3dB Frequency	3Hz	13Hz	16Hz	26Hz	66Hz	262Hz
Effective Resolution	16 bits	16 bits	16 bits	16 bits	15 bits	10 bits

[1] Integer mode must be used for RTS values lower than 25mS. The minimum RTS value for the module will be dependent on the channel with the lowest notch filter setting.
[2] Worst case settling time to 100% of a step change would include 0-100% step response time plus one RTS sample time.

To see how to choose a Notch Filter, see page 10-10.

Real Time Sampling

This parameter instructs the module to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data.

During module configuration, you specify a Real Time Sampling (RTS) period and a Requested Packet Interval (RPI) period. These features both instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For an example of how to set the RTS rate, see page 10-10.

Underrange/Overrange Detection

This feature detects when the isolated input module is operating beyond limits set by the input range. For example, If you are using the 1756-IF6I module in the 0V-10V input range and the module voltage increases to 11V, the Overrange detection detects this condition.

Use the following table to see the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition:

Table 5.E
Low and High Signal Limits on the Isolated Input Module

Input module:	Available range:	Lowest signal in range:	Highest signal in range:
1756-IF6I	+/- 10V	-10.54688V	10.54688V
	0V-10V	0V	10.54688V
	0V-5V	0V	5.27344V
	0mA-20mA	0mA	21.09376mA

Digital Filter

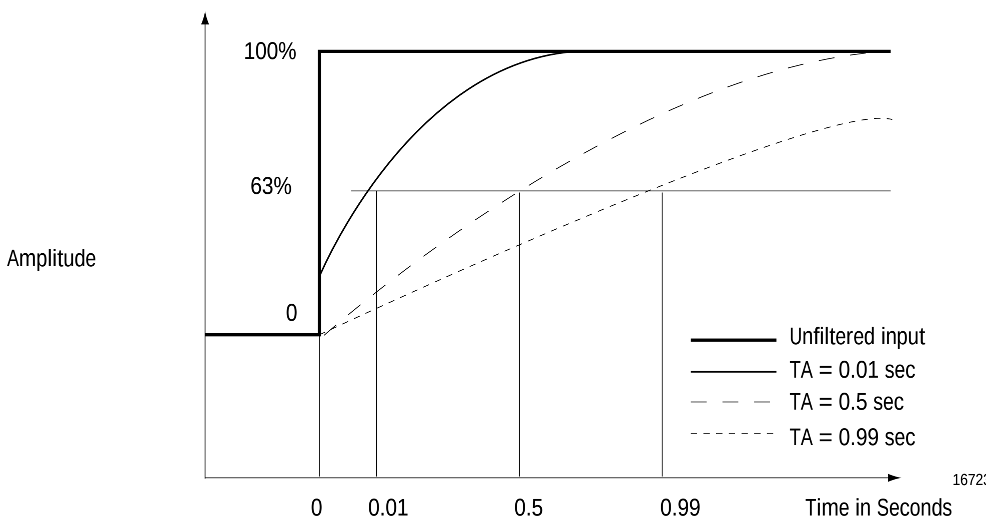
The digital filter smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA}\,(X_n - Y_n\text{-}1)$$

Yn = present output, filtered peak voltage (PV)
Yn-1 = previous output, filtered PV
Δt = module channel update time (seconds)
TA = digital filter time constant (seconds)
Xn = present input, unfiltered PV

Using a step input change to illustrate the filter response, as shown below, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.



Important: The digital filter is only available in applications using floating point mode.

Process Alarms

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

- High high
- High
- Low
- Low low

Important: Process alarms are only available in applications using floating point mode. The values for each limit are entered in scaled engineering units.

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

To see how to set Process Alarms, see page 10-10.

Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel.

Important: The rate alarm is only available in applications using floating point mode.

For example, if you set an IF6I (with normal scaling in Volts) to a rate alarm of 1.0 V/S, the rate alarm will only trigger if the difference between measured input samples changes at a rate > 1.0 V/S.

If the module's RTS is 100 ms (i.e. sampling new input data every 100ms) and at time 0, the module measures 5.0 volts and at time 100ms measures 5.08 V, the rate of change is (5.08V - 5.0V) / (100mS) = 0.8 V/S. The rate alarm would not set as the change is less than the trigger point of 1.0V/s.

If the next sample taken is 4.9V, the rate of change is (4.9V-5.08V)/(100mS)=-1.8V/S. The absolute value of this result is > 1.0V/S, so the rate alarm will set. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the Rate Alarm, see page 10-10.

Wire Off Detection

The 1756-IF6I module will alert you when a wire has been disconnected from one of its channels or the RTB has been removed from the module. When a wire off condition occurs for this module, two events occur:

- Input data for that channel changes to a specific scaled value
- A fault bit is set in the owner controller which may indicate the presence of a wire off condition

Because the 1756-IF6I module can be used in voltage or current applications, differences exist as to how a wire off condition is detected in each application.

Wire Off in Voltage Applications

When a wire off condition occurs for a module channel in voltage applications, the following occurs:

- Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode
- The ChxOverrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix B.

Wire Off in Current Applications

When a wire off condition occurs for a module channel in current applications, the following occurs:

- Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode
- The ChxUnderrange (x=channel number) tag is set to 1

Important: In current applications, if wire off detection occurs because the RTB has been disconnected from the module, the module reacts with the same conditions as described in voltage applications.

For more information about tags in the tag editor, see Appendix B.

Fault and Status Reporting Between the 1756-IF6I Module and Controllers

The 1756-IF6I module multicasts status/fault data to the owner/listening controllers with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

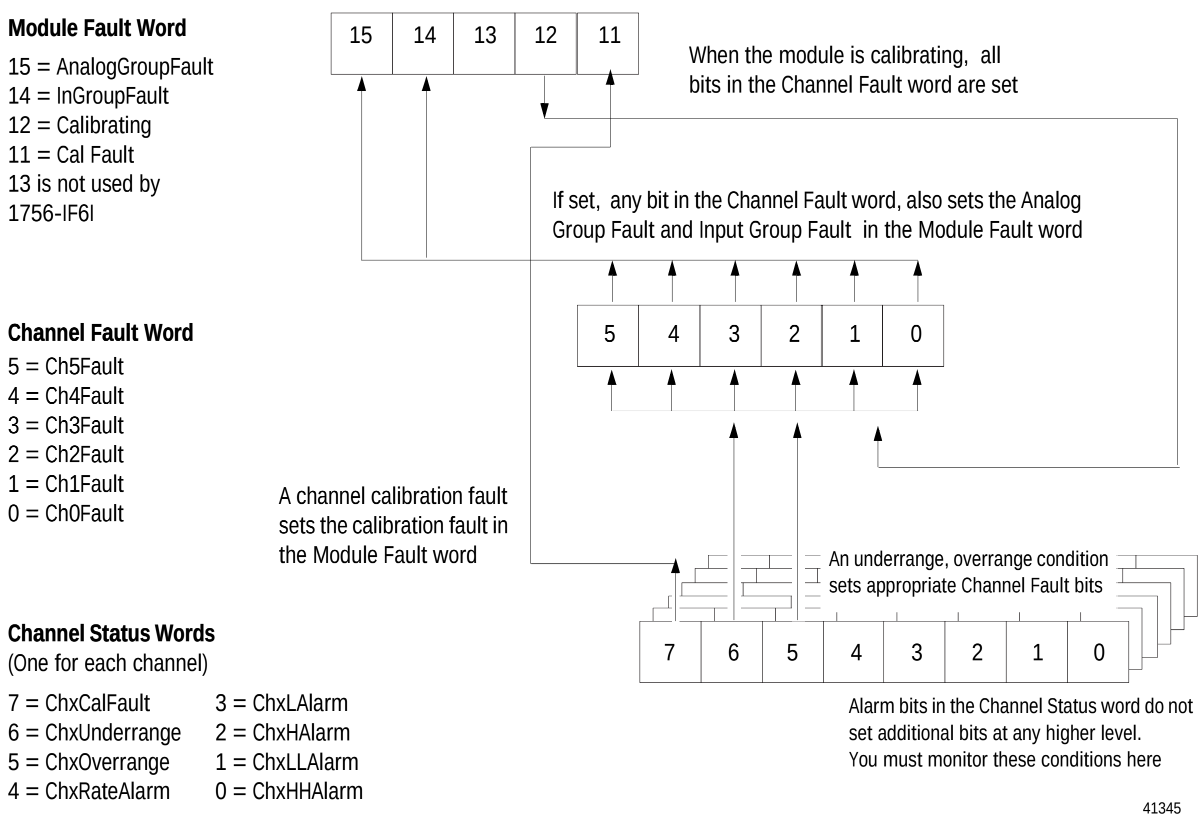
The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Module Fault Word -** This word provides fault summary reporting. Its tag name is ModuleFaults.
- **Channel Fault Word -** This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults.
- **Channel Status Words -** This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus.

Important: Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

Fault Reporting in Floating Point Mode

The following graphic provides an overview of the fault reporting process in floating point mode.



Module Fault Word Bits in Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Analog Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
- **Input Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup.
- **Calibrating -** This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. It tag name is Calibrating.
- **Calibration Fault -** This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits in Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition.

Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

The following conditions set **all** Channel Fault word bits:

- A channel is being calibrated - in this case, the module sets the bits to display “003F”
- A communications fault occurred between the module and its owner controller. In this case, the bits are set by the controller and set to display “FFFF”.

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

Channel Status Word Bits in Floating Point Mode

Any of the 6 Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

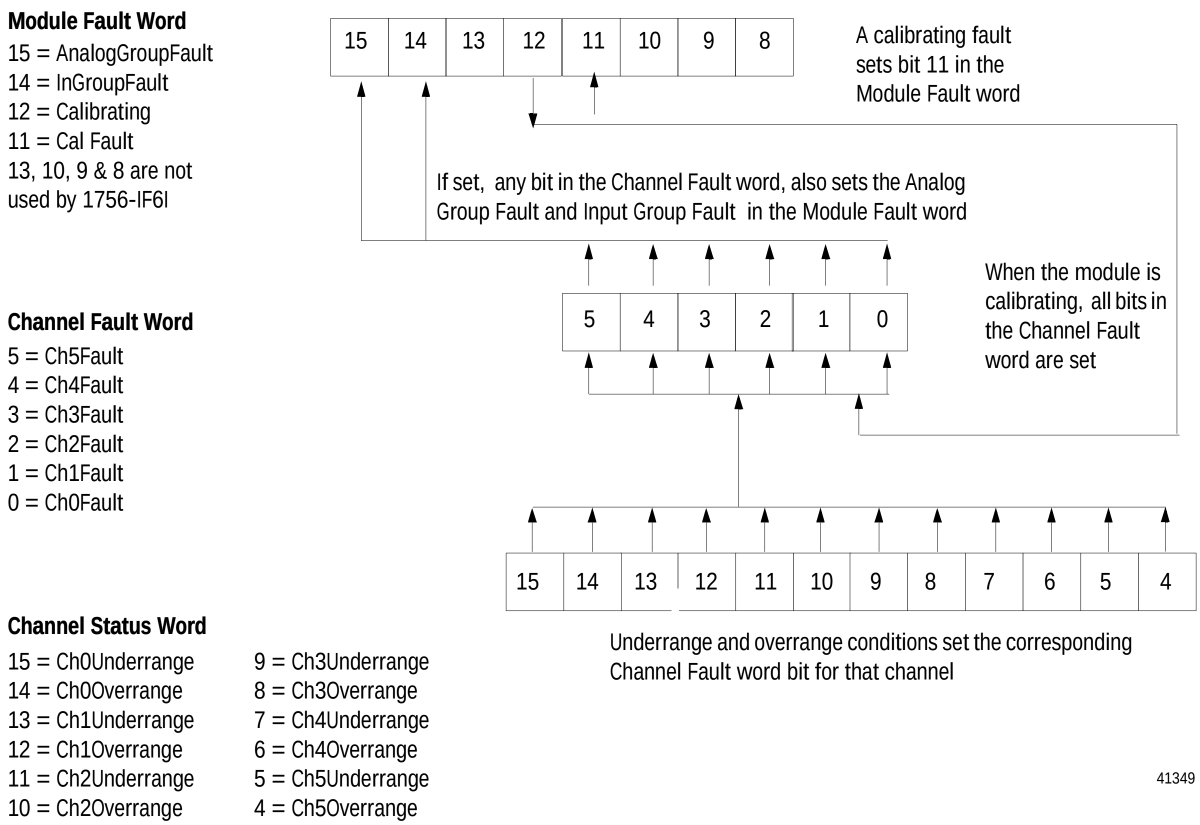
When the Underrange and Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word.

- **ChxCalFault - Bit 7 -** This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 11 in the Module Fault word
- **UnderRange - Bit 6 -** This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 5.E on page 5-4. This bit also sets the appropriate bit in the Channel Fault word.
- **OverRange - Bit 5 -** This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 5.E on page 5-4. This bit also sets the appropriate bit in the Channel Fault word.
- **ChxRateAlarm - Bit 4 -** This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched.
- **ChxLAlarm - Bit 3 -** This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxHAlarm - Bit 2 -** This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxLLAlarm - Bit 1 -** This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.
- **ChxHHAlarm - Bit 0 -** This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.

Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process in integer mode.



Module Fault Word Bits in Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode, see page 5-9.

Channel Fault Word Bits in Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode, see page 5-9.

Channel Status Word Bits in Integer Mode

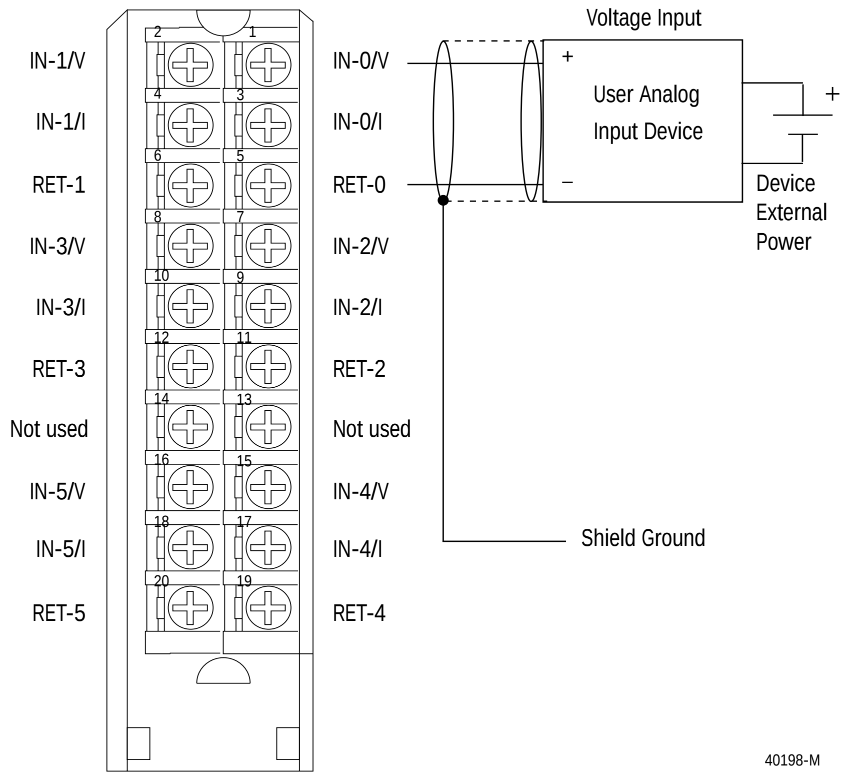
The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.

  Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word will activate if a channel is not properly calibrated.
- There is only 1 Channel Status word for all 6 channels.

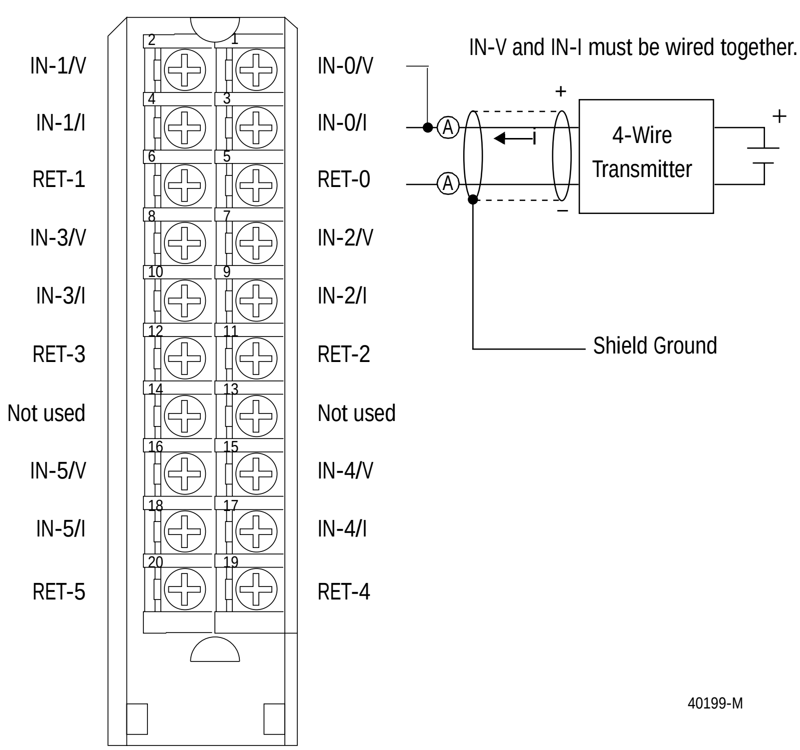
Module Wiring Examples and Specifications

1756-IF6I Voltage wiring example



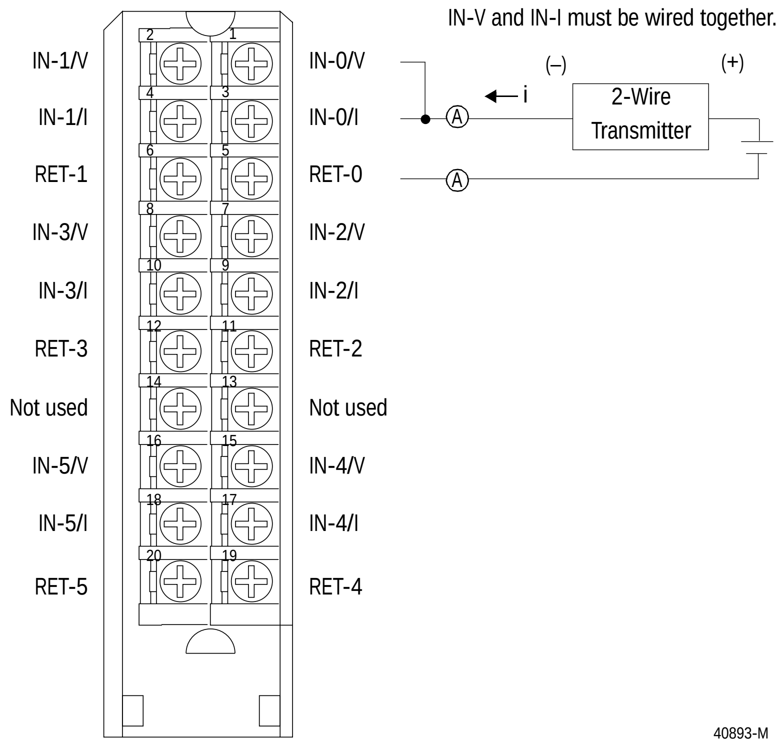
1756-IF6I Current wiring example with a 4-wire transmitter

NOTE: Place additional loop devices (e.g. strip chart recorders, etc.) at either A location.



1756-IF6I Current wiring example with a 2-wire transmitter

NOTE: Place additional loop devices (e.g. strip chart recorders, etc.) at either A location.



1756-IF6I Specifications

Number of Inputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No module external power requirements)	250mA @5.1V dc & 100mA @ 24V dc (3.7W)
Power Dissipation within Module Thermal Dissipation	3.7W voltage 4.3W current 12.62 BTU/hr voltage 14.32 BTU/hr current
Input Range	+/-10.5V, 0-10.5V, 0-5.25V, 0-21mA overrange indication when exceeded
Resolution +/-10.5V range 0 to 10.5V range 0 to 5.25V range 0-21mA range	Approximately 16 bits across each range shown below 343µV/count 171µV/count 86µV/count 0.34µA/count
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance	>10MΩ Voltage, 249Ω Current
Open Circuit Detection Time	Positive full scale reading within 5s
Overvoltage Protection	120V ac/dc (Voltage ranges) 8V ac/dc with on-board current resistor (Current Ranges)
Normal Mode Noise Rejection[1]	60dB at 60Hz
Common Mode Noise Rejection	120dB at 60Hz, 100dB at 50Hz
Channel Bandwidth[1]	15Hz (-3dB)
Settling Time to 5% of Full Scale[1]	<80ms
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Input Offset Drift with Temperature	2µV/degree C typical
Gain Drift with Temperature	35 ppm/degree C typical (80 ppm maximum) Voltage 45 ppm/degree C typical (90 ppm maximum) Current
Module Error over Full Temp. Range	0.54% of range
Minimum Module Scan Time for all Channels[1] (Sample Rate)	25ms minimum floating point 10ms minimum integer
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
Module Conversion Method	Sigma-Delta
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
Field Wiring Arm and Housing	20 Position RTB (1756-TBNH or TBSH)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge ($2mm^2$) stranded [2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[5] FM Class I Div 2 Hazardous[5] CE marked for all applicable directives[6]

1 These specifications are notch filter dependent.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use conductor category information for planning conductor routing as described in the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

Chapter Summary and What's Next

In this chapter you learned about features specific to the 1756-IF6I module.

Move on to chapter 6 to learn about features specific to temperature measuring analog modules.

Temperature Measuring Analog Modules (1756-IR6I & 1756-IT6I)

What This Chapter Contains

This chapter describes features specific to temperature measuring ControlLogix analog modules. The following table describes what this chapter contains and its location.

The following modules support the features described in this chapter:

- 1756-IR6I
- 1756-IT6I

In addition to the features described in this chapter, the temperature measuring analog modules support all features described in chapter 3.

The following table lists which additional features your temperature measuring modules support and the page of description of each feature.

Table 6.A
Features Supported by Temperature Measuring Modules

Feature:	Page of description:
Removal and Insertion Under Power (RIUP)	3-2
Module Fault Reporting	3-2
Fully Software Configurable	3-2
Electronic Keying	3-3
Timestamping	3-4
Producer/Consumer Model	3-4
LED Status Information	3-5
Full Class I Division 2 Compliance	3-5
Multiple Choices of Data Type	3-6
On-Board Calibration	3-5
Alarm Latching	3-6
Scaling	3-9

Choosing a Data Format

Data format determines the features that are available to your application. You can choose one of the two following data formats:

- Integer mode
- Floating point mode

The following table shows which features are available in each format.

Table 6.B
Features Available in Each Data Format

Data format:	Features available:	Features not available:
Integer mode	Multiple input ranges Notch filter Real time sampling Cold Junction Temperature (1756-IT6I only)	Temperature values Process alarms Digital filtering Rate alarms
Floating point mode	All features	N/A

Important: Integer mode does not support temperature conversion on temperature measuring modules. If you choose integer mode, the 1756-IR6I is strictly an ohms (Ω) module and the 1756-IT6I is strictly a millivolts (mV) module.

Specific Features of Temperature Measuring Modules

The following features are specific to ControlLogix temperature measuring modules.

Multiple Input Ranges

You can select from a series of operational ranges for **each channel** on your module. The range designates the minimum and maximum signals that are detectable by the module.

Table 6.C
Possible Input Ranges

Module:	Possible ranges:
1756-IR6I	1 to 487Ω 2 to 1000Ω 4 to 2000Ω 8 to 4080Ω
1756-IT6I	-12 to 78mV -12 to 30mV

For an example of how to choose an input range, see chapter 8.

Notch Filter

An Analog-to-Digital Convertor (ADC) filter removes line noise in your application for **each channel**.

Choose a notch filter that most closely matches the anticipated noise frequency in your application. Remember that each filter time affects the response time of your module. Also, the highest frequency notch filter settings also limit the effective resolution of the channel.

Important: 60Hz is the default setting for the notch filter.

Use the table below to choose a notch filter setting.

Table 6.D
Notch Filter Settings

Notch setting:	10Hz	50Hz	60Hz (Default)	100Hz	250Hz	1000Hz
Minimum Sample Time (RTS[1] - Integer mode)	102mS	22mS	19mS	12mS	10mS	10mS
Minimum Sample Time (RTS[2] - Floating point mode)	102mS	25mS	25mS	25mS	25mS	25mS
0-100% Step Response Time[3]	400mS + RTS	80mS + RTS	68mS + RTS	40mS + RTS	16mS + RTS	4mS + RTS
-3dB Frequency	3Hz	13Hz	16Hz	26Hz	66Hz	262Hz
Effective Resolution	16 bits	16 bits	16 bits	16 bits	15 bits	10 bits

[1] Integer mode must be used for RTS values lower than 25mS. The minimum RTS value for the module will be dependent on the channel with the lowest notch filter setting.
[2] In mV mode, 50mS minimum, if linearizing.
[3] Worst case settling time to 100% of a step change would include 0-100% step response time plus one RTS sample time.

To see how to choose a Notch Filter, see page 10-10.

Real Time Sampling

This parameter instructs the module to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data.

During module configuration, you specify a Real Time Sampling (RTS) period and a Requested Packet Interval (RPI) period. These features both instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For an example of how to set the RTS rate, see page 10-10.

Underrange/Overrange Detection

This feature detects when a temperature measuring input module is operating beyond limits set by the input range. For example, If you are using the 1756-IR8I module in the 2Ω-1000Ω input range and the module voltage increases to 1050Ω, the Overrange detection detects this condition.

Use the following table to see the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition:

Table 6.E
Low and High Signal Limits on Temperature Measuring Input Modules

Input module:	Available range:	Lowest signal in range:	Highest signal in range:
1756-IR6I	1Ω – 487Ω	0.859068653Ω	507.862Ω
	2Ω – 1000Ω	2Ω	1016.502Ω
	4Ω – 2000Ω	4Ω	2033.780Ω
	8Ω – 4020Ω	8Ω	4068.392Ω
1756-IT6I	-12mV - 30mV	-15.80323mV	31.396mV
	-12mV - 78mV	-15.15836mV	79.241mV

Digital Filter

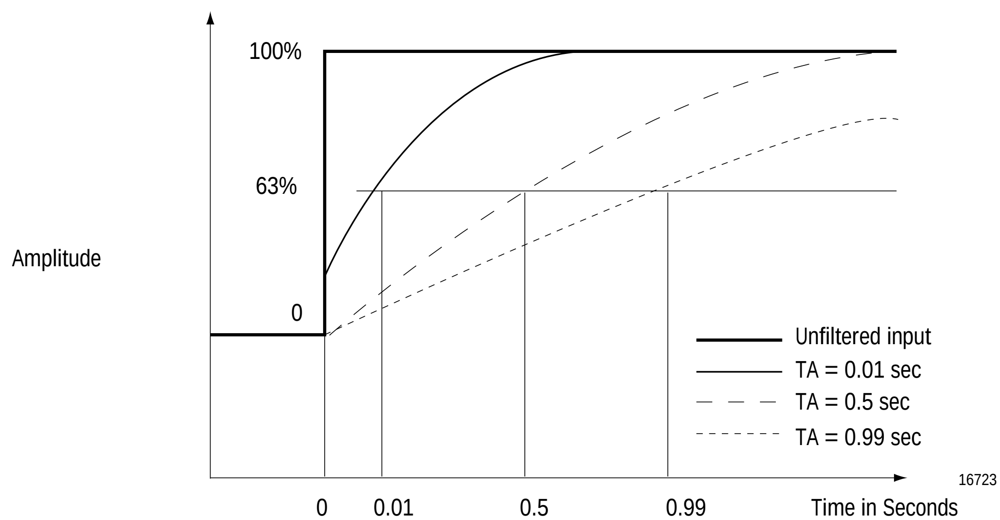
The digital filter smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA}(X_n - Y_n\text{-}1)$$

Yn = present output, filtered peak voltage (PV)
Yn-1 = previous output, filtered PV
Δt = module channel update time (seconds)
TA = digital filter time constant (seconds)
Xn = present input, unfiltered PV

Using a step input change to illustrate the filter response, as shown below, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.



Important: The digital filter is only available in applications using floating point mode.

Process Alarms

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

- High high
- High
- Low
- Low low

Important: Process alarms are only available in applications using floating point mode. The values for each limit are entered in scaled engineering units.

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

To see how to set Process Alarms, see page 10-10.

Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel.

Important: The rate alarm is only available in applications using floating point mode.

For example, if you set an IF6I (with normal scaling in Volts) to a rate alarm of 1.0 V/S, the rate alarm will only trigger if the difference between measured input samples changes at a rate > 1.0 V/S.

If the module's RTS is 100 ms (i.e. sampling new input data every 100ms) and at time 0, the module measures 5.0 volts and at time 100ms measures 5.08 V, the rate of change is (5.08V - 5.0V) / (100mS) = 0.8 V/S. The rate alarm would not set as the change is less than the trigger point of 1.0V/s.

If the next sample taken is 4.9V, the rate of change is (4.9V-5.08V)/(100mS)=-1.8V/S. The absolute value of this result is > 1.0V/S, so the rate alarm will set. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the Rate Alarm, see page 10-10.

10 Ohm Offset

This feature allows you to compensate for a small offset error in a 10 ohm copper RTD. Values can range from -0.99 to +0.99 ohms in units of 0.01 ohms.

For example, if the resistance of a copper RTD used with this channel was 9.74 ohms at 25^{o}C, you would enter -0.26 in this field.

To see how to set the 10 Ohm Offset, see page 10-16.

Wire Off Detection

The ControlLogix temperature measuring modules will alert you when a wire has been disconnected from one of their channels.

When a wire off condition occurs for these modules, two events occur:

- Input data for that channel changes to a specific scaled value
- A fault bit is set in the owner controller which may indicate the presence of a wire off condition

Because these modules can each be used in various applications, differences exist when a wire off condition is detected in each application.

Wire Off Conditions for the 1756-IR6I Module in Temperature Applications

There are two conditions in which the 1756-IR6I module detects a disconnected wire in temperature applications.

1. When any combination of wires are disconnected from the module, except the loss of a wire from terminal B by itself (see wiring diagram on page 6-16), the following occurs:

- input data for the channel changes to the highest scaled temperature value associated with the selected RTD type
- the ChxOverrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix A.

2. When only the wire connected to terminal B (see wiring diagram on page 6-16) is lost, the following occurs:

- input data for the channel changes to the lowest scaled temperature value associated with the selected RTD type
- the ChxUnderrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix B.

Wire Off Conditions for the 1756-IR6I Module in Ohms Applications

There are two conditions in which the 1756-IR6I module detects a disconnected wire in ohms applications.

1. When any combination of wires are disconnected from the module, except the loss of a wire from terminal B by itself (see wiring diagram on page 6-16), the following occurs:

- input data for the channel changes to the highest scaled ohm value associated with the selected ohms range
- the ChxOverrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix B.

2. When only the wire connected to terminal B (see wiring diagram on page 6-16) is lost, the following occurs:

- input data for the channel changes to the lowest scaled ohm value associated with the selected ohms range
- the ChxUnderrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix B.

Wire Off Conditions for the 1756-IT6I Module in Temperature Applications

When wires are disconnected from the 1756-IT6I module in temperature applications, the following occurs:

- input data for the channel changes to the highest scaled temperature value associated with the selected thermocouple type
- the ChxOverrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix B.

Wire Off Conditions for the 1756-IT6I Module in Millivolt Applications

When wires are disconnected from the 1756-IT6I module in millivolt applications, the following occurs:

- input data for the channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode
- the ChxOverrange (x=channel number) tag is set to 1

For more information about tags in the tag editor, see Appendix B.

Fault and Status Reporting Between the 1756-IR6I and 1756-IT6I Modules and Controllers

The 1756-IR6I and -IT6I modules multicast status/fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

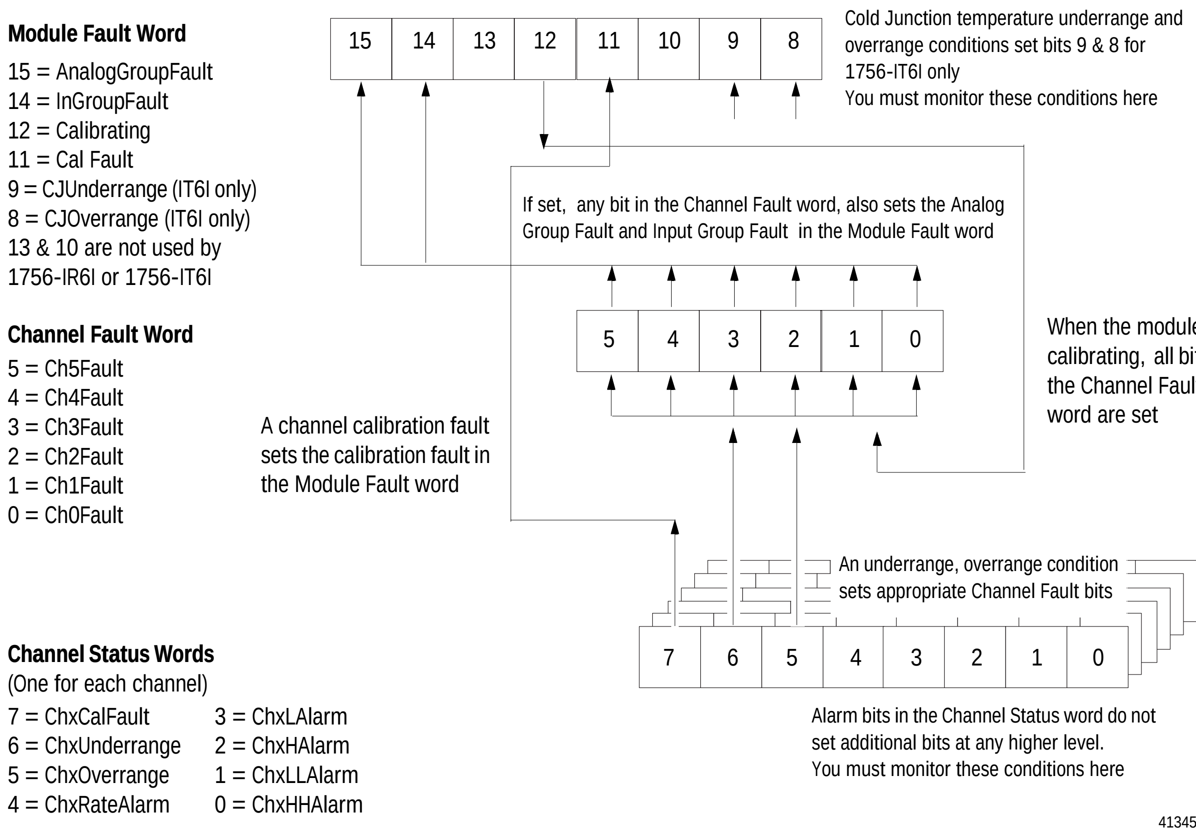
The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Module Fault Word -** This word provides fault summary reporting. Its tag name is ModuleFaults.
- **Channel Fault Word -** This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults.
- **Channel Status Words -** This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus.

Important: Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

1756-IR6I and 1756-IT6I Fault Reporting in Floating Point Mode

The following graphic provides an overview of the fault reporting process in floating point mode.



Module Fault Word Bits in Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The following tags are found in the Module Fault Word:

- **Analog Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
- Input Group Fault **-** This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup.
- **Calibrating -** This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
- **Calibration Fault -** This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.
- **ColdJunctionUnderrange -** This bit is only used on the **1756-IT6I** module. It is set when the ambient temperature around the Cold Junction Sensor is below 0^{o}C. Its tag name is CJUnderrange.
- **ColdJunctionOverrange -** This bit is only used on the **1756-IT6I** module. It is set when the ambient temperature around the Cold Junction Sensor is above 86^{o}C. Its tag name is CJOverrange.

Channel Fault Word Bits in Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition.

Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

The following conditions set **all** Channel Fault word bits:

- A channel is being calibrated **-** in this case, the module sets the bits to display “003F”
- A communications fault occurred between the module and its owner controller. In this case, the bits are set by the controller and set to display “FFFF”.

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

Channel Status Word Bits in Floating Point Mode

Any of the 6 Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

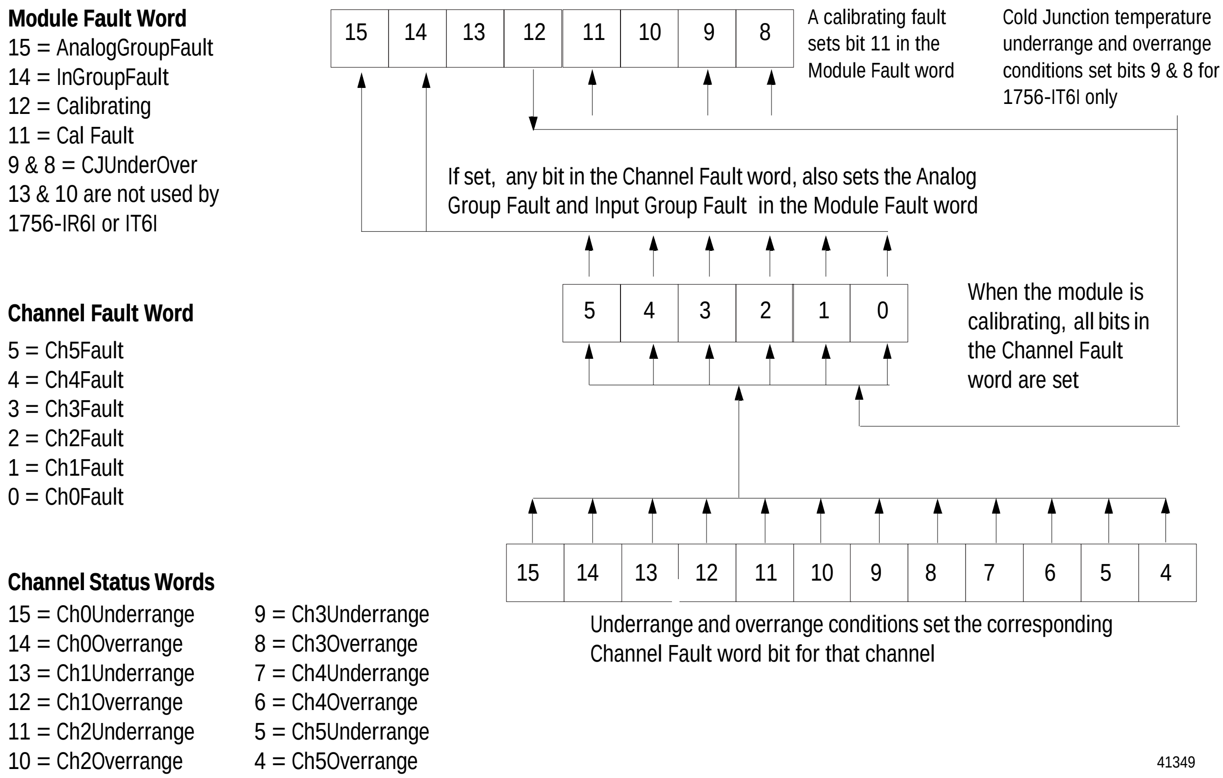
When the Underrange and Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word.

- **ChxCalFault - Bit 7 -** This bit is set if an error occurs during calibration for that channel. This bit also sets bit 11 in the Module Fault word
- **UnderRange - Bit 6 -** This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 3.3 on page 3-9. This bit also sets the appropriate bit in the Channel Fault word.
- **OverRange - Bit 5 -** This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 3.3 on page 3-9. This bit also sets the appropriate bit in the Channel Fault word.
- **ChxRateAlarm - Bit 4 -** This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched.
- **ChxLAlarm - Bit 3 -** This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxHAlarm - Bit 2 -** This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband.
- **ChxLLAlarm - Bit 1 -** This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.
- **ChxHHAlarm - Bit 0 -** This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband.

1756-IR6I and 1756-IT6I Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process in integer mode.



1756-IR6I and 1756-IT6I Module Fault Word Bits in Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode, see page 6-10.

1756-IR6I and 1756-IT6I Channel Fault Word Bits in Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode, see page 6-10.

1756-IR6I and 1756-IT6I Channel Status Word Bits in Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.

  Alarming and Calibration Fault activities are not available. The Calibration Fault bit in the Module Fault word will activate.
- There is only 1 Channel Status word for all 6 channels.

Sensor Type

Two analog modules, the RTD (1756-IR6I) and Thermocouple (1756-IT6I), allow you to configure a **Sensor Type for each channel** that linearizes the analog signal into a temperature value. The RTD module linearizes ohms into temperature and the Thermocouple module linearizes millivolts into temperature.

Important: Sensor types are only available in applications using floating point mode.

Also, these modules can only linearize signals to temperature values in the floating point mode.

Use the following table to see which sensors are available for your application:

Table 6.F
Available Sensors for Temperature Measuring Modules

Module:	Available sensors:
1756-IR6I	10Ω - Copper 427 type 100Ω - Platinum 385, Platinum 3916, and Nickel 618 types 120Ω - Nickel 618 and Nickel 672 types 200Ω - Platinum 385, Platinum 3916, and Nickel 618 types 500Ω - Platinum 385, Platinum 3916, and Nickel 618 types 1000Ω - Platinum 385 and Platinum 3916 types
1756-IT6I	B, C, E, J, K, N, R, S, and T

When any of the sensor types listed above are selected during configuration, the RSLogix 5000 software will use the following default values in the scaling box:

Table 6.G
Default Signal and Engineering Values in RSLogix 5000

1756-IT6I		1756-IR6I	
Low signal = -12	Low eng. = -12	Low signal = 1	Low eng. = 1
High signal = 78	High eng. = 78	High signal = 487	High eng. = 487

The module will send back temperature values over the entire sensor range (listed in Table 6.7 on next page) as long as the Low signal value equals the Low engineering value and the High signal value equals the High engineering value. The actual numbers used in the signal and engineering fields are irrelevant as long as they are equal.

The following table displays the temperature range for each 1756-IT6I sensor type. (Values listed in Celsius.)

Table 6.H
Temperature Limits for 1756-IT6I Sensor Types

1756-IT6I Sensor type:	B	C	E	J	K	N	R	S	T
Low temperature	300.0	0.0	-270.0	-210.0	-270.0	-270.0	-50.0	-50.0	-270.0
High temperature	1820.0	2315.0	1000.0	1200.0	1372.0	1300.0	1768.1	1768.1	400.0

Important: The table above lists temperature limits for sensors using the -12 to 78mV range only. When the -12 to 30mV range is used, temperature limits are truncated to the temperature value that corresponds to 30mV.

The following table displays the temperature range for each 1756-IR6I sensor type. (Values listed in Celsius.)

Table 6.I
Temperature Limits for 1756-IR6I Sensor Types

1756-IR6I Sensor type:	Copper 427	Nickel 618	Nickel 672	Platinum 385	Platinum 3916
Low temperature	-200.0	-60.0	-80.0	-200.0	-200.0
High temperature	260.0	250.0	320.0	870.0	630.0

To see how to choose a Sensor Type, see page 10-16.

Temperature Units

The RTD (1756-IR6I) and Thermocouple (1756-IT6I) modules provide the choice of working in Celsius or Fahrenheit. This choice affects all channels per module.

To see how to choose Temperature Units, see page 10-16.

Cold Junction Compensation

When using the Thermocouple (1756-IT6I) module, you must account for additional voltage that may be generated on the wiring connector. The junction of thermocouple field wires with the screw terminations of an RTB generates a small voltage. This thermoelectric effect alters the input signal.

To accurately measure the input signal from your module, you must use a cold junction sensor (CJS) to account for the increased voltage.

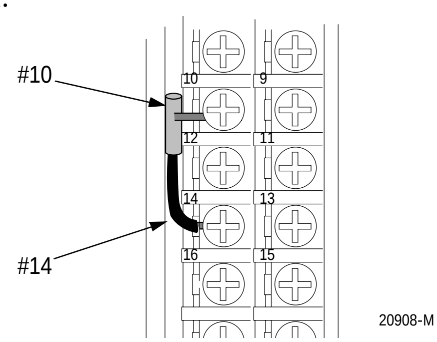
RSLogix 5000 provides the following three CJS options for Thermocouple applications:

- Remote CJ Compensation - option must be enabled if you decide to use a CJS on an IFM
- CJ Offset - option allows you to accurately account for offset inaccuracies in the CJS
- CJ Disable - option must be enabled if you decide not to use a CJS with your application

To see how to set these options, see page 10-17.

Important: If you use an IFM to connect wiring to your thermocouple module, you do not need to attach the CJS. The IFM compensates for any additional voltage (has a CJS internally).

To ease installation, wire terminal #12 before connecting the cold junction sensor.

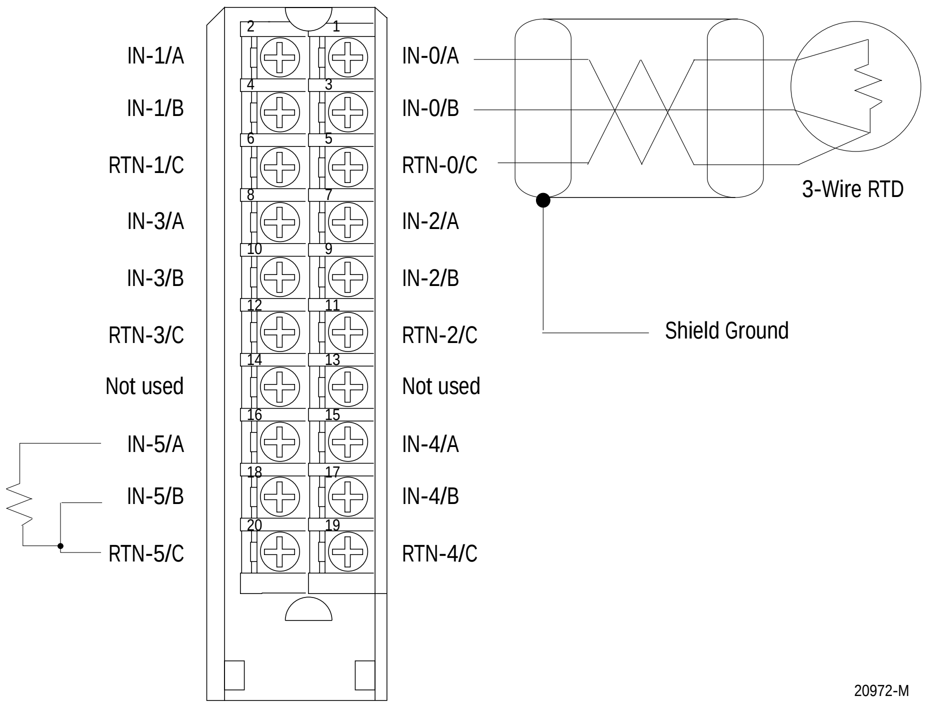


The CJS is part number 94238301. Contact your local Allen-Bradley sales representative to order additional sensors, if necessary.

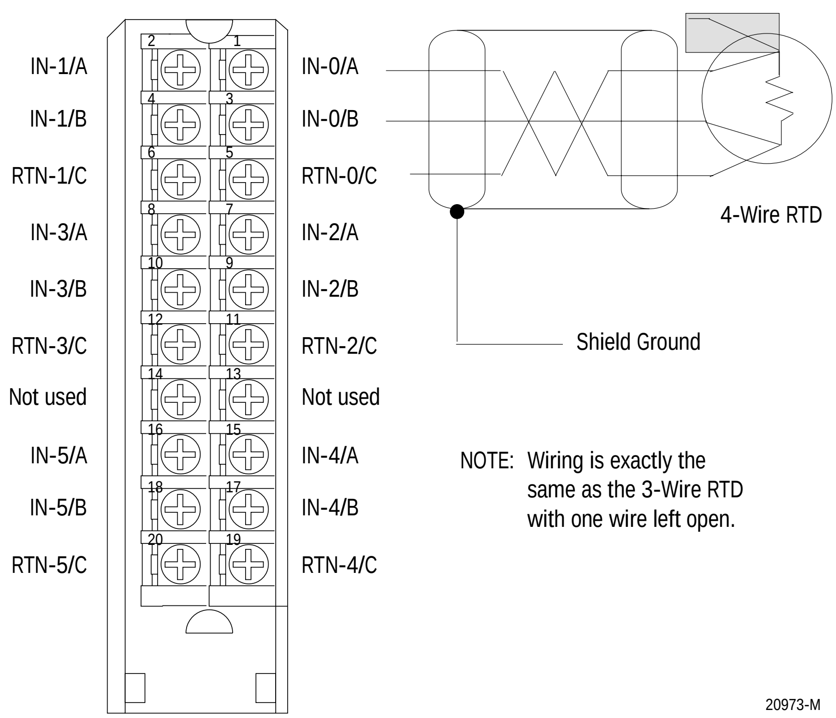
1756-IR6I Module Wiring Examples and Specifications

1756-IR6I 3-Wire RTD wiring example

IMPORTANT: For 2-wire resistor applications including calibration, make sure IN-x/B and RTN-x/C are shorted together as shown



1756-IR6I 4-Wire RTD wiring example



1756-IR6I Specifications

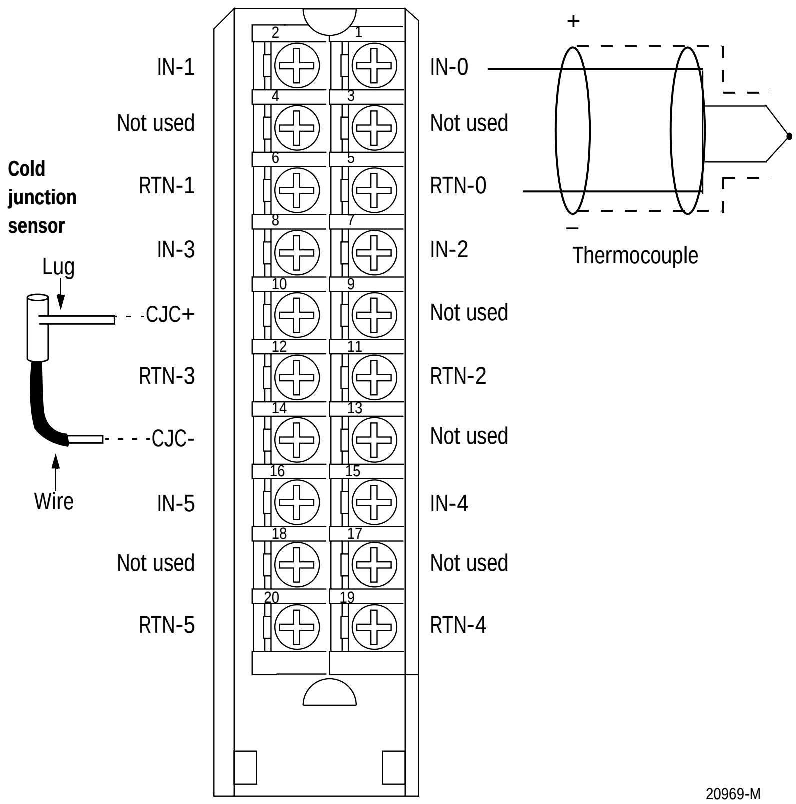
Number of Inputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 125mA @ 24V dc (4.25W)
Power Dissipation within Module Thermal Dissipation	4.3W 14.66 BTU/hr
Input Range	1-487Ω, 2-1000Ω, 4-2000Ω, 8-4020Ω
Resolution in Ranges 487Ω 1000Ω 2000 4020Ω	Approximately 16 bits across each input range 7.7mΩ/count 15mΩ/count 30mΩ/count 60mΩ/count
Sensors Supported	Resistance 4-4020Ω 100, 200, 500, 1000Ω Platinum, alpha=385 100, 200, 500, 1000Ω Platinum, alpha=3916 120Ω Nickel, alpha=672 100, 120, 200, 500Ω Nickel, alpha=618 10Ω Copper
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Open Circuit Detection Time	Positive full scale reading within 5s with any combination of lost wires, except input terminal B alone. If input terminal B is lost by itself, the module reads a negative full scale reading within 5s.
Overvoltage Protection	24V ac/dc maximum
Normal Mode Noise Rejection[1]	60dB at 60Hz
Common Mode Noise Rejection	120dB at 60Hz, 100db at 50Hz
Channel Bandwidth[1]	15Hz
Settling Time to 5% of Full Scale[1]	<80ms
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Input Offset Drift with Temperature	10mΩ/degree C
Gain Drift with Temperature	50 ppm/degree C typical (90 ppm maximum)
Module Error over Full Temp. Range	0.54% of range
Module Scan Time for all Channels[1] (Sample Rate)	25ms minimum floating point (ohms) 50ms minimum floating point (temperature) 10ms minimum integer (ohms)
Module Conversion Method	Sigma-Delta
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined mechanical keying
Field Wiring Arm and Housing	20 Position RTB (1756-TBNH or TBSH)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge ($2mm^2$) stranded[2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	5/16 inch (8mm) maximum

Agency Certification (when product or packaging is marked)	 Class I Div 2 Hazardous[5] Class I Div 2 Hazardous[5] marked for all applicable directives[6]

1 These specifications are notch filter dependent.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use conductor category information for planning conductor routing as described in the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

1756-IT6I Module Wiring Examples and Specifications

1756-IT6I wiring example



1756-IT6I Specifications

Number of Inputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 125mA @ 24V dc (4.3W)
Power Dissipation within Module Thermal Dissipation	4.3W 14.66 BTU/hr
Input Ranges	-12mV to +78mV -12mV to +30mV (high resolution range)
Supported Thermocouple Types	B, C, E, J, K, N, R, S, T Linearization based on ITS-90
Resolution	16 bits (1.4µV typical) 0.7µV/count on high resolution range
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance	>10MΩ
Open Circuit Detection Time	Positive full scale reading within 2s
Overvoltage Protection	120V ac/dc maximum
Normal Mode Noise Rejection[1]	60dB at 60Hz
Common Mode Noise Rejection	120dB at 60Hz, 100dB at 50Hz
Channel Bandwidth[1]	15Hz
Settling Time to 5% of Full Scale[1]	<80ms
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Accuracy (Cold Junction Sensor) Local CJ Sensor Uncertainty Remote CJ Sensor	 From +/-0.3 up to +/-3.2°C, depending on channel +/-0.3°C
Input Offset Drift with Temperature	0.5µV/degree C typical
Gain Drift with Temperature	65 ppm/degree C typical (80 ppm maximum)
Module Error over Full Temp. Range	0.5% of range
Minimum Module Scan Time for all Channels[1] (Sample Rate)	25ms minimum floating point (millivolt) 50ms minimum floating point (temperature) 10ms minimum integer (millivolt)
Module Conversion Method	Sigma-Delta
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
Field Wiring Arm and Housing	20 Position RTB (1756-TBNH or TBSH)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge ($2mm^2$) stranded[2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[5] FM Class I Div 2 Hazardous[5] CE marked for all applicable directives[6]

1 These specifications are notch filter dependent. Values represent 60Hz setting.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use conductor category information for planning conductor routing as described in the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

Chapter Summary and What's Next

In this chapter you learned about features specific to temperature measuring modules.

Move on to chapter 7 to learn about non-isolated analog output modules.

Non-Isolated Analog Output Modules (1756-OF4 & 1756-OF8)

What This Chapter Contains

This chapter describes features specific to ControlLogix non-isolated analog output modules. The following table describes what this chapter contains and its location.

The following modules support the features described in this chapter:

- 1756-OF4
- 1756-OF8

In addition to the features described in this chapter, the non-isolated analog output modules support all features described in chapter 3.

The following table lists which additional features your non-isolated output modules support and the page of the description of each feature.

Table 7.A
Features Supported by Non-Isolated Analog Output Modules

Feature:	Page of description:
Removal and Insertion Under Power (RIUP)	3-2
Module Fault Reporting	3-2
Fully Software Configurable	3-2
Electronic Keying	3-3
Timestamping	3-4
Producer/Consumer Model	3-4
LED Status Information	3-5
Full Class I Division 2 Compliance	3-5
Multiple Choices of Data Format	3-6
On-Board Calibration	3-5
Alarm Latching	3-6
Scaling	3-9

Choosing a Data Format

Data format defines the format of channel data sent from the controller to the module, defines the format of the "data echo" that the module produces, and determines the features that are available to your application. You can choose one of the two following data formats:

- Integer mode
- Floating point mode

The following table shows which features are available in each format.

Table 7.B
Features Available in Each Data Format

Data format:	Features available:	Features not available:
Integer mode	Ramp to program value Ramp to fault value Hold for initialization Hold Last State or User Value in fault or program mode	Clamping Ramp in Run mode Rate and Limit alarms Scaling
Floating point mode	All features	N/A

Features Specific to Analog Output Modules

The following features are available only with analog output modules.

Ramping/Rate Limiting

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. Ramping is also known as **rate limiting**.

Ramping is possible in the following situations:

- **Run mode ramping -** Occurs during run mode and begins operation at the configured maximum ramp rate when the module receives a new output level.

  Important: This is only available in floating point mode.

- **Ramp to program mode -** Occurs when the present output value changes to the Program Value after a Program Command is received from the controller
- **Ramp to fault mode -** Occurs when the present output value changes to the Fault Value after a communications fault occurs

The maximum rate of change in outputs is expressed in engineering units per second and called the **maximum ramp rate**. To see how to enable Run mode ramping and set the maximum ramp rate, see page 10-15.

Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

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

- Initial connection is established after power-up
- A new connection is established after a communications fault occurs
- There is a transition to Run mode from Program state

The InHold bit for a channel indicates that the channel is holding.

Open Wire Detection

This feature detects when current flow is not present at any channel. The 1756-OF4 and 1756-OF8 modules must be configured for 0-20mA operation to use this feature. At least 0.1mA of current must be flowing from the output for detection to occur.

When an open wire condition occurs at any channel, a status bit is set for that channel. For more information on the use of status bits, see page 7-5.

Clamping/Limiting

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

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

For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals.

Clamping alarms can be disabled or latched on a per channel basis.

Important: Clamping is only available in floating point mode.

To see how to set the clamping limits, see page 10-15.

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 to the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

Using the example above, if a module has clamping limits of 8V and -8V but then receives data to apply 9V, only 8V is applied to the screw terminals and the module sends a status bit back to the controller informing it that the 9V value exceeds the module's clamping limits.

Important: Limit alarms are only available in floating point mode.

Data Echo

Data Echo automatically multicasts channel data values which match the analog signals at the module's screw terminals at that time.

Fault and status data is also sent.This data is sent in the format (floating point or integer) selected at the Requested Packet Interval (RPI).

Fault and Status Reporting Between the 1756-OF4 and 1756-OF8 Modules and Controllers

The 1756-OF4 and 1756-OF8 modules multicast status/fault data to the owner/listening controller with their channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

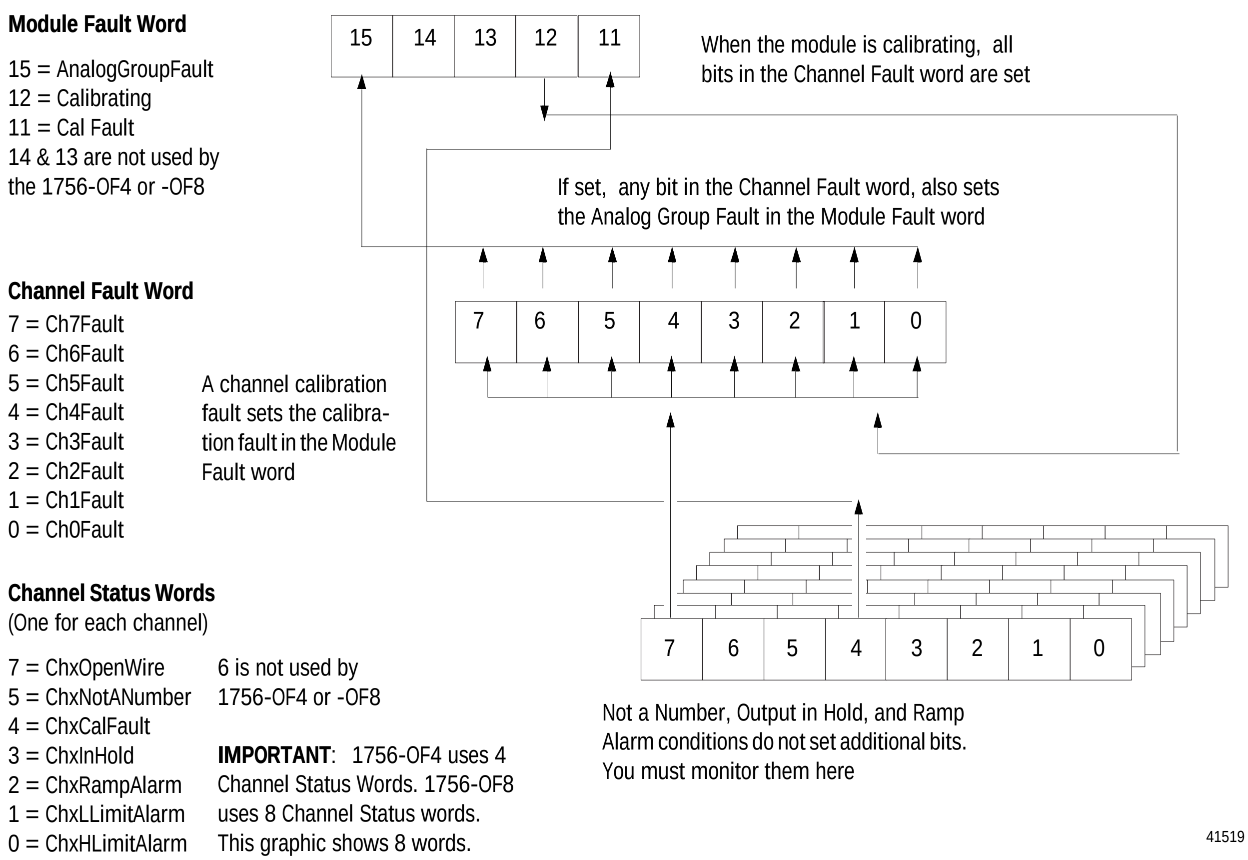
The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Module Fault Word -** This word provides fault summary reporting. Its tag name is ModuleFaults.
- **Channel Fault Word -** This word provides a summary of communications fault and open wire detection. Its tag name is ChannelFaults.
- **Channel Status Words -** This word provides individual channel status for low and high limit alarms, ramp alarms, open wire and calibration faults. Its tag name is ChxStatus.

Important: Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

1756-OF4 and 1756-OF8 Fault Reporting in Floating Point Mode

The following graphic provides an overview of the fault reporting process in floating point mode.



Module Fault Word Bits in Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The following tags are found in the Module Fault Word:

- **Analog Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
- **Calibrating -** This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
- **CalibrationFault -** This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits in Floating Point Mode

During normal module operation, Channel Fault word bits are set if any of the respective channels has a High or Low Limit Alarm or an Open Wire condition (0-20mA configuration only).

When using the Channel Fault Word, the 1756-OF4 module uses bits 0-3, and the 1756-OF8 uses bits 0-7. Checking this word for a nonzero condition is a quick way to check for these conditions on a channel.

The following conditions set **all** Channel Fault word bits:

- A channel is being calibrated - in this case, the 1756-OF4 module sets the bits to display “000F” and the 1756-OF8 module sets the bits to display “00FF”.
- A communications fault occurred between the module and its owner controller. In this case, the bits are set by the controller and set to display “FFFF”

Your application’s logic should monitor the Channel Fault bit for a particular output, if you either:

- enable output clamping

or

- checking for a open wire condition (0-20mA configuration only)

Channel Status Words Bits in Floating Point Mode

Any of the Channel Status words (4 words for 1756-OF4 and 8 words for 1756-OF8), one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

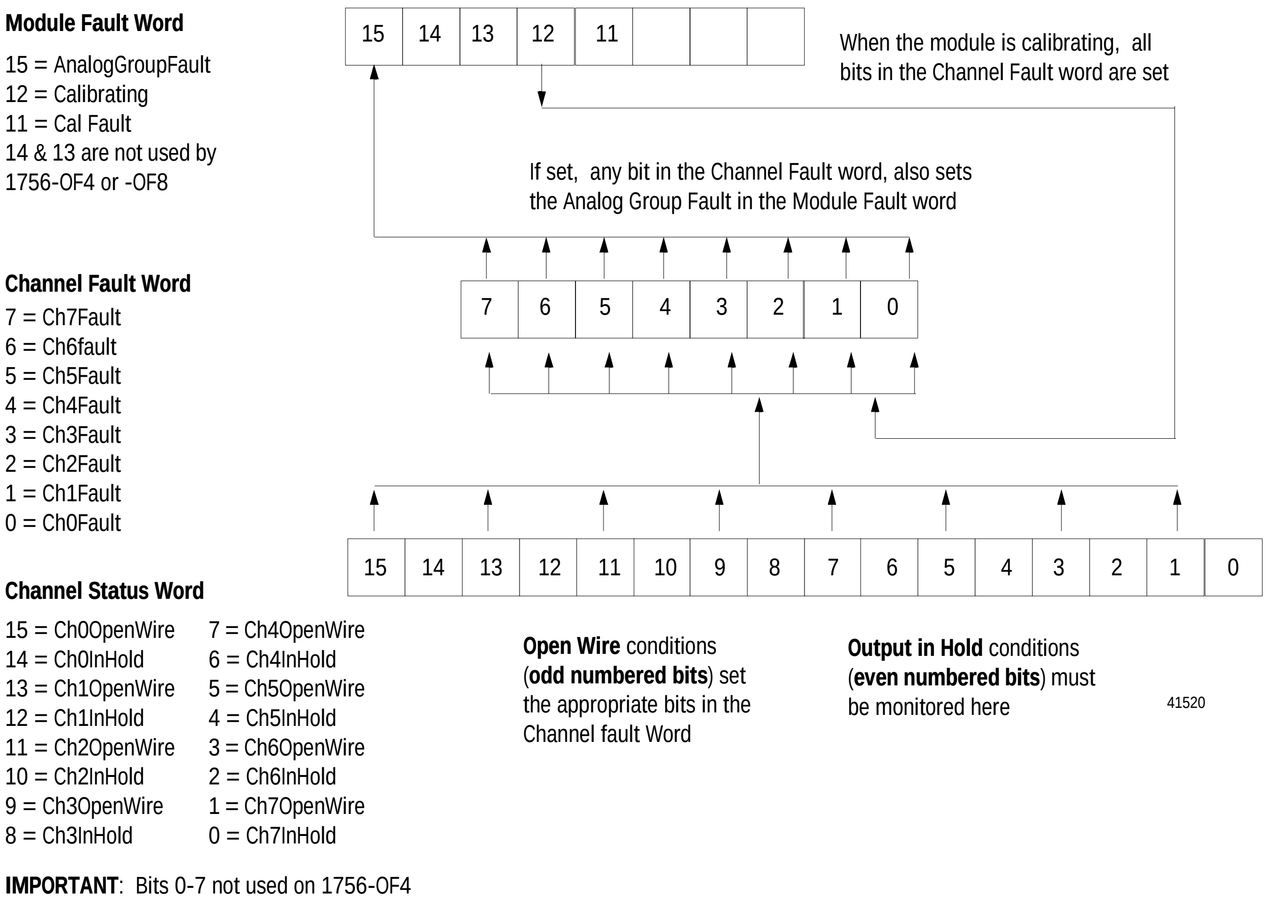
When the High or Low Limit Alarm bits (bits 1 & 0) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 4) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word.

- **ChxOpenWire - Bit 7 -** This bit is set only if the configured Output Range is 0-20mA, and the circuit becomes open due to a wire falling or being cut when the output being driven is above 0.1mA. The bit will remain set until correct wiring is restored.
- **ChxNotaNumber - Bit 5 -** This bit is set when the output value received from the controller is NotaNumber (the IEEE NAN value). The output channel will hold its last state.
- **ChxCalFault - Bit 4 -** This bit is set when an error occurred when calibrating   This bit also sets the appropriate bit in the Channel Fault word.
- **ChxInHold - Bit 3 -** This bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value.
- **ChxRampAlarm - Bit 2 -** This bit is set when the output channel's requested rate of change would exceed the configured maximum ramp rate requested parameter. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it will remain set until it is unlatched.
- **ChxLLimitAlarm - Bit 1 -** This bit is set when the requested output value is beneath the configured low limit value. It remains set until the requested output is above the low limit. If the bit is latched, it will remain set until it is unlatched.
- **ChxHLimitAlarm - Bit 0 -** This bit is set when the requested output value is above the configured high limit value. It remains set until the requested output is below the high limit. If the bit is latched, it will remain set until it is unlatched.

1756-OF4 and 1756-OF8 Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process in integer mode.



Module Fault Word Bits in Integer Mode

In integer mode, Module Fault word bits (bits 15-11) operate exactly as described in floating point mode, see page 7-6.

Channel Fault Word Bits in Integer Mode

In integer mode, Channel Fault word bits (bits 7-0) operate exactly as described in floating point mode for calibration and communications faults, see page 7-6. During normal operation, these bits are only set for an open wire condition.

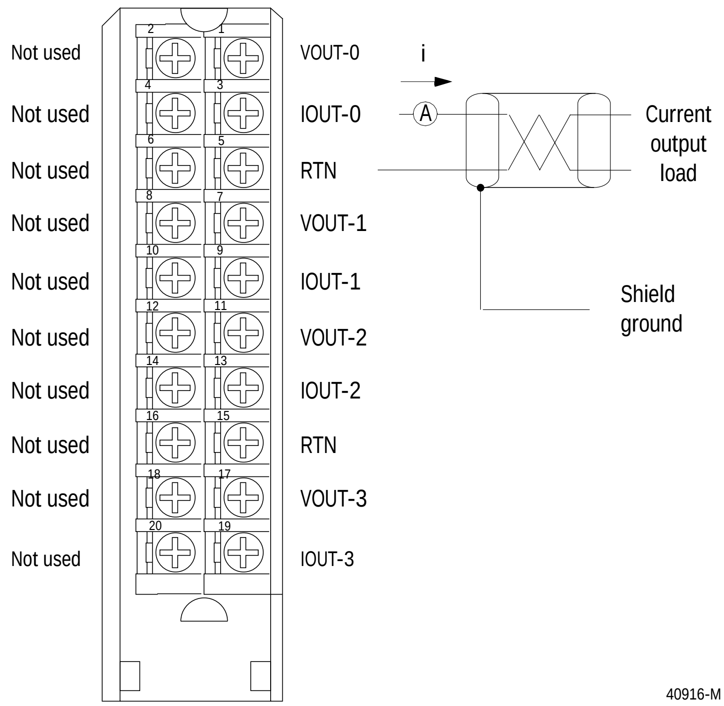
Channel Status Word Bits in Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only the Output in Hold and Open Wire conditions are reported by the module.
- Calibration Fault reporting is not available in this word, although the Calibration Fault bit in the Module Fault word will still activate when that condition exists on any channel.
- There is only 1 Channel Status word for all 4 channels on 1756-OF4 and all 8 channels on 1756-OF8.

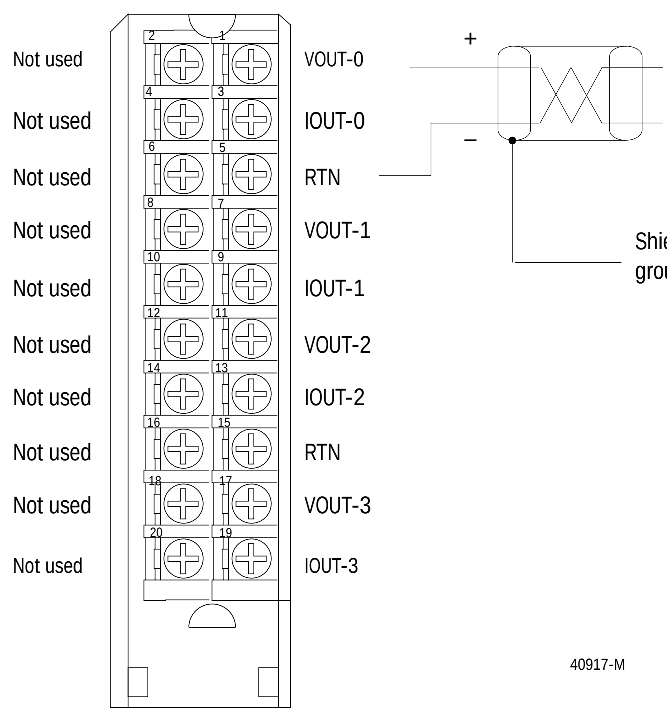
1756-OF4 Module Wiring Examples and Specifications

1756-OF4 Current wiring example



NOTE: Place additional loop devices (e.g. strip chart recorders, etc.) at the A location noted above.

1756-OF4 Voltage wiring example



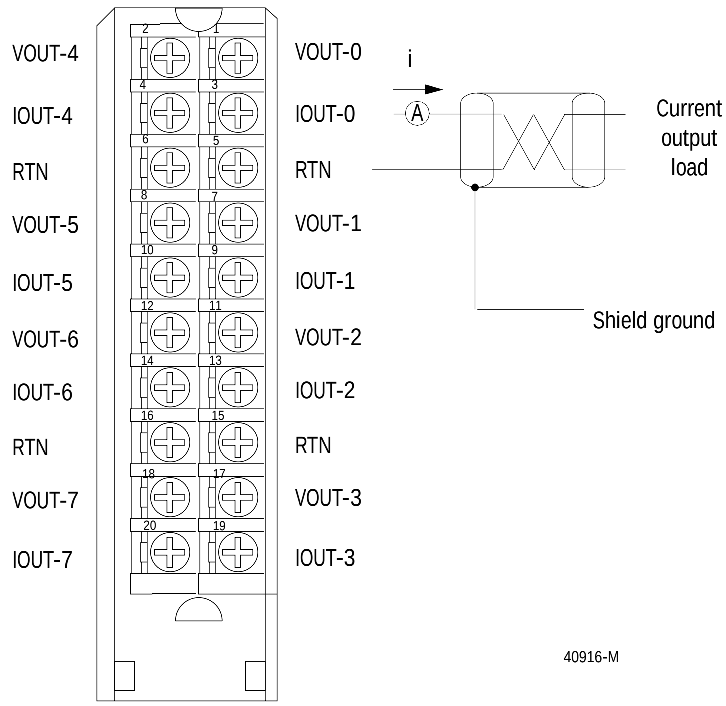
1756-OF4 Specifications

Number of Outputs	4 voltage or current outputs
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 120mA @ 24V dc (3.65W)
Power Dissipation within Module Thermal Dissipation	3.2W - 4 channel current 10.91 BTU/hr
Output Range	0 to 21mA +/- 10.4V
Resolution	15 bits across 21mA - 650nA/bit 15 bits across 10.4V - 320µV/bit
Data Format	Integer mode (Left justified, 2s complement) Floating point IEEE 32 bit
Open Circuit Detection	Current output only (Output must be set to >0.1mA)
Output Overvoltage Protection	24V dc
Output Short Circuit Protection	Electronically current limited to 21mA or less
Drive Capability	>2000Ω - voltage 0-750Ω - current
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.05% of range from 4mA to 21mA, -10.4V to 10.4V Twelve months typical
Output Offset Drift with Temperature	50 µV/degree C typical 100nA/degree C typical
Gain Drift with Temperature	25 ppm/degree C maximum - voltage 50 ppm/degree C maximum - current
Module Error over Full Temp. Range	0.15% of range - voltage 0.3% of range - current
Module Scan Time for all Channels	12ms minimum floating point 8ms minimum integer
Isolation Voltage User to system	 100% tested at 2550V dc for 1s
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge ($2mm^2$) stranded maximum[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[4] FM Class I Div 2 Hazardous[4] CE marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use this conductor category information for planning conductor routing as described in the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

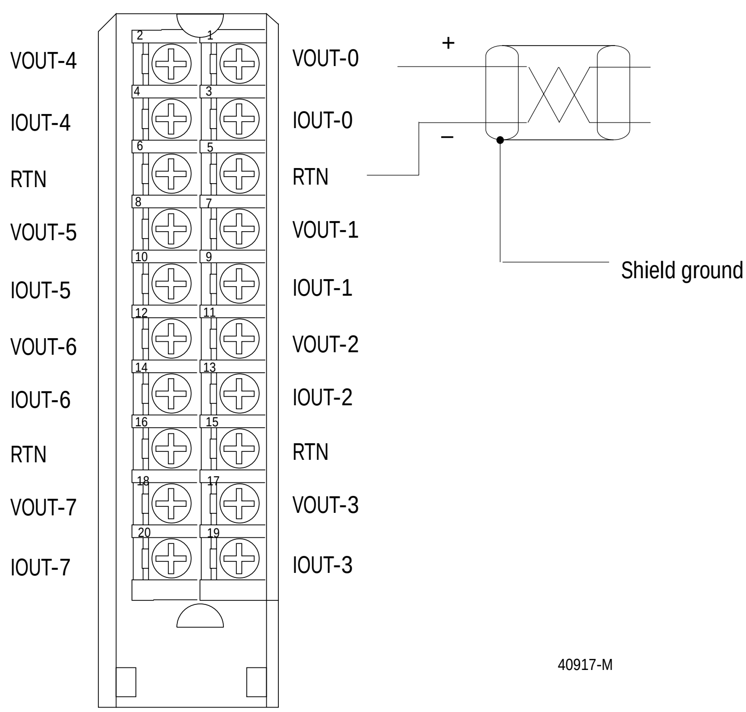
1756-OF8 Module Wiring Examples and Specifications

1756-OF8 Current wiring example



NOTE: Place additional loop devices (e.g. strip chart recorders, etc.) at the A location noted above.

1756-OF8 Voltage wiring example



1756-OF8 Specifications

Number of Outputs	8 voltage or current outputs
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 210mA @ 24V dc (5.8W)
Power Dissipation within Module Thermal Dissipation	4.92W - 8 channel current 16.78 BTU/hr
Output Range	0 to 21mA +/- 10.4V
Resolution	15 bits across 21mA - 650nA/bit 15 bits across 10.4V - 320µV/bit
Data Format	Integer mode (Left justified, 2s complement) Floating point IEEE 32 bit
Open Circuit Detection	Current output only (Output must be set to >0.1mA)
Output Overvoltage Protection	24V dc
Output Short Circuit Protection	Electronically current limited to 21mA or less
Drive Capability	>2000Ω - voltage 0-750Ω - current
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.05% of range from 4mA to 21mA, -10.4V to 10.4V Twelve months typical
Output Offset Drift with Temperature	50 µV/degree C typical 100nA/degree C typical
Gain Drift with Temperature	25 ppm/degree C maximum - voltage 50 ppm/degree C maximum - current
Module Error over Full Temp. Range	0.15% of range - voltage 0.3% of range - current
Module Scan Time for all Channels	12ms minimum floating point 8ms minimum integer
Isolation Voltage User to system	 100% tested at 2550V dc for 1s
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
Field Wiring Arm and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded maximum[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[4] FM Class I Div 2 Hazardous[4] CE marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use conductor category information for planning conductor routing as described in the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

Chapter Summary and What's Next

In this chapter you learned about features specific to non-isolated analog output modules.

Move on to chapter 8 to learn about features specific to isolated analog output modules.

Isolated Analog Output Modules (1756-OF6CI & 1756-OF6VI)

What This Chapter Contains

This chapter describes features specific to ControlLogix non-isolated analog output modules. The following table describes what this chapter contains and its location.

The following modules support the features described in this chapter:

- 1756-OF6CI
- 1756-OF6VI

In addition to the features described in this chapter, the isolated analog output modules support all features described in chapter 3.

The following table lists which additional features your isolated output modules support and the page of the description of each feature.

Table 8.A
Features Supported by Isolated Analog Output Modules

Feature:	Page of description:
Removal and Insertion Under Power (RIUP)	3-2
Module Fault Reporting	3-2
Fully Software Configurable	3-2
Electronic Keying	3-3
Timestamping	3-4
Producer/Consumer Model	3-4
LED Status Information	3-5
Full Class I Division 2 Compliance	3-5
Multiple Choices of Data Format	3-6
On-Board Calibration	3-5
Alarm Latching	3-6
Scaling	3-9

Choosing a Data Format

Data format defines the format of channel data sent from the controller to the module, defines the format of the “data echo” that the module produces, and determines the features that are available to your application. You can choose one of the two following data formats:

- Integer mode
- Floating point mode

The following table shows which features are available in each format.

Table 8.B
Features Available in Each Data Format

Data format:	Features available:	Features not available:
Integer mode	Ramp to program value Ramp to fault value Hold for initialization Hold Last State or User Value in fault or program mode	Clamping Ramp in Run mode Rate and Limit alarms Scaling
Floating point mode	All features	N/A

Features Specific to Analog Output Modules

The following features are available only with analog output modules.

Ramping/Rate Limiting

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. Ramping is also known as **rate limiting**.

Ramping is possible in the following situations:

- **Run mode ramping -** Occurs during run mode and begins operation at the configured maximum ramp rate when the module receives a new output level.

  Important: This is only available in floating point mode.

- **Ramp to program mode -** Occurs when the present output value changes to the Program Value after a Program Command is received from the controller
- **Ramp to fault mode -** Occurs when the present output value changes to the Fault Value after a communications fault occurs

The maximum rate of change in outputs is expressed in engineering units per second and called the **Maximum Ramp Rate**. To see how to enable Run mode ramping and set the maximum ramp rate, see page 10-15.

Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

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

- Initial connection is established after power-up
- A new connection is established after a communications fault occurs
- There is a transition to Run mode from Program state

The InHold bit for a channel indicates that the channel is holding.

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

For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals.

Clamping alarms can be disabled or latched on a per channel basis.

Important: Clamping is only available in floating point mode.

To see how to set the clamping limits, see page 10-15.

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 to the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

Using the example above, if a module has clamping limits of 8V and -8V but then receives data to apply 9V, only 8V is applied to the screw terminals and the module sends a status bit back to the controller informing it that the 9V value exceeds the module's clamping limits.

Important: Limit alarms are only available in floating point mode.

Data Echo

Data Echo automatcially multicasts channel data values which match the analog signals at the module's screw terminals at that time.

Fault and status data is also sent. This data is sent in the format (floating point or integer) selected and is sent at the Requested Packet Interval (RPI).

Fault and Status Reporting Between the 1756-OF6CI and 1756-OF6VI Modules and Controllers

The 1756-OF6CI and 1756-OF6VI modules multicast status/fault data to the owner/listening controller with their channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

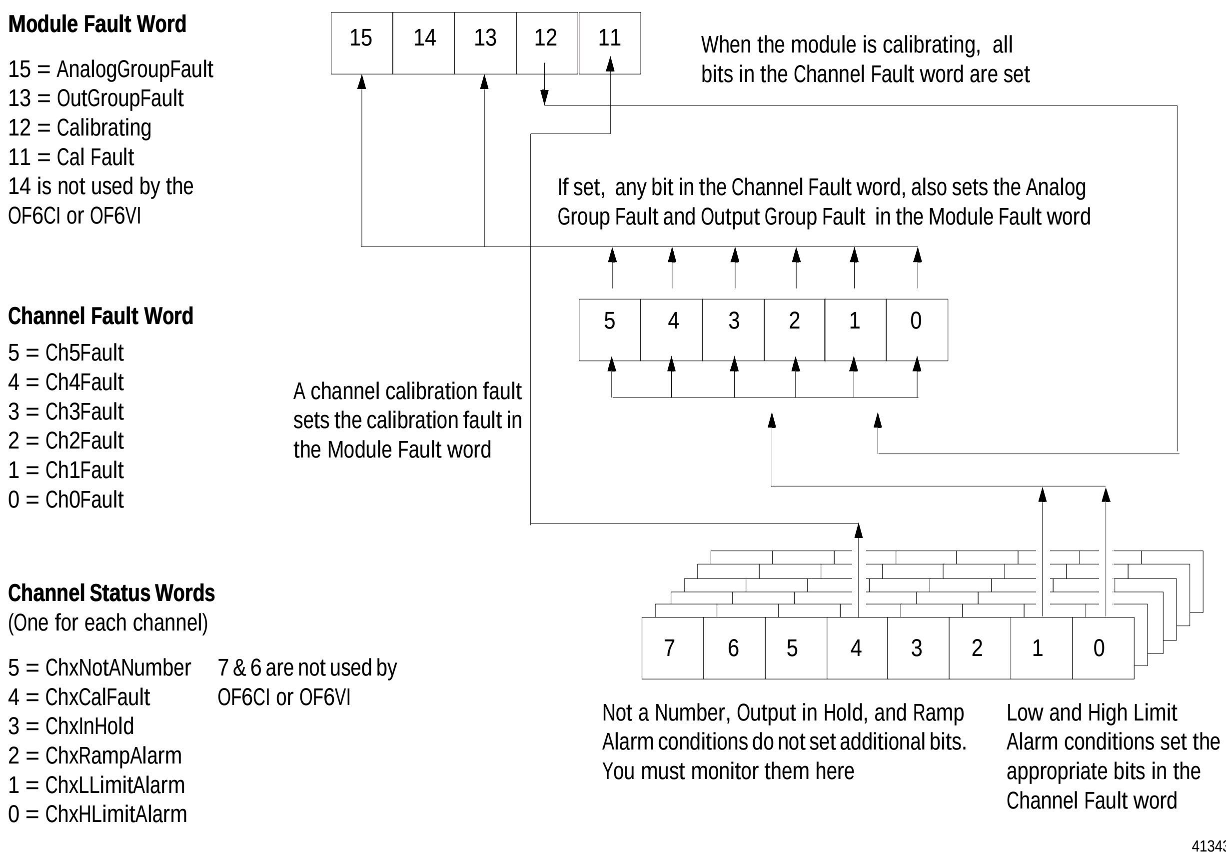
The following tags can be examined in ladder logic to indicate when a fault has occurred:

- **Module Fault Word -** This word provides fault summary reporting. Its tag name is ModuleFaults.
- **Channel Fault Word -** This word provides low limit and high limit and communications fault reporting. Its tag name is ChannelFaults.
- **Channel Status Words -** This word provides individual channel status for low and high limit alarms, ramp alarms and calibration faults. Its tag name is ChxStatus.

Important: Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

Fault Reporting in Floating Point Mode

The following graphic provides an overview of the fault reporting process in floating point mode.



Module Fault Word Bits in Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

The following tags are found in the Module Fault Word:

- **Analog Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
- **Output Group Fault -** This bit is set when any bits in the Channel Fault word are set. Its tag name is OutputGroupFault.
- **Calibrating -** This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating.
- **Calibration Fault -** This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault.

Channel Fault Word Bits in Floating Point Mode

During normal module operation, Channel Fault word bits are set if any of the respective channels has a High or Low Limit Alarm.

Checking this word for a nonzero condition is a quick way to check for High or Low Limit Alarm condition on a channel.

The following conditions set **all** Channel Fault word bits:

- A channel is being calibrated - in this case, the module sets the bits to display “003F”
- A communications fault occurred between the module and its owner controller. In this case, the bits are set by the controller and set to display “FFFF”

Your application’s logic will monitor the Channel Fault bit for a particular output, if you either:

- set the high and low limit alarms outside your operating range

or

- disable output limiting

Channel Status Word Bits in Floating Point Mode

Any of the 6 Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

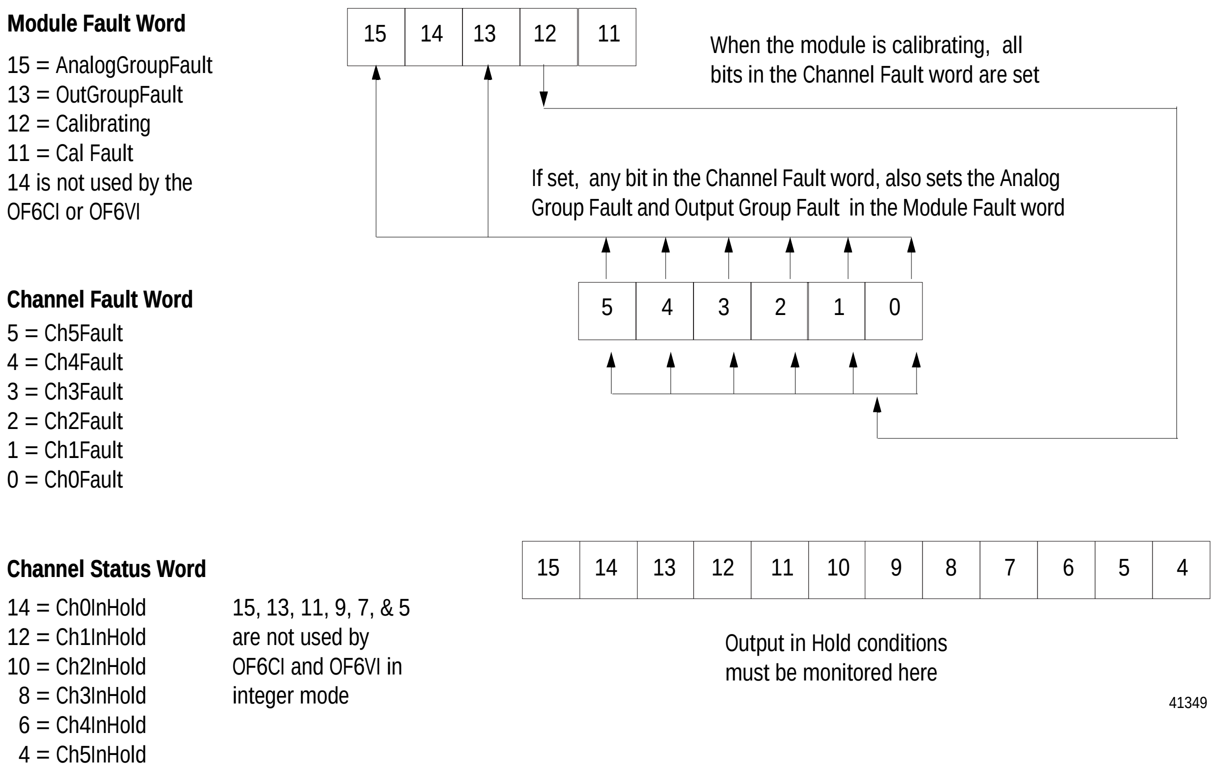
When the High or Low Limit Alarm bits (bits 1 & 0) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 4) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word.

- **ChxNotaNumber - Bit 5 -** This bit is set when the output value received from the controller is NotaNumber (the IEEE NAN value). The output channel will hold its last state
- **ChxCalFault - Bit 4 -** This bit is set when an error occurred when calibrating   This bit also sets the appropriate bit in the Channel Fault word
- **ChxInHold - Bit 3 -** This bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value
- **ChxRampAlarm - Bit 2 -** This bit is set when the output channel’s requested rate of change would exceed the configured maximum ramp rate requested parameter. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it will remain set until it is unlatched.
- **ChxLLimitAlarm - Bit 1 -** This bit is set when the requested output value is beneath the configured low limit value. It remains set until the requested output is above the low limit. If the bit is latched, it will remain set until it is unlatched.
- **ChxHLimitAlarm - Bit 0 -** This bit is set when the requested output value is above the configured high limit value. It remains set until the requested output is below the high limit. If the bit is latched, it will remain set until it is unlatched.

Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process in integer mode.



Module Fault Word Bits in Integer Mode

In integer mode, Module Fault word bits (bits 15-11) operate exactly as described in floating point mode, see page 8-6.

Channel Fault Word Bits in Integer Mode

In integer mode, Channel Fault word bits (bits 5-0) operate exactly as described in floating point mode for calibration and communications faults, see page 8-6.

Channel Status Word Bits in Integer Mode

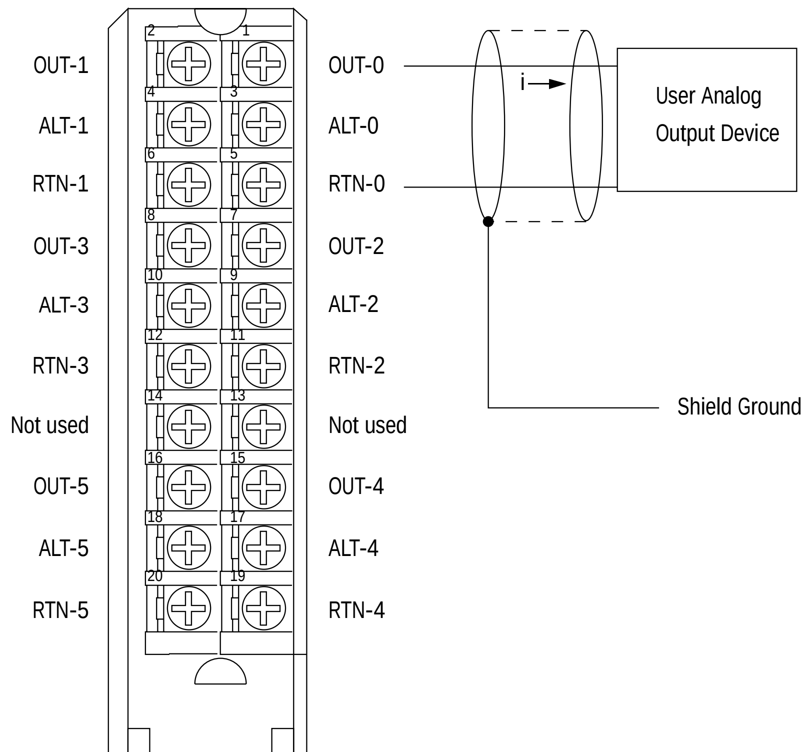
The Channel Status word has the following differences when used in integer mode:

- Only the Output in Hold condition is reported by the module.
- Calibration Fault reporting is not available in this word, although the Calibration Fault bit in the Module Fault word will still activate when that condition exists on any channel
- There is only 1 Channel Status word for all 6 channels.

1756-OF6CI Module Wiring Examples and Specifications

1756-OF6CI Wiring example for Loads of 0-550Ω

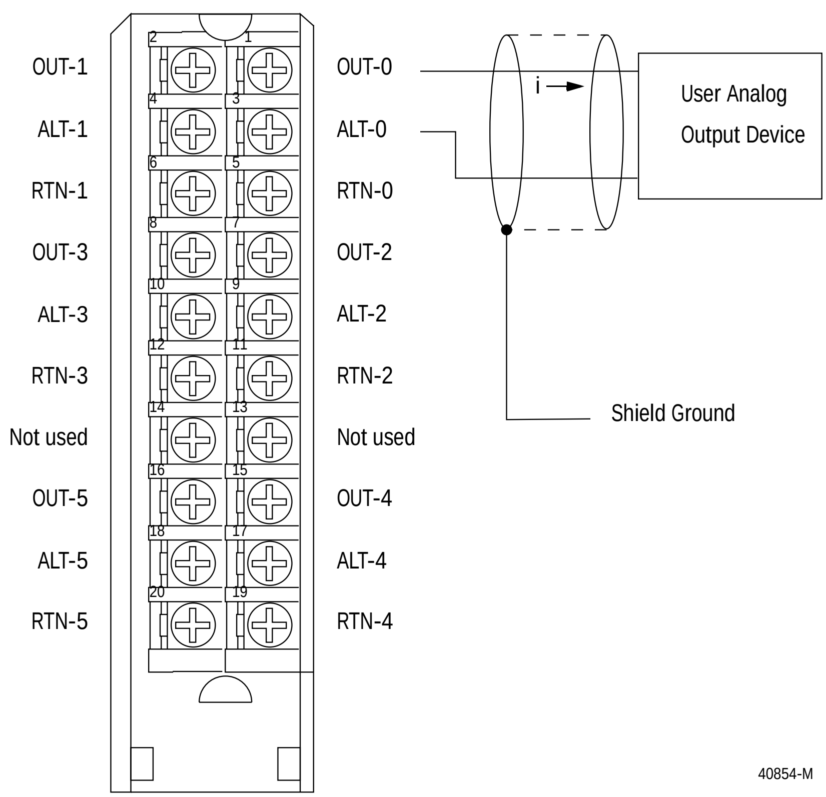
NOTE: Place additional devices anywhere in the loop.



20967-M

1756-OF6CI Wiring example for Loads of 551-1000Ω

NOTE: Place additional devices anywhere in the loop.



40854-M

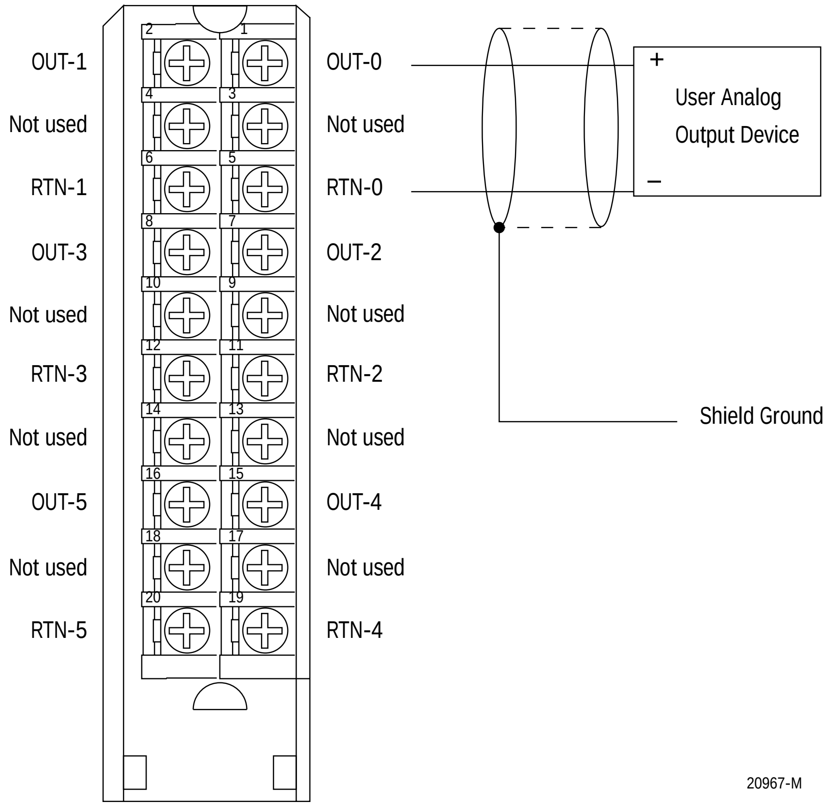
1756-OF6CI Specifications

Number of Outputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 225mA @ 24V dc (0-550Ω loads terminated on OUTs and RTNs) (6.7W) 250mA @ 5.1V dc & 300mA @ 24V dc (551-1000Ω loads terminated on OUTs and ALTs) (8.5W)
Power Dissipation within Module Thermal Dissipation	5.5W (0-550Ω loads) 6.1W (551-1000Ω loads) 18.76 BTU/hr (0-550Ω loads) 20.80 BTU/hr (551-1000Ω loads)
Output Current Range	0 to 21mA
Current Resolution	13 bits across 21mA (2.7µA)
Data Format	Integer mode (Left justified, 2s complement) Floating point IEEE 32 bit
Open Circuit Detection	None
Output Overvoltage Protection	24V ac/dc maximum
Output Short Circuit Protection	Electronically current limited to 21mA or less
Drive Capability	0-1000Ω Separate field terminations for ranges 0-550Ω or 551-1000Ω
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range from 4mA to 21mA 12 months typical
Output Offset Drift with Temperature	1 µA/degree C typical
Gain Drift with Temperature	60 ppm/degree C typical (100 ppm maximum)
Module Error over Full Temp. Range	0.6% of range
Minimum Module Scan Time for All Channels	25ms minimum floating point 10ms minimum integer
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
Inductive Load	<1 mH
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
Field Wiring Arm and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge ($2mm^2$) stranded maximum[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[4] FM Class I Div 2 Hazardous[4] CE marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use conductor category information for planning conductor routing as described in the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

1756-OF6VI Module Wiring Examples and Specifications

1756-OF6VI Wiring example



1756-OF6VI Specifications

Number of Outputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 175mA @ 24V dc (5.5W)
Power Dissipation within Module Thermal Dissipation	4.85W 16.54 BTU/hr
Output Voltage Range	+/- 10.5V maximum
Voltage Resolution	14 bits across 21V (1.3mV) (13 bits across 10.5V +sign bit)
Data Format	Integer mode (Left justified, 2s complement) Floating point IEEE 32 bit
Output Impedance	<1Ω
Open Circuit Detection	None
Output Overvoltage Protection	24V ac/dc maximum
Output Short Circuit Protection	Electronically current limited
Drive Capability	≥1000Ω loads, 10mA maximum
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Output Offset Drift with Temperature	60 µV/degree C typical
Gain Drift with Temperature	50 ppm/degree C typical (80 ppm maximum)
Module Error over Full Temp. Range	0.5% of range
Minimum Module Scan Time for all Channels	25ms minimum floating point 10ms minimum integer
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
Capacitive Load	<1 µFd
Module Keying (Backplane)	Electronic
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge ($2mm^2$) stranded[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[4] FM Class I Div 2 Hazardous[4] CE marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use conductor category information for planning conductor routing as described in the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

Chapter Summary and What's Next

In this chapter you learned about features specific to isolated analog output modules.

Move on to chapter 6 to learn about features specific to temperature measuring modules.

Installing the ControlLogix I/O Module

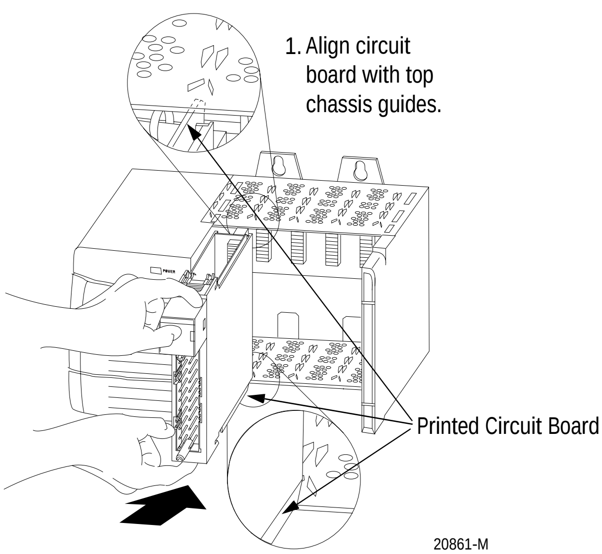
What this Chapter Contains

This chapter describes how to install ControlLogix modules. The following table describes what this chapter contains and its location.

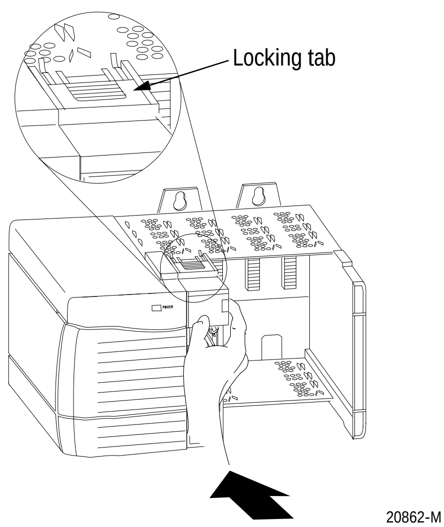
Installing the ControlLogix I/O Module

You can install or remove the module while chassis power is applied.

ATTENTION: The module is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature.



2. Align circuit board with bottom chassis guides.



Slide module into chassis until module tabs 'click'.

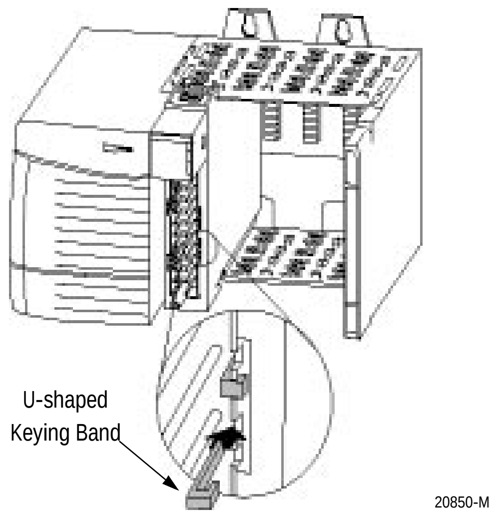
Keying the Removable Terminal Block

Key the RTB to prevent inadvertently connecting the incorrect RTB to your module.

When the RTB mounts onto the module, keying positions will match up. For example, if you place a U-shaped keying band in position #4 on the module, you cannot place a wedge-shaped tab in #4 on the RTB or your RTB will not mount on the module.

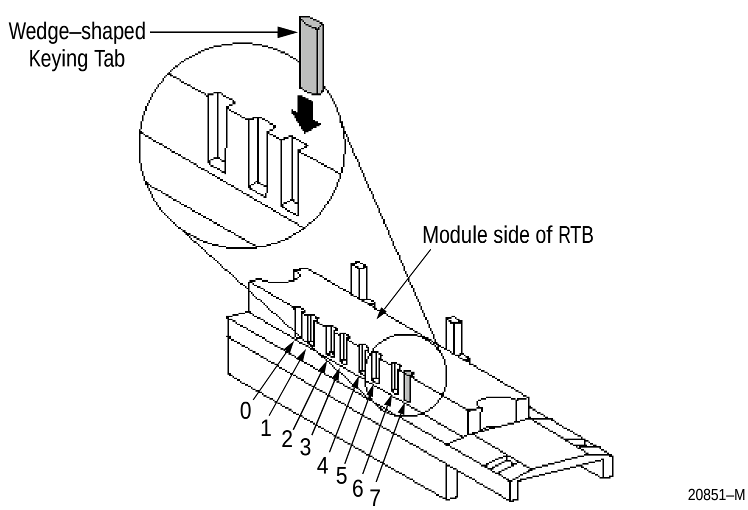
We recommend that you use a unique keying pattern for each slot in the chassis.

1. Insert the U-shaped band with the longer side near the terminals. Push the band onto the module until it snaps into place.



2. Key the RTB in positions that correspond to unkeyed module positions. Insert the wedge-shaped tab on the RTB with the rounded edge first. Push the tab onto the RTB until it stops.

Important: When keying your RTB and module, you must begin with a wedge-shaped tab in position #6 or #7.



Connecting Wiring

You can use an RTB or a Bulletin 1492 prewired Interface Module (IFM) to connect wiring to your module. If you are using an RTB, follow the directions below to connect wires to the RTB. An IFM has been prewired before you received it.

If you are using an IFM to connect wiring to the module, skip this section and move to page 9-7.

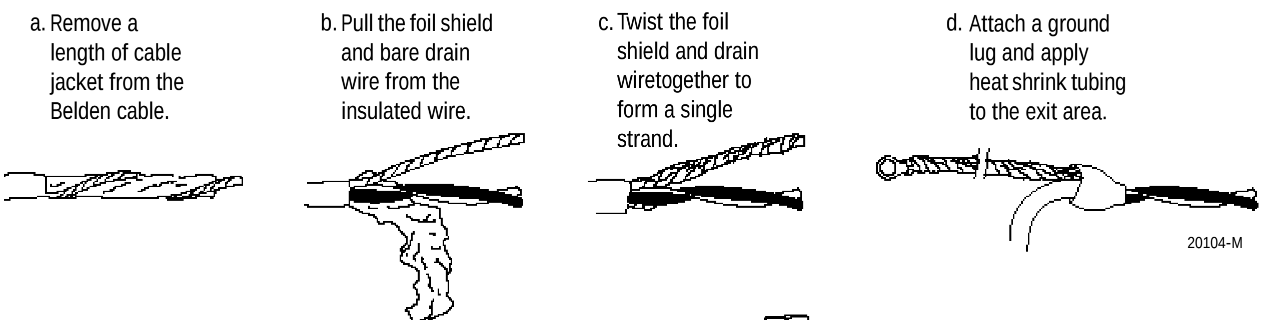
For all ControlLogix analog modules, except the 1756-IR6I, we recommend you use Belden 8761 cable to wire the RTB. For the 1756-IR6I module, we recommend you use Belden 9533 or 83503 cable to wire the RTB. The RTB terminations can accommodate 22-14 gauge shielded wire.

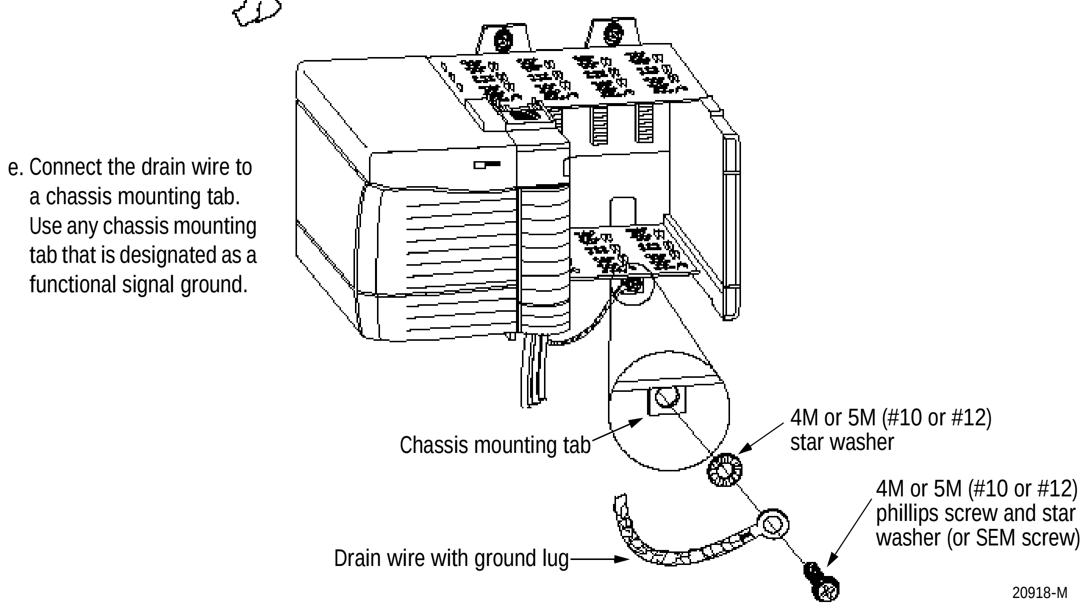
Before wiring the RTB, you must connect ground wiring.

Connect Grounded End of the Cable

1. Ground the drain wire.

Important: We recommend you ground the drain wire at the field-side. If you cannot ground at the field-side, ground at an earth ground on the chassis as shown below.





2. Connect the insulated wires to the field-side.

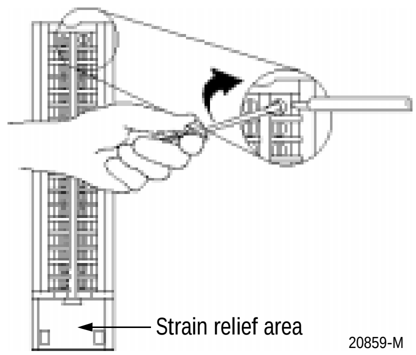
Connect Ungrounded End of the Cable

1. Cut the foil shield and drain wire back to the cable casing and apply shrink wrap.
2. Connect the insulated wires to the RTB, as shown below.

Three Types of RTBs (each RTB comes with housing)

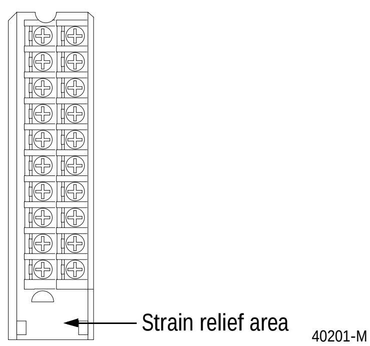
- **Cage clamp -** Catalog number 1756-TBCH

1. Insert the wire into the terminal.
2. Turn the screw clockwise to close the terminal on the wire.



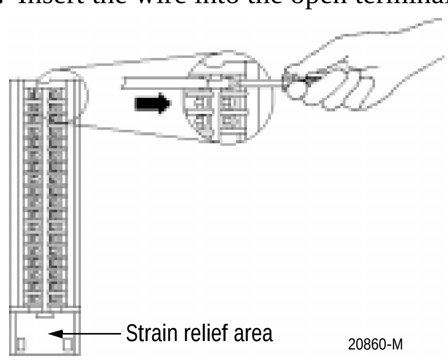
- **NEMA clamp -** Catalog number 1756-TBNH

Terminate wires at the screw terminals.



- **Spring clamp -** Catalog number 1756-TBSH or TBS6H

1. Insert the screwdriver into the outer hole of the RTB.
2. Insert the wire into the open terminal and remove the screwdriver.



Recommendations for Wiring Your RTB

We recommend you follow these guidelines when wiring your RTB:

1. Begin wiring the RTB at the bottom terminals and move up.

2. Use a tie to secure the wires in the strain relief area of the RTB.

3. Order and use an extended-depth housing (Cat. No.1756-TBE) for applications that require heavy gauge wiring.

Refer to table below for the page number of the specific wiring diagram for each ControlLogix I/O module.

Table 9.A
Wiring Diagrams

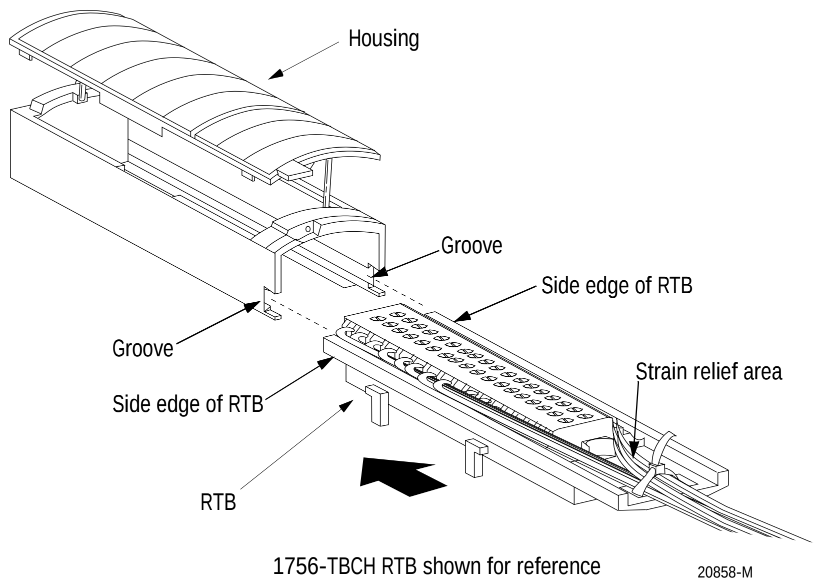
Catalog number:	Wiring connections:
1756-IF16	4-20
1756-IF8	4-25
1756-IF6I	5-20
1756-IR6I	6-16
1756-IT6I	6-16
1756-OF4	7-9
1756-OF8	7-11
1756-OF6CI	8-9
1756-OF6VI	8-11

Assembling The Removable Terminal Block and the Housing

Removable housing covers the wired RTB to protect wiring connections when the RTB is seated on the module.

1. Align the grooves at the bottom of each side of the housing with the side edges of the RTB.

2. Slide the RTB into the housing until it snaps into place.



1756-TBCH RTB shown for reference

Important: If additional wire routing space is required for your application, use extended-depth housing 1756-TBE.

Installing the Removable Terminal Block onto the Module

Install the RTB onto the module to connect wiring.

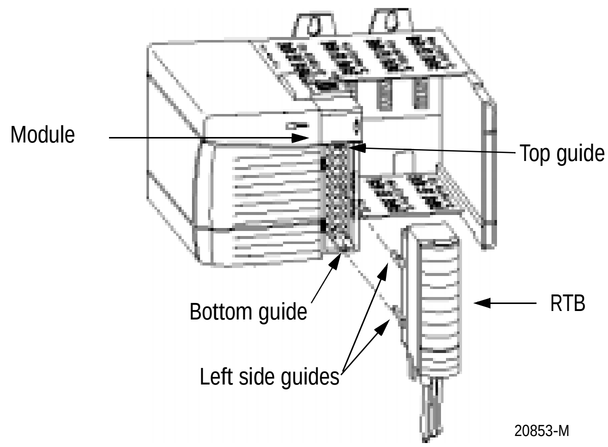
ATTENTION: Shock hazard exists. If the RTB is installed onto the module while the field-side power is applied, the RTB will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature. It is recommended that field-side power be removed before installing the RTB onto the module.

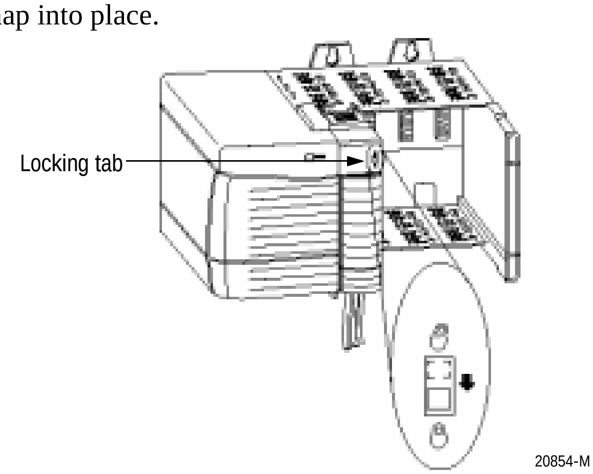
Before installing the RTB, make certain:

- field-side wiring of the RTB has been completed.
- the RTB housing is snapped into place on the RTB.
- the RTB housing door is closed.
- the locking tab at the top of the module is unlocked.

1. Align the top, bottom and left side guides of the RTB with matching guides on the module.



2. Press quickly and evenly to seat the RTB on the module until the latches snap into place.



3. Slide the locking tab down to lock the RTB onto the module.

Removing the Removable Terminal Block from the Module

If you need to remove the module from the chassis, you must first remove the RTB from the module.

ATTENTION: Shock hazard exists. If the RTB is removed from the module while the field-side power is applied, the module will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

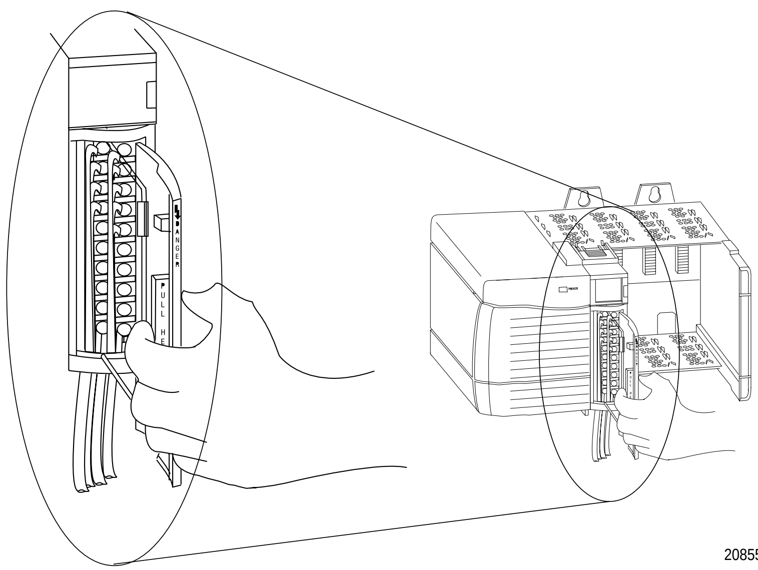
The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature. It is recommended that field-side power be removed before removing the module.

1. Unlock the locking tab at the top of the module.

2. Open the RTB door using the bottom tab.

3. Hold the spot marked PULL HERE and pull the RTB off the module.

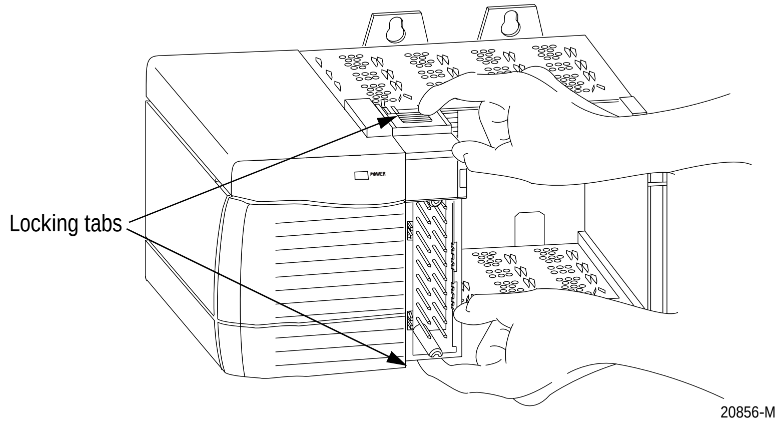
Important: Do not wrap your fingers around the entire door. A shock hazard exists.



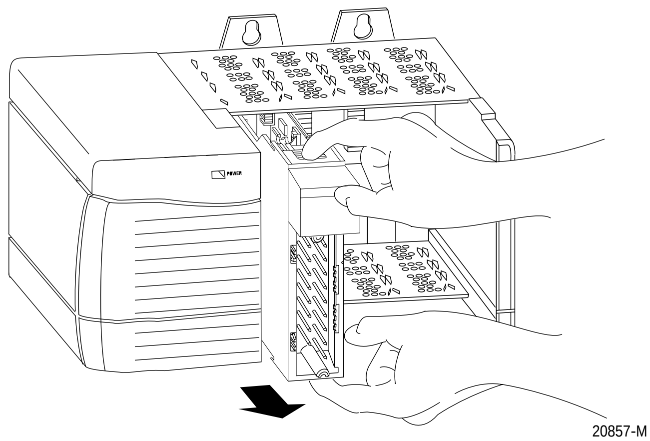
20855-M

Removing the Module from the Chassis

1. Push in the top and bottom locking tabs.



2. Pull module out of the chassis.



Chapter Summary and What's Next

In this chapter you learned about:

- installing the module
- keying the removable terminal block
- connecting wiring
- assembling the removable terminal block and the housing
- installing the removable terminal block or interface module onto the module
- removing the removable terminal block from the module
- removing the module from the chassis

Move on to chapter 10 to learn how to configure your module.

Configuring the ControlLogix Analog I/O Module

What This Chapter Contains

This chapter describes how to configure ControlLogix analog I/O modules. The following table describes what this chapter contains and its location.

Configuring Your I/O Module

You must configure your module upon installation. The module will not work until it has been configured.

Important: This chapter focuses on configuring I/O modules in a local chassis. To configure I/O modules in a remote chassis, you must follow all the detailed procedures with two additional steps. An explanation of the additional steps is listed at the end of this chapter.

RSLogix 5000 Configuration Software

Use RSLogix 5000 software to write configuration for your ControlLogix analog I/O module. You have the option of accepting the default configuration for your module or writing point level configuration specific to your application.

Both options are explained in detail, including views of software screens, in this chapter.

Overview of the Configuration Process

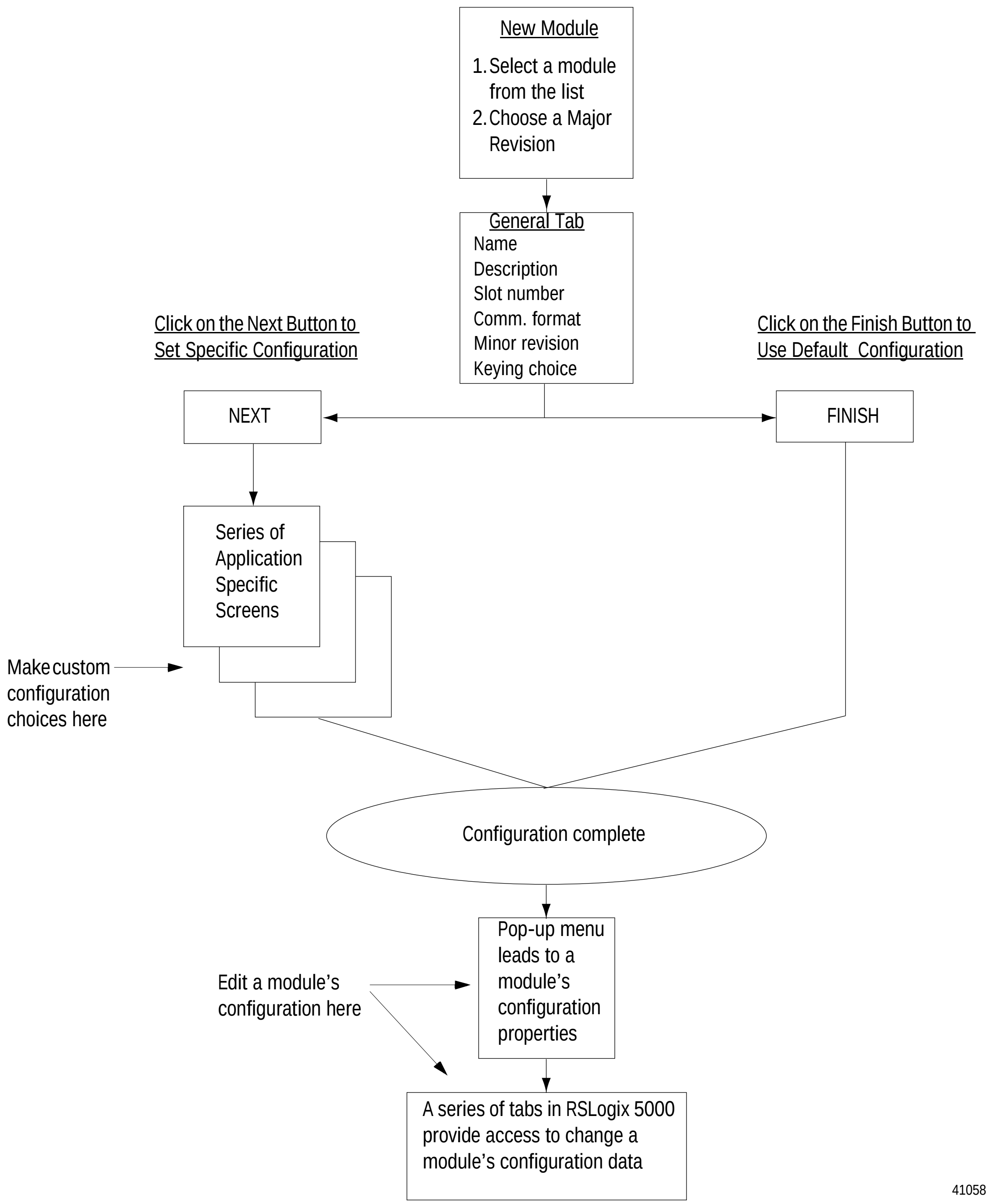
When you use the RSLogix 5000 software to configure a ControlLogix analog I/O module, you must perform the following steps:

1. create a new module

2. accept default configuration or write specific configuration for the module

3. edit configuration for a module when changes are needed

The following diagram shows an overview of the configuration process.

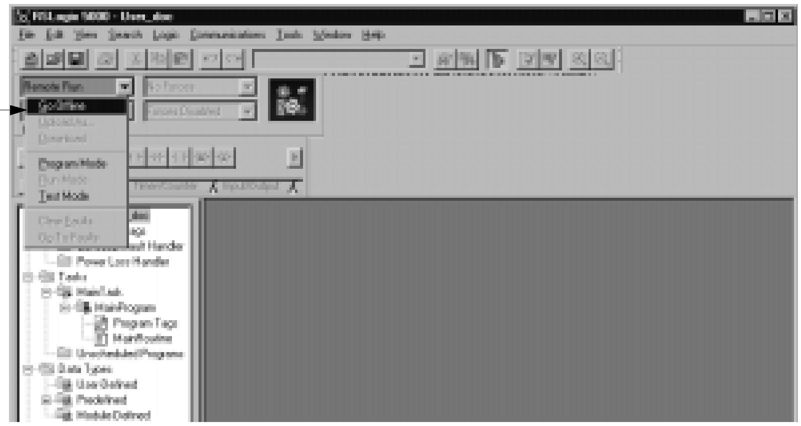


Creating a New Module

After you have started RSLogix 5000 and created a processor, you must create a new module. The wizard allows you to create a new module and configure it.

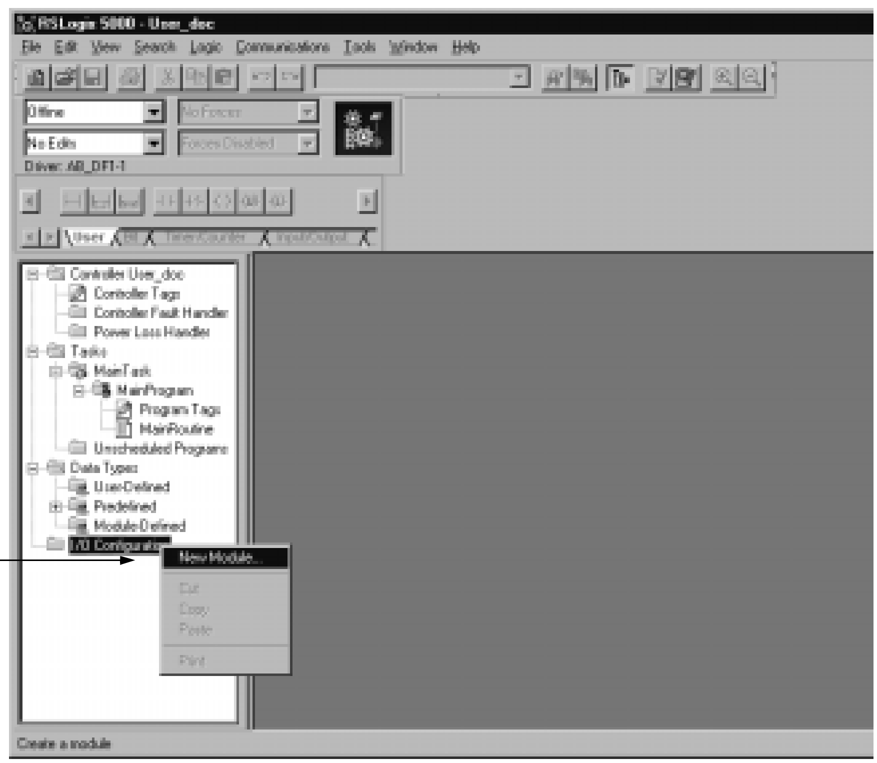
Important: You must be offline when you create a new module.

If you are not offline, use this pull-down menu to go offline

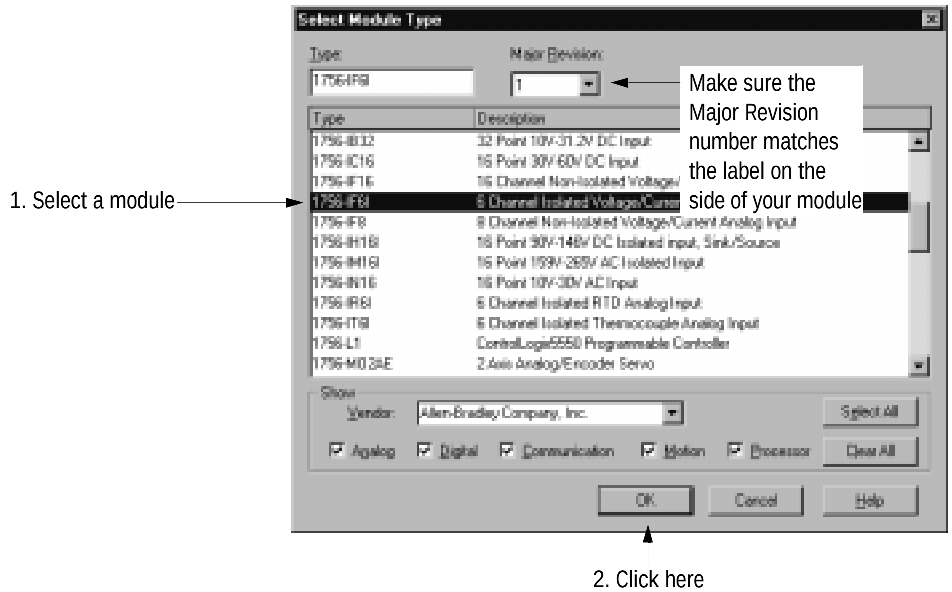


When you are offline, you must select a new module.

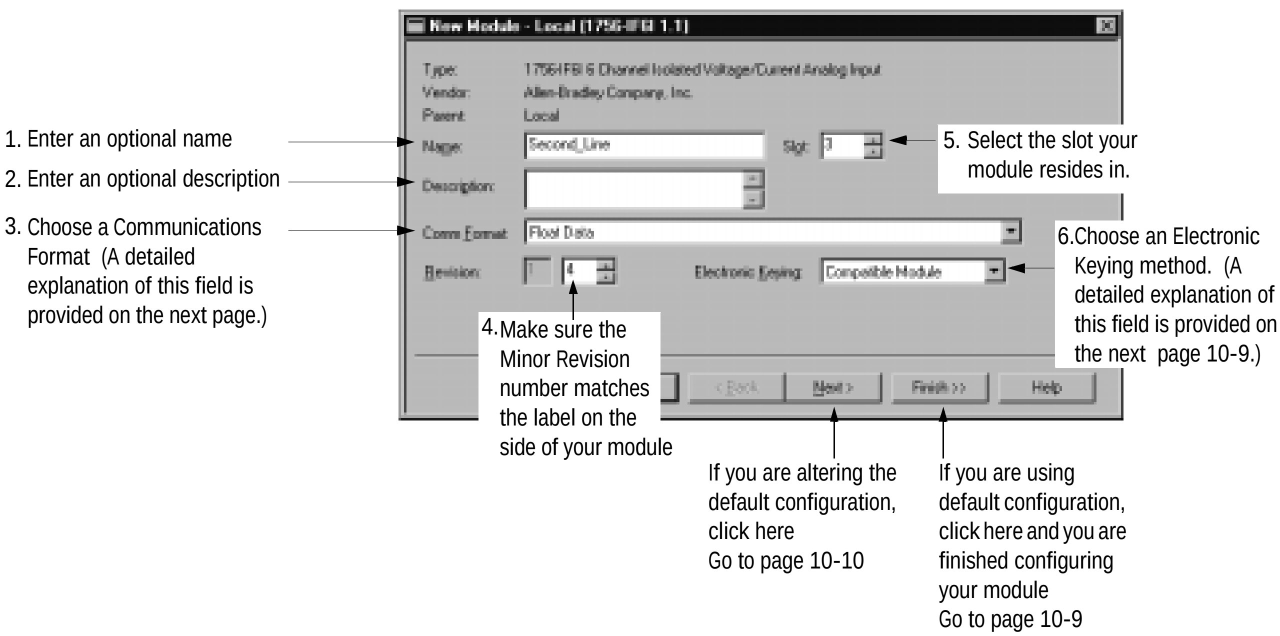
1. Select I/O Configuration
2. Click on the right mouse button to display the menu
3. Select New Module



A screen appears with a list of possible new modules for your application.



You enter the wizard on a naming page.



Communications Format

The communications format determines what type of configuration options are made available, what type of data is transferred between the module and its owner controller, and what tags are generated when configuration is complete.

This feature also defines the connection between the controller writing the configuration and the module itself.

Important: In addition to description below, each format returns status data and rolling timestamp data.

Input Module Formats

The following are possible Communications Format choices for input modules:

- **Float data -** module returns floating point input data
- **Integer data -** module returns integer input data
- **CST timestamped float data -** module returns floating point input data with the value of the system clock (from its local chassis) when the input data is sampled
- **CST timestamped integer data -** module returns integer input data with the value of the system clock (from its local chassis) when the input data is sampled
- **CST timestamped float data - differential mode -** 1756-IF16/IF8 module operating in the differential mode returns floating point input data with the value of the system clock (from its local chassis) when the input data is sampled
- **CST timestamped float data - high speed mode -** 1756-IF16/IF8 module operating in the high speed mode returns floating point input data with the value of the system clock (from its local chassis) when the input data is sampled
- **CST timestamped float data - single-ended mode -** 1756-IF16/IF8 module operating in the single-ended mode returns floating point input data with the value of the system clock (from its local chassis) when the input data is sampled
- **CST timestamped integer data - differential mode -** 1756-IF16/IF8 module operating in the differential mode returns integer input data with the value of the system clock (from its local chassis) when the input data is sampled
- **CST timestamped integer data - high speed mode -** 1756-IF16/IF8 module operating in the high speed mode returns integer input data with the value of the system clock (from its local chassis) when the input data is sampled
- **CST timestamped integer data - single-ended mode -** 1756-IF16/IF8 module operating in the single-ended mode returns integer input data with the value of the system clock (from its local chassis) when the input data is sampled

- **Float data - differential mode -** 1756-IF16/IF8 module operating in the differential mode only returns floating point input data
- **Float data - high speed mode -** 1756-IF16/IF8 module operating in the high speed mode only returns floating point input data
- **Float data - single-ended mode -** 1756-IF16/IF8 module operating in the single-ended mode only returns floating point input data
- **Integer data - differential mode -** 1756-IF16/IF8 module operating in the differential mode only returns integer input data
- **Integer data - high speed mode -** 1756-IF16/IF8 module operating in the high speed mode only returns integer input data
- **Integer data - single-ended mode -** 1756-IF16/IF8 module operating in the single-ended mode only returns integer input data

The following additional Communications Format choices are used by controllers that want to listen to an input module but not own it. These choices have the same definition as similarly-named choices above:

- Listen only CST timestamped float data
- Listen only CST timestamped integer data
- Listen only float data
- Listen only integer data
- Listen only CST timestamped float data - differential mode
- Listen only CST timestamped float data - high speed mode
- Listen only CST timestamped float data - single-ended mode
- Listen only CST timestamped integer data - differential mode
- Listen only CST timestamped integer data - high speed mode
- Listen only CST timestamped integer data - single-ended mode
- Listen only Float data - differential mode
- Listen only Float data - high speed mode
- Listen only Float data - single-ended mode
- Listen only Integer data - differential mode
- Listen only Integer data - high speed mode
- Listen only Integer data - single-ended mode

For example, the screen below shows some of the choices available when you are configuring a 1756-IF6I module.

Important: Once the module is created, the communications format cannot be changed. The module must be deleted and recreated.

Output Module Formats

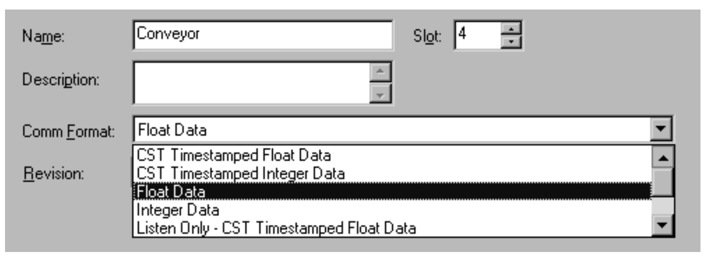
The following are possible Communications Format choices for output modules:

- **Float data -** owner controller sends the module only floating point output data
- **Integer data -** owner controller sends the module only integer output data
- **CST timestamped float data -** owner controller sends the module floating point output data and receives data echo values with a CST timestamp value
- **CST timestamped integer data -** owner controller sends the module integer output data and receives data echo values with a CST timestamp value

The following additional Communications Format choices are used by controllers that want to listen to an output module but not own it. These choices have the same definition as similarly-named choices above:

- Listen only - float data
- Listen only - integer data
- Listen only - CST timestamped float data
- Listen only - CST timestamped integer data

For example, the screen below shows some of the choices available when you are configuring a 1756-OF6CI module in a local chassis.

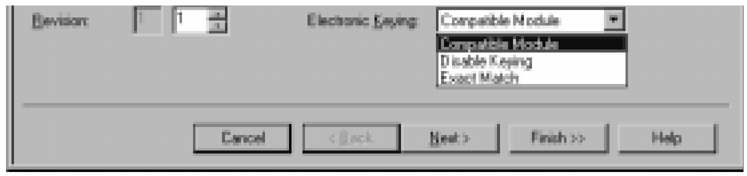


Important: Once the module is created, the communications format cannot be changed. The module must be deleted and recreated.

Electronic Keying

When you write configuration for a module you can choose how specific the keying must be when a module is inserted into a slot in the chassis.

The screen below shows the choices available when you are configuring any analog module.



For more information on electronic keying, see page 3-3.

Using the Default Configuration

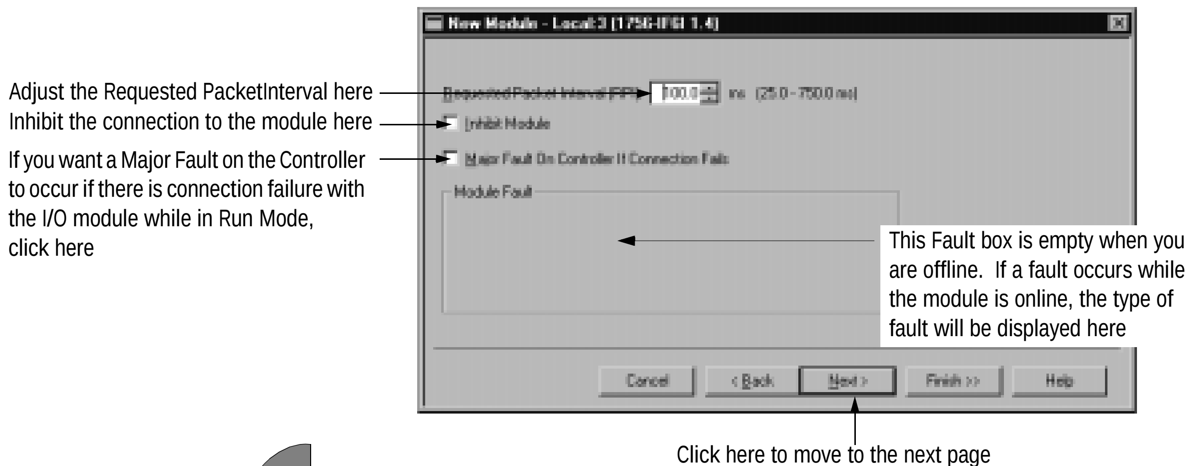
If you use the default configuration and click on Finish, you are done.

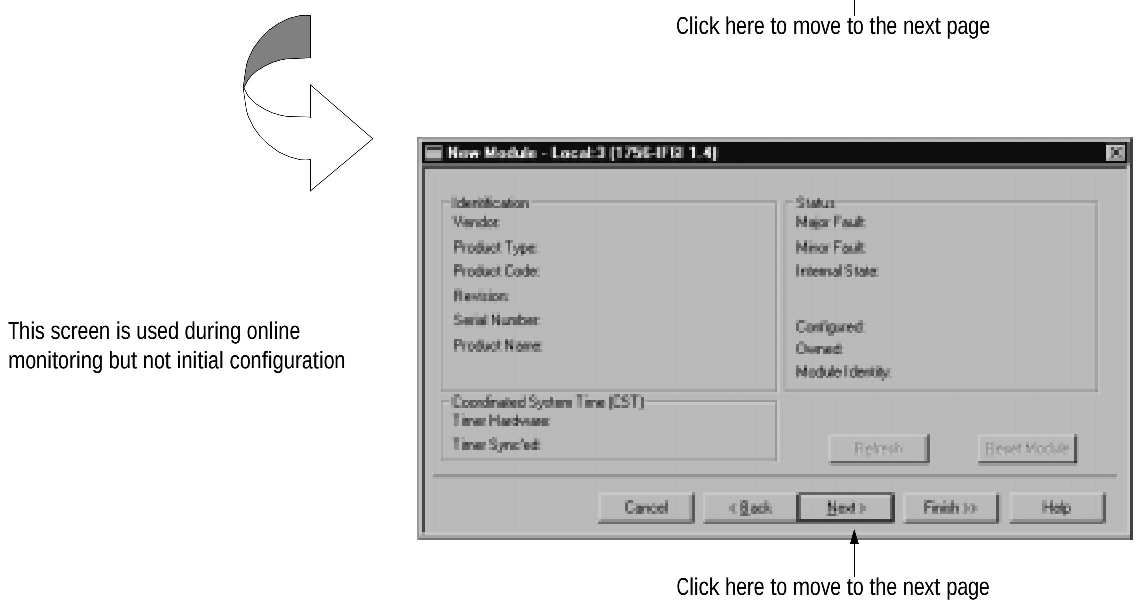
Altering the Default Configuration for Input Modules

If you write specific configuration and click on Next, you see the series of wizard screens that enable you to configure the module. This example shows the process for input modules. To see an example for output modules, see page 10-13.

Although each screen maintains importance during online monitoring, some of the screens that appear during this initial module configuration process are blank. They are shown here to maintain the graphical integrity of RSLogix 5000. To see these screens in use, see Appendix A.

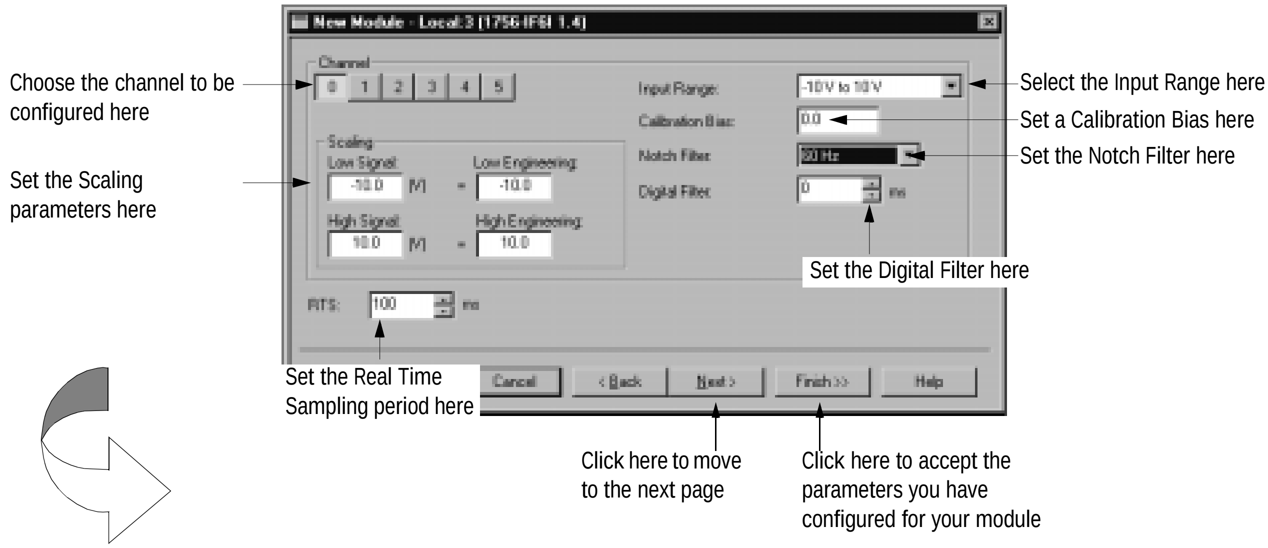
After the naming page, this series of screens appears.



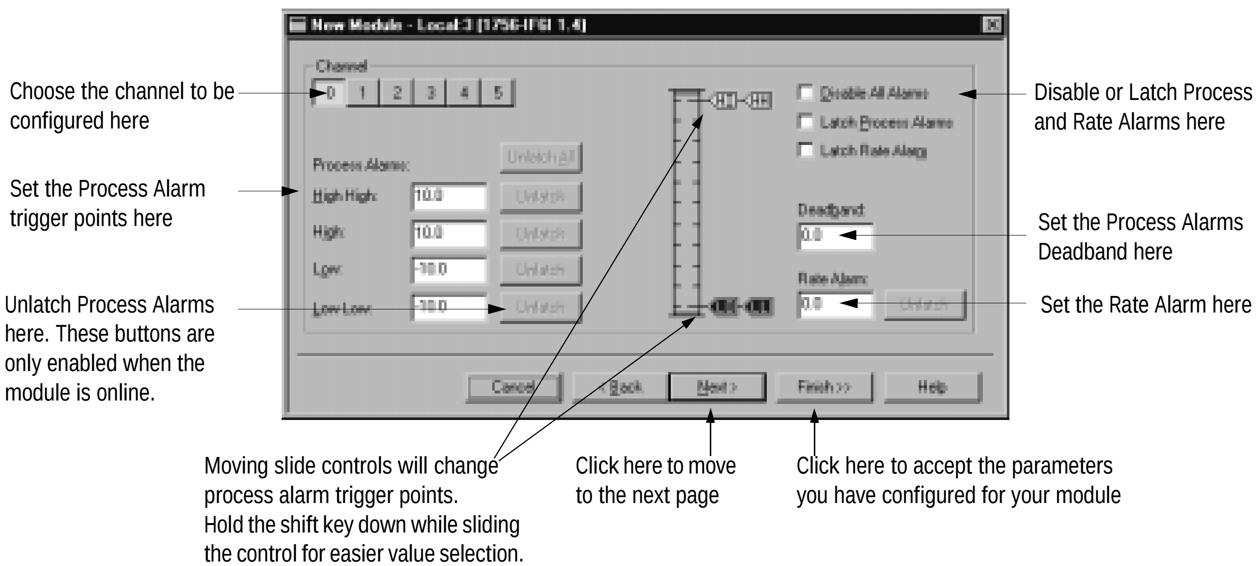


The configuration page appears next. For example, this screen appears for the 1756-IF6I module. The choices available on the configuration screen will vary according to the module selected.

IMPORTANT: Set all the configuration parameters for each channel on this page before moving to the next page

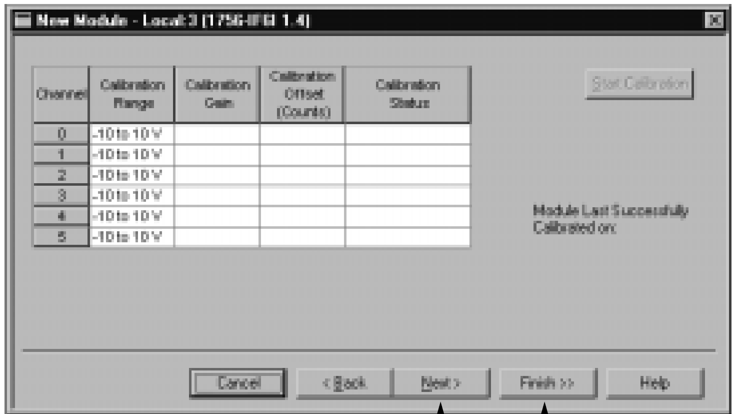


IMPORTANT: Set all the configuration parameters for each channel on this page before moving to the next page



The following screens are shown to maintain RSLogix 5000's graphical integrity but are not necessary to initial configuration. If you choose Finish on the previous screens, these screens will not appear.

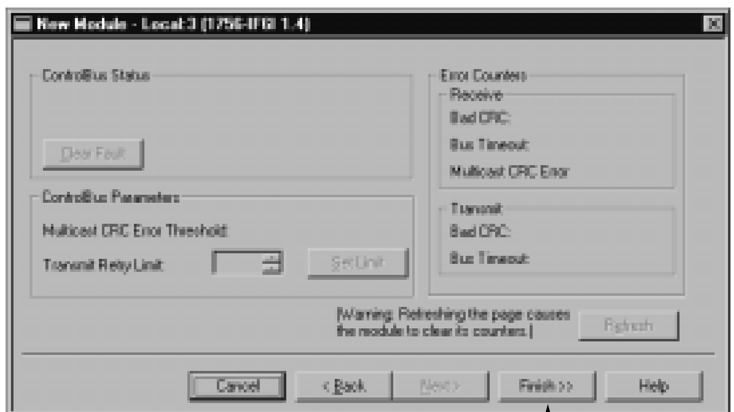
This screen appears next in the wizard series of screens. It is used during calibration but not initial configuration



Click here to move to the next page

Click here to accept the parameters you have configured for your module

This screen appears last in the wizard series of screens. It is used during online monitoring but not initial configuration



Click here to accept the parameters you have configured for your module

Altering the Default Configuration for Output Modules

If you write specific configuration and click on Next, you see the series of wizard screens that enable you to configure the module. This example shows the process for output modules.

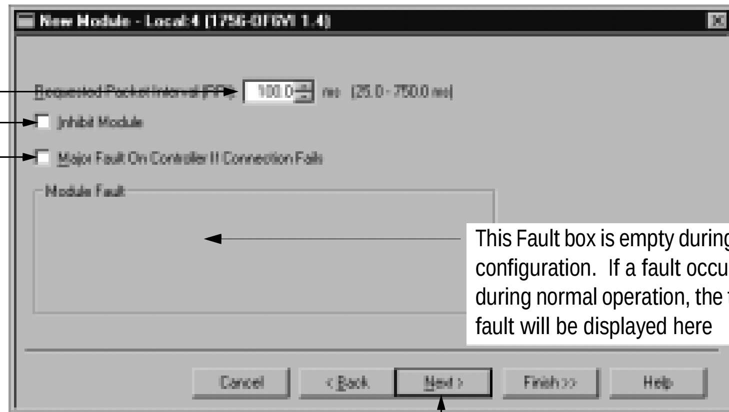
Although each screen maintains importance during online monitoring, some of the screens that appear during this initial module configuration process are blank. They are shown here to maintain the graphical integrity of RSLogix 5000. To see these screens in use, see Appendix A.

After the naming page, this series of screens appears.

Adjust the Requested Packet Interval here

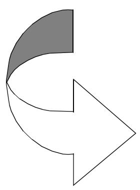
Inhibit the connection to the module here

If you want a Major Fault on the Controller to occur if there is connection failure with the I/O module while in Run Mode, click here

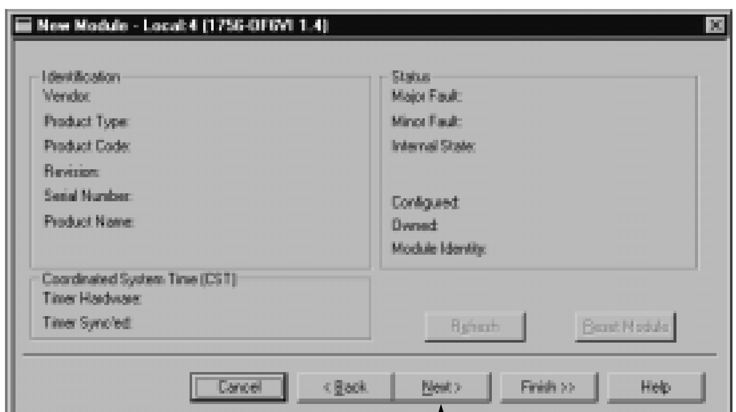


This Fault box is empty during initial configuration. If a fault occurs during normal operation, the type of fault will be displayed here

Click here to move to the next page



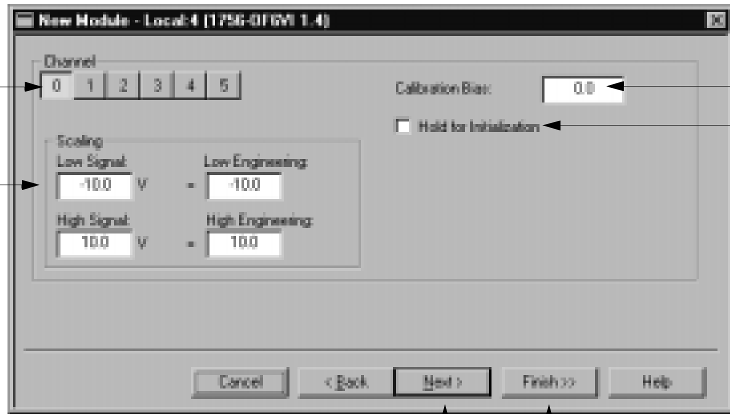
This screen is used during online monitoring but not initial configuration



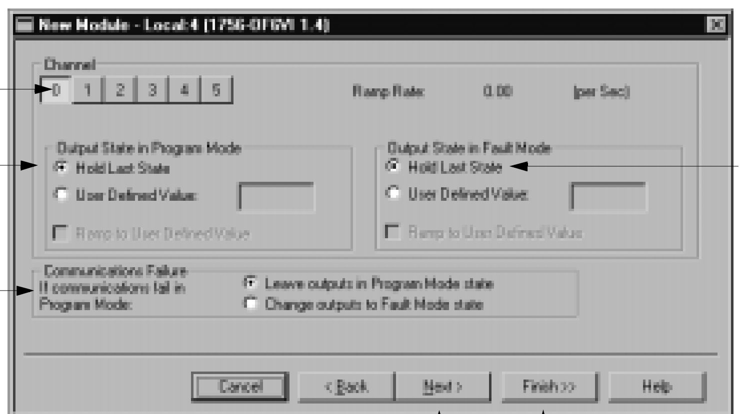
Click here to move to the next page

The configuration page appears next. For example, this screen appears for the 1756-OF6VI module. The choices available on the configuration screen will vary according to the module selected.

IMPORTANT: Set all the configuration parameters for each channel on this page before moving to the next page



IMPORTANT: Set all the configuration parameters for each channel on this page before moving to the next page



IMPORTANT: Outputs always go to Fault mode if communications fail in Run mode

These screens appear next.

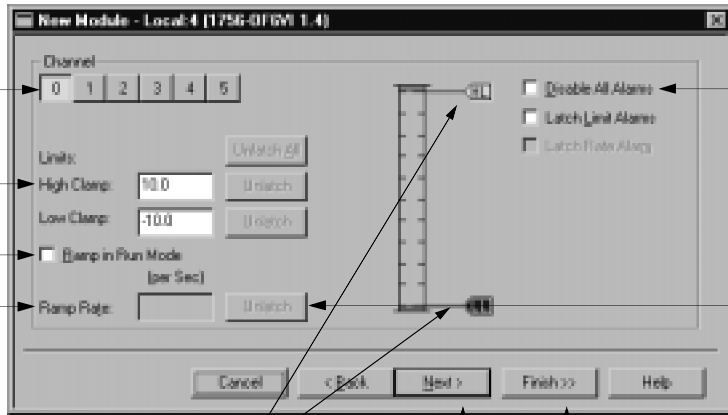
IMPORTANT: Set all the configuration parameters for each channel on this page before moving to the next page

Choose the channel to be configured here

Set Clamp Limits here

Select Ramp in Run here

Set Ramp Rate here



Disable or latch limit Ramp and Rate Alarms here

Unlatch Process Alarms here. These buttons are only enabled when the module is online.

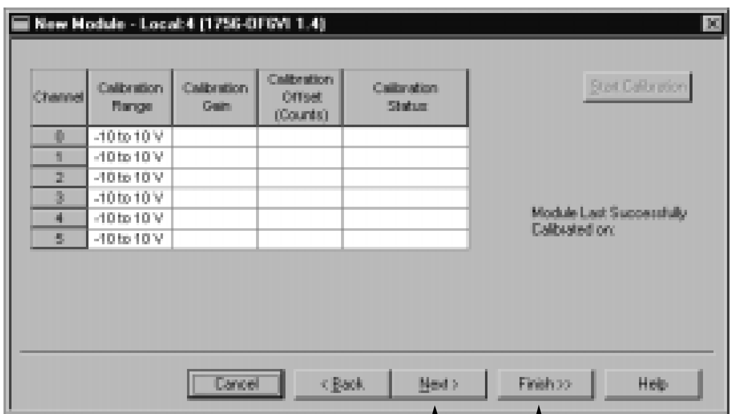
Moving slide controls will change Clamp Limit trigger points. Hold the shift key down while sliding the control for easier value selection.

Click here to move to the next page

Click here to accept the parameters you have configured for your module

IMPORTANT: The last two screens only appear if you click on Next after setting the process alarms above

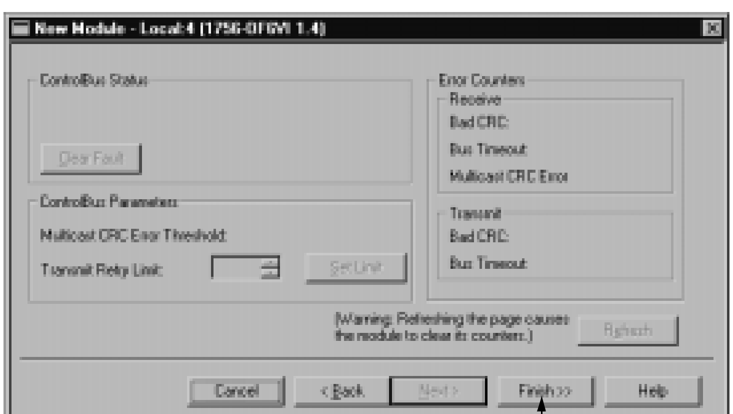
This screen appears next in the wizard series of screens. It is used during calibration but not initial configuration



Click here to move to the next page

Click here to accept the parameters you have configured for your module

This screen appears last in the wizard series of screens. It is used during online monitoring but not initial configuration



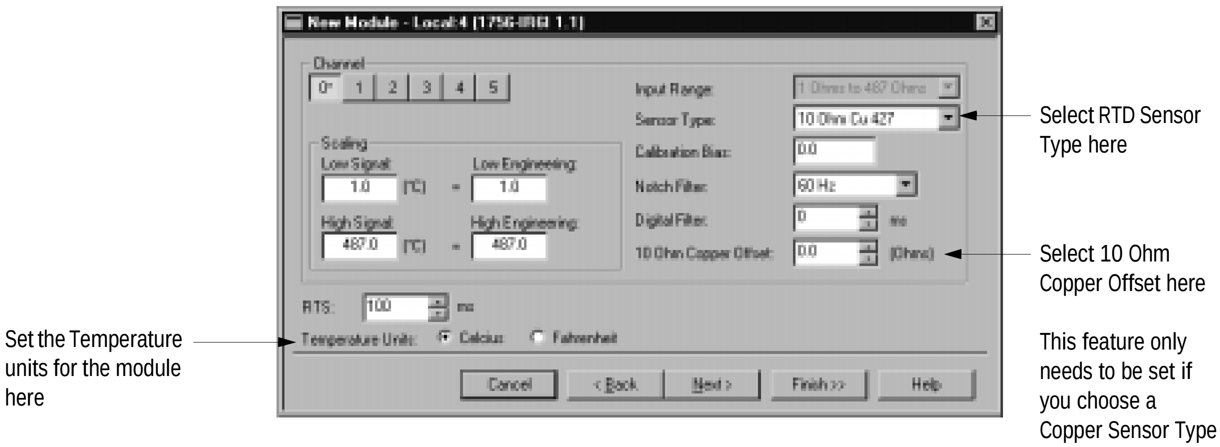
Click here to accept the parameters you have configured for your module

Configuring the RTD Module

The RTD module (Cat. No. 1756-IR6I) has additional configurable points, temperature units and 10Ω copper offset options.

All of this module's configuration screens match the series listed for input modules beginning on page 10-10 except for the third screen. The screen below shows the aforementioned screen for the 1756-IR6I module.

IMPORTANT: Set all the configuration parameters for each channel on this page before moving to the next page All configurable options are the same except for the addition of those features that account for the module's temperature measuring capability. They are shown below.

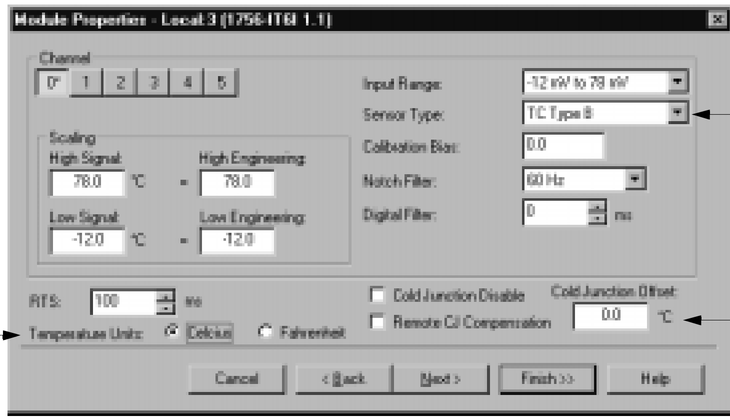


Configuring the Thermocouple Module

The thermocouple module (Cat. No. 1756-IT6I) has additional configurable points, temperature units and cold junction options.

All of this module’s configuration screens match the series listed for input modules beginning on page 10-10 except for the third screen. The screen below shows the aforementioned screen for the 1756-IT6I module.

IMPORTANT: Set all the configuration parameters for each channel on this page before moving to the next page All configurable options are the same except for the addition of those features that account for the module’s temperature measuring capability. They are shown below.



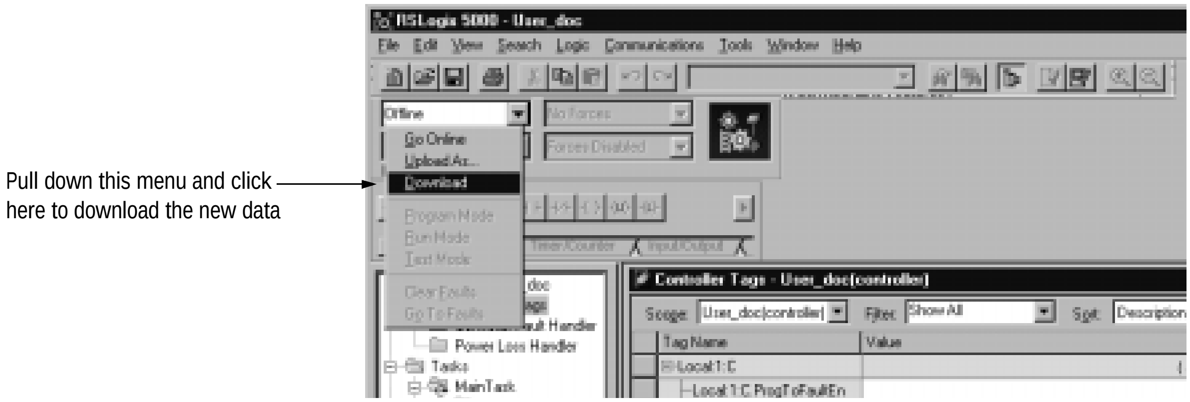
Important: The module will send back temperature values over the entire sensor range as long as the High signal value equals the High engineering value and the Low signal value equals the Low engineering value.

For the example above, if High Signal = 78.0^{o}C,

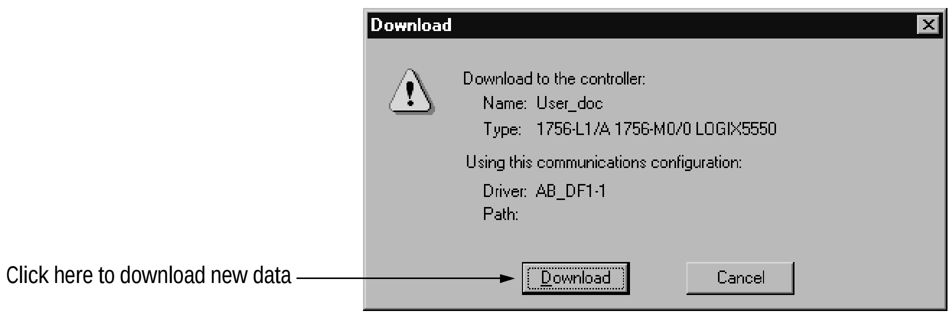
High Engineering must = 78.0. If Low signal = -12.0^{o}C, Low Engineering must = -12.0

Downloading New Configuration Data

After you have changed the configuration data for a module, the change does not actually take affect until you download the new program which contains that information. This downloads the entire program to the controller overwriting any existing programs.



RSLogix 5000 verifies the download process with this pop-up screen.



This completes the download process.

Editing Configuration

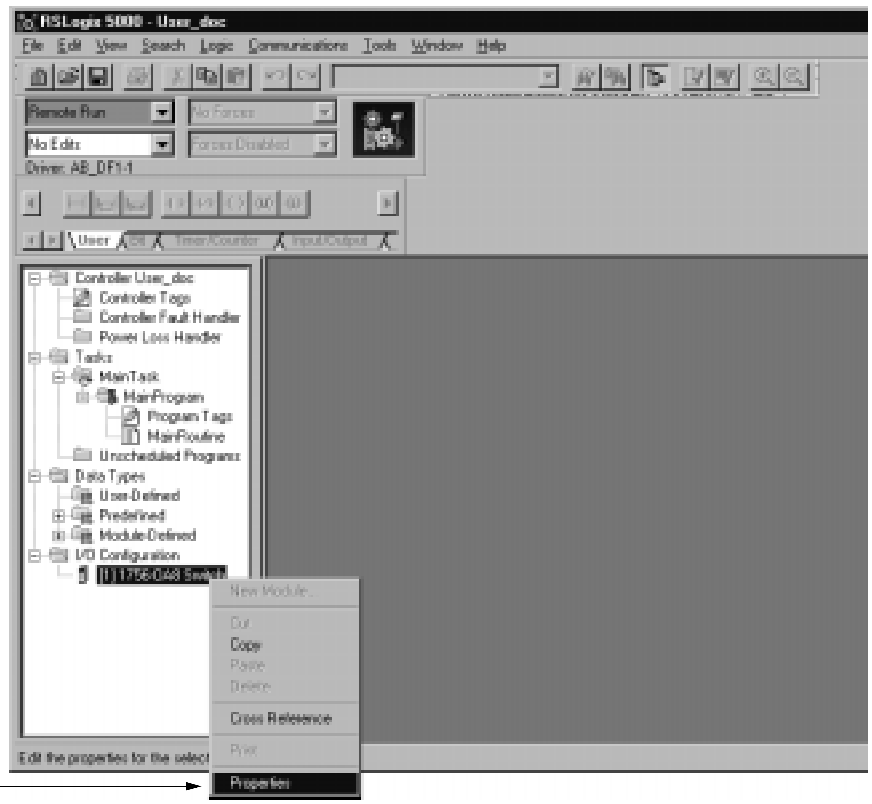
After you set configuration for a module, you can review and change it. You can change configuration data and download it to the controller while online. This is called **dynamic reconfiguration**.

Your freedom to change some configurable features, though, depends on whether the controller is in Remote Run Mode or Program Mode.

Important: Although you can change configuration while online, you must go offline to add or delete modules from the program.

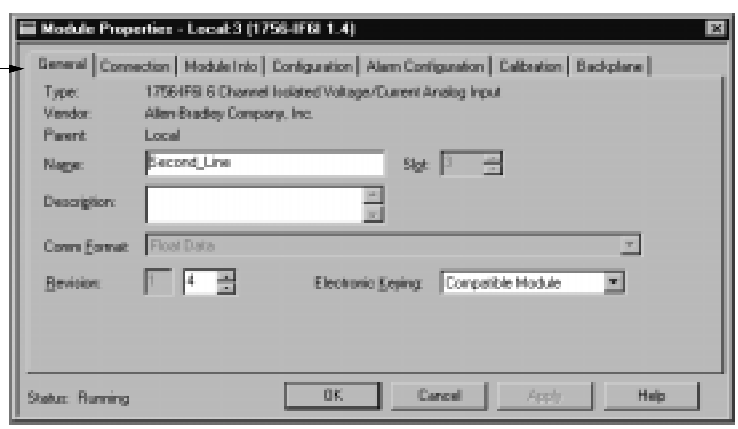
The editing process begins on the main page of RSLogix 5000.

1. Select the module
2. Click on the right mouse button to display the menu
3. Select Properties



You see this screen.

Click on the tab of the page you want to view or reconfigure



Reconfiguring Module Parameters in Run Mode

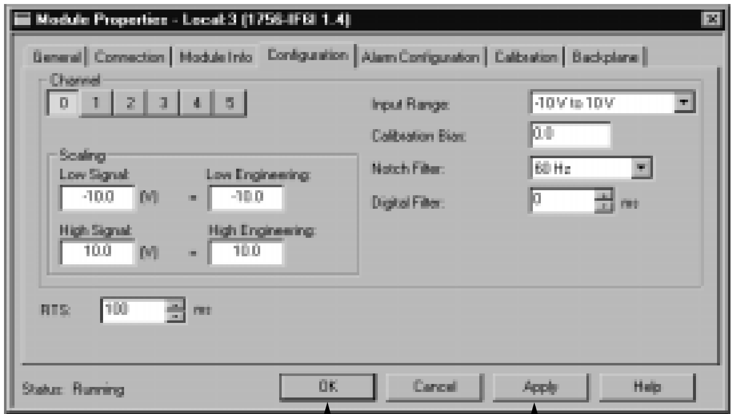
Your module can operate in Remote Run Mode or Hard Run Mode. You can only change any configurable features that are enabled by the software in Remote Run Mode.

If any feature is disabled in either Run Mode, change the controller to Program Mode and make the necessary changes.

For example, the following screen shows the configuration page for the 1756-IF6I module while it is in Run Mode.

1. Make the necessary configuration changes

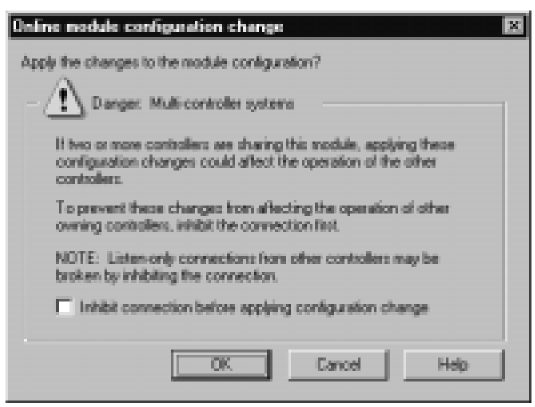
   In this example, all configurable features are enabled in Run Mode



2. Click here to transfer the new data and close the screen

Click here to transfer the new data and keep the screen open

When you try to download new configuration data to the module, the following warning appears.



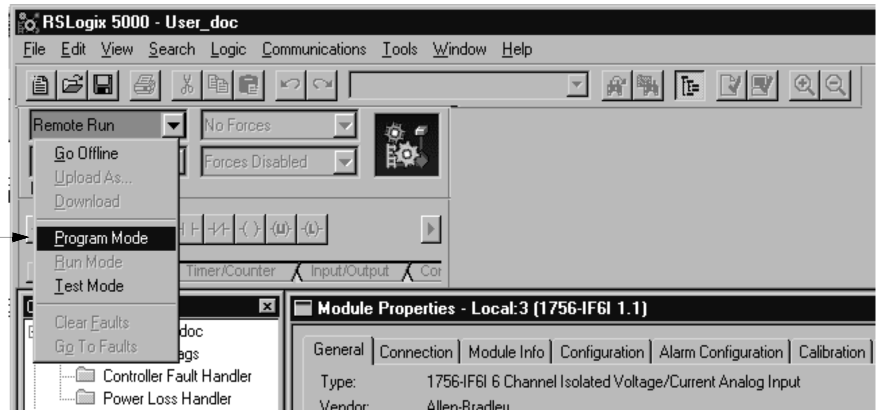
Important: If you change the configuration for a module, you must consider whether the module has more than one owner controller. If so, be sure each owner has exactly the same configuration data as the others.

For more information on changing configuration in a module with multiple owner controllers, see page 2-12.

Reconfiguring Module Parameters in Program Mode

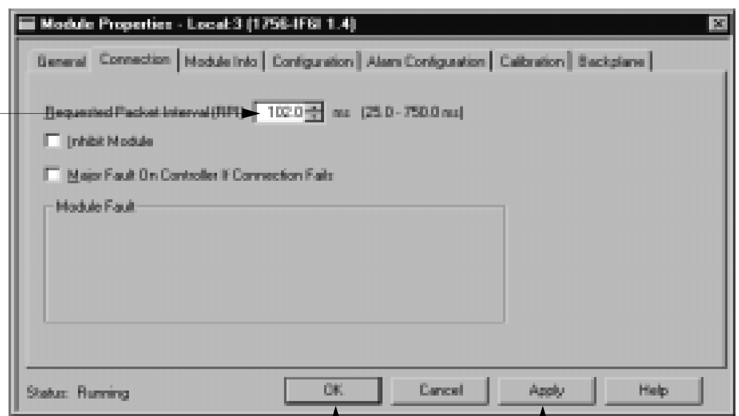
Change the module from Run Mode to Program Mode before changing configuration in the Program Mode.

Use this pull-down menu to switch to Program Mode



Make any necessary changes. For example, the RPI can only be changed in Program Mode.

1. Update the RPI rate



2. Click here to transfer the new data and close the screen

Click here to transfer the new data and keep the screen open

Before the RPI rate is updated online, RSLogix 5000 will verify your desired change.

Click here to continue with the RPI change

The RPI has been changed and the new configuration data has been transferred to the controller.

After making the necessary changes to your module's configuration in Program Mode, it is recommended that you change the module back to Run Mode.

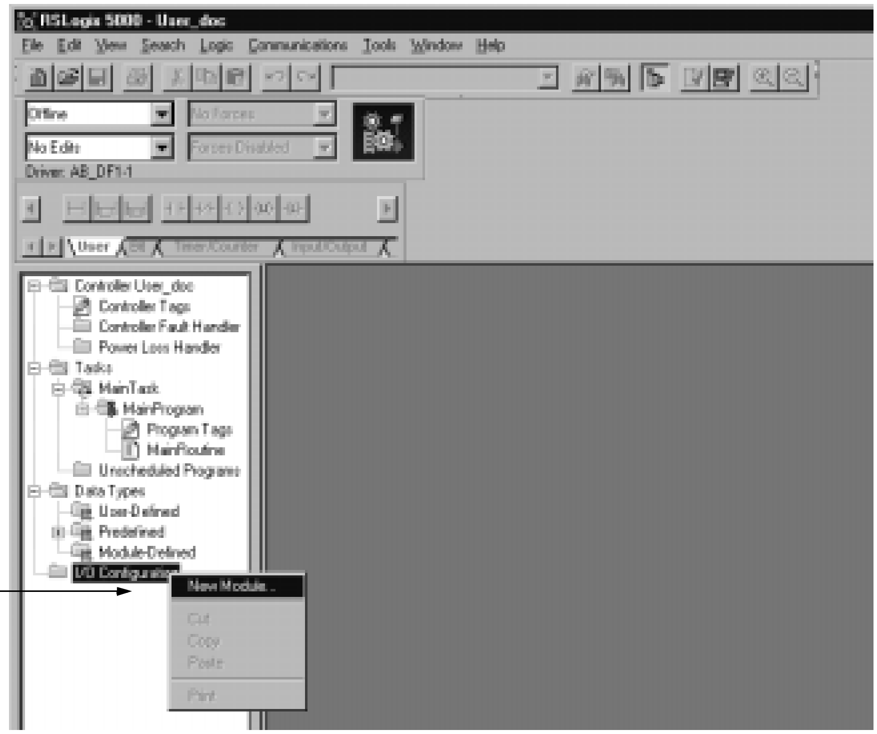
Configuring I/O Modules in a Remote Chassis

ControlLogix ControlNet Interface modules (1756-CNB or 1756-CNBR) are required to communicate with I/O modules in a remote chassis.

You must configure the communications module in the local chassis and the remote chassis before adding new I/O modules to the program.

1. Configure a communications module for the local chassis. This module handles communications between the controller chassis and the remote chassis.

1. Select I/O Configuration
2. Click on the right mouse button to display the menu
3. Select New Module

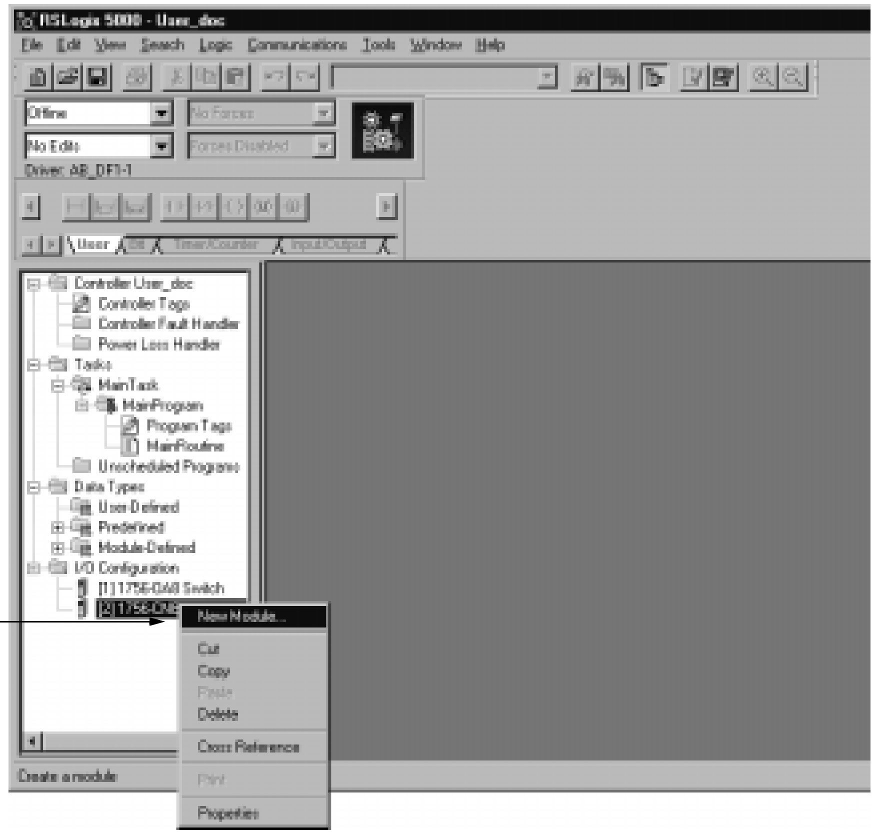


2. Choose a 1756-CNB or 1756-CNBR module and configure it.

For more information . . .

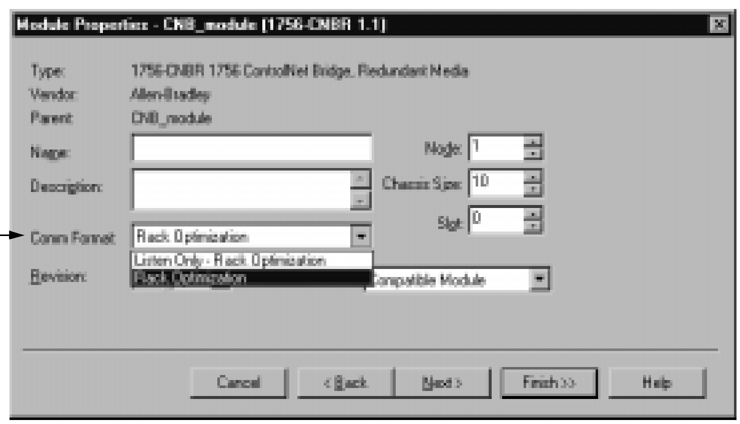
For more information on the ControlLogix ControlNet Interface modules, see the ControlLogix ControlNet Interface Installation Instructions, publication 1756-5.32.

3. Configure a communications module for the remote chassis.



1. Select the local communications module
2. Click on the right mouse button and select New Module

4. Choose a 1756-CNB or 1756-CNBR module and configure it.



IMPORTANT: Be aware of the two Communications Format choices available for 1756-CNB modules. For more information on the differences between Rack Optimization and Listen-Only Rack Optimization, see chapter 2 of the ControlLogix Digital I/O Modules User Manual, publication 1756-6.5.8.

For more information . . .

For more information on the ControlLogix ControlNet Interface modules, see the ControlLogix ControlNet Interface Installation Instructions, publication 1756-5.32.

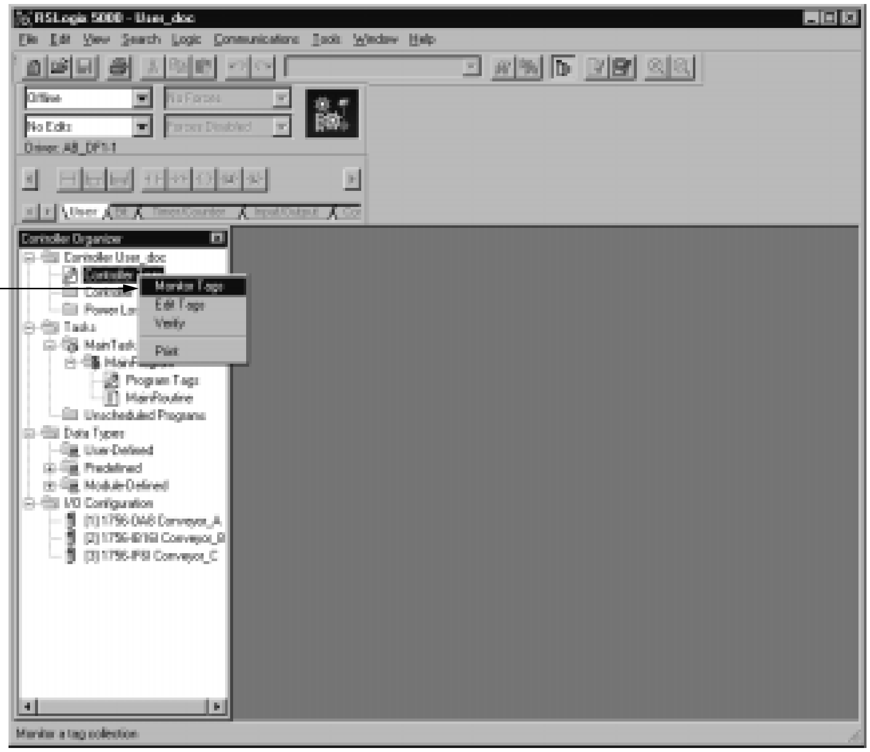
Now you can configure the remote I/O modules by adding them to the remote communications module. Follow the same procedures as you do for configuring local I/O modules as detailed earlier in this chapter.

Viewing and Changing Module Tags

When you create a module, you establish a series of tags in the ControlLogix system that can be viewed in the Tag Editor of RSLogix 5000. Each configurable feature on your module has a distinct tag that can be used in the processor's ladder logic.

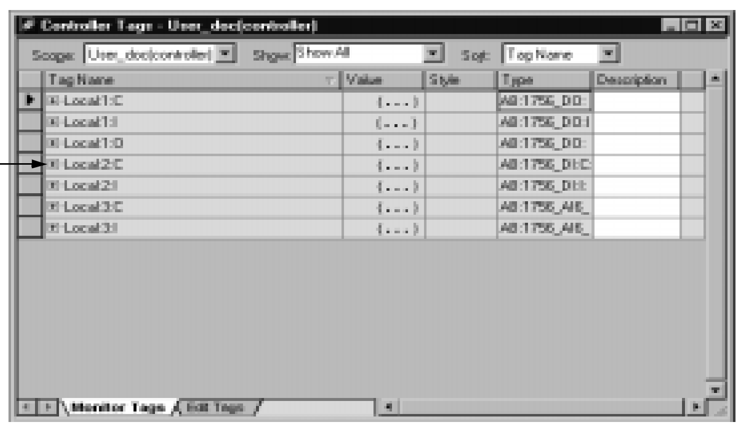
You can access a module's tags through RSLogix 5000 as shown below.

1. Select Controller Tags
2. Click on the right mouse button to display the menu
3. Select Monitor Tags



You can view the tags from here.

Click on the slot number of the module you want to see



Because the process of viewing and changing a module's configuration tags is broader in scope than can be addressed in this chapter, you must turn to Appendix A for more information and sample tag collections.

Chapter Summary and What's Next

In this chapter you learned about:

- configuring ControlLogix analog I/O modules
- editing module configuration
- configuration tags

Move on to chapter 11 to calibrate your module.

Calibrating the ControlLogix Analog I/O Modules

What This Chapter Contains

This chapter describes how to calibrate ControlLogix analog modules. The following table describes what this chapter contains and its location.

Your ControlLogix analog I/O module comes from the factory with a default calibration. You may choose to recalibrate your module to increase its accuracy for your specific application.

This chapter is broken into two sections, calibrating input modules and calibrating output modules.

You do not have to configure a module before you calibrate it. If you decide to calibrate your analog I/O modules first, you must add them to your program. To see how to add a new module to your program, see page 10-4.

Important: Analog I/O modules can be calibrated on a channel by channel basis or with the channels grouped together. Regardless of which option you choose, we recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

Calibration is meant to correct any hardware inaccuracies that may be present on a particular channel. The calibration procedure compares a known standard, either input signal or recorded output, with the channel's performance and then calculating a linear correction factor between the measured and the ideal.

The linear calibration correction factor is applied on every input or output same to obtain maximum accuracy.

Difference Between Calibrating An Input Module and Calibrating An Output Module

Although the purpose of calibrating analog modules is the same for input and output modules, to improve the module's accuracy and repeatability, the procedures involved differs for each.

When you calibrate input modules, you use current, voltage or ohms calibrators to send a signal to the module to calibrate it.

When you calibrate output modules, you use a digital multimeter (DMM) to measure the signal the module is sending out.

To maintain your module's accuracy specifications, we recommend you use calibration instruments with specific ranges. The following table lists the recommended instruments for each module.

Table 11.A
Recommended Calibration Instruments for ControlLogix Analog Modules

Modules:	Recommended instrument ranges:
1756-IF16 & 1756-IF8	0 to 10.25V source +/-150µV Voltage
1756-IF6I	0 to 10.00V source +/-150µV Voltage 1.00 to 20.00mA source +/-0.15µA Current
1756-IR6I	1.0 and 487.0Ω resistors[1] +/-0.01%
1756-IT6I	-12mV to 78mV source +/-0.3µV
1756-OF4 & 1756-OF8	DMM better than 0.3mV or 0.6µA
1756-OF6VI	DMM with resolution better than 0.5mV
1756-OF6CI	DMM with resolution better than 1.0µA

[1] We suggest you use the following precision resistors:
KRL Electronics
534A1-1R0T 1.0 Ohm 0.01% / 534A1-487R0T 487 Ohm 0.01%
A precision decade resistor box can also be used that meets or exceeds the required accuracy specifications. The user is responsible for assuring that the decade box maintains accuracy by periodic calibration as specified by the following vendors:

Electro Scientific Industries	IET Labs	Julie Research Labs
Portland, OR	Westbury, NY	New York, NY
Series DB 42	HARS-X Series	DR100 Series

Calibrate in Either Program or Run Mode

You must be online to calibrate your analog I/O modules. When you are online, you can choose either Program or Run Mode as the state of your program during calibration. We recommend the module not be actively controlling a process when you calibrate it.

Important: The module will freeze the state of each channel and will not update the controller with new data until after calibration ends. This could be hazardous if active control were attempted during calibration.

We recommend that you change your controller to Program Mode before beginning calibration.

Use this pull-down menu to change to Run or Program Mode.

Calibrating Input Modules

Input calibration is a multi-step process that involves multiple services being sent to the module. This section has three parts. Each input module requires attention be paid to specific calibration ranges.

Calibrating the 1756-IF16 or 1756-IF8 Modules

This module can be used for applications requiring voltage or current. You can only calibrate the module using a voltage signal.

The 1756-IF16 and 1756-IF8 offer 4 input ranges:

- -10 to 10V
- 0 to 5V
- 0 to 10V
- 0 to 20mA

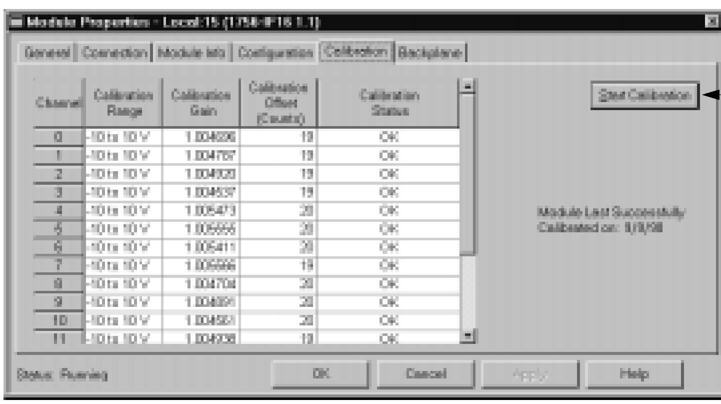
Important: Regardless of what application range is selected prior to calibration, all calibration uses a +/-10V range.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-19.

Follow these steps:

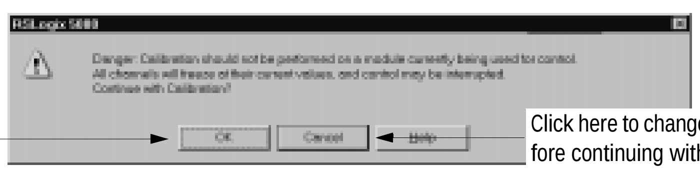
1. Connect your voltage calibrator to the module.

2. Go to the Calibration page. (Click on the tab for this page.)



Click here to start calibration

You see this warning.



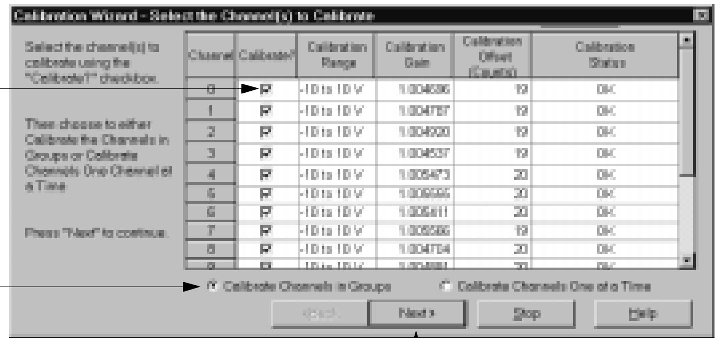
Click here to continue calibration with the channels frozen at their current values

Click here to change to Program Mode before continuing with calibration

3. Set the channels to be calibrated.

1. Choose the channels you want to calibrate here

2. Choose whether you want to calibrate channels in groups or one at a time here

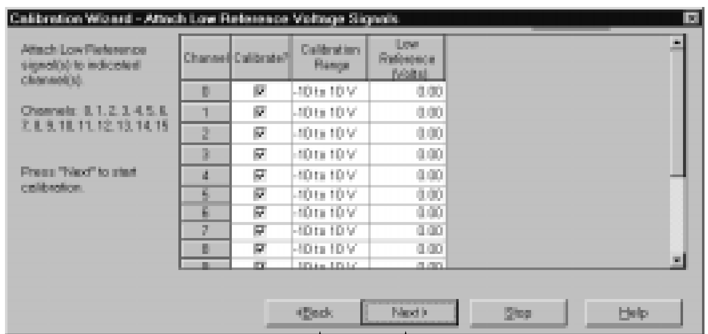


3. Click here to continue

The low reference screen appears first.

This screen shows which channels will be calibrated for a low reference and the range of that calibration.

It also shows what reference signal is expected on the input.

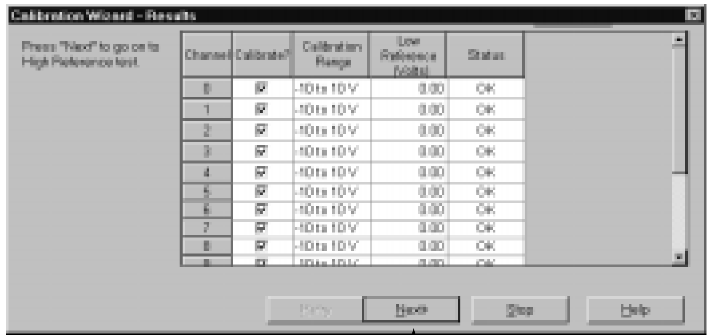


Click here to return to the last screen and make any necessary changes

Click here to calibrate the low reference

4. Set the calibrator for the low reference and apply it to the module.

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 5 until the status is OK.

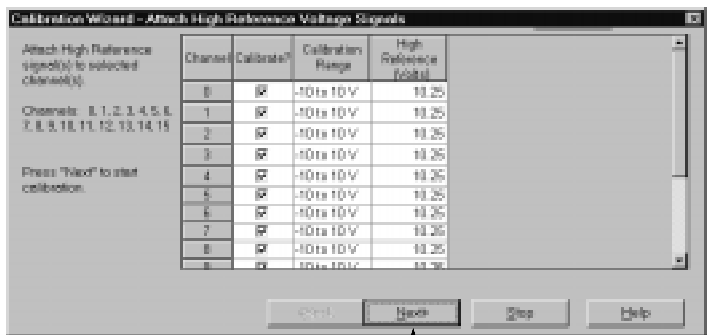


Click here to continue

5. Set the calibrator for the high reference and apply it to the module.

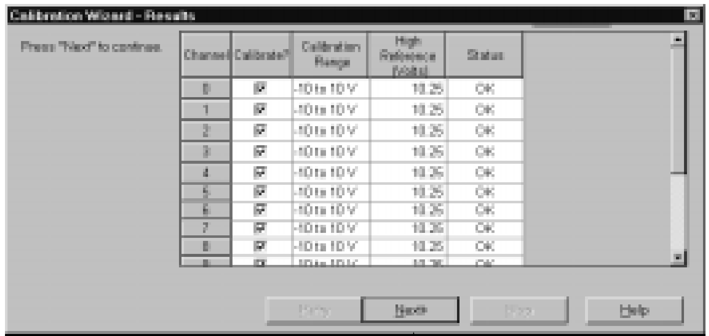
This screen shows which channels will be calibrated for a high reference and the range of that calibration.

It also shows what reference signal is expected at the input.



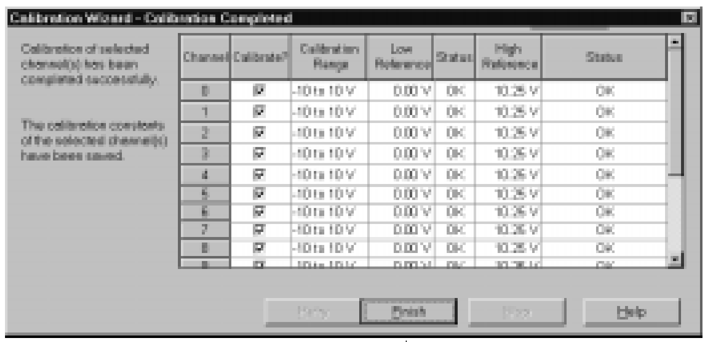
Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 6 until the status is OK.



Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both.



Click here to finish calibration and return the module to normal operation

Calibrating the 1756-IF6I Module

This module can be used for applications requiring voltage or current. Calibrate the module for your specific application.

Calibrating the 1756-IF6I for Voltage Applications

The 1756-IF6I offers 3 input voltage ranges:

- -10 to 10V
- 0 to 5V
- 0 to 10V

Important: Regardless of what voltage application range is selected prior to calibration, all voltage calibration uses a +/-10V range.

Calibrating the 1756-IF6I for Current Applications

The 1756-IF6I offers a 0 to 20mA current range. Calibrating the 1756-IF6I module for current uses the same process as calibrating it for voltage except the change in input signal.

Important: The following example shows how you can calibrate the 1756-IF6I module for voltage.

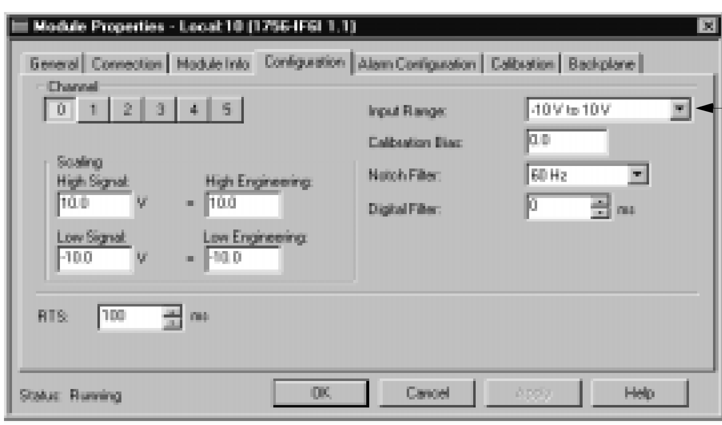
While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-19.

Follow these steps:

1. Connect your voltage calibrator to the module.

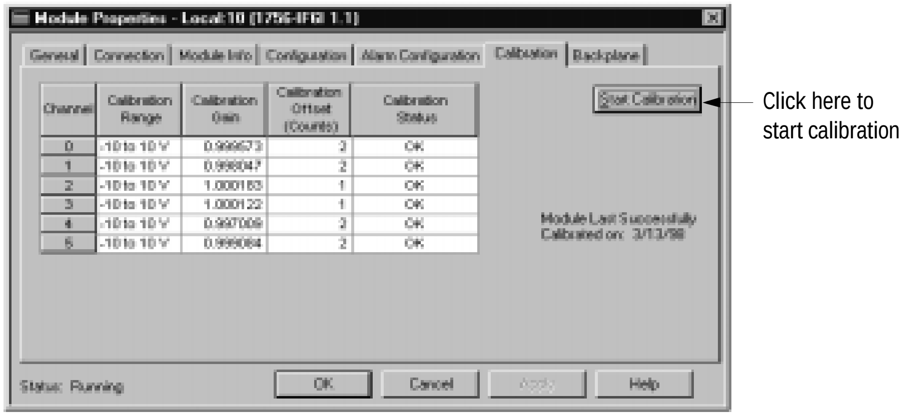
2. Go to the Configuration page.

IMPORTANT: Make sure you choose the correct input range for each channel to be calibrated.

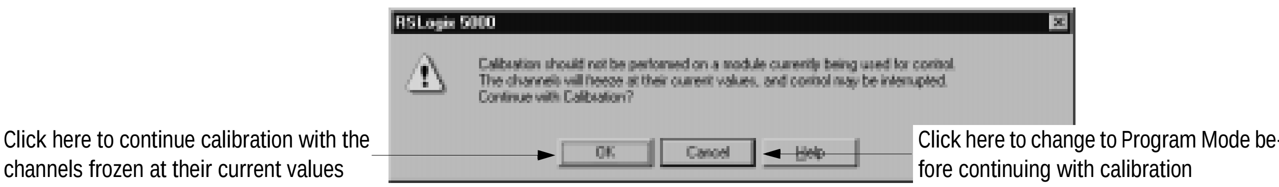


Use this pull-down menu to choose the Input Range to which you want to calibrate

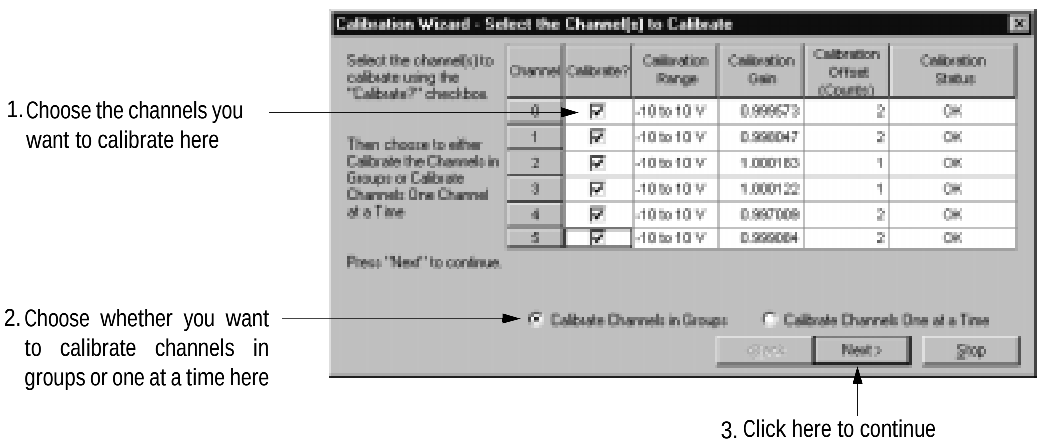
3. Go to the Calibration page. (Click on the tab for this page.)



You see this warning.



4. Set the channels to be calibrated.

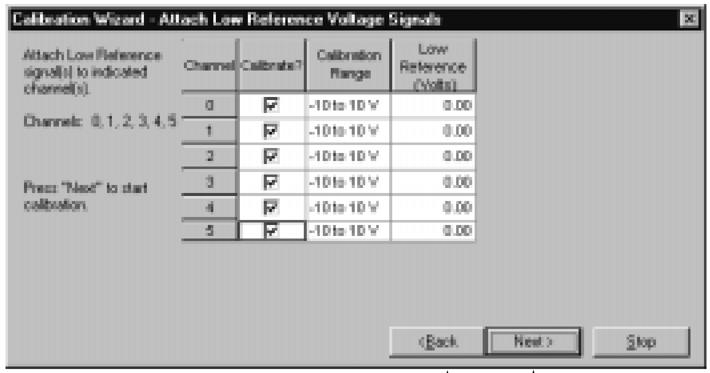


The low reference screen appears first.

5. Set the calibrator for the low reference and apply it to the module.

This screen shows which channels will be calibrated for a low reference and the range of that calibration.

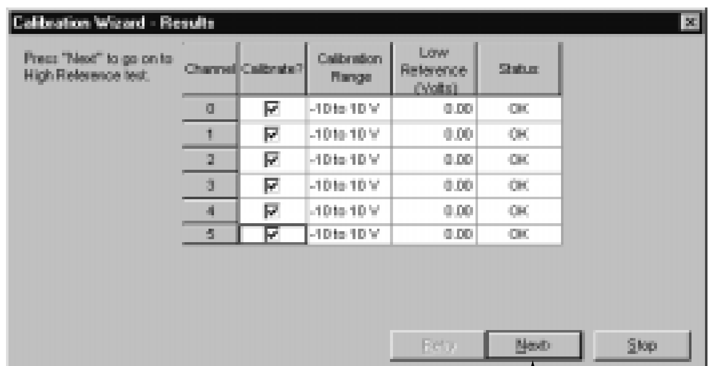
It also shows what reference signal is expected on the input.



Click here to return to the last screen and make any necessary changes

Click here to calibrate the low reference

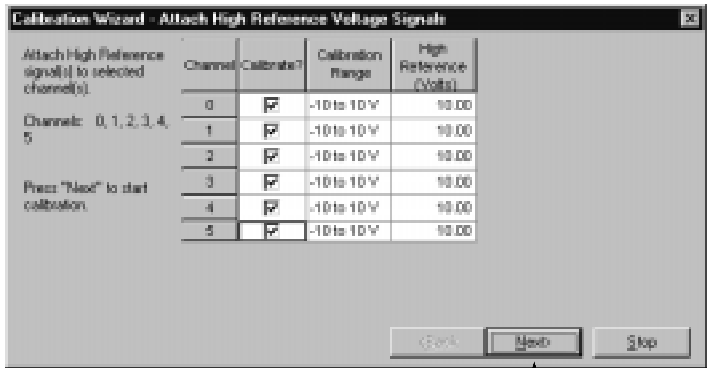
This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 5 until the status is OK.



Click here to continue

Now you must calibrate each channel for a high reference voltage.

6. Set the channels to be calibrated.

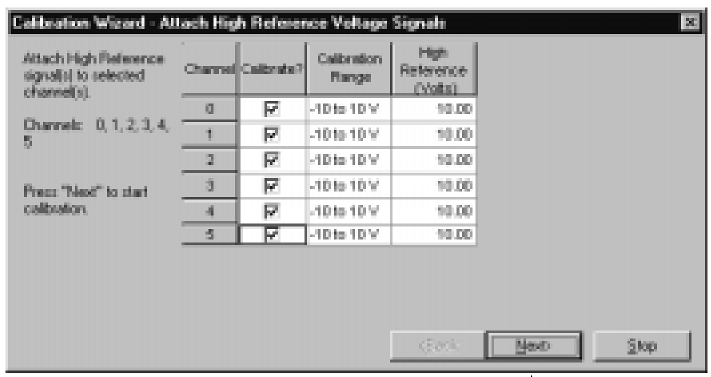


Click here to continue

7. Set the calibrator for the high reference and apply it to the module.

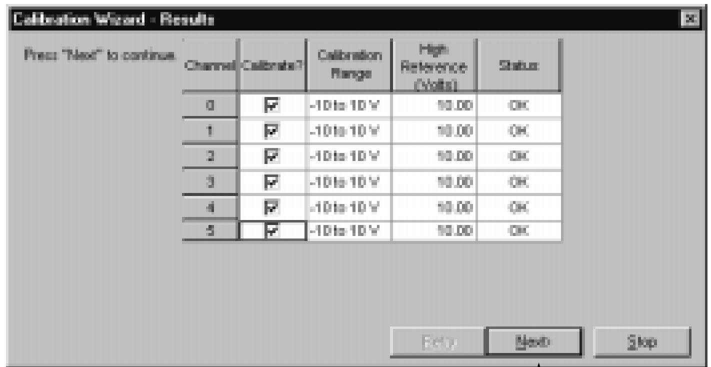
This screen shows which channels will be calibrated for a high reference and the range of that calibration.

It also shows what reference signal is expected at the input.



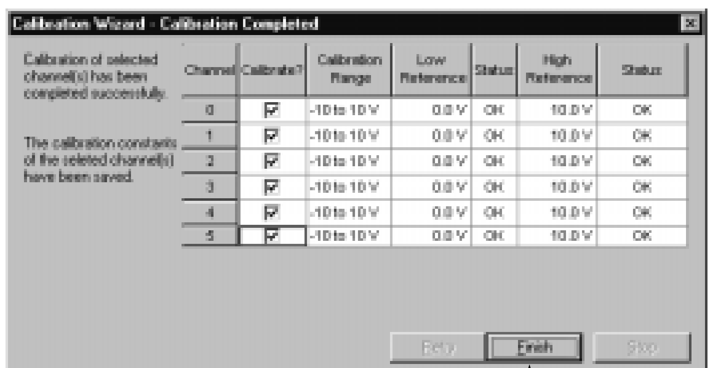
Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 6 until the status is OK.



Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both.



Click here to finish calibration and return the module to normal operation

Calibrating the 1756-IR6I

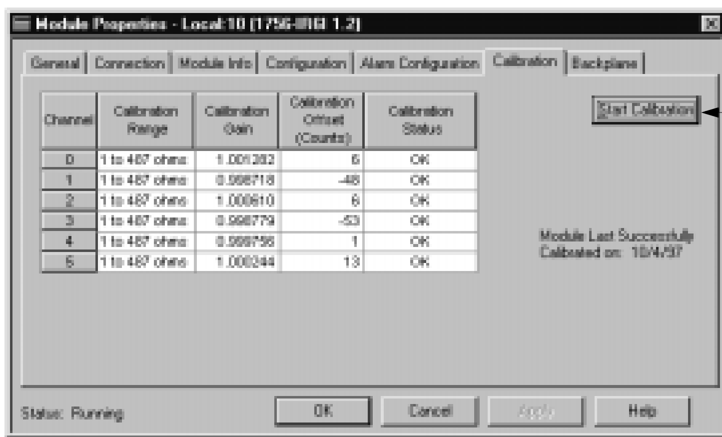
This module does not calibrate for voltage or current. It uses two precision resistors to calibrate the channels in ohms. You must connect a 1Ω precision resistor for low reference calibration and a 487Ω precision resistor for high reference calibration. The 1756-IR6I only calibrates in the 1-487Ω range.

Important: When you are wiring precision resistors for calibration, follow the wiring example on page 6-16. Make sure terminals IN-x/B and RTN-x/C are shorted together at the RTB.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-19.

Follow these steps:

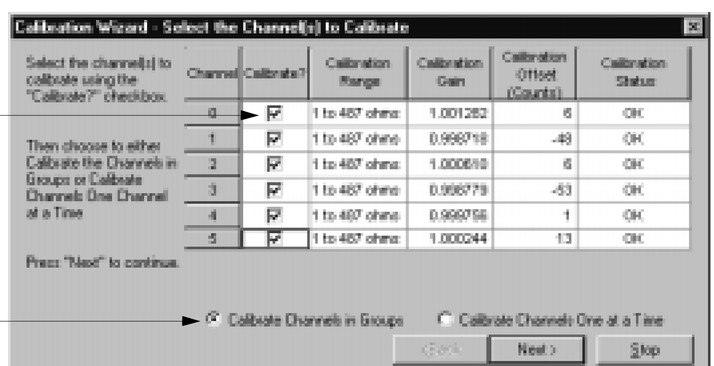
1. Go to the Calibration page. (Click on the tab for this page.)



Click here to start calibration

Important: Regardless of what ohms application range is selected prior to calibration, the 1756-IR6I only calibrates in the 1-487Ω range.

2. Set the channels to be calibrated.



1. Choose the channels you want to calibrate here

2. Choose whether you want to calibrate channels in groups or one at a time here

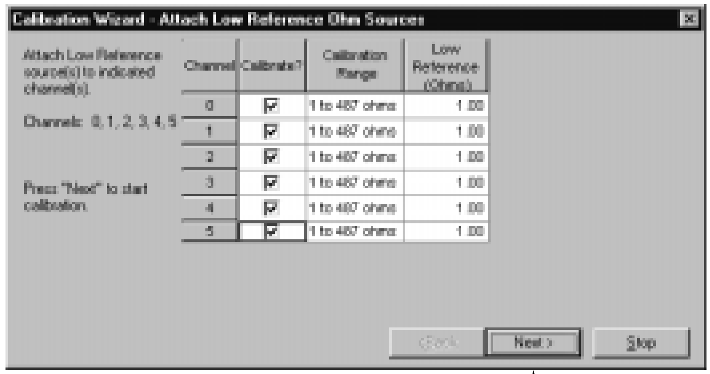
3. Click here to continue

The low reference screen appears first.

3. Connect a 1Ω resistor to each channel being calibrated.

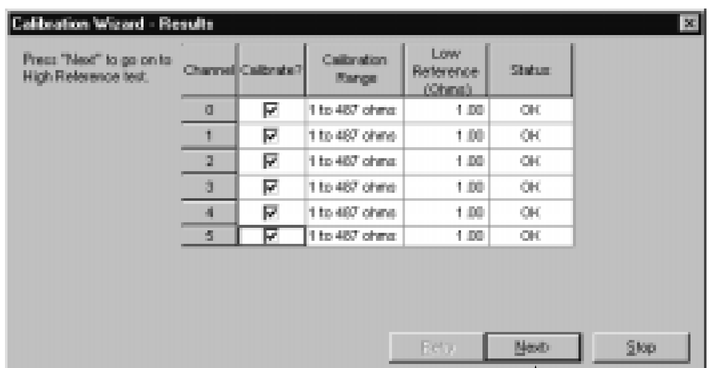
This screen shows which channels will be calibrated for a low reference and the range of that calibration.

It also shows what reference signal is expected on the input.



Click here to calibrate the low reference

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 4 until the status is OK.



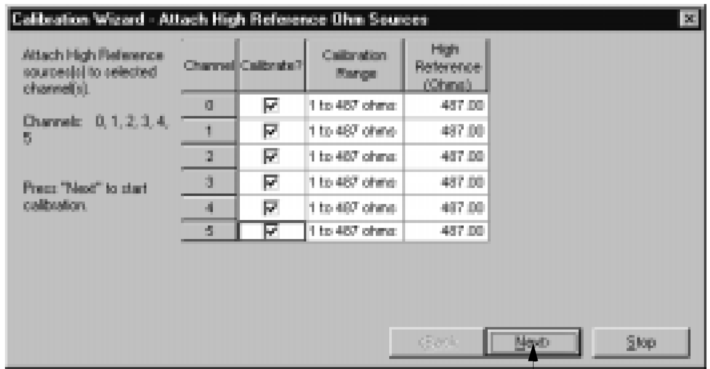
Click here to continue

Now you must calibrate each channel for a high reference.

4. Connect a 487Ω resistor to each channel being calibrated.

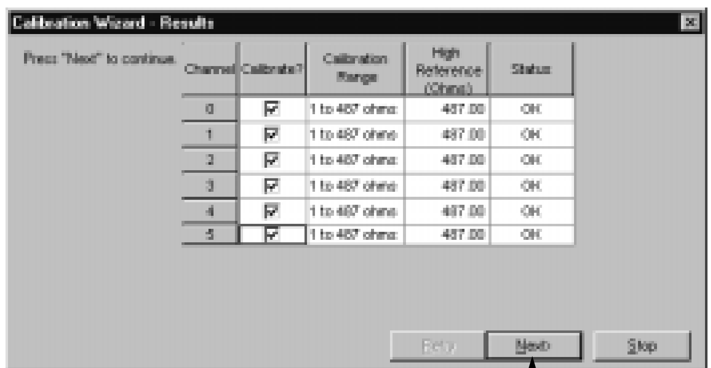
This screen shows which channels will be calibrated for a high reference and the range of that calibration.

It also shows what reference signal is expected on the input.



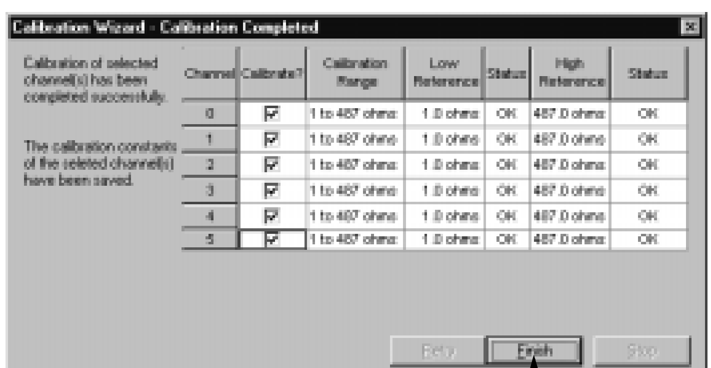
Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 5 until the status is OK.



Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.



Click here to finish calibration and return the module to normal operation

Calibrating the 1756-IT6I

This module only calibrates in millivolts. You can calibrate the module to either a -12 to 30mV range or -12 to 78mV range, depending upon your specific application.

Calibrating the 1756-IT6I for a -12mV to 30mV Range

This example shows the steps for calibrating a 1756-IT6I module for a -12mV to 30mV range. Use the same steps to calibrate for a -12mV to 78mV range.

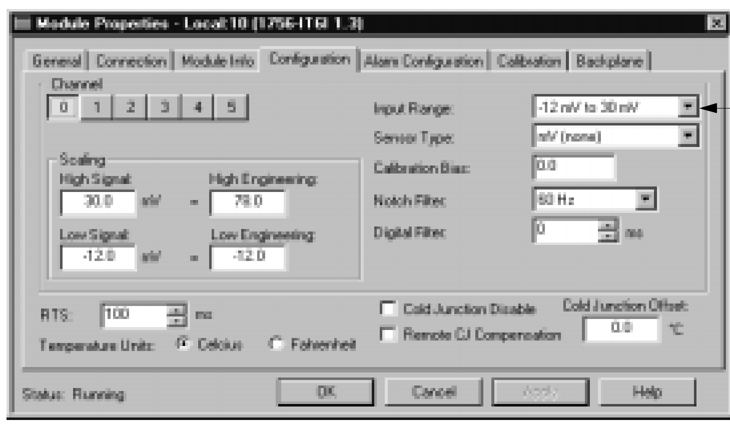
While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-19.

Follow these steps:

1. Connect your voltage calibrator to the module.

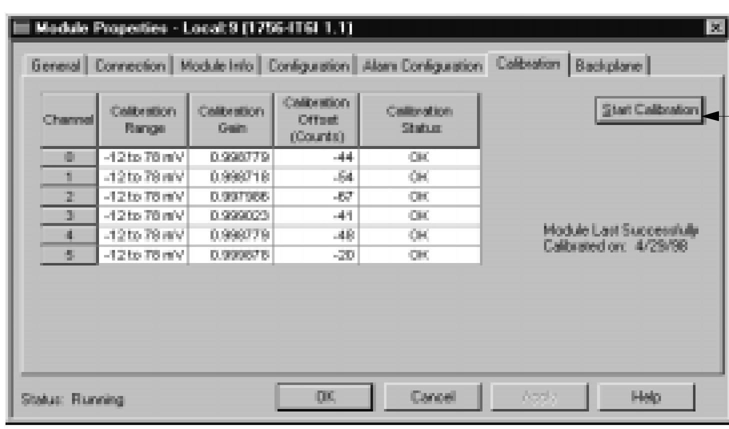
2. Go to the Configuration page.

IMPORTANT: The input range selected prior to calibration is the range in which the module will calibrate.



Use this pull-down menu to choose the Input Range

3. Go to the Calibration page. (Click on the tab for this page.)

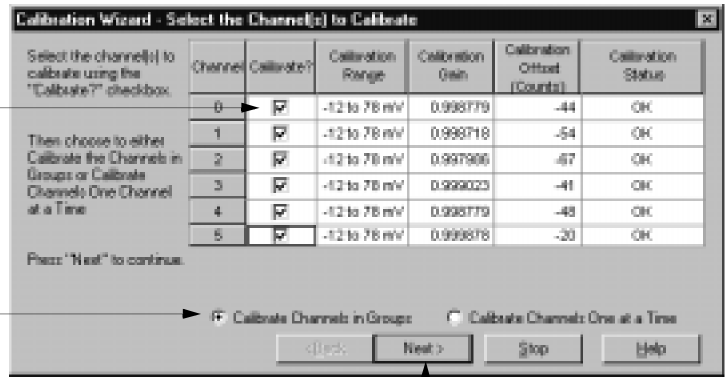


Click here to start calibration

4. Set the channels to be calibrated.

1. Choose the channels you want to calibrate here

2. Choose whether you want to calibrate channels in groups or one at a time here



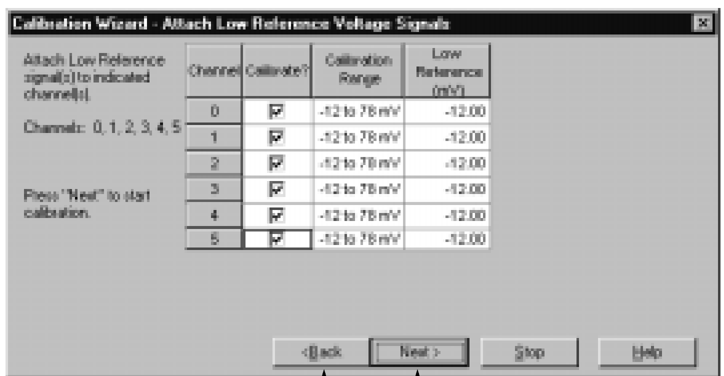
3. Click here to continue

The low reference screen appears first.

5. Set the calibrator for the low reference and apply it to the module.

This screen shows which channels will be calibrated for a low reference and the range of that calibration.

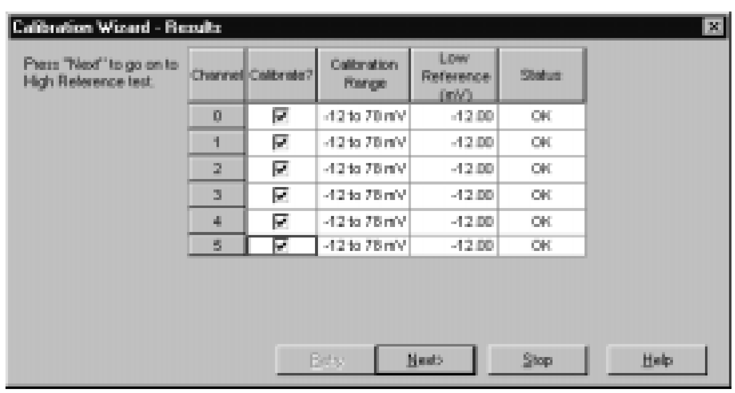
It also shows what reference signal is expected on the input.



Click here to return to the last screen and make any necessary changes

Click here to calibrate the low reference

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 5 until the status is OK.

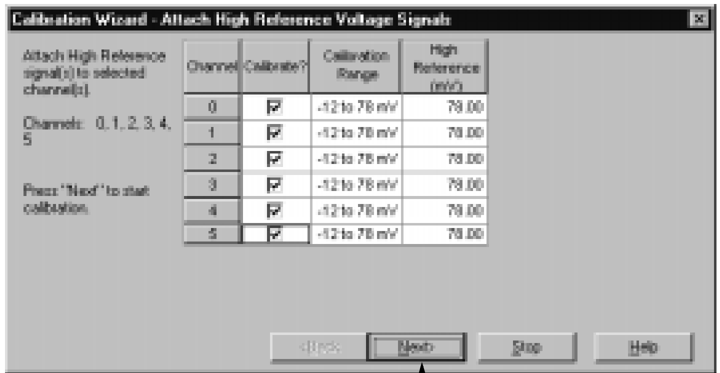


Now you must calibrate each channel for a high reference voltage.

6. Set the calibrator for the high reference and apply it to the module.

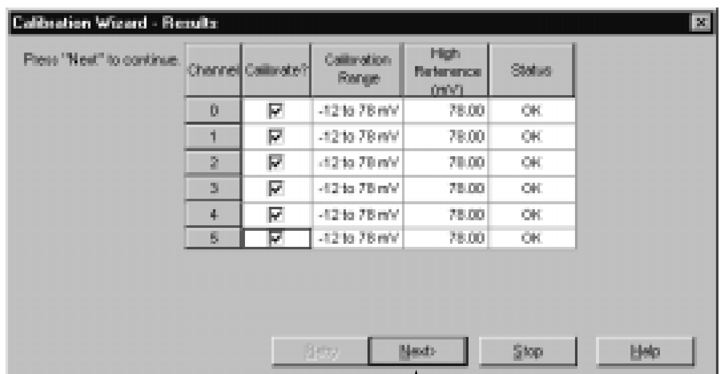
This screen shows which channels will be calibrated for a high reference and the range of that calibration.

It also shows what reference signal is expected on the input.



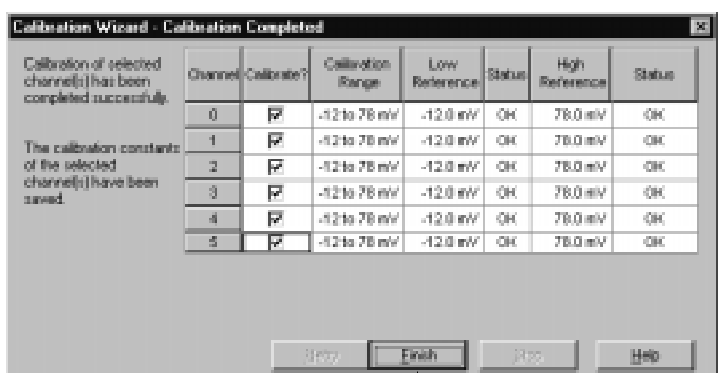
Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry Step 6 until the status is OK.



Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.



Click here to finish calibration

Calibrating Output Modules

Output calibration is a multi-step process that involves measuring a signal from the module. This section has two parts.

Calibrating the 1756-OF6CI

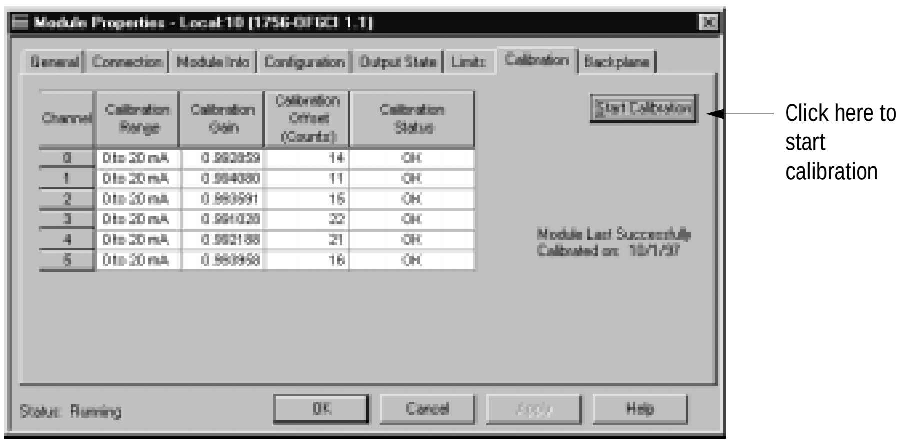
This module must be calibrated for current. RSLogix 5000 commands the module to output specific levels of current. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-19.

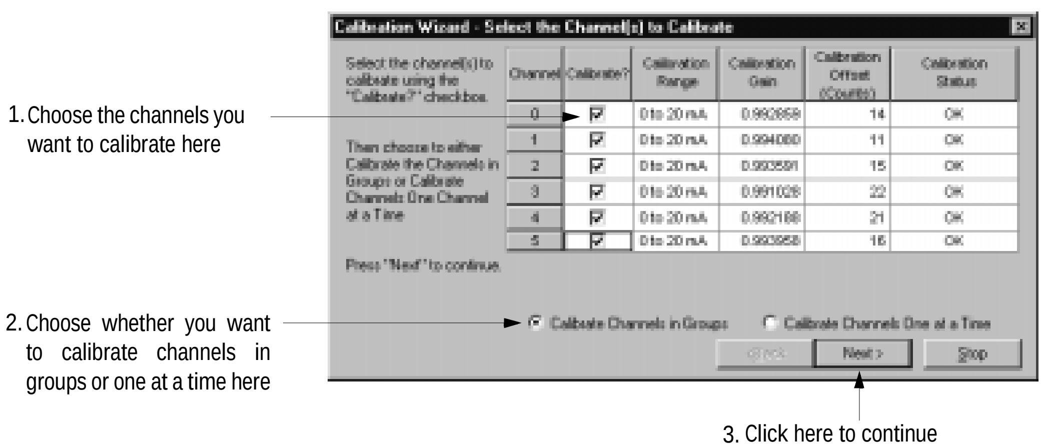
Follow these steps:

1. Connect your current meter to the module.

2. Go to the Calibration page. (Click on the tab for this page.)

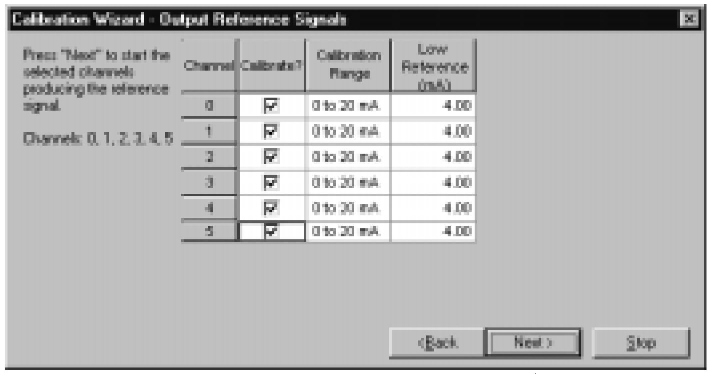


3. Set the channels to be calibrated.



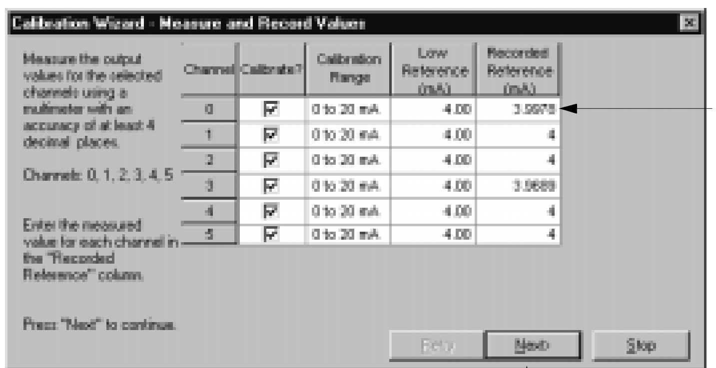
The low reference screen appears first.

This screen shows which channels will be calibrated for a low reference and the range of that calibration



Click here to calibrate the low reference

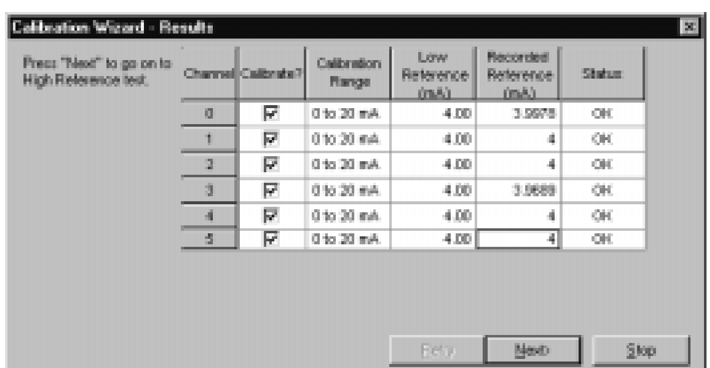
4. Record the results of your measurement.



Record measurement values here

Click here to continue

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to Step 4 until the status is OK.

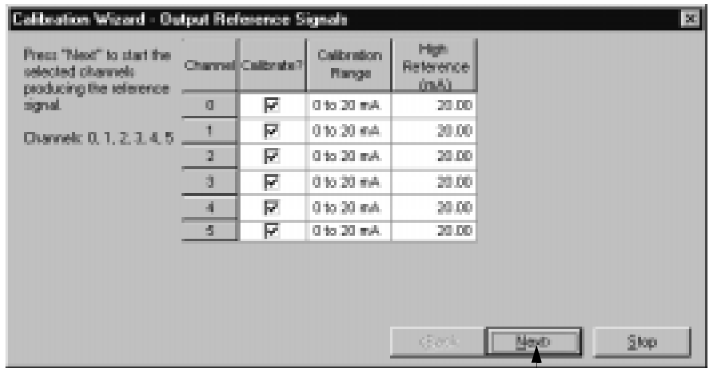


Click here to continue

Now you must calibrate each channel for a high reference voltage.

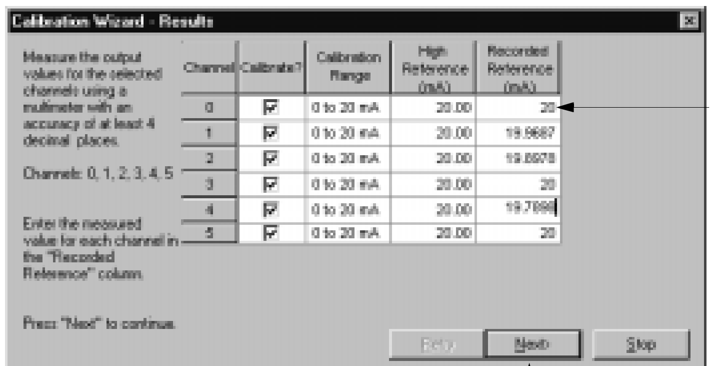
5. Set the channels to be calibrated.

This screen shows which channels will be calibrated for a high reference and the range of that calibration



Click here to calibrate the high reference

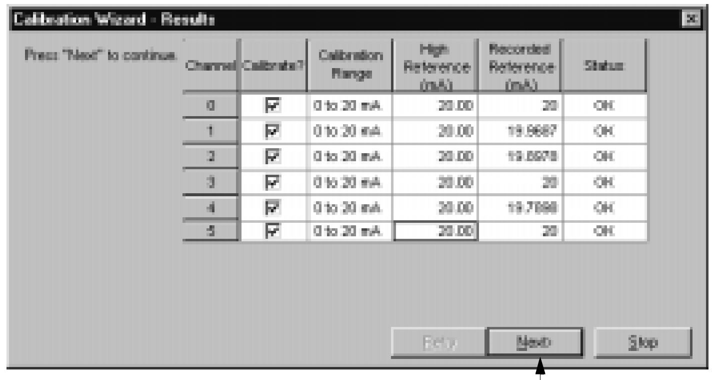
6. Record the measurement.



Record measurement values here

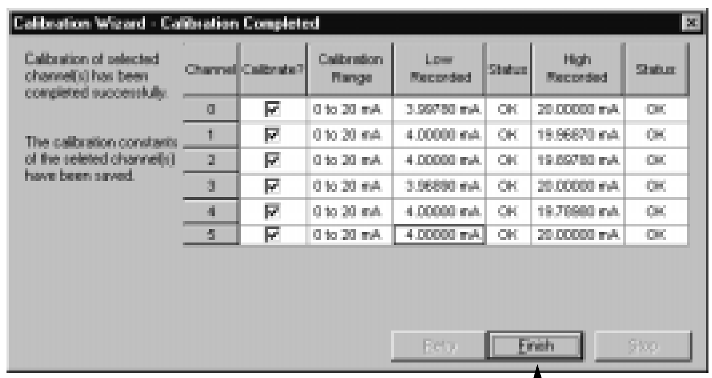
Click here to continue

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to Step 6 until the status is OK.



Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.



Click here to finish calibration and return the module to normal operation

Calibrating the 1756-OF6VI

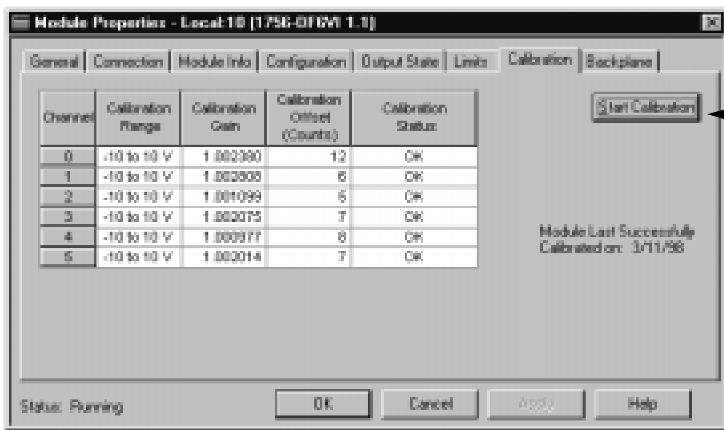
This module must be calibrated for voltage. RSLogix 5000 commands the module to output specific levels of voltage. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-19.

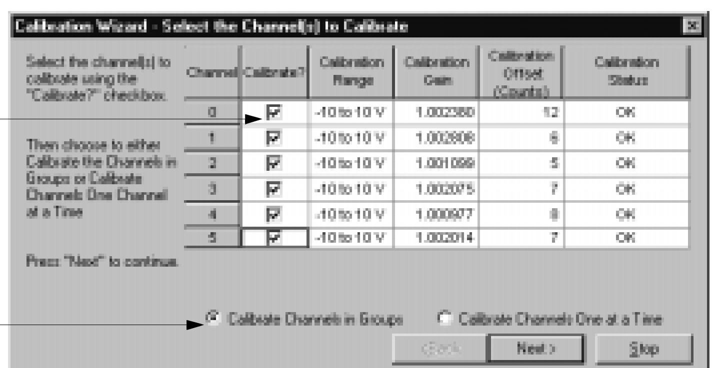
Follow these steps:

1. Connect your voltage meter to the module.

2. Go to the Calibration page. (Click on the tab for this page.)

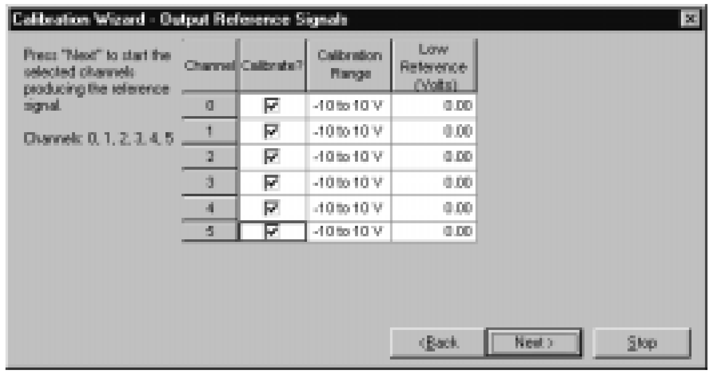


3. Set the channels to be calibrated.



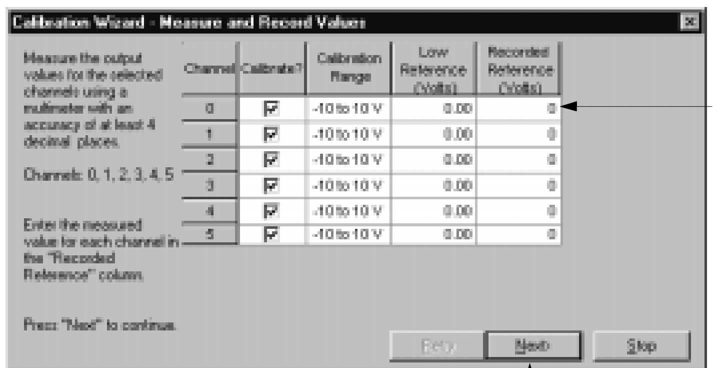
The low reference screen appears first.

This screen shows which channels will be calibrated for a low reference and the range of that calibration



Click here to calibrate the low reference

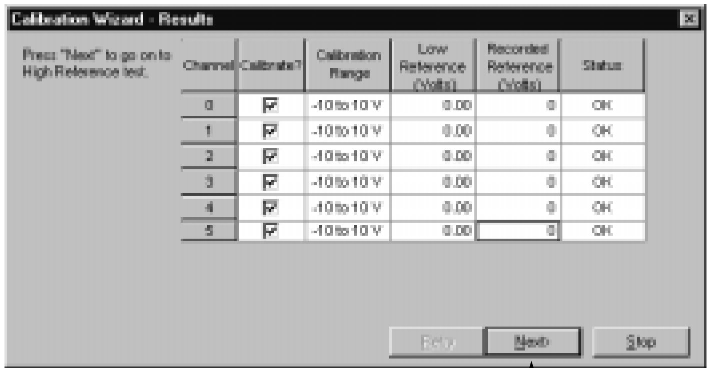
4. Record the results of your measurement.



Record measurement values here

Click here to continue

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to Step 4 until the status is OK.

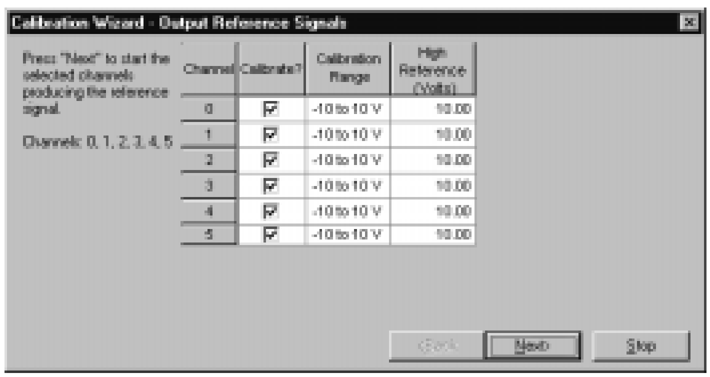


Click here to continue

Now you must calibrate each channel for a high reference voltage.

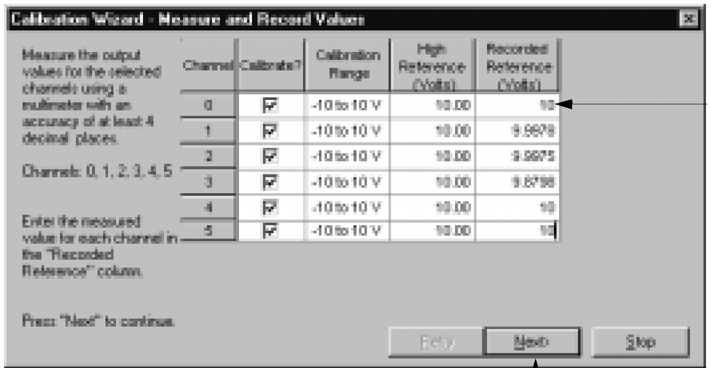
5. Set the channels to be calibrated.

This screen shows which channels will be calibrated for a high reference and the range of that calibration



Click here to calibrate the high reference

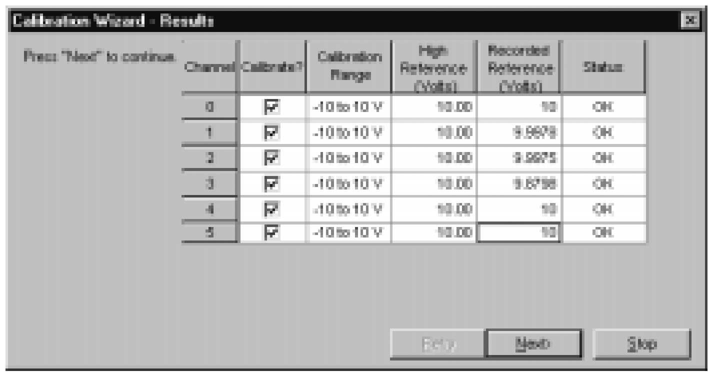
6. Record the measurement.



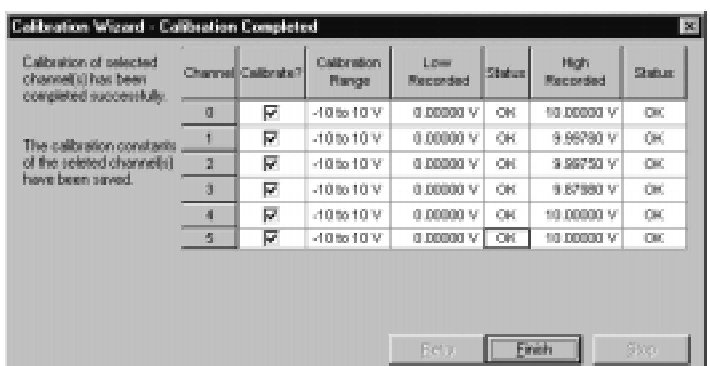
Record measurement values here

Click here to continue

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to Step 6 until the status is OK.



After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.



Click here to finish calibration and return the module to normal operation

Calibrating the 1756-OF4 or 1756-OF8 Modules

These modules can be used for current or voltage applications.

Current applications

RSLogix 5000 commands the module to output specific levels of current. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

Voltage applications

RSLogix 5000 commands the module to output specific levels of voltage. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

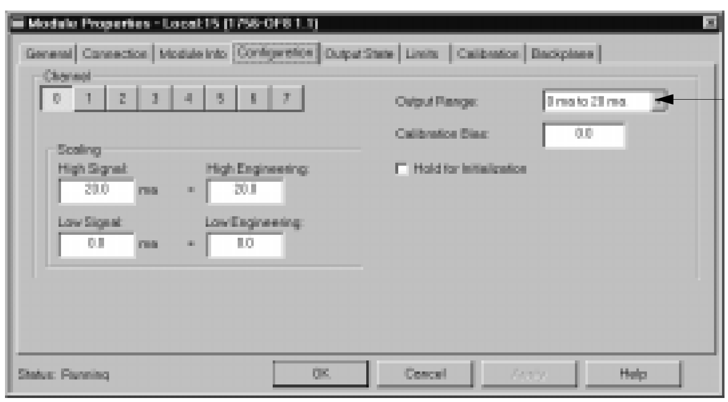
Important: This example shows a module calibrated for a current application. Use the same steps to calibrate for voltage.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-19.

Follow these steps:

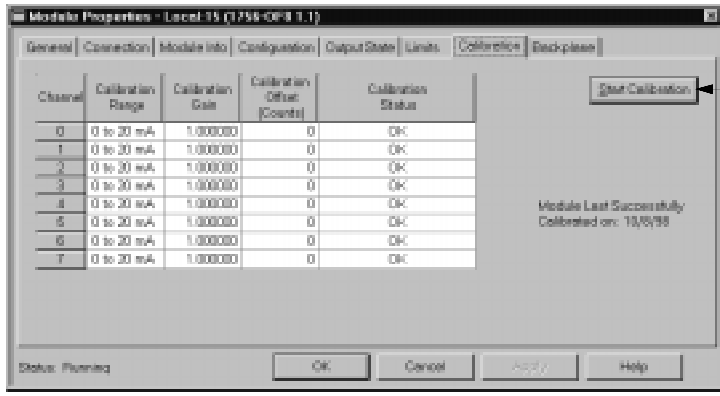
1. Connect your current meter to the module.

2. Go to the Configuration page. (Click on the tab for this page.)



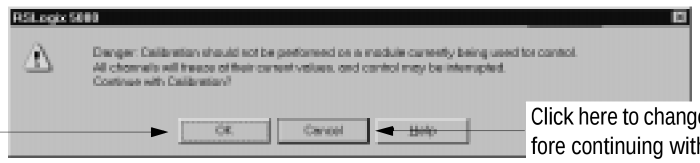
Use this pull-down menu to choose the Output Range to which you want to calibrate

3. Go to the Calibration page. (Click on the tab for this page.)



Click here to start calibration

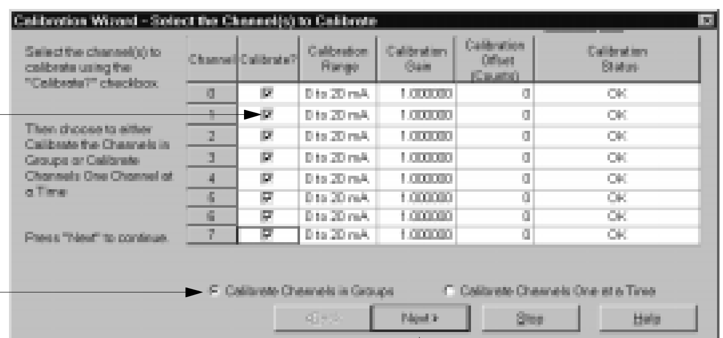
You see this warning.



Click here to continue calibration with the channels frozen at their current values

Click here to change to Program Mode before continuing with calibration

4. Set the channels to be calibrated.



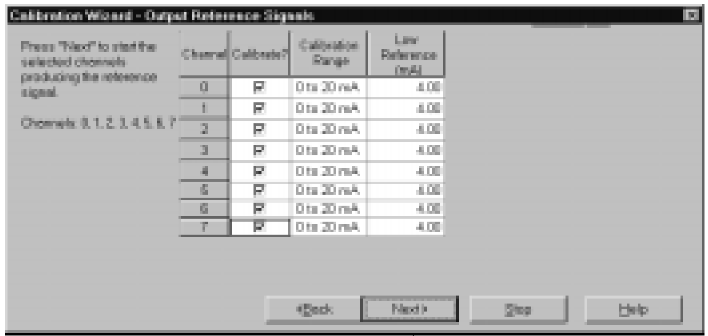
1. Choose the channels you want to calibrate here

2. Choose whether you want to calibrate channels in groups or one at a time here

3. Click here to continue

The low reference screen appears first.

This screen shows which channels will be calibrated for a low reference and the range of that calibration



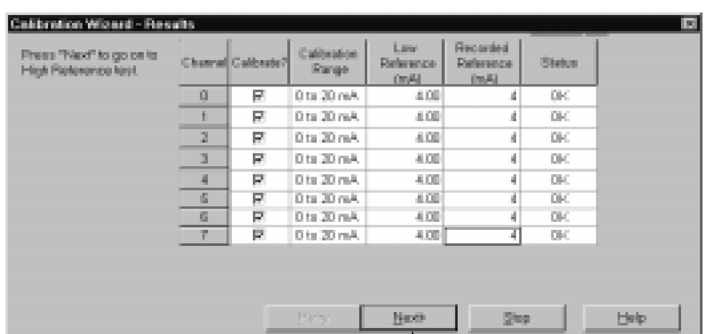
Click here to calibrate the low reference

5. Record the results of your measurement.

Record measurement values here

Click here to continue

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to Step 4 until the status is OK.



Click here to continue

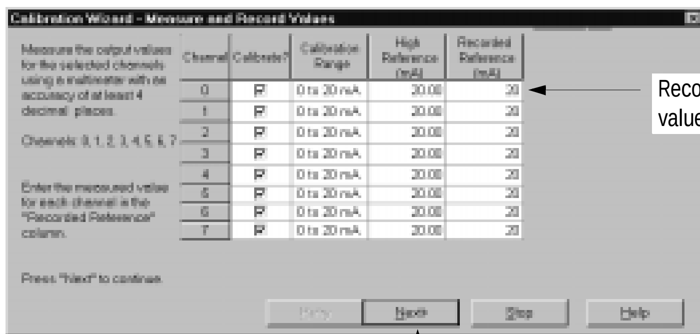
Now you must calibrate each channel for a high reference voltage.

6. Set the channels to be calibrated.

This screen shows which channels will be calibrated for a high reference and the range of that calibration

Click here to calibrate the high reference

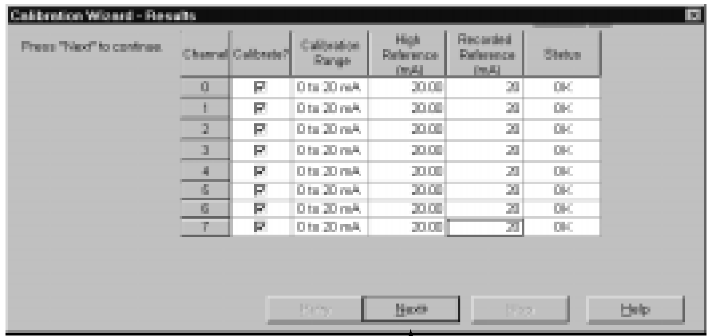
7. Record the measurement.



Record measurement values here

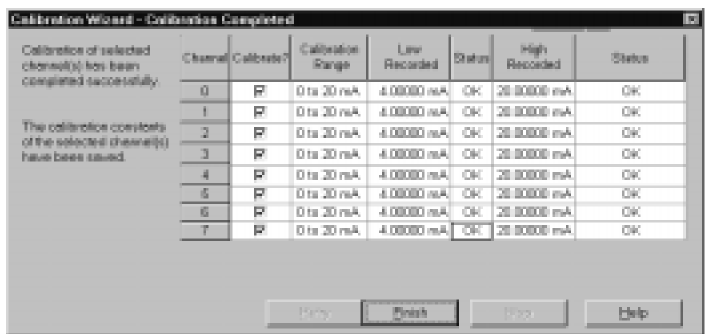
Click here to continue

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to Step 6 until the status is OK.



Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.



Click here to finish calibration and return the module to normal operation

Chapter Summary and What's Next

In this chapter you learned about:

- calibrating input modules
- calibrating output modules

Move on to Chapter 12 to learn how to troubleshoot the module.

Troubleshooting

Chapter Objectives

In this chapter you will learn about the indicators on the ControlLogix analog I/O module, and how to use them to troubleshoot the module. The following table describes what this chapter contains and its location.

Using Module Indicators to Troubleshoot Your Module

Each ControlLogix analog I/O module has indicators which provide indication of module status. ControlLogix modules use the following:

Table 12.A
LED Indicators for Input Modules

LED indicators:	This display:	Means:	Take this action:
OK	Steady green light	The inputs are being multicast and in normal operating state.	None
OK	Flashing green light	The module has passed internal diagnostics but is not currently performing connected communication.	None
OK	Flashing red light	Previously established communication has timed out.	Check controller and chassis communication
OK	Steady red light	The module must be replaced.	Replace the module.
CAL	Flashing green light	The module is in calibration mode.	None

The following LED display is used with ControlLogix analog input modules:

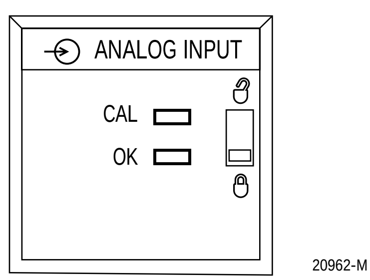
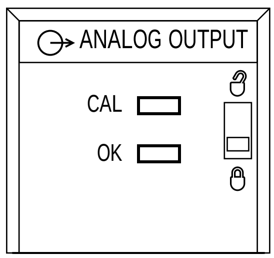


Table 12.B
LED Indicators for Output Modules

LED indicators:	This display:	Means:	Take this action:
OK	Steady green light	The outputs are in a normal operating state in Run Mode.	None
OK	Flashing green light	The module has passed internal diagnostics but is not actively controlled. In this case, the connection may or may not be open.	None
OK	Flashing red light	Previously established communication has timed out.	Check controller and chassis communication
OK	Steady red light	The module must be replaced.	Replace the module.
CAL	Flashing green light	The module is in calibration mode.	None

The following LED display is used with ControlLogix analog output modules:



20965-M

Using RSLogix 5000 to Troubleshoot Your Module

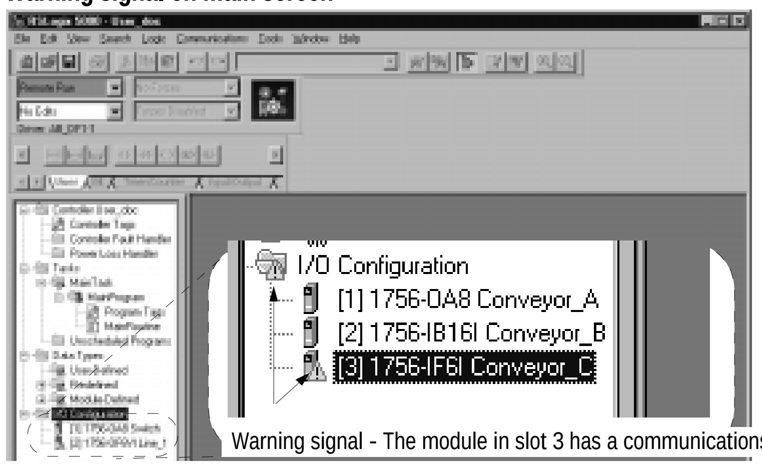
In addition to the LED display on the module, RSLogix 5000 will alert you to fault conditions. You will be alerted in one of three ways:

- Warning signal on the main screen next to the module-This occurs when the connection to the module is broken
- Fault message in a screen's status line
- Notification in the Tag Editor - General module faults are also reported in the Tag Editor. Diagnostic faults are only reported in the Tag Editor
- Status on the Module Info Page

The screens below display fault notification in RSLogix 5000.

Warning signal on main screen

Warning icon when a communications fault occurs or if the module is inhibited

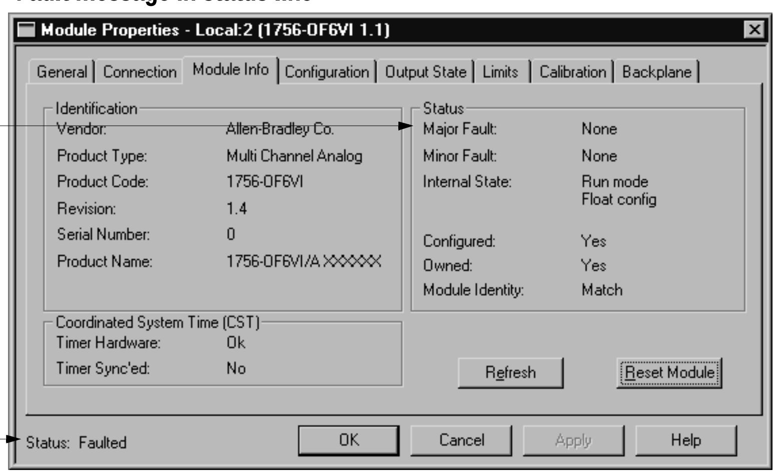


Warning signal - The module in slot 3 has a communications fault

Fault message in status line

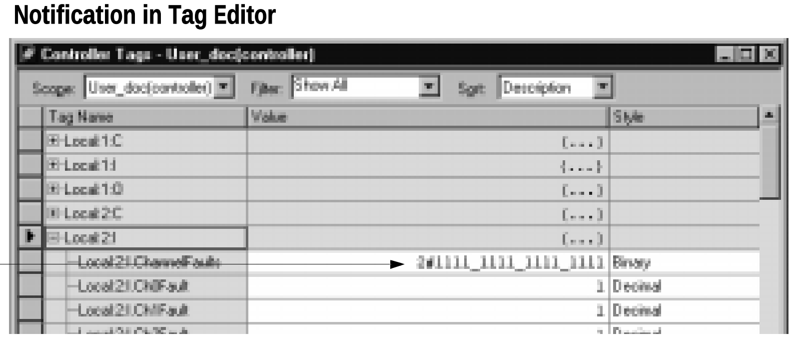
Status section lists Major and Minor Faults and the Internal State of the module

Status line provides information on the connection to the module



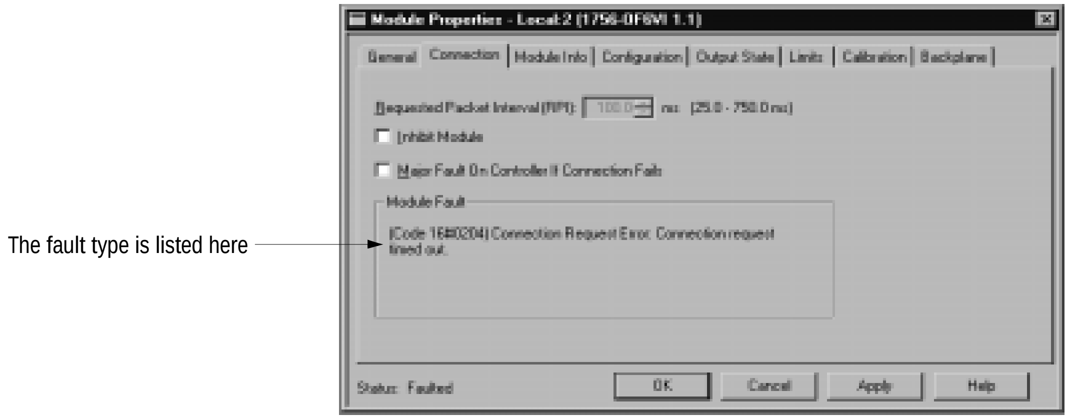
Notification in Tag Editor

A fault has occurred for any point that lists the number 1 in the Fault line



Determining Fault Type

When you are monitoring a module's configuration properties in RSLogix 5000 and receive a Communications fault message, the Connection page lists the type of fault.



For a detailed listing of the possible faults, their causes and suggested solutions, see Module Table Faults in the online help.

Chapter Summary and What's Next

In this chapter you learned about troubleshooting the module.

Move on to Appendix A to see the Specifications for each module.

Module Specifications

This appendix provides the specifications for all ControlLogix analog I/O modules. Use the table below to find your module's specifications:

1756-IF16 Specifications

Number of Inputs	16 single ended, 8 differential or 4 differential (high speed)
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 65mA @ 24V dc (2.33W)
Power Dissipation within Module Thermal Dissipation	2.3W voltage 3.9W current 7.84 BTU/hr voltage 13.30 BTU/hr current
Input Range and Resolution	+/-10.25V – 320µV/cnt (15 bits plus sign bipolar) 0-10.25V – 160µV/cnt (16 bits) 0-5.125V – 80µV/cnt (16 bits) 0-20.5mA – 0.32µA/cnt (16 bits)
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance Voltage Current	 >1megΩ 249Ω
Open Circuit Detection Time	Differential voltage - Positive full scale reading within 5s Single Ended/Diff. current - Negative full scale reading within 5s Single Ended voltage -Even numbered channels go to positive full scale reading within 5s, odd numbered channels go to negative full scale reading within 5s
Overvoltage Protection	30V dc voltage 8V dc current
Normal Mode Noise Rejection[1]	>80dB at 50/60Hz
Common Mode Noise Rejection	>100dB at 50/60Hz
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.05% of range - voltage Better than 0.15% of range - current
Input Offset Drift with Temperature	45µV/degree C
Gain Drift with Temperature	15 ppm/degree C - voltage 20 ppm/degree C - current
Module Error over Full Temp. Range	0.1% of range - voltage 0.3% of range - current
Module Scan Time for All Channels (Sample Rate Module Filter Dependent)	16 pt single ended - 16-488ms 8 pt differential - 8-244ms 4 pt differential - 5-122ms
Module Conversion Method	Sigma-Delta
Isolation Voltage User to system	 100% tested at 2550 dc for 1s
Module Keying (Backplane)	Electronic
RTB Screw Torque (Cage clamp)	4.4 inch-pounds (0.4Nm)
RTB Keying	User defined
RTB and Housing	36 Position RTB (1756-TBCH or TBS6H)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded [2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	1/8 inch (3.2mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[5] FM Class I Div 2 Hazardous[5] CE marked for all applicable directives[6]

[1] This specification is module filter dependent.
[2] Maximum wire size will require extended housing - 1756-TBE.
[3] Use conductor category information for planning conductor routing as described in the system level installation manual.
[4] Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
[5] CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
[6] Shielded cable required.

1756-IF6I Specifications

Number of Inputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No module external power requirements)	250mA @5.1V dc & 100mA @ 24V dc (3.7W)
Power Dissipation within Module Thermal Dissipation	3.7W voltage 4.3W current 12.62 BTU/hr voltage 14.32 BTU/hr current
Input Range	+/-10.5V, 0-10.5V, 0-5.25V, 0-21mA overrange indication when exceeded
Resolution +/-10.5V range 0 to 10.5V range 0 to 5.25V range 0-21mA range	Approximately 16 bits across each range shown below 343µV/count 171µV/count 86µV/count 0.34µA/count
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance	>10MΩ Voltage, 249Ω Current
Open Circuit Detection Time	Positive full scale reading within 5s
Overvoltage Protection	120V ac/dc (Voltage ranges) 8V ac/dc with on-board current resistor (Current Ranges)
Normal Mode Noise Rejection[1]	60dB at 60Hz
Common Mode Noise Rejection	120dB at 60Hz, 100dB at 50Hz
Channel Bandwidth[1]	15Hz (-3dB)
Settling Time to 5% of Full Scale[1]	<80ms
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Input Offset Drift with Temperature	2µV/degree C typical
Gain Drift with Temperature	35 ppm/degree C typical (80 ppm maximum) Voltage 45 ppm/degree C typical (90 ppm maximum) Current
Module Error over Full Temp. Range	0.54% of range
Minimum Module Scan Time for all Channels[1] (Sample Rate)	25ms minimum floating point 10ms minimum integer
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
Module Conversion Method	Sigma-Delta
Module Keying (Backplane)	Electronic
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded [2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	 Class I Div 2 Hazardous[5] Class I Div 2 Hazardous[5] marked for all applicable directives[6]

1 These specifications are notch filter dependent.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use conductor category information for planning conductor routing as described in the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

1756-IF8 Specifications

Number of Inputs	8 single ended, 4 differential or 2 differential (high speed)
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 40mA @ 24V dc (2.33W)
Power Dissipation within Module Thermal Dissipation	1.73W voltage 2.53W current 5.9 BTU/hr voltage 8.6 BTU/hr current
Input Range and Resolution	+/-10.25V – 320µV/cnt (15 bits plus sign bipolar) 0-10.25V – 160µV/cnt (16 bits) 0-5.125V – 80µV/cnt (16 bits) 0-20.5mA – 0.32µA/cnt (16 bits)
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance Voltage Current	 >1megΩ 249Ω
Open Circuit Detection Time	Differential voltage - Positive full scale reading within 5s Single Ended/Diff. current - Negative full scale reading within 5s Single Ended voltage -Even numbered channels go to positive full scale reading within 5s, odd numbered channels go to negative full scale reading within 5s
Overvoltage Protection	30V dc voltage 8V dc current
Normal Mode Noise Rejection[1]	>80dB at 50/60Hz
Common Mode Noise Rejection	>100dB at 50/60Hz
Calibrated Accuracy at 25°C	Better than 0.05% of range - voltage Better than 0.15% of range - current
Input Offset Drift with Temperature	45µV/degree C
Gain Drift with Temperature	15 ppm/degree C - voltage 20 ppm/degree C - current
Module Error over Full Temp. Range	0.1% of range - voltage 0.3% of range - current
Module Scan Time for All Channels (Sample Rate Module Filter Dependent)	8 pt single ended - 16-488ms 4 pt differential - 8-244ms 2 pt differential - 5-122ms
Module Conversion Method	Sigma-Delta
Isolation Voltage User to system	 100% tested at 2550 dc for 1s
Module Keying (Backplane)	Electronic
RTB Screw Torque (Cage clamp)	4.4 inch-pounds (0.4Nm)
RTB Keying	User defined
RTB and Housing	36 Position RTB (1756-TBCH or TBS6H)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge (2mm^2) stranded [2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	1/8 inch (3.2mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[5] FM Class I Div 2 Hazardous[5] CE marked for all applicable directives[6]

1 This specification is module filter dependent.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use conductor category information for planning conductor routing as described n the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

1756-IR6I Specifications

Number of Inputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 125mA @ 24V dc (4.25W)
Power Dissipation within Module Thermal Dissipation	4.3W 14.66 BTU/hr
Input Range	1-487Ω, 2-1000Ω, 4-2000Ω, 8-4020Ω
Resolution in Ranges 487Ω 1000Ω 2000Ω 4020Ω	Approximately 16 bits across each input range 7.7mΩ/count 15mΩ/count 30mΩ/count 60mΩ/count
Sensors Supported	Resistance 4-4020Ω 100, 200, 500, 1000Ω Platinum, alpha=385 100, 200, 500, 1000Ω Platinum, alpha=3916 120Ω Nickel, alpha=672 100, 120, 200, 500Ω Nickel, alpha=618 10Ω Copper
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Open Circuit Detection Time	Positive full scale reading within 5s with any combination of lost wires, except input terminal B alone. If input terminal B is lost by itself, the module reads a negative full scale reading within 5s.
Overvoltage Protection	24V ac/dc maximum
Normal Mode Noise Rejection[1]	60dB at 60Hz
Common Mode Noise Rejection	120dB at 60Hz, 100db at 50Hz
Channel Bandwidth[1]	15Hz
Settling Time to 5% of Full Scale[1]	<80ms
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Input Offset Drift with Temperature	10mΩ/degree C
Gain Drift with Temperature	50 ppm/degree C typical (90 ppm maximum)
Module Error over Full Temp. Range	0.54% of range
Module Scan Time for all Channels[1] (Sample Rate)	25ms minimum floating point (ohms) 50ms minimum floating point (temperature) 10ms minimum integer (ohms)
Module Conversion Method	Sigma-Delta
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
Module Keying (Backplane)	Electronic
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
RTB Keying	User defined mechanical keying
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded[2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[5] FM Class I Div 2 Hazardous[5] CE marked for all applicable directives

1 These specifications are notch filter dependent.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use conductor category information for planning conductor routing as described in the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

1756-IT6I Specifications

Number of Inputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 125mA @ 24V dc (4.3W)
Power Dissipation within Module Thermal Dissipation	4.3W 14.66 BTU/hr
Input Ranges	-12mV to +78mV -12mV to +30mV (high resolution range)
Supported Thermocouple Types	B, C, E, J, K, N, R, S, T Linearization based on ITS-90
Resolution	16 bits (1.4µV typical) 0.7µV/count on high resolution range
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Input Impedance	>10MΩ
Open Circuit Detection Time	Positive full scale reading within 2s
Overvoltage Protection	120V ac/dc maximum
Normal Mode Noise Rejection[1]	60dB at 60Hz
Common Mode Noise Rejection	120dB at 60Hz, 100dB at 50Hz
Channel Bandwidth[1]	15Hz
Settling Time to 5% of Full Scale[1]	<80ms
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Accuracy (Cold Junction Sensor) Local CJ Sensor Uncertainty Remote CJ Sensor	 From +/-0.3 up to +/-3.2°C, depending on channel +/-0.3°C
Input Offset Drift with Temperature	0.5µV/degree C typical
Gain Drift with Temperature	65 ppm/degree C typical (80 ppm maximum)
Module Error over Full Temp. Range	0.5% of range
Minimum Module Scan Time for all Channels[1] (Sample Rate)	25ms minimum floating point (millivolt) 50ms minimum floating point (temperature) 10ms minimum integer (millivolt)
Module Conversion Method	Sigma-Delta
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
Module Keying (Backplane)	Electronic
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[2]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded[2] 3/64 inch (1.2mm) insulation maximum 2[3, 4]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	 Class I Div 2 Hazardous[5] Class I Div 2 Hazardous[5] marked for all applicable directives[6]

1 These specifications are notch filter dependent. Values represent 60Hz setting.
2 Maximum wire size will require extended housing - 1756-TBE.
3 Use conductor category information for planning conductor routing as describedin the system level installation manual.
4 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
5 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
6 Shielded cable required.

1756-OF4 Specifications

Number of Outputs	4 voltage or current outputs
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 120mA @ 24V dc (3.65W)
Power Dissipation within Module Thermal Dissipation	3.2W - 4 channel current 10.91 BTU/hr
Output Range	0 to 21mA +/- 10.4V
Resolution	15 bits across 21mA - 650nA/bit 15 bits across 10.4V - 320µV/bit
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Open Circuit Detection	Current output only (Output must be set to >0.1mA)
Output Overvoltage Protection	24V dc
Output Short Circuit Protection	Electronically current limited to 21mA or less
Drive Capability	>2000Ω - voltage 0-750Ω - current
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.05% of range from 4mA to 21mA, -10.4V to 10.4V Twelve months typical
Output Offset Drift with Temperature	50 µV/degree C typical 100nA/degree C typical
Gain Drift with Temperature	25 ppm/degree C maximum - voltage 50 ppm/degree C maximum - current
Module Error over Full Temp. Range	0.15% of range - voltage 0.3% of range - current
Module Scan Time for all Channels	12ms minimum floating point 8ms minimum integer
Isolation Voltage User to system	 100% tested at 2550V dc for 1s
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
Module Keying (Backplane)	Electronic
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded maximum[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	 Class I Div 2 Hazardous[4] Class I Div 2 Hazardous[4] marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use conductor category information for planning conductor routing as described in the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

1756-OF6CI Specifications

Number of Outputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 225mA @ 24V dc (0-550Ω loads terminated on OUTs and RTNs) (6.7W) 250mA @ 5.1V dc & 300mA @ 24V dc (551-1000Ω loads terminated on OUTs and ALTs) (8.5W)
Power Dissipation within Module Thermal Dissipation	5.5W (0-550Ω loads) 6.1W (551-1000Ω loads) 18.76 BTU/hr (0-550Ω loads) 20.80 BTU/hr (551-1000Ω loads)
Output Current Range	0 to 21mA
Current Resolution	13 bits across 21mA (2.7µA)
Data Format	Integer mode (Left justified, 2s complement) Floating point IEEE 32 bit
Open Circuit Detection	None
Output Overvoltage Protection	24V ac/dc maximum
Output Short Circuit Protection	Electronically current limited to 21mA or less
Drive Capability	0-1000Ω Separate field terminations for ranges 0-550Ω or 551-1000Ω
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range from 4mA to 21mA 12 months typical
Output Offset Drift with Temperature	1 µA/degree C typical
Gain Drift with Temperature	60 ppm/degree C typical (100 ppm maximum)
Module Error over Full Temp. Range	0.6% of range
Minimum Module Scan Time for All Channels	25ms minimum floating point 10ms minimum integer
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
Inductive Load	<1 mH
Module Keying (Backplane)	Electronic
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
Conductors Wire Size Category	22-14 gauge ($2mm^2$) stranded maximum[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[4] FM Class I Div 2 Hazardous[4] CE marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use this conductor category information for planning conductor routing as described in the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

1756-OF6VI Specifications

Number of Outputs	6 individually isolated channels
Module Location	1756 ControlLogix Chassis
Backplane Power Requirements (No external power requirements)	250mA @ 5.1V dc & 175mA @ 24V dc (5.5W)
Power Dissipation within Module Thermal Dissipation	4.85W 16.54 BTU/hr
Output Voltage Range	+/- 10.5V maximum
Voltage Resolution	14 bits across 21V (1.3mV) (13 bits across 10.5V +sign bit)
Data Format	Integer mode (Left justified, 2s complement) Floating point IEEE 32 bit
Output Impedance	<1Ω
Open Circuit Detection	None
Output Overvoltage Protection	24V ac/dc maximum
Output Short Circuit Protection	Electronically current limited
Drive Capability	≥1000Ω loads, 10mA maximum
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.1% of range 12 months typical
Output Offset Drift with Temperature	60 µV/degree C typical
Gain Drift with Temperature	50 ppm/degree C typical (80 ppm maximum)
Module Error over Full Temp. Range	0.5% of range
Minimum Module Scan Time for all Channels	25ms minimum floating point 10ms minimum integer
Isolation Voltage Channel to channel User to system	Optoisolated, transformer isolated 100% tested at 1700V dc for 1s, based on 250V ac 100% tested at 1700V dc for 1s, based on 250V ac
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
Capacitive Load	<1 µFd
Module Keying (Backplane)	Electronic
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	 Class I Div 2 Hazardous[4] Class I Div 2 Hazardous[4] marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use conductor category information for planning conductor routing as describedin the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

1756-OF8 Specifications

Number of Outputs	8 voltage or current outputs
Module Location	1756 ControlLogix Chassis
Backplane Current	150mA @ 5.1V dc & 210mA @ 24V dc (5.8W)
Power Dissipation within Module Thermal Dissipation	4.92W - 8 channel current 16.78 BTU/hr
Output Range	0 to 21mA +/- 10.4V
Resolution	15 bits across 21mA - 650nA/bit 15 bits across 10.4V - 320µV/bit
Data Format	Integer mode (2s complement) Floating point IEEE 32 bit
Open Circuit Detection	Current output only (Output must be set to >0.1mA)
Output Overvoltage Protection	24V dc
Output Short Circuit Protection	Electronically current limited to 21mA or less
Drive Capability	>2000Ω - voltage 0-750Ω - current
Output Settling Time	<2ms to 95% of final value with resistive loads
Calibrated Accuracy at 25°C Calibration Interval	Better than 0.05% of range from 4mA to 21mA, -10.4V to 10.4V Twelve months typical
Output Offset Drift with Temperature	50 µV/degree C typical 100nA/degree C typical
Gain Drift with Temperature	25 ppm/degree C maximum - voltage 50 ppm/degree C maximum - current
Module Error over Full Temp. Range	0.15% of range - voltage 0.3% of range - current
Module Scan Time for all Channels	12ms minimum floating point 8ms minimum integer
Isolation Voltage User to system	 100% tested at 2550V dc for 1s
Module Conversion Method	R-Ladder DAC, monotonicity with no missing codes
Module Keying (Backplane)	Electronic
RTB Screw Torque (NEMA)	7-9 inch-pounds (0.8-1Nm)
RTB Keying	User defined
RTB and Housing	20 Position RTB (1756-TBNH or TBSH)[1]
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 0 to 60°C (32 to 140°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing
ConductorsWire Size Category	22-14 gauge ($2mm^2$) stranded maximum[1] 3/64 inch (1.2mm) insulation maximum 2[2, 3]
Screwdriver Width for RTB	5/16 inch (8mm) maximum
Agency Certification (when product or packaging is marked)	UL CSA Class I Div 2 Hazardous[4] FM Class I Div 2 Hazardous[4] CE marked for all applicable directives[5]

1 Maximum wire size will require extended housing - 1756-TBE.
2 Use conductor category information for planning conductor routing as described in the system level installation manual.
3 Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"
4 CSA certification–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
FM approved–Class I, Division 2, Group A, B, C, D or nonhazardous locations.
5 Shielded cable required.

Using Software Configuration Tags

Important: Although this appendix presents the option of changing a module's configuration through the Tag Editor of RSLogix 5000, we suggest that you use the configuration screens to update and download configuration changes when possible.

When you write configuration for a module, you create tags in the Tag Editor of RSLogix 5000. Each configurable feature on your module has a distinct tag in the processor's ladder logic.

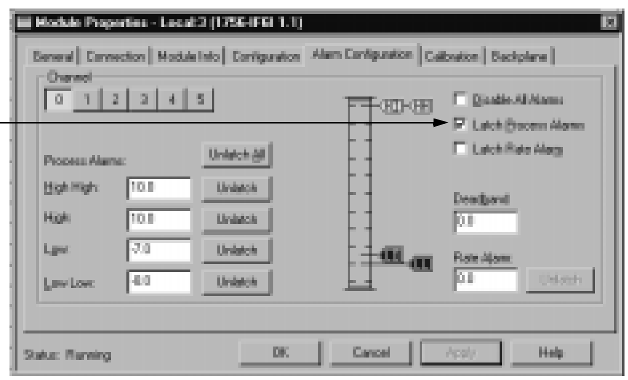
The series of tags that are generated vary for each module. There is also variation among the tags for any particular module, depending on which Communications Format you chose during configuration.

For example, the 1756-IF6I module has eight choices for Communications Format: Float Data, Integer Data, Listen-Only CST Timestamped Float Data, Listen-Only CST Timestamped Integer Data, Listen-Only Float Data, Listen-Only Integer, CST Float, and CST Integer.

The following screens show the difference between latching process alarms through the Module property page or the Tag Editor.

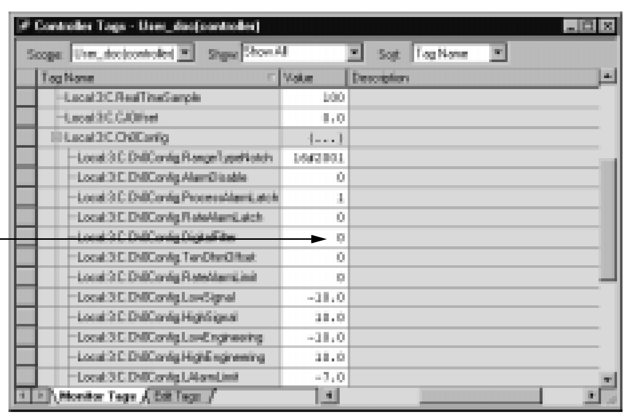
Module Property page

Latch process alarms here



Tag editor

Latch process alarms here



Both screens perform the same function on the module.

Communications Mode Tag Names and Definitions

The set of tags associated with any module depends on the type of module and the Communications Format chosen during configuration. For each communications format, integer and floating point, there are three sets of tags, input, output and configuration. There are three sets of tags, integer, floating point and configuration, for input modules and for output modules.

Integer Mode Tags

The following tables list and define all tags that may be used by ControlLogix analog modules using integer mode.

Important: Each application's series of tags will vary but no input module application will contain any tags that are not listed here.

Integer Input Tags

Tag Name	Data Type	Applicable Modules	Definition:
ChannelFaults	INT	All	Collection of individual channel fault bits in one word. Can address individual channel fault via bit notation: ex. ChannelFaults 3 for channel 3
Ch0Fault	BOOL	All	Individual channel fault status bit. Indicates a "hard" fault has occurred on the channel which means: calibration is ongoing; or if an input, an overrange or underrange condition is present; or if an output, a low or high clamp condition is occurring. These bits are also set by the controller if communications are lost with the I/O module.
ModuleFaults	INT	All	Collection of all module level fault bits
AnalogGroupFault	BOOL	All	Indicates if a channel fault has occurred on any channel
InGroupFault	BOOL	All inputs	Indicates if a channel fault has occurred on any input channel
Calibrating	BOOL	All	Indicates if a calibration is currently in progress on any channel
CalFault	BOOL	All	Status bit indicating if any channel has a "bad" calibration. "Bad" calibration means the last attempt to calibrate the channel failed with an error
CJUnderrange	BOOL	1756-IT6I	Status bit to indicate if the Cold Junction reading is currently beneath the lowest detectable temperature of 0.0 degrees Celsius
CJOverrange	BOOL	1756-IT6I	Status bit to indicate if the Cold Junction reading is currently above the highest detectable temperature of 86.0 degrees Celsius
ChannelStatus	INT	All	Collection of individual channel status bits
Ch0Underrange	BOOL	All inputs	Alarm bits indicating the channel's input is less than the minimum detectable input signal
Ch0Overrange	BOOL	All inputs	Alarms bit indicating the channel's input is greater than the maximum detectable input signal
Ch0Data	INT	All inputs	The channel input signal represented in counts where -32,768 counts is the minimum detectable input signal and 32,767 counts is the maximum detectable
CJData	INT	1756-IT6I	The cold junction sensor temperature in counts where -32,768 counts is 0 degree Celsius and 32,767 counts is 86 degrees Celsius
CSTTimestamp	Array of DINT	All (if the CST connection is selected)	Timestamp taken at time the input data was sampled, or if an output when the output was applied, and placed in terms of Coordinated System Time which is a 64 bit quantity in microseconds coordinated across the rack. Must be addressed in 32 bit chunks as an array
RollingTimestamp	INT	All	Timestamp taken at time the input data was sampled, or if an output when the output was applied, which is in terms of milliseconds relative solely to the individual module

Integer Output Tags

These tags are set automatically during configuration using RSLogix 5000.

Tag Name	Data Type	Applicable Modules	Definition:
Ch0Data	INT	All outputs	The value the channel is to output in counts where the minimum producible output is -32,768 counts and 32,767 counts is the maximum producible
Ch0DataEcho	INT	All outputs	The value the channel is currently outputting in counts where -32,768 counts is the minimum producible output signal and 32, 767 counts is the maximum producible
OutGroupFault	BOOL	All outputs	Indicates if a channel fault has occurred on any output channel
Ch0InHold	BOOL	All outputs	Bit which indicates if the output channel is currently holding until the Output value sent to the module (O tag Ch0Data) matches the current output value (I tag Ch0Data) within 0.1% of the channel's full scale

Integer Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
CJDisable	BOOL	All inputs (only used for the 1756-IT6I)	Disables the cold junction sensor which turns off cold junction compensation when linearizing thermocouple inputs
RealTimeSample	INT	All input	Determines how often the input signal is to be sampled in terms of milliseconds
Ch0RangeNotch	SINT	1756-IF6I, IR6I, IT6I	Configures the channel's input range and notch filter settings. The input range is the upper nibble (bits 4-7) and determines the signal range the input channel can detect. Input range values are as follows: 0=-10 to 10V (1756-IF6I) 1=0 to 5V (1756-IF6I) 2=0 to 10V (1756-IF6I) 3=0 to 20mA (1756-IF6I) 4=-12 to 78mV (1756-IT6I) 5=-12 to 30mV (1756-IT6I) 6=1 to 487Ω (1756-IR6I) 7=2 to 1,000Ω (1756-IR6I) 8=4 to 2,000Ω (1756-IR6I) 9=8 to 4,020Ω (1756-IR6I) The notch filter provides superior frequency filtering at the selected value and its harmonics. The notch filter is the lowest nibble (bits 0-3) 0=10Hz 1=50Hz 2=60Hz 3=100Hz 4=250Hz 5=1,000Hz
ProgToFaultEn	BOOL	All outputs	The program to fault enable bit determines how the outputs should behave if a communications fault were to occur while the output module is in the program mode. When set the bit will cause the outputs to transition to their programmed fault state if a communications fault occurs while in the program state. If not set, outputs will remain in their configured program state despite a communications fault occurring
Ch0Config	SINT	All outputs	Contains all individual configuration bits for channel

Tag Name	Data Type	Applicable Modules	Definition
Ch0HoldForInit	BOOL	All outputs	When set configures the channel to hold, or not change, until initialized with a value within 0.1% of full scale of its current value when one of the following conditions occurs: 1 - Module initial connection (power up) 2 - Module transition from Program mode back to Run mode 3 - Module reestablishes communications after fault
Ch0Fault Mode	BOOL	All outputs	Selects the behavior the output channel should take if a communications fault were to occur. Either hold last state (0) or go to a user defined value (1). Ch0FaultValue defines the value to go to on fault if the bit is set
Ch0ProgMode	BOOL	All outputs	Selects the behavior the output channel when transitioned into Program mode. Either hold last state (0) or go to a user defined value (1). Ch0ProgValue defines the value to go to on fault if the bit is set
Ch0RampToProg	BOOL	All outputs	Enables ramping of the output value to a user defined program value, Ch0ProgValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0RampRate
Ch0RampToFault	BOOL	All outputs	Enables ramping of the output value to a user defined fault value, Ch0FaultValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0RampRate
Ch0FaultValue	INT	All outputs	Defines the value, in counts, the output should take on if a communications fault occurs when the Ch0FaultMode bit it set
Ch0ProgValue	INT	All outputs	Defines the value, in counts, the output should take on when the connection transitions to Program mode if the Ch0ProgMode bit is set
Ch0RampRate	INT	All outputs	Configures the maximum rate at which the output value may change when transitioning to either the Ch0FaultValue or Ch0ProgValue if either the Ch0RampToFault or Ch0RampToProg bits are set respectively. In terms of percent full-scale per second

Floating Point Mode Tags

The following tables list and define all tags that may be used by ControlLogix analog modules using floating point mode.

Important: Each application’s series of tags will vary but no input module application will contain any tags that are not listed here.

Floating Point Input Tags

Tag Name	Data Type	Applicable Modules	Definition:
ChannelFaults	INT	All	Collection of individual channel fault bits in one word. Can address individual channel fault via bit notation: ex. ChannelFaults 3 for channel 3
Ch0Fault	BOOL	All	Individual channel fault status bit. Indicates a “hard” fault has occurred on the channel which means: calibration is ongoing; or if an input, an overrange or underrange condition is present; or if an output, a low or high clamp condition is occurring. These bits are also set by the controller if communications are lost with the I/O module.
ModuleFaults	INT	All	Collection of all module level fault bits
AnalogGroupFault	BOOL	All	Indicates if a channel fault has occurred on any channel

Tag Name	Data Type	Applicable Modules	Definition:
InGroupFault	BOOL	All inputs	Indicates if a channel fault has occurred on any input channel
Calibrating	BOOL	All	Indicates if a calibration is currently in progress on any channel
CalFault	BOOL	All	Status bit indicating if any channel has a “bad” calibration. “Bad” calibration means the last attempt to calibrate the channel failed with an error and was aborted
CJUnderrange	BOOL	1756-IT6I	Status bit to indicate if the Cold Junction reading is currently beneath the lowest detectable temperature of 0.0 degrees Celsius
CJOverrange	BOOL	1756-IT6I	Status bit to indicate if the Cold Junction reading is currently above the highest detectable temperature of 86.0 degrees Celsius
Ch0Status	INT	All	Collection of individual channel status bits
Ch0CalFault	BOOL	All inputs	Status bit indicating if the channel has a “bad” calibration. “Bad” calibration means the last attempt to calibrate the channel failed with an error and was aborted
Ch0Underrange	BOOL	All inputs	Alarm bits indicating the channel’s input is less than the minimum detectable input signal
Ch0Overrange	BOOL	All inputs	Alarms bit indicating the channel’s input is greater than the maximum detectable input signal
Ch0RateAlarm	BOOL	All inputs	Alarm bit which sets when the input channel’s rate of change exceeds the configured Ch0ConfigRateAlarmLimit. Remains set until the rate change drops below the configured limit unless latched via Ch0ConfigRateAlarmLatch in the configuration
Ch0LAlarm	BOOL	All inputs	Low alarm bits which sets when the input signal moves beneath the configured low alarm trigger point, Ch0ConfigLAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via Ch0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the low alarm trigger point
ChOHAlarm	BOOL	All inputs	High alarm bit which sets when the input signal moves above the configured high alarm trigger point, Ch0ConfigHAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched viaCh0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the high alarm trigger point
Ch0LLAlarm	BOOL	All inputs	Low low alarm bit which sets when the input signal moves beneath the configured low low alarm trigger point, Ch0ConfigLLAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via Ch0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the low low alarm trigger point
CH0HHAlarm	BOOL	All inputs	High high alarm bit which sets when the input signal moves above the configured high high alarm trigger point, Ch0ConfigProcAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched via Ch0ConfigAlmDeadband, of the high high alarm trigger point
Ch0Data	REAL	All inputs	The channel input signal represented in engineering units. The input signal is measured and then scaled based on the user configuration
CJData	REAL	1756-IT6I	The cold junction sensor temperature in degrees Celsius or Fahrenheit
CSTTimestamp	Array of DINT	All (if the CST connection is selected)	Timestamp taken at time the input data was sampled, or if an output when the output was applied, and placed in terms of Coordinated System Time which is a 64 bit quantity in microseconds coordinated across the rack. Must be addressed in 32 bit chunks as an array
RollingTimestamp	INT	All inputs	Timestamp taken at time the input data was sampled, or if an output when the output was applied, which is in terms of milliseconds relative solely to the individual module

Floating Point Output Tags

These tags are set automatically during configuration using RSLogix 5000.

Tag Name	Data Type	Applicable Modules	Definition:
Ch0Data	REAL	All outputs	The value the channel is set to output in engineering units based upon the configured scaling for the channel
Ch0DataEcho	REAL	All outputs	The value the channel is currently outputting in engineering units based upon the configured user scaling. Will match the requested output value, O tag Ch0Data, unless: in Program mode, calibrating, beneath Low Limit, above High Limit, currently ramping or In Hold
OutGroupFault	BOOL	All outputs	Indicates if a channel fault has occurred on any output channel
Ch0NotANumber	BOOL	All outputs	Bit indicating the received output value from the controller, O tag Ch0Data, was an invalid IEEE floating point value. When an invalid value is received, the output value holds its last known valid state
Ch0InHold	BOOL	All outputs	Bit which indicates if the output channel is currently holding until the Output value sent to the module (O tag Ch0Data) matches the current output value (I tag Ch0Data) within 0.1% of the channel's full scale
CH0RampAlarm	BOOL	All outputs	Alarm bit which sets when the requested output value, Ch0ConfigRampToRun set, and the difference between the new output value requested and the current output exceeds the configured ramp limit, Ch0ConfigMaxRampRate. The bit will remain set until ramping ceases unless the alarm is latched via Ch0ConfigRampAlarmLatch
Ch0LLimitAlarm	BOOL	All outputs	Alarm bit which sets when the requested output value, Ch0Data, is below the configured low limit, Ch0ConfigLowLimit, in which case the output will stop at the configured low limit which the echo will reflect. Remains set until the requested output moves above the low limit unless latched by Ch0ConfigLimitAlarmLatch
Ch0HLimitAlarm	BOOL	All outputs	Alarm bit which sets when the requested output value, Ch0Data, is above the configured high limit, Ch0ConfigHighLimit, in which case the output will stop at the configured high limit which the echo will reflect. Remains set until the requested output moves below the high limit unless latched by Ch0ConfigLimitAlarmLatch

Floating Point Configuration Tags

Tag Name	Data Type	Applicable Modules	Definition
RemoteTermination	BOOL	1756-IT6I	Indicates if the cold junction sensor is mounted on a remote termination block when set, rather than on the local terminal block. Needed for proper cold junction compensation when linearizing thermocouples
CJDisable	BOOL	1756-IT6I	Disables the cold junction sensor which turns off cold junction compensation when linearizing thermocouple inputs
TempMode	BOOL	1756-IR6I, IT6I	Controls the temperature scale to use on the module: 0=Celsius 1=Fahrenheit
ProgToFaultEn	BOOL	All outputs	The program to fault enable bit determines how the outputs should behave if a communications fault were to occur while the output module is in the program mode. When set, the bit will cause the outputs to transition to their programmed fault state if a communications fault occurs while in the program state. If not set, outputs will remain in their configured program state despite a communications fault occurring
RealTimeSample	INT	All input	Determines how often the input signal is to be sampled in terms of milliseconds

Tag Name	Data Type	Applicable Modules	Definition
CJOffset	REAL	1756-IT6I	Provides a user selected offset to add into the read cold junction sensor value. Allows a sensor with a built in bias to be compensated for
Ch0Config	Struct	All	Master structure beneath which the channel's configuration parameters are set
Ch0Config RangeTypeNotch	INT	1756-IF6I, IR6I, IT6I	Configures the channel's input range, sensor type and notch filter settings. The input range is bits 8-11 and determines the signal range the input channel can detect. Input range values are as follows: 0=-10 to 10V (1756-IF6I) 1=0 to 5V (1756-IF6I) 2=0 to 10V (1756-IF6I) 3=0 to 20mA (1756-IF6I) 4=-12 to 78mV (1756-IT6I) 5=-12 to 30mV (1756-IT6I) 6=1 to 487Ω (1756-IR6I) 7=2 to 1,000Ω (1756-IR6I) 8=4 to 2,000Ω (1756-IR6I) 9=8 to 4,020Ω (1756-IR6I) Sensor type is bits 4-7 and selects the sensor type to use for linearization on the 1756-IR6I, IT6I. Sensor types values are as follows: 0=no linearization, Ω (1756-IR6I), mV (1756-IT6I) 1=100Ω Platinum 385 (1756-IR6I) B (1756-IT6I) 2=200Ω Platinum 385 (1756-IR6I), C (1756-IT6I) 3=500Ω Platinum 385 (1756-IR6I), E (1756-IT6I) 4=1000Ω Platinum 385 (1756-IR6I), J (1756-IT6I) 5=100Ω Platinum 3916 (1756-IR6I), K (1756-IT6I) 6=200Ω Platinum 3916 (1756-IR6I), N (1756-IT6I) 7=500Ω Platinum 3916 (1756-IR6I), R (1756-IT6I) 8=1000Ω Platinum 3916 (1756-IR6I), S (1756-IT6I) 9=10Ω Copper 427 (1756-IR6I), T (1756-IT6I) 10=120Ω Nickel 672 (1756-IR6I) 11=100Ω Nickel 618 (1756-IR6I) 12=120Ω Nickel 618 (1756-IR6I) 13=200Ω Nickel 618 (1756-IR6I) 14=500Ω Nickel 618 (1756-IR6I) The notch filter provides superior frequency filtering at the selected value and its harmonics. The notch filter is the lower nibble (bits 0-3) 0=10Hz 1=50Hz 2=60Hz 3=100Hz 4=250Hz 5=1,000Hz
Ch0ConfigAlarm Disable	BOOL	All	Disables all alarms for the channel
Ch0ConfigProcess AlarmLatch	BOOL	All inputs	Enables latching for all four process alarms: low, low low, high and high high. Latching causes the process alarm to remain set until an unlatch service is explicitly sent to the channel or alarm
Ch0ConfigRate AlarmLatch	BOOL	All inputs	Enables latching for the rate alarm. Latching causes the rate alarm to remain set until an unlatch service is explicitly sent to the channel or alarm
Ch0ConfigDigital Filter	INT	All inputs	A non-zero value enables the filter, providing a time constant in milliseconds used in a first order lag filter to smooth the input signal
Ch0ConfigTenOhm Offset	INT	1756-IR6I	A value from -100 to 100 which represents -1.00 to 1.00Ω and is an offset used when linearizing a 10Ω copper sensor type's input

Tag Name	Data Type	Applicable Modules	Definition
Ch0ConfigRate AlarmLimit	INT	All inputs	The trigger point for the rate alarm status bit which will set if the input signal changes at a rate faster than the configured rate alarm. Configured in percent full scale per second
Ch0ConfigLow Signal	REAL	All	One of four points used in scaling. The low signal is in terms of the inputs signal units and corresponds to the low engineering term when scaled. The scaling equation is as follows: $data=\frac{(Signal-LowSignal)(HighEngineering-LowEngineering)}{HighSignal-LowSignal} + LowEngineering$
Ch0ConfigHigh Signal	REAL	All	One of four points used in scaling. The high signal is in terms of the inputs signal units and corresponds to the high engineering term when scaled. The scaling equation is as follows: $data=\frac{(Signal-LowSignal)(HighEngineering-LowEngineering)}{HighSignal-LowSignal} + LowEngineering$
Ch0ConfigLow Engineering	REAL	All	One of four points used in scaling. The low engineering helps determine the engineering units the signal values scale into. The low engineering term corresponds to the low signal value. The scaling equation used is: $data=\frac{(Signal-LowSignal)(HighEngineering-LowEngineering)}{HighSignal-LowSignal} + LowEngineering$
C0ConfigHigh Engineering	REAL	All	One of four points used in scaling. The high engineering helps determine the engineering units the signal values scale into. The high engineering term corresponds to the high signal value. The scaling equation used is: $data=\frac{(Signal-LowSignal)(HighEngineering-LowEngineering)}{HighSignal-LowSignal} + LowEngineering$
Ch0ConfigLAlarm Limit	REAL	All inputs	The low alarm trigger point. Causes the Ch0LAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units
Ch0ConfigHAlarm Limit	REAL	All inputs	The high alarm trigger point. Causes the Ch0HAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units
Ch0ConfigLLAlarm Limit	REAL	All inputs	The low low alarm trigger point. Causes the Ch0LLAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units
Ch0ConfigHH AlarmLimit	REAL	All inputs	The high high alarm trigger point. Causes the Ch0HHAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units
Ch0ConfigAlarm Deadband	REAL	All inputs	Forms a deadband around the process alarms which causes the corresponding process alarm status bit to remain set until the input moves beyond the trigger point by greater than the amount of the alarm deadband
Ch0ConfigCalBias	REAL	All inputs	A user configurable offset added directly into the data, Ch0Data. used to compensate for inherent sensor offset
Ch0ConfigConfig Bits	INT	All outputs	Collection of channel's individual configuration bits
Ch0ConfigHoldForInit	BOOL	All outputs	When set configures the channel to hold, or not change, until initialized with a value within 0.1% of full scale of its current value when one of the following conditions occurs: 1 - Module initial connection (power up) 2 - Module transition from Program mode back to Run mode 3 - Module reestablishes communications after fault
Ch0ConfigRamp AlarmLatch	BOOL	All outputs	Enables latching for the rate alarm. Latching causes the rate alarm to remain set until an unlatch service is explicitly sent to the channel or alarm
Ch0ConfigLimit AlarmLatch	BOOL	All outputs	Enables latching for the clamp limit alarms. Latching causes the limit alarms to remain set until an unlatch service is explicitly sent to the channel or alarm

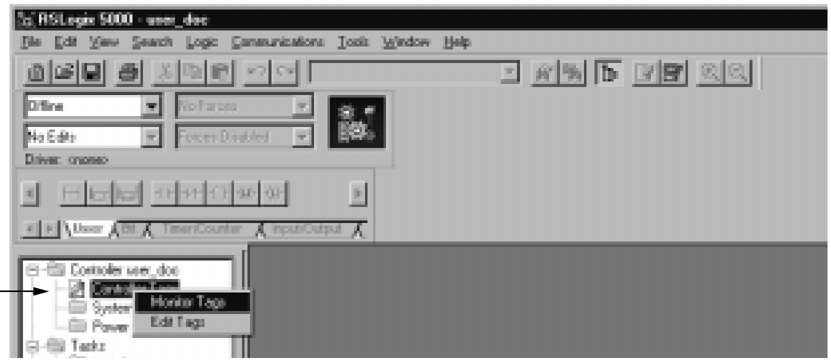
Tag Name	Data Type	Applicable Modules	Definition
Ch0ConfigFault Mode	BOOL	All outputs	Selects the behavior the output channel should take if a communications fault were to occur. Either hold last state (0) or go to a user defined value (1). Ch0ConfigFaultValue defines the value to go to on fault if the bit is set
Ch0ConfigProg Mode	BOOL	All outputs	Selects the behavior the output channel when transitioned into Program mode. Either hold last state (0) or go to a user defined value (1). Ch0ConfigProgValue defines the value to go to on program if the bit is set
Ch0ConfigRampTo Run	BOOL	All outputs	Enables ramping of the output value during Run mode between the current output level and a newly requested output. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0ConfigRampRate
Ch0ConfigRampToProg	BOOL	All outputs	Enables ramping of the output value to a user defined program value, Ch0ConfigProgValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0ConfigRampRate
Ch0ConfigRampToFault	BOOL	All outputs	Enables ramping of the output value to a user defined fault value, Ch0FaultValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0ConfigRampRate
Ch0ConfigMax RampRate	INT	All outputs	Configures the maximum rate at which the output value may change when transitioning to either the Ch0ConfigFaultValue or Ch0ConfigProgValue if either the Ch0ConfigRampToFault or Ch0ConfigRampToProg bits are set respectively, or in Run mode if Ch0ConfigRampToRun is set. In terms of percent full-scale per second
Ch0ConfigFault Value	REAL	All outputs	Defines the value, in engineering terms, the output should take on if a communications fault occurs when the Ch0ConfigFaultMode bit it set
Ch0ConfigProg Value	REAL	All outputs	Defines the value, in engineering units, the output should take on when the connection transitions to Program mode if the Ch0ConfigProgMode bit is set
Ch0ConfigLow Limit	REAL	All outputs	Defines the minimum value the output is allowed to take on within the process. If an output beneath the low limit is requested, the Ch0LLimit alarm is set and the output signal will remain at the configured low limit
Ch0ConfigHigh Limit	REAL	All outputs	Defines the maximum value the output is allowed to take on within the process. If an output above the high limit is requested, the Ch0HLimit alarm is set and the output signal will remain at the configured high limit

Accessing the Tags

When you access tags, you have two options. You can:

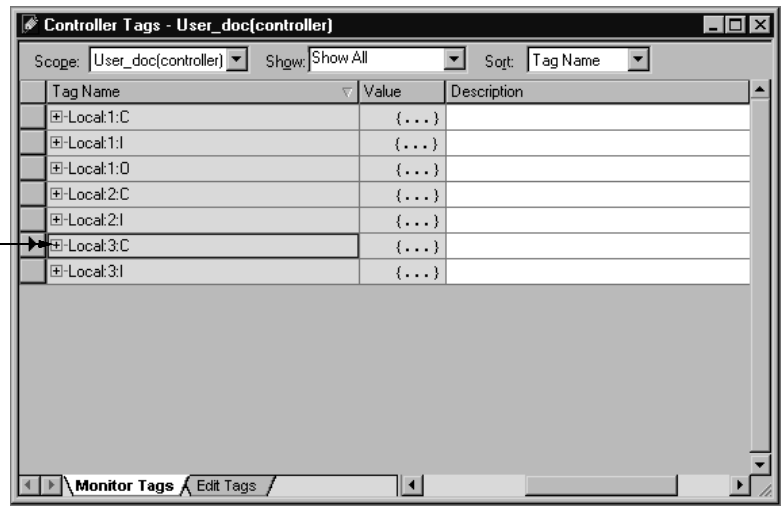
- monitor tags - this option allows you to view tags and change their values
- edit tags - this option allows you to add or delete tags but not to change their values

1. Select Controller Tags
2. Click on the right mouse button to display the menu
3. Select Monitor Tags

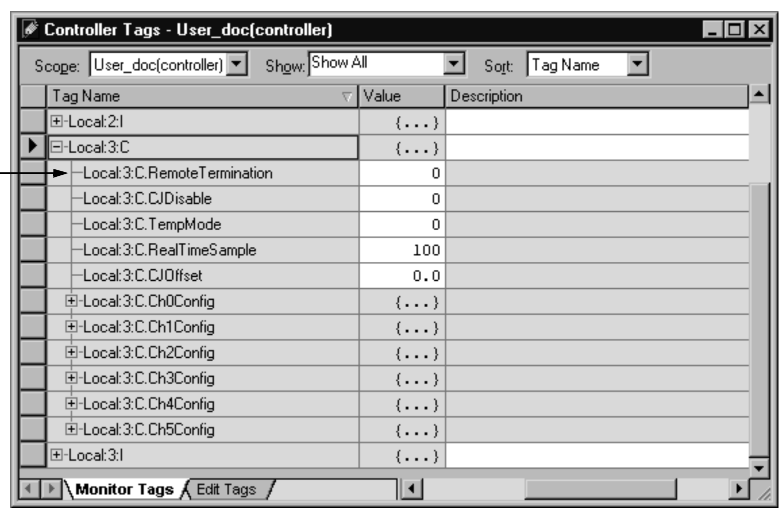


You can view tags here.

Click on the slot number of the module you want to see



Configuration information is listed for each point on the module located at Local 3:C



Changing Configuration Through the Tags

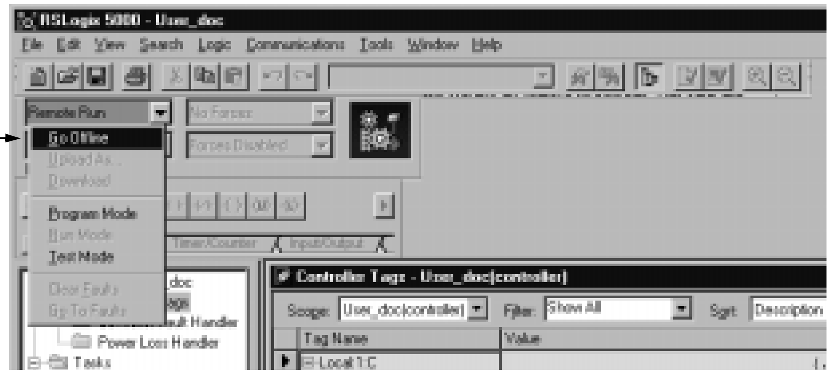
Some configurable features are changed on a module-wide basis and some on a point-by-point basis.

Important: Although you can change the value for any point in the tags, the module's configuration is not updated until you download the information, see page A-13.

Before you make configuration changes, you must first go offline.

Module Properties Dialog

Pull down this menu and click here to go offline.



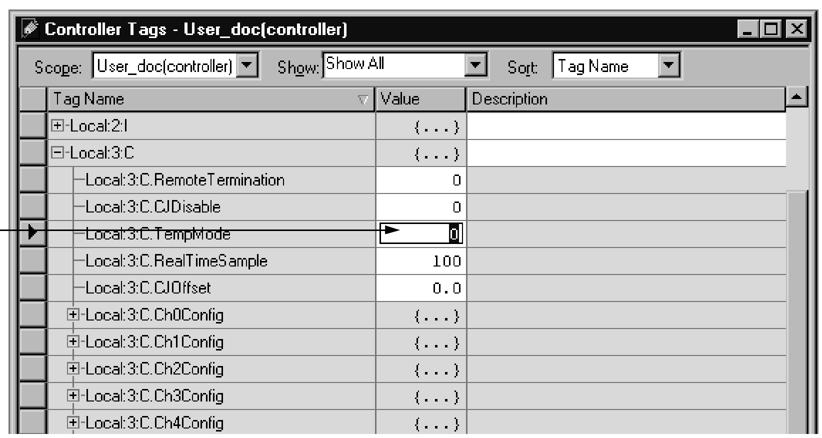
Once you are offline, you can make configuration changes.

Module-wide Configurable Features

For features, such as Program to Fault enable, that are configured on a module-wide basis, highlight the value and type in the new value, as shown below.

1. Highlight the value here

2. Type a new value



Point-by-Point Configurable Features

For features, such as Cold Junction offset, that are configured on a point-by-point basis, there are two ways to change the configuration. You can either:

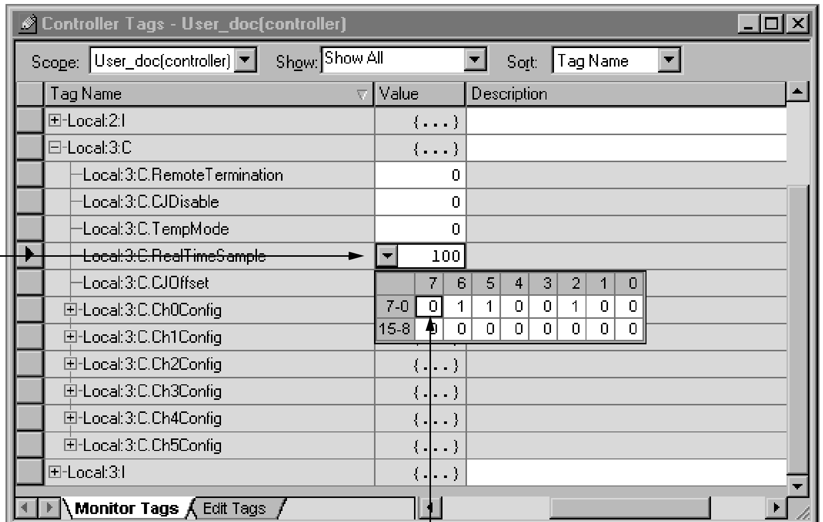
- use a pulldown menu

or

- highlight the value of a particular feature for a particular point and type a new value

Pulldown menu

1. Click on the far left side of the Value column and a pulldown menu appears

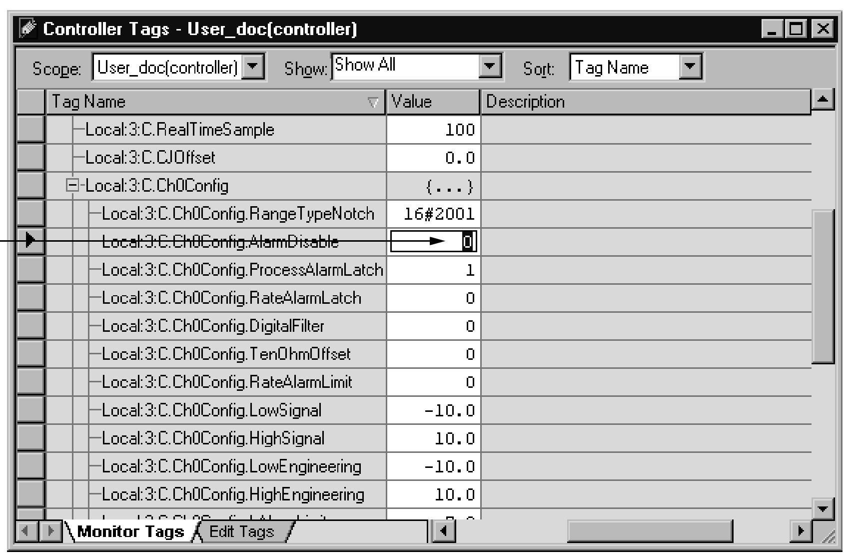


2. Highlight the point that needs to be changed and type a valid new value

Highlight value

1. Highlight the value of the feature you want to change. Note that this series of values is listed in descending order of point number. Make sure you have highlighted the point you want to change.

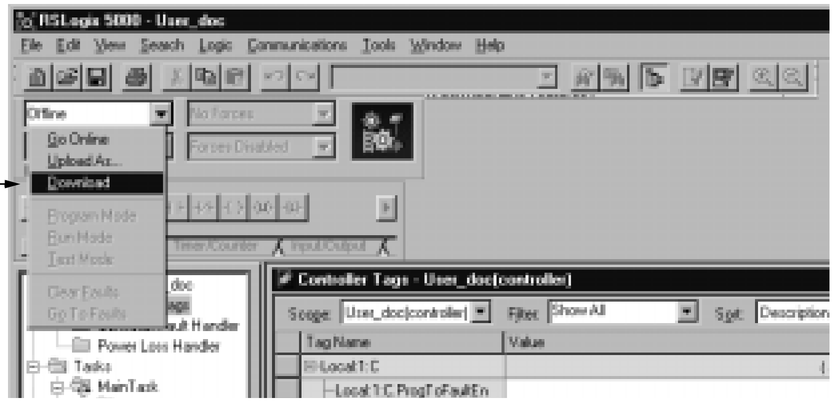
2. Type in the valid new value.



Downloading New Configuration Data

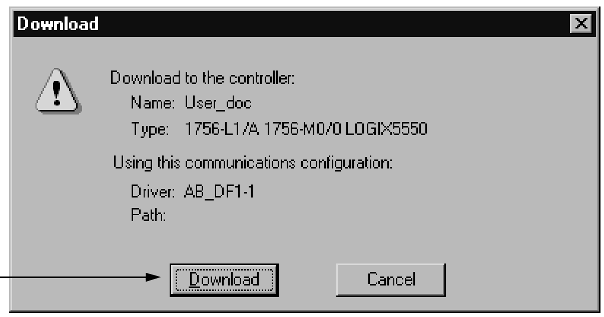
After you have changed the configuration data for a module, the change does not actually take affect until you download the new information.

Pull down this menu and click here to download the new data



RSLogix 5000 verifies the download process with this pop-up screen.

Click here to download new data



This completes the download process.

Using Ladder Logic To Perform Run Time Services and Reconfiguration

You can use ladder logic to perform run time services on your module. For example, page 10-10 shows how to unlatch alarms on the 1756-IF6I module using RSLogix 5000. This appendix provides an example of how to unlatch those same alarms **without using RSLogix 5000.**

In addition to performing run time services, you can use ladder logic to change configuration. Chapter 10 explained how to use the RSLogix 5000 software to set configuration parameters in your ControlLogix analog I/O module. Some of those parameters may also be changed through ladder logic.

Using Message Instructions

In ladder logic, you can use Message instructions to send occasional services to any ControlLogix I/O module. Message instructions send an explicit service to the module, causing specific behavior to occur, for example, unlatching a high alarm.

Message instructions maintain the following characteristics:

- messages use unscheduled portions of system communications bandwidth
- one service is performed per instruction
- performing module services does not impede module functionality, such as sampling inputs or applying new outputs

Processing Real-Time Control and Module Services

Services sent via message instructions are not as time critical as the module behavior defined during configuration and maintained by a real-time connection. Therefore, the module processes messaging services only after the needs of the I/O connection have been met.

For example, you may want to unlatch all process alarms on the module, but real-time control of your process is still occurring using the input value from that same channel. Because the input value is critical to your application, the module prioritizes the sampling of inputs ahead of the unlatch service request.

This prioritization allows input channels to be sampled at the same frequency and the process alarms to be unlatched in the time between sampling and producing the real-time input data.

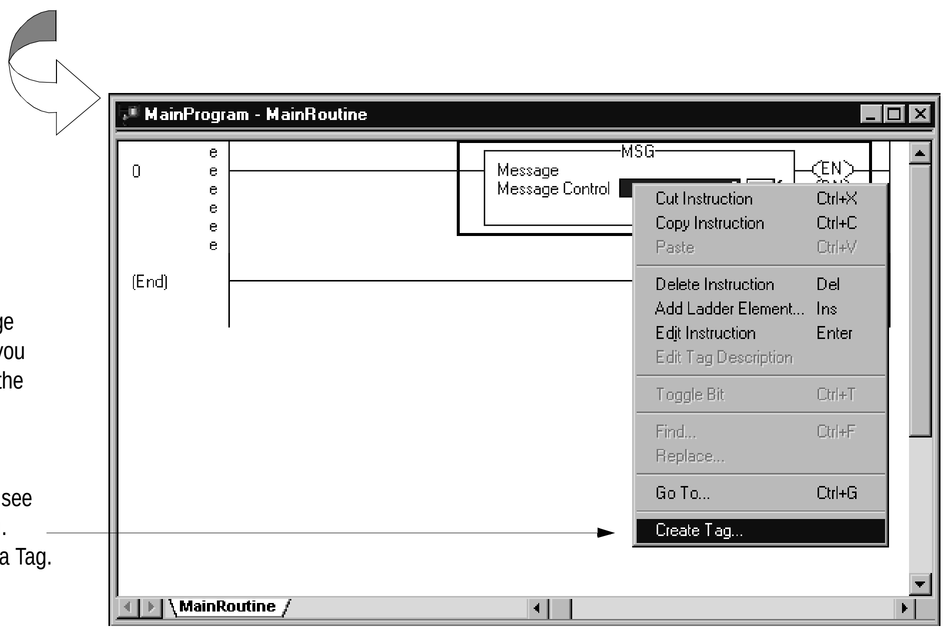
One Service Performed Per Instruction

Message instructions will only cause a module service to be performed once per execution. For example, if a message instruction sends a service to the module to unlatch the high high alarm on a particular channel, that channel’s high high alarm will unlatch, but may be set on a subsequent channel sample. The message instruction must then be reexecuted to unlatch the alarm a second time.

Creating a New Tag

This ladder logic is written in the Main Routine section of RSLogix 5000.

Double-click here to enter the Main Routine



After adding a message instruction to a rung, you must create a tag for the message instruction

1 Right-click on the question mark (?) to see this pull-down menu.
2 Click here to Create a Tag.

You must fill in the following information when the New Tag pop-up screen appears:

Important: We suggest you name the tag to indicate what module service is sent by the message instruction. For example, the message instruction below is used to unlatch a high alarm, and the tag is named to reflect this..

Name the tag here.

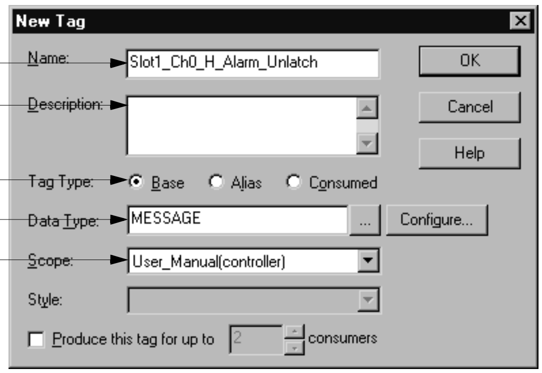
Enter an optional description here.

Choose the **Base** Tag Type here.

Choose the **Message** Data Type here.

Choose the **Controller** Scope here.

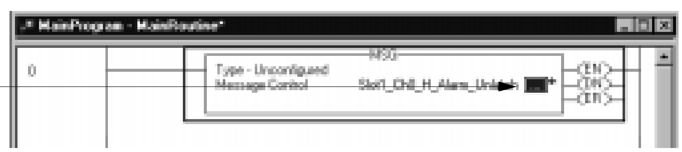
IMPORTANT: Message tags can only be created with the Controller Scope.



Enter Message Configuration

After creating a new tag, you must enter message configuration.

Click here to see the message configuration pop-up screens



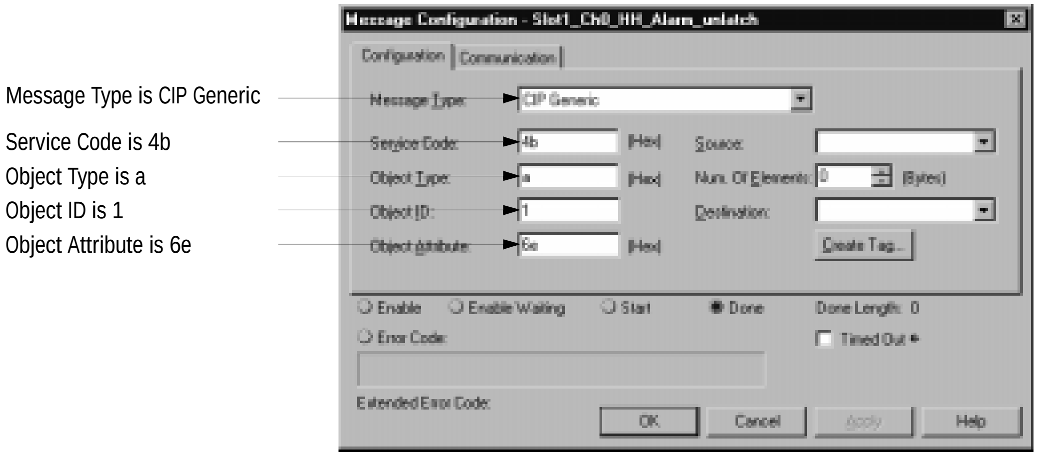
Enter message configuration on the following screens:

- Configuration pop-up screen
- Communications pop-up screen

A description of the purpose and set-up of each screen follows.

Configuration Pop-Up Screen

This pop-up screen provides information on what module service to perform and where to perform it. For example, you must use this screen to unlatch high high alarms (module service) on channel 0 of a 1756-IF6I module (where to perform service).



The following table contains information that must be entered on the configuration pop-up screen to perform input module services:

Table C.A
Analog Input Modules Configuration Pop-Up Screen Information

Enter the following:	To unlatch the high high alarm:	To unlatch the high alarm:	To unlatch the low alarm:	To unlatch the low low alarm:	To unlatch the rate alarm:
Service Code	4B	4B	4B	4B	4B
Object Type	0A	0A	0A	0A	0A
Object ID[1] (Channel Number)	1-6 or 1-8	1-6 or 1-8	1-6 or 1-8	1-6 or 1-8	1-6 or 1-8
Object Attribute	6E	6C	6B	6D	6F
Number of Elements	0 bytes	0 bytes	0 bytes	0 bytes	0 bytes

[1] The 1756-IF16 module does not have any unlatchable features in the 16 channel mode.

Important: For input or output modules, the Object Attribute determines which alarm feature for the selected channel to unlatch. If this field is left blank, **all alarms for the selected channel** will be unlatched.

You must send separate message instructions to control specific alarms on each channel of the module.

Also, Object ID represents channel number. For the 1756-IF6I, 1756-IR6I and 1756-IT6I modules, channels 0-5 are represented by Object ID 1-6. For the 1756-IF16 (in differential mode only) and 1756-IF8 modules, channels 0-7 are represented by Object ID 1-8.

The following table contains information that must be entered on the configuration pop-up screen to perform output module services:

Table C.B
Analog Output Modules Configuration Pop-Up Screen Information

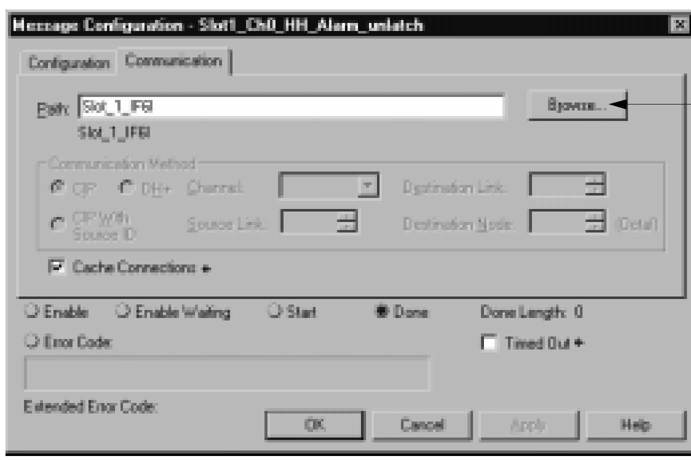
Enter the following:	To unlatch the high alarm:	To unlatch the low alarm:	To unlatch the ramp alarm:
Service Code	4B	4B	4B
Object Type	0B	0B	0B
Object ID (Channel Number)	1-6 or 1-8	1-6 or 1-8	1-6 or 1-8
Object Attribute	6F	6E	70
Number of Elements	0 bytes	0 bytes	0 bytes

Communications Pop-Up Screen

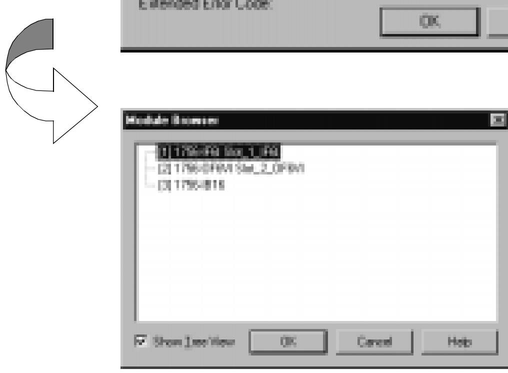
This pop-up screen provides information on the path of the message instruction. For example, the slot number of a 1756-IT6I distinguishes exactly which module a message is designated for.

Important: Use the Browse button to see a list of the I/O modules in the system. You choose a path when you choose a module from the list.

You must name an I/O module during initial module configuration to choose a path for your message instruction..



Use this Browse button to see a list such as the one displayed below.



Unlatch Alarms in the 1756-IF6I

Example Rungs 0-4 show how to unlatch the following alarms in a 1756-IF6I module, named *Slot_1_IF6I*:

- Channel 0 High high alarm - Rung 0
- Channel 0 High alarm - Rung 1
- Channel 0 Low alarm - Rung 2
- Channel 0 Low low alarm - Rung 3
- Channel 0 Rate alarm - Rung 4

Important: An I/O module must be configured to latch alarms, see pages 10-10 & 10-15, before you can perform unlatch services using ladder logic. If an unlatch service is received by a module not configured to latch alarms, the message instruction will error.

Also, all alarms for channel 0 can be unlatched simultaneously with a single message instruction by leaving the object attribute field blank.

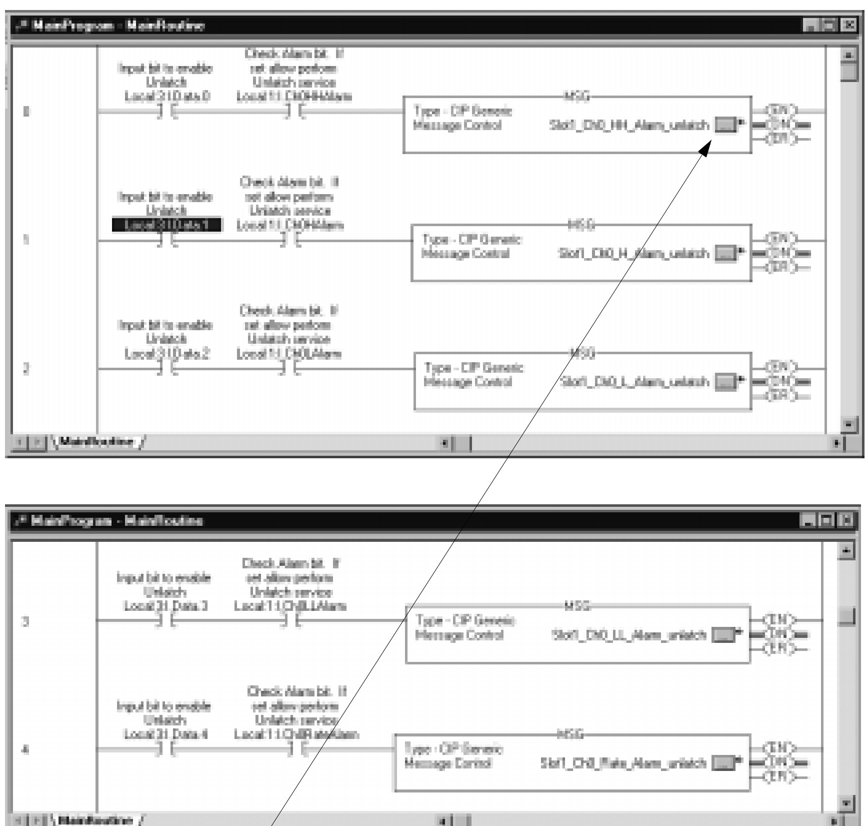
Rung 0 unlatches the high high alarm.

Rung 1 unlatches the high alarm.

Rung 2 unlatches the low alarm.

Rung 3 unlatches the low low alarm.

Rung 4 unlatches the rate alarm.

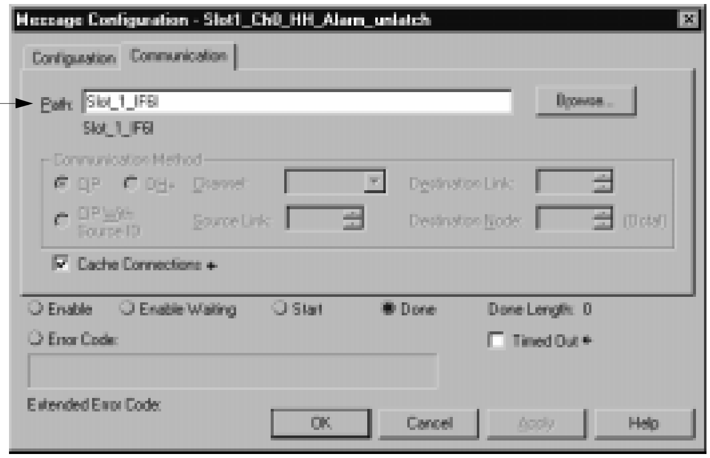


Click on the box in each rung to see the configuration and communication information pop-up associated with it. An explanation of the pop-ups used in these rungs is below.

Communications Pop-Up Screens

The screen below shows the Communications pop-up for Rung 0. This pop-up screen is the same for each rung of this example.

Set the module's message path here



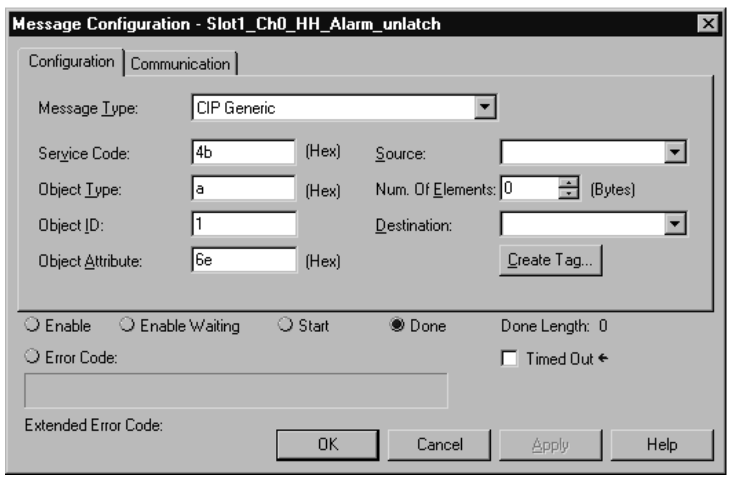
Important: You must name an I/O module to set the message path under that module's communication tab.

Configuration Pop-Up Screens

The screen below shows the Configuration pop-up for Rungs 0.

Configuration Pop-Up Screen

This pop-up screen contains the same information for each rung, except for the Object Attribute field. The information in this field is as follows:
Rung 0 - 6e
Rung 1 - 6c
Rung 2 - 6b
Rung 3 - 6d
Rung 4 - 6f



Unlatch Alarms in the 1756-OF6VI

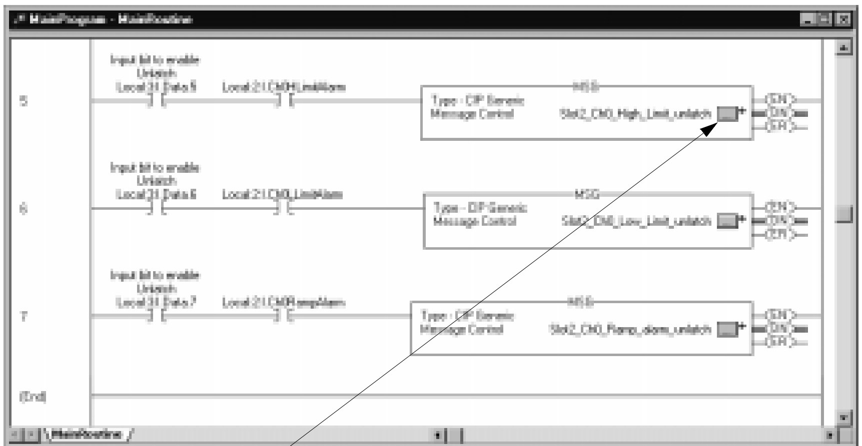
Example Rungs 5-7 show how to unlatch the following alarms in a 1756-OF6VI module:

- High limit alarm - Rung 5
- Low limit alarm - Rung 6
- Ramp alarm - Rung 7

Rung 5 unlatches the high limit alarm.

Rung 6 unlatches the low limit alarm.

Rung 7 unlatches the ramp alarm.

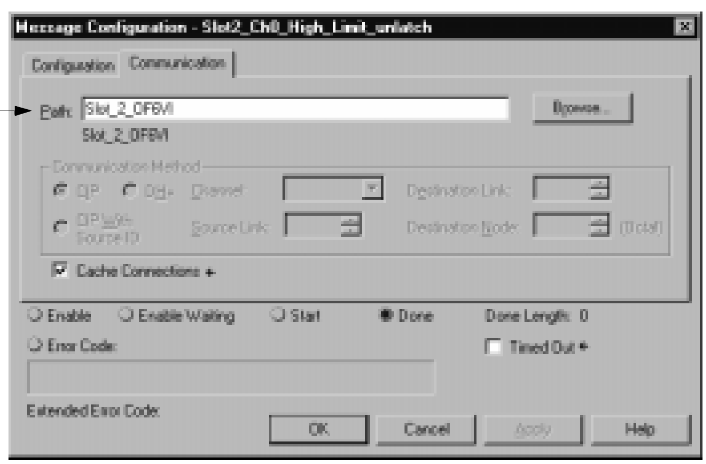


Click on the box in each rung to see the configuration and communication information pop-up associated with it. An explanation of the pop-ups used in these rungs is below.

Communications Pop-Up Screens

The screen below shows the Communications pop-up for Rung 0. This pop-up is the same for each rung in this example..

Set the module's message path here

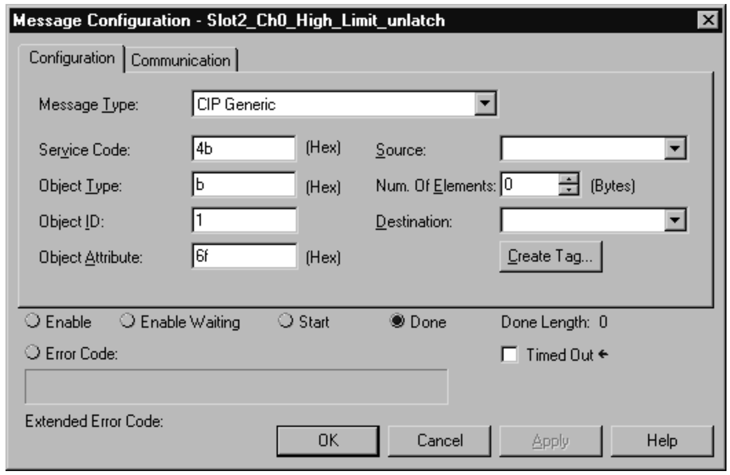


Important: You must name an I/O module to set the message path under that module's communication tab.

The screen below shows the Configuration pop-up for Rung 5.

Configuration Pop-Up Screen

This pop-up screen contains the same information for each rung, except for the Object Attribute field. The information in this field is as follows:
Rung 5 - 6f
Rung 6 - 6e
Rung 7 - 70



Reconfiguring a 1756-IR6I Module

It is sometimes advantageous to change the functional operation of a module in the ControlLogix system automatically via the user program rather than using RSLogix5000 software to reconfigure it.

This way, changes in the process can dictate when the reconfiguration should take place rather than the user performing that function manually.

The following steps are used in this example when reconfiguring a module via ladder are:

1. Moving new configuration parameters to the Configuration portion of the Tag Structure associated with the module

2. Using the Message instruction to send a Reset Module service to the same module to trigger sending the configuration data.

Before the new configuration parameters are sent to the module, the user must make sure that their relationship to each other is in a format the module will accept (see tables below).

Important: Reconfiguring analog modules via ladder should be limited to functions that involve **the changing of values only**. We do not recommend that enabling or disabling features be done via ladder. Use RSLogix 5000 to enable or disable these features.

The following tables list module parameters that may be changed via ladder logic:

Table C.C
Permissible Analog Input Module Parameters to Change Via Ladder Logic

Feature:	Restriction:
High Engineering Value	Must not be equal to low engineering value
Low Engineering Value	Must not be equal to high engineering value
High-High Alarm Value	Must be greater than or equal to high alarm value
High Alarm Value	Must be greater than low alarm value
Low Alarm Value	Must be less than high alarm value
Low-Low Alarm Value	Must be less than or equal to low alarm value
Deadband	Must be less than half of high alarm minus low alarm

Table C.D
Permissible Analog Output Module Parameters to Change Via Ladder Logic

Feature:	Restriction:
High Clamp Value[1]	Must be greater than low clamp value
Low Clamp Value[1]	Must be less than high clamp value

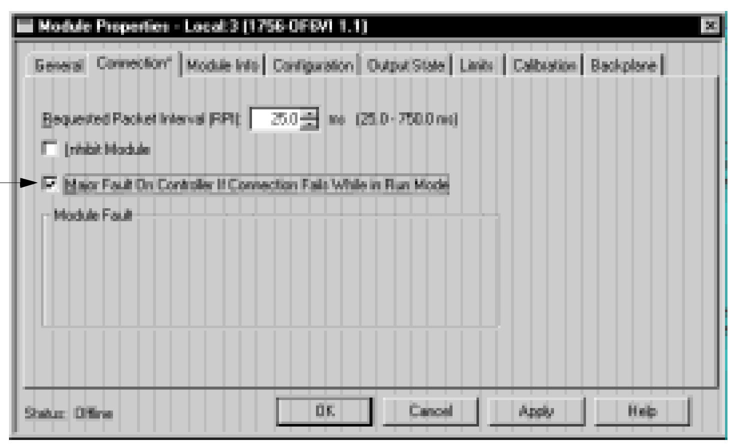
1 The values for user-defined state at Fault or Program (set during initial configuration) must fall within the range of the High and Low Clamp values.

Considerations With This Ladder Logic Example

Remember the following when using this method of module reconfiguration using the reset service:

- When this method of reconfiguration is used on Output modules, ALL module outputs will be reset to Zero for at least three seconds
- This method of reconfiguration will cause a Major Fault in the controller if the module was initially configured to do so on the following screen:

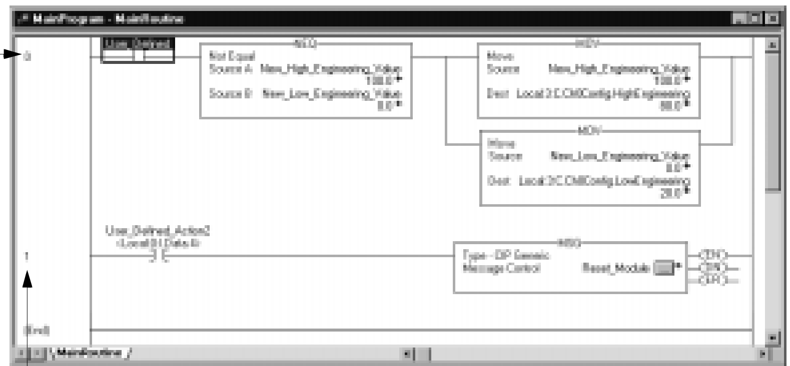
Choose a Major Fault in controller here



- All Listen-Only controllers will lose their connections to the module for a minimum of three seconds after the Reset is performed.

- If the Reconfiguration is performed on an Input module with multiple owners, then all owners will lose their connections simultaneously after the Reset is performed. In order to re-establish all their connections, all owners must change their configuration to the same values BEFORE the Reset is performed.

The following ladder example shows how to change the High and Low Engineering Values (Scaling Parameters) for an Analog Output module in Slot 3 of the Local Chassis:



Rung 0

This rung moves new Channel 0 scaling parameters to the configuration portion of the structure associated with an analog output module in Slot 3 of the local chassis.

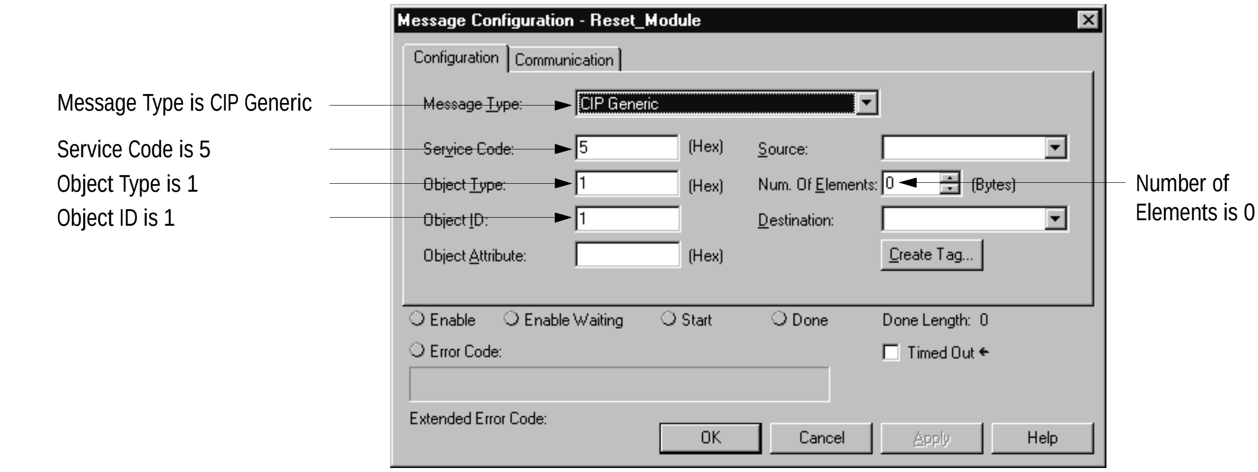
The new values move at the user's discretion (represented by the user defined XIC instruction) after making sure the desired new high value is not equal to the desired new low value. This rung only moves the data to the configuration portion of the structure but does not send it to the module.

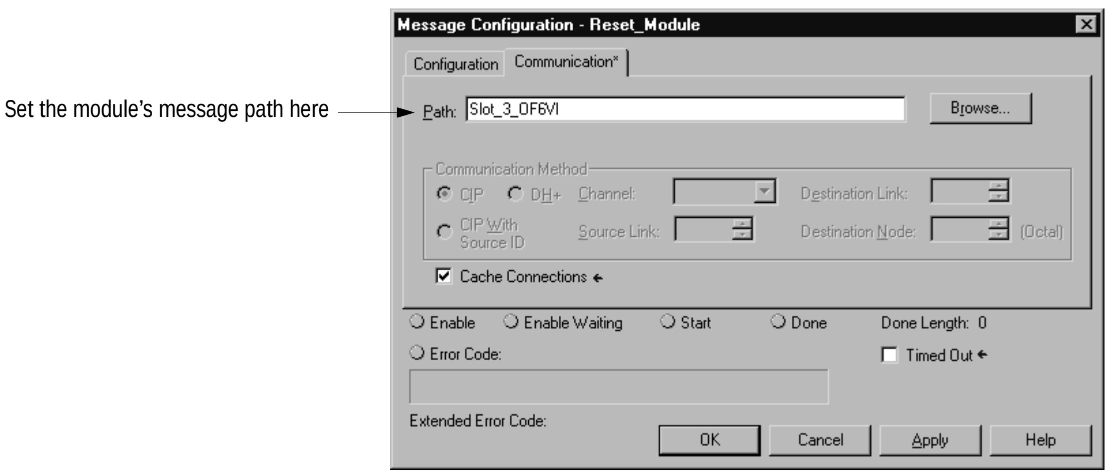
Rung 1

This rung sends the Reset Module service to the analog output module. Upon receipt, the module will initiate a hardware reset on itself, behaving as though it has just been inserted into the system. A connection is established and the new configuration parameters are sent.

Perform Module Reset Service

The following configuration and communication pop-up screens show the **message instruction to perform the Reset service** and its path:





Power Supply Sizing Chart

Use the following chart to check the power your ControlLogix chassis is using.

Slot number	Module Catalog Number	Current @ 5.1 VDC (mA)		Power @ 5.1 VDC (Watts)	Current @ 24 VDC (mA)		Power @ 24 VDC (Watts)	Current @ 3.3 VDC (mA)		Power @ 3.3 VDC (Watts)
0			x 5.1V =			x 24V =			x 3.3V =	
1			x 5.1V =			x 24V =			x 3.3V =	
2			x 5.1V =			x 24V =			x 3.3V =	
3			x 5.1V =			x 24V =			x 3.3V =	
4			x 5.1V =			x 24V =			x 3.3V =	
5			x 5.1V =			x 24V =			x 3.3V =	
6			x 5.1V =			x 24V =			x 3.3V =	
7			x 5.1V =			x 24V =			x 3.3V =	
8			x 5.1V =			x 24V =			x 3.3V =	
9			x 5.1V =			x 24V =			x 3.3V =	
10			x 5.1V =			x 24V =			x 3.3V =	
11			x 5.1V =			x 24V =			x 3.3V =	
12			x 5.1V =			x 24V =			x 3.3V =	
13			x 5.1V =			x 24V =			x 3.3V =	
14			x 5.1V =			x 24V =			x 3.3V =	
15			x 5.1V =			x 24V =			x 3.3V =	
16			x 5.1V =			x 24V =			x 3.3V =	
	TOTALS	mA		W	mA		W	mA		W
		This number cannot exceed 10000mA			This number cannot exceed 2800mA			This number cannot exceed 4000mA		
				These three numbers added together cannot exceed: 70W @40°C 55W @ 60°C						

Important: We recommend that you copy this worksheet for use in checking the power supply of each ControlLogix chassis used.

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