

ControlLogix High-speed Analog I/O Module

Catalog Number 1756-IF4FXOF2F



Important User Information

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

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



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



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.



SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

IMPORTANT

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

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This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

New and Updated Information

This table contains the changes made to this revision.

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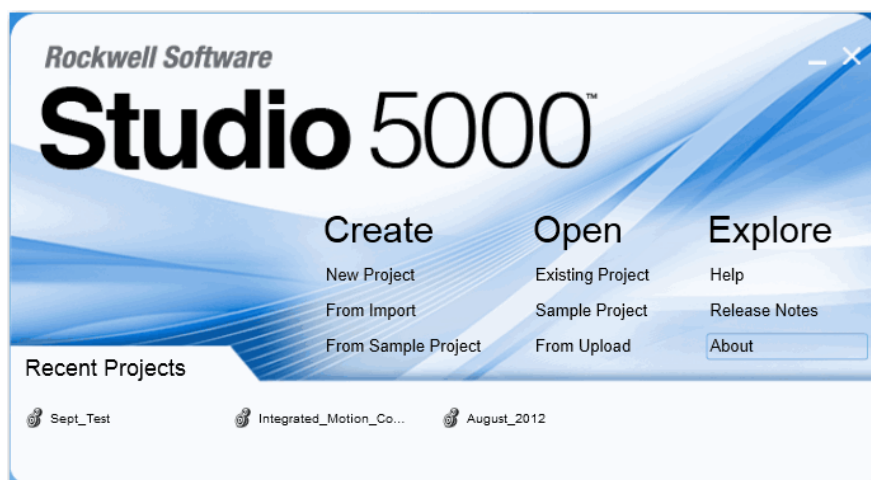
Glossary

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This manual describes how to install, configure, and troubleshoot your ControlLogix® high-speed analog I/O module. You must be able to program and operate a ControlLogix controller to efficiently use your high-speed analog I/O module.

Studio 5000 Environment

The Studio 5000 Engineering and Design Environment combines engineering and design elements into a common environment. The first element in the Studio 5000 environment is the Logix Designer application. The Logix Designer application is the rebranding of RSLogix 5000 software and will continue to be the product to program Logix5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.



The Studio 5000 environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. It is the one place for design engineers to develop all the elements of their control system.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
1756 ControlLogix I/O Modules Specifications Technical Data, publication 1756-TD002	Provides specifications for ControlLogix I/O modules.
ControlLogix Analog I/O Modules User Manual, publication 1756-UM009	Describes how to install, configure, and troubleshoot ControlLogix analog I/O modules.
ControlLogix System User Manual, publication 1756-UM001	Describes how to install, configure, program, and operate a ControlLogix system.
ControlLogix Chassis and Power Supplies Installation Instructions, publication 1756-IN005	Describes how to install and troubleshoot standard and ControlLogix-XT™ versions of the 1756 chassis and power supplies, including redundant power supplies.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

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

What is the ControlLogix High-speed Analog I/O Module?

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The ControlLogix high-speed analog I/O module is an interface module that converts analog signals to digital values for inputs and converts digital values to analog signals for outputs. Using the producer/consumer network model, the module produces information when needed while providing additional system functions.

Available Features

The following are some of the features available on the module:

- Input Synchronization—This feature lets you synchronize the sampling of inputs across multiple fast analog modules in the same chassis, allowing those inputs to sample at the same rate within microseconds of each other. For more information, see [Synchronize Module Inputs on page 45](#).
- Combination module offering 4 differential inputs and 2 outputs
- Sub-millisecond input sampling
- One millisecond output updates
- On-board alarms and scaling
- Removal and insertion under power (RIUP)
- Producer/consumer communication
- Rolling timestamp of data in milliseconds
- Coordinated System Time (CST) timestamp of data in microseconds
- IEEE 32 bit floating point
- Class I/Division 2, UL, CSA, CE, and C-Tick Agency Certification

To see a complete listing, including detailed explanations of all module features, see [Chapter 3](#).

High-speed Analog I/O Modules in the ControlLogix System

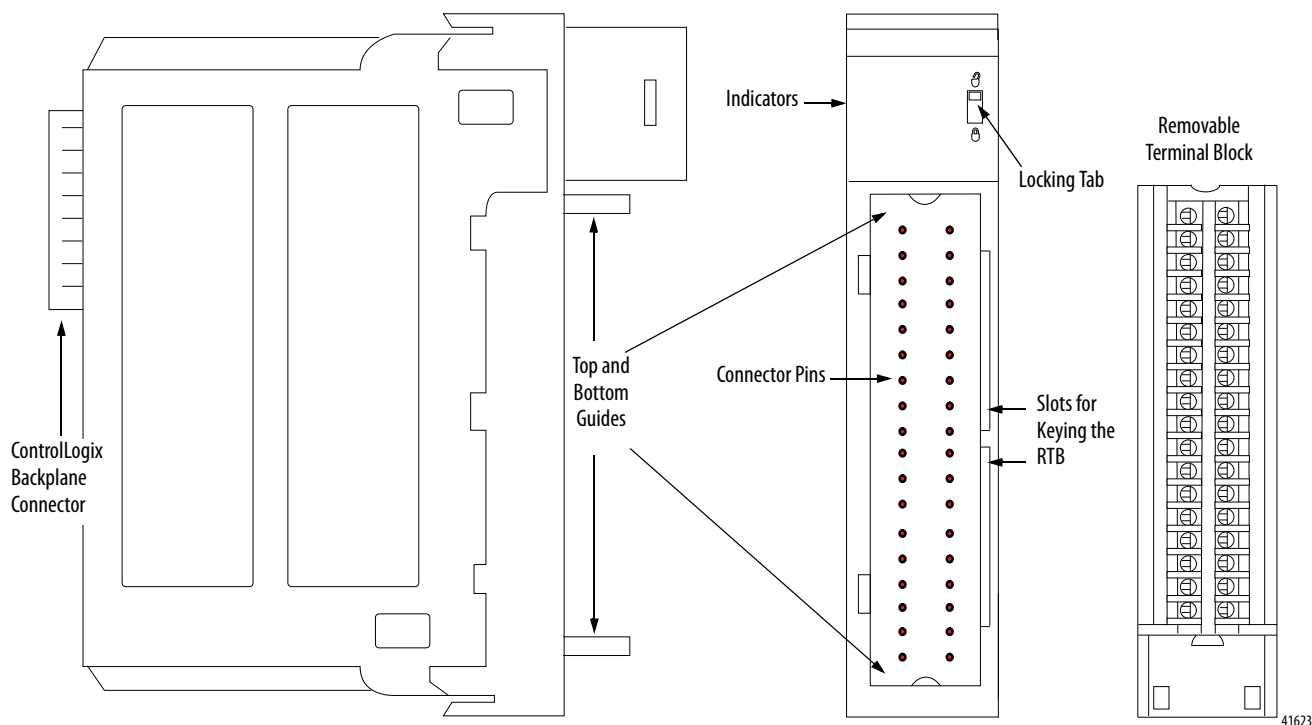
A ControlLogix high-speed analog I/O module mounts in a ControlLogix chassis and uses a Removable Terminal Block (RTB) or Interface Module (IFM) to connect all field-side wiring.

Before you install and use your module, do the following:

- Install and ground a 1756 chassis and power supply. Refer to the publications listed in [Additional Resources on page 10](#).
- Order and receive an RTB or IFM and its components for your application.

IMPORTANT RTBs and IFMs are not included with your module purchase. You must order them separately. For more information, contact your local distributor or Rockwell Automation representative.

Figure 1 - Physical Features of the High-speed Analog I/O Module



[Table 1](#) lists the physical features on the ControlLogix high-speed analog I/O module.

Table 1 - ControlLogix High-speed Analog I/O Module Physical Features

Feature	Description
ControlLogix backplane connector	Provides an interface to the ControlLogix system by connecting the module to the backplane.
Connector pins	Input/output, power, and grounding connections are made to the module through these pins with the use of an RTB.
Locking tab	Anchors the RTB on the module to maintain wiring connections.
Slots for keying	Slots mechanically key the RTB to prevent you from making the wrong wire connections to your module.
Status indicators	Display the status of communication, module health, and calibration information. Use these indicators to help in troubleshooting.
Top and bottom guides	Provide assistance in seating the RTB onto the module.

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IMPORTANT A ControlLogix high-speed analog I/O module's performance behavior varies depending upon whether it operates in the local chassis or in a remote chassis. Module performance is limited in a remote chassis. The network cannot effectively accommodate the fastest module update rates because the size of the data broadcast requires a large portion of the network's bandwidth. For maximum module performance, we recommend you use it in a local chassis. This chapter describes how the ControlLogix high-speed analog I/O module operates in a local chassis. For more information on how the module operates in a remote chassis, see [Appendix E](#).

Ownership and Connections

Every high-speed analog I/O module in the ControlLogix system must be owned by a ControlLogix controller. This owner-controller stores configuration data for the module and can be local or remote in reference to the module's position. The owner-controller sends the high-speed analog I/O module configuration data to define the module's behavior and begin operation.

The ControlLogix high-speed analog I/O module is limited to a single owner and must continuously maintain communication with the owner to operate normally.

ControlLogix input modules allow multiple owner-controllers that each store the module's configuration data. The high-speed analog I/O module, however, also has outputs and cannot support multiple owner-controllers. Other controllers can make listen-only connections to the module, though. For more information on listen-only connections, see [page 22](#).

Configure the Module

The I/O configuration portion of the Studio 5000 Logix Designer application generates the configuration data for each high-speed analog I/O module in the control system.

With the configuration dialog boxes in the Logix Designer application, you can configure the inputs and outputs of a high-speed analog module at the same time. Configuration data is transferred to the owner-controller during the program download and subsequently transferred to the appropriate modules.

Follow these guidelines when configuring high-speed analog I/O modules.

1. Configure all modules for the controller by using the software.
2. Download configuration information to the controller.
3. Go online with your Logix Designer project to begin operation.

For more information on how to use the software to configure the module, see [Chapter 5](#).

Direct Connections

A direct connection is a real-time data transfer link between the controller and the module 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, the controller automatically sends the configuration data and one of the following events occurs:

- 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 appears 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 continuously 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. Relay ladder logic may be used to monitor this data area to detect the module's failures.

Inputs and Outputs on the Same Module

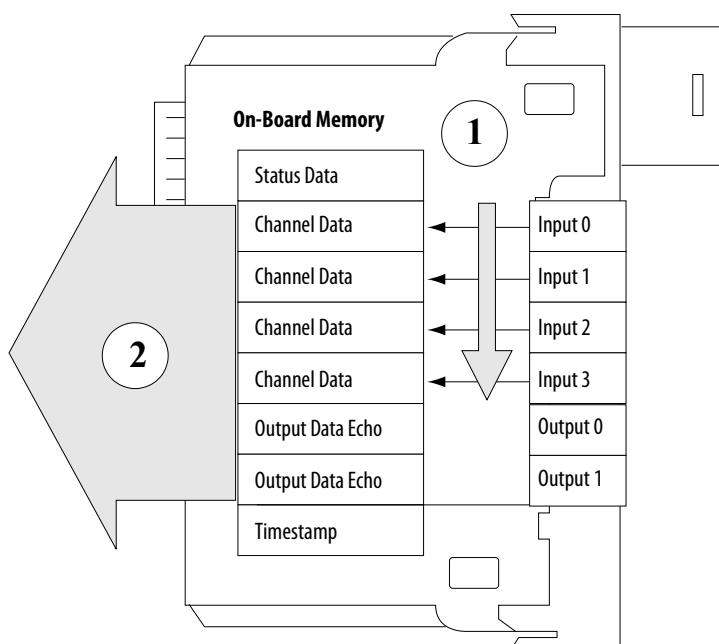
The ControlLogix high-speed analog I/O module has 4 inputs and 2 outputs. The following configurable parameters affect module behavior:

- [Real Time Sample \(RTS\)](#)—Defines the input update rate.
- [Requested Packet Interval \(RPI\)](#)—Defines the output update rate and additional transfers of input data.

Real Time Sample (RTS)

The RTS is a configurable parameter (0.3...25 ms) that defines the input update rate. This parameter causes the module to do the following.

1. Scan all input channels and store the data in on-board memory.
2. Multicast the updated channel data, as well as other status data, to the backplane of the local chassis.

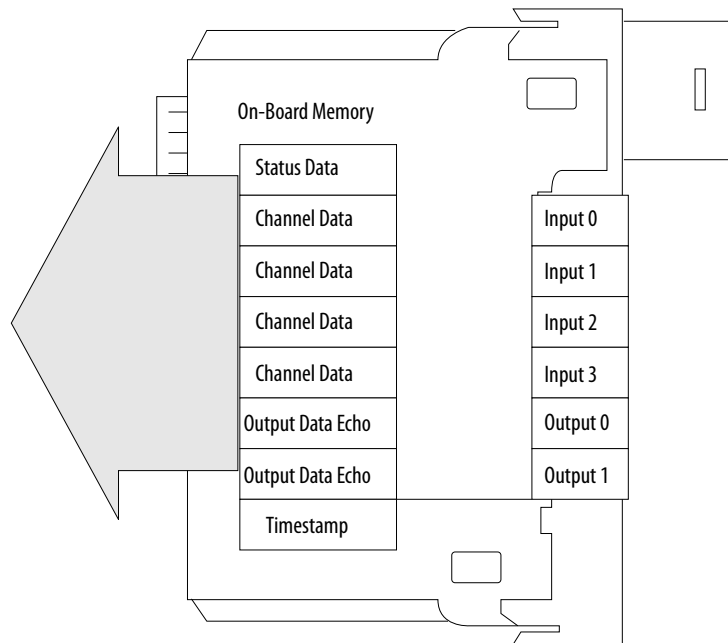


IMPORTANT The RTS value is set during the initial configuration. This value can be adjusted anytime. To use sub-millisecond values, type values with a decimal point. For example, to use 800 ms, type 0.8.

For more information on how to set the RTS, see [Chapter 5](#).

Requested Packet Interval (RPI)

The RPI is a configurable parameter that also instructs the module to multicast its channel and status data to the local chassis backplane. However, the RPI instructs the module to multicast the **current contents** of its on-board memory, including input and output data echo, when the RPI expires. When the RPI expires, the module does not update its channels prior to the multicast. The RPI also instructs the owner-controller to update the module outputs.



IMPORTANT The owner-controller sends output data to the high-speed analog I/O module outputs asynchronously to when channel data and output data echo data are returned over the ControlLogix backplane.

The RPI value is set during the initial module configuration. Adjusting the RPI causes the connection to close and reopen.

Differences between Inputs and Outputs

The ControlLogix high-speed analog I/O module uses both inputs and outputs. However, there are significant differences between how each channel type operates.

Module Input Operation

In traditional I/O systems, controllers poll module inputs to obtain their status. The owner-controller does not poll the ControlLogix high-speed analog inputs once a connection is established. Rather, the module multi-casts its input data periodically. Multicast frequency depends on module configuration, such as RTS and RPI rates.

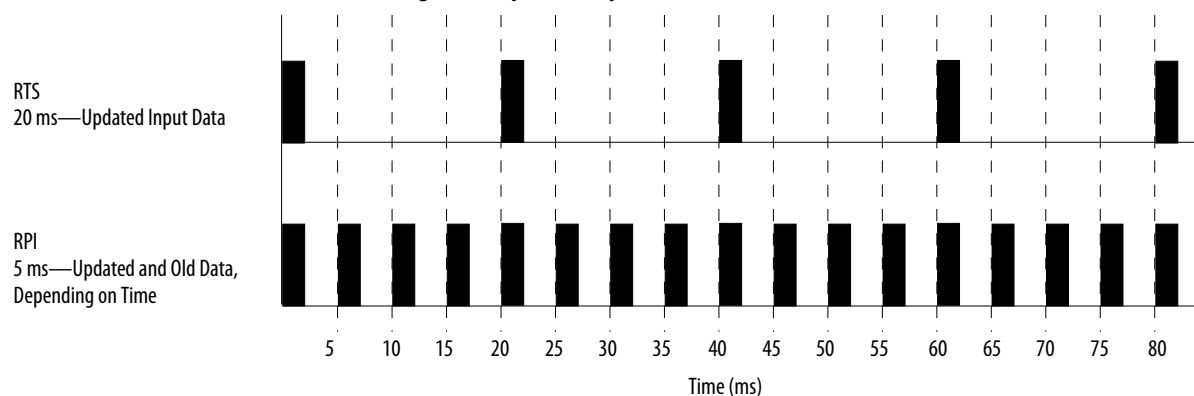
IMPORTANT

The module only sends data at the RPI in these scenarios:

- $RPI < RTS$. In this case, the module multicasts at both the RTS rate and the RPI rate. Their respective values dictate how often the owner-controller receives data and how many multicasts from the module contain updated channel data.
- If the $RPI > RTS$, each multicast from the module has updated channel data. In effect, the module is only multicasting at the RTS rate.
- The module is operating in a mode where inputs are not being sampled, for example calibration.

In [Figure 2](#), the RTS value is 20 ms and the RPI value is 5 ms. Only every fourth multicast contains updated channel data.

Figure 2 - Input Data Update Rate



Updated input channel data is received at 0 ms, 20 ms, 40 ms, 60 ms, and 80 ms. The data received at other RPI times repeats the most previous RTS. For example, data received at 30 ms repeats that received at 20 ms.

Module Output Operation

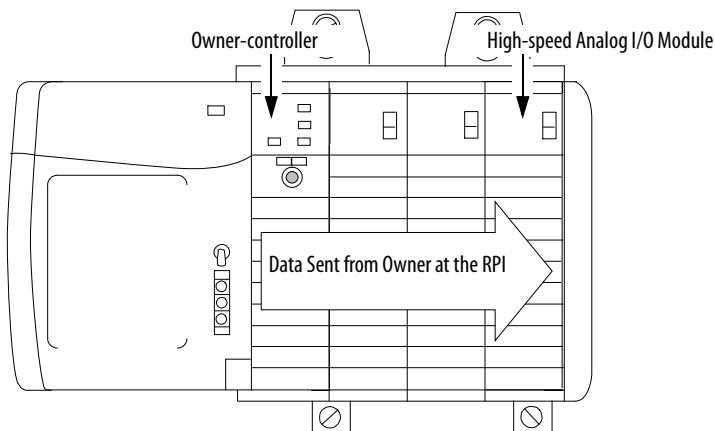
When specifying an RPI value for the high-speed analog I/O module, you define when the controller broadcasts output data to the module. If the module resides in the same chassis as the owner-controller, the module receives the data almost immediately.

High-speed analog module outputs receive data from the owner-controller and echo output data **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 a high-speed analog I/O module receives **new data** from an owner-controller, the module multicasts or echoes the output data value that corresponds to the analog signal applied to the output terminals⁽¹⁾ to the rest of the control system at the next RPI or RTS, whichever occurs first. This feature, called **Output Data Echo**.

Depending on the value of the RPI, with respect to the length of the controller program scan, the 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.



(1) Although the output value at the RTB screw terminal typically matches the output data echo value, it is not guaranteed to match. The output data echo that is multicast to the rest of the control system represents the value the outputs were commanded to be.

Listen-only Mode

Any controller in the system can **listen** to the data from a high-speed analog I/O module (input data or echoed output data) even if the controller does not own the module. The module does not have to hold the module's configuration data to listen to the module.

During the I/O configuration process, you can specify a Listen-only mode in the Communication Format field. For more information on Communication Format, see [page 75](#).

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

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 the owner and the module is broken, the module stops multicasting data and connections to all listening controllers are also broken.
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Module Features

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Input Compatibility

ControlLogix high-speed analog I/O module inputs convert the following analog signals into digital values:

- Volts
- Milliamps

The digital value that represents the magnitude of the analog signal is then transmitted on the backplane to an owner-controller or other control entities.

Output Compatibility

ControlLogix high-speed analog I/O module outputs convert a digital value delivered to the module via the backplane into an analog signal:

- -10.5...10.5V
- or
- 0...21 mA

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.

General Module Features

This section describes features available on ControlLogix high-speed analog I/O modules that are common with other ControlLogix I/O modules.

Removal and Insertion Under Power (RIUP)

ControlLogix high-speed analog 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 high-speed analog I/O modules provide both hardware and software indication when a module fault has occurred. Each module has a fault status indicator. The Logix Designer application graphically displays the fault and includes a fault message describing the nature of the fault. This feature lets you to determine how your module has been affected and what action to take to resume normal operation.

For more information about fault and status reporting, see [page 49](#).

Fully Software Configurable

The Logix Designer application uses an interface to configure the module. All module features are enabled or disabled through the I/O configuration portion of the application.

The user can also use the software to interrogate any module in the system to retrieve the following:

- Serial number
- Revision information
- Catalog number
- Vendor identification
- Error/fault information
- Diagnostic counters

Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the Logix Designer I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected.

For each module in the I/O Configuration tree, the user-selected keying option determines if, and how, an electronic keying check is performed. Typically, three keying options are available:

- [Exact Match](#)
- [Compatible Keying](#)
- [Disabled Keying](#)

You must carefully consider the benefits and implications of each keying option when selecting between them. For some specific module types, fewer options are available.

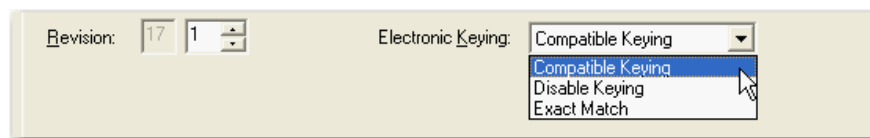
Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

Table 2 - Keying Attributes

Attribute	Description
Vendor	The manufacturer of the module, for example, Rockwell Automation/Allen-Bradley.
Product Type	The general type of the module, for example, communication adapter, AC drive, or digital I/O.
Product Code	The specific type of module, generally represented by its catalog number, for example, 1756-IB16L.
Major Revision	A number that represents the functional capabilities and data exchange formats of the module. Typically, although not always, a later, that is higher, Major Revision supports at least all of the data formats supported by an earlier, that is lower, Major Revision of the same catalog number and, possibly, additional ones.
Minor Revision	A number that indicates the module's specific firmware revision. Minor Revisions typically do not impact data compatibility but may indicate performance or behavior improvement.

You can find revision information on the General tab of a module's Properties dialog box.

Figure 3 - General Tab



IMPORTANT Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Exact Match

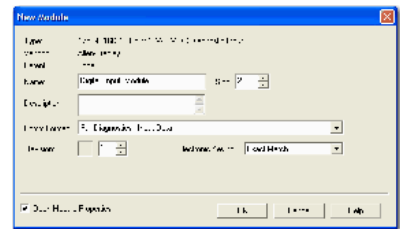
Exact Match keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication. If any attribute does not match precisely, I/O communication is not permitted with the module or with modules connected through it, as in the case of a communication module.

Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic Firmware Update for the module via the Firmware Supervisor feature from a Logix5000 controller.

EXAMPLE In this scenario, **Exact Match keying prevents I/O communication.** The module configuration is for a 1756-IB16D module with module revision 3.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is prevented because the Minor Revision of the module does not match precisely.

Module Configuration

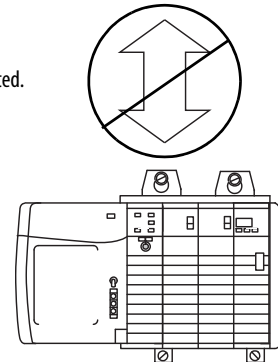
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 1



Communication is prevented.

Physical Module

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



IMPORTANT Changing electronic keying selections online may cause the I/O Communication connection to the module to be disrupted and may result in a loss of data.

Compatible Keying

Compatible Keying indicates that the module determines whether to accept or reject communication. Different module families, communication adapters, and module types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products. Release notes for individual modules indicate the specific compatibility details.

Compatible Keying is the default setting. Compatible Keying allows the physical module to accept the key of the module configured in the software, provided that the configured module is one the physical module is capable of emulating. The exact level of emulation required is product and revision specific.

With Compatible Keying, you can replace a module of a certain Major Revision with one of the same catalog number and the same or later, that is higher, Major Revision. If a Major Revision is the same, then make sure that the Minor Revision is the same or higher than it is configured in the project. In some cases, the selection makes it possible to use a replacement that is a different catalog number than the original. For example, you can replace a 1756-CNBR module with a 1756-CN2R module.

When a module is created, the module developers consider the module's development history to implement capabilities that emulate those of the previous module. However, the developers cannot know future developments. Because of this, when a system is configured, we recommend that you configure your module using the earliest, that is, lowest, revision of the physical module that you believe will be used in the system. By doing this, you can avoid the case of a physical

module rejecting the keying request because it is an earlier revision than the one configured in the software.

EXAMPLE

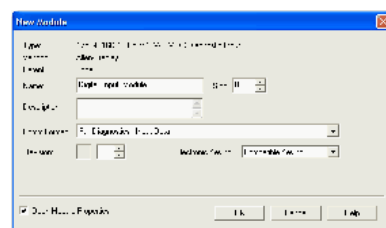
In this scenario, **Compatible Keying prevents I/O communication.**

The module configuration is for a 1756-IB16D module with module revision 3.3. The physical module is a 1756-IB16D module with module revision 3.2.

In this case, communication is prevented because the minor revision of the module is lower than expected and may not be compatible with 3.3.

Module Configuration

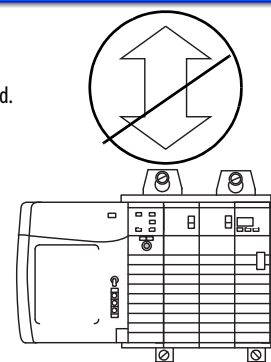
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 3



Communication is prevented.

Physical Module

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



EXAMPLE In this scenario, **Compatible Keying allows I/O communication.**

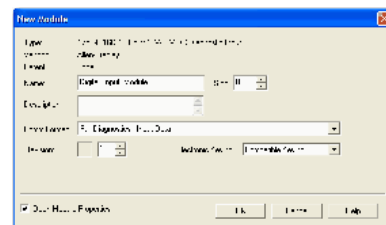
The module configuration is for a 1756-IB16D module with module revision 2.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is allowed because the major revision of the physical module is higher than expected and the module determines that it is compatible with the prior major revision.

Module Configuration

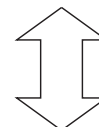
Vendor = Allen-Bradley

Product Type = Digital Input Module

Catalog Number = 1756-IB16D

Major Revision = 2**Minor Revision = 1**

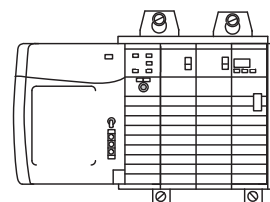
Communication is allowed.

Physical Module

Vendor = Allen-Bradley

Product Type = Digital Input Module

Catalog Number = 1756-IB16D

Major Revision = 3**Minor Revision = 2****IMPORTANT**

Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Disabled Keying

Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module. Other attributes, such as data size and format, are considered and must be acceptable before I/O communication is established. With Disabled Keying, I/O communication may occur with a module other than the type specified in the I/O Configuration tree with unpredictable results. We generally do not recommend using Disabled Keying.



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

If you use Disabled Keying, you must take full responsibility for understanding whether the module being used can fulfill the functional requirements of the application.

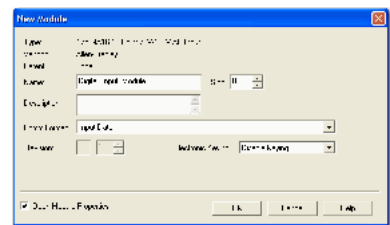
EXAMPLE

In this scenario, **Disable Keying prevents I/O communication.**

The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IF16 analog input module. In this case, communication is prevented because the analog module rejects the data formats that the digital module configuration requests.

Module Configuration

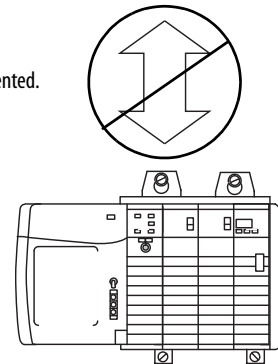
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 3
Minor Revision = 1



Communication is prevented.

Physical Module

Vendor = Allen-Bradley
Product Type = Analog Input Module
Catalog Number = 1756-IF16
Major Revision = 3
Minor Revision = 2

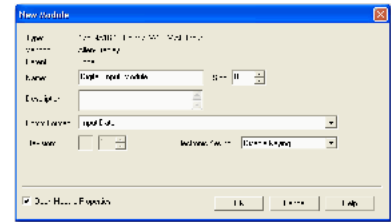


EXAMPLE In this scenario, **Disable Keying** allows I/O communication.

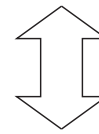
The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IB16 digital input module. In this case, communication is allowed because the two digital modules share common data formats.

Module Configuration

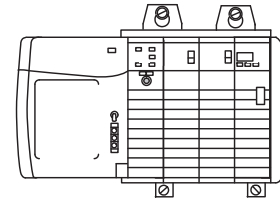
Vendor = Allen-Bradley
 Product Type = Digital Input Module
 Catalog Number = 1756-IA16
 Major Revision = 2
 Minor Revision = 1



Communication is allowed.

Physical Module

Vendor = Allen-Bradley
 Product Type = Digital Input Module
 Catalog Number = 1756-IB16
 Major Revision = 3
 Minor Revision = 2



IMPORTANT Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Access to System Clock for Timestamping Functions

Certain modules, such as controllers, in the ControlLogix chassis maintain a system clock. The clock is a free-running, 64-bit number that increments every microsecond. It is used to place a timestamp on the sampling of input data within the local chassis.

You can configure your high-speed analog I/O modules to access this clock and timestamp input data when the module multicasts to the system. You decide how to timestamp data when you choose a communication format. For more information about choosing a communication format, see [page 75](#).

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. This clock is also used to synchronize inputs across multiple modules in the same chassis. For more information about synchronizing module inputs, see [page 45](#).

Rolling Timestamp

Each high-speed analog I/O module maintains a rolling timestamp that is unrelated to the Coordinated System Time (CST). The rolling timestamp is an on-board, continuously running 15-bit timer that counts in milliseconds.

For module inputs, when the module scans its input 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.

Because the high-speed analog I/O module offers sub-millisecond sample times and the rolling timestamp counts in milliseconds, it is possible that a new sample can be taken without altering the rolling timestamp. If accurate time deltas are required in such sub-millisecond cases, the CST timestamp's lower 32 bits offer the necessary precision.

Producer/Consumer Model

The producer/consumer model is an intelligent data exchange between modules and other system devices in which each module produces data without having first been polled. The modules produce the data and any owner or listen-only controller device can decide to consume it.

For example, module inputs produce 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](#).

Status Information

Each ControlLogix high-speed analog I/O module has status indicators that allow you to check module health and operational status.

The following status can be checked with the indicators:

- **Calibration status**—The display blinks to indicate when your module is in the Calibration mode.
- **Module status**—The display indicates the module's communication status.

To see the status indicators on the ControlLogix high-speed analog I/O module, see [Chapter 7](#).

Full Class I Division 2 Compliance

All ControlLogix high-speed 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	Do not pull modules under power or remove a powered RTB when a hazardous environment is present.
------------------	--

CE/CSA/UL/C-Tick Agency Certification

The ControlLogix high-speed analog I/O module has obtained multiple agency certifications, such as CE, CSA, UL, and C-Tick. If the module has received an agency certification, it is marked as such.

Field Calibration

ControlLogix high-speed analog I/O modules allow you to calibrate each channel individually or in groups, such as all inputs at once. The Logix Designer application provides an interface to perform calibration.

To see how to calibrate your module, see [Chapter 6](#).

Latching of Alarms

The latching feature allows the high-speed analog I/O module to latch an alarm in the set position once it has been triggered, even if the condition causing the alarm to occur disappears. Once an alarm is latched, you must unlatch it via the Logix Designer application or a message instruction.

To see how to unlatch an alarm, see [page 77](#).

Alarm Disable

The Logix Designer application provides the option to disable all of the process alarms available on the module, as described on pages [44](#), [45](#), and [48](#).

To see how to disable the process alarms, see [page 77](#).

Data Format

Your high-speed analog I/O module multicasts floating point data. Floating point data uses a 32-bit IEEE format. **Integer mode is not available** on the ControlLogix high-speed analog I/O module.

Module Inhibiting

Module inhibiting provides the option to close the connection between a high-speed analog I/O module and its owner-controller. This feature stops the data transfer between the owner-controller and a configured module. The connection is reopened when the module is uninhibited.

IMPORTANT	Whenever you inhibit a high-speed analog I/O module, all outputs change to the state configured for the Program mode. For example, if the module is configured so that the state of the outputs go to zero during Program mode, whenever the module is inhibited, the outputs go to zero.
------------------	--

Understand Module Resolution, Scaling and Data Format

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

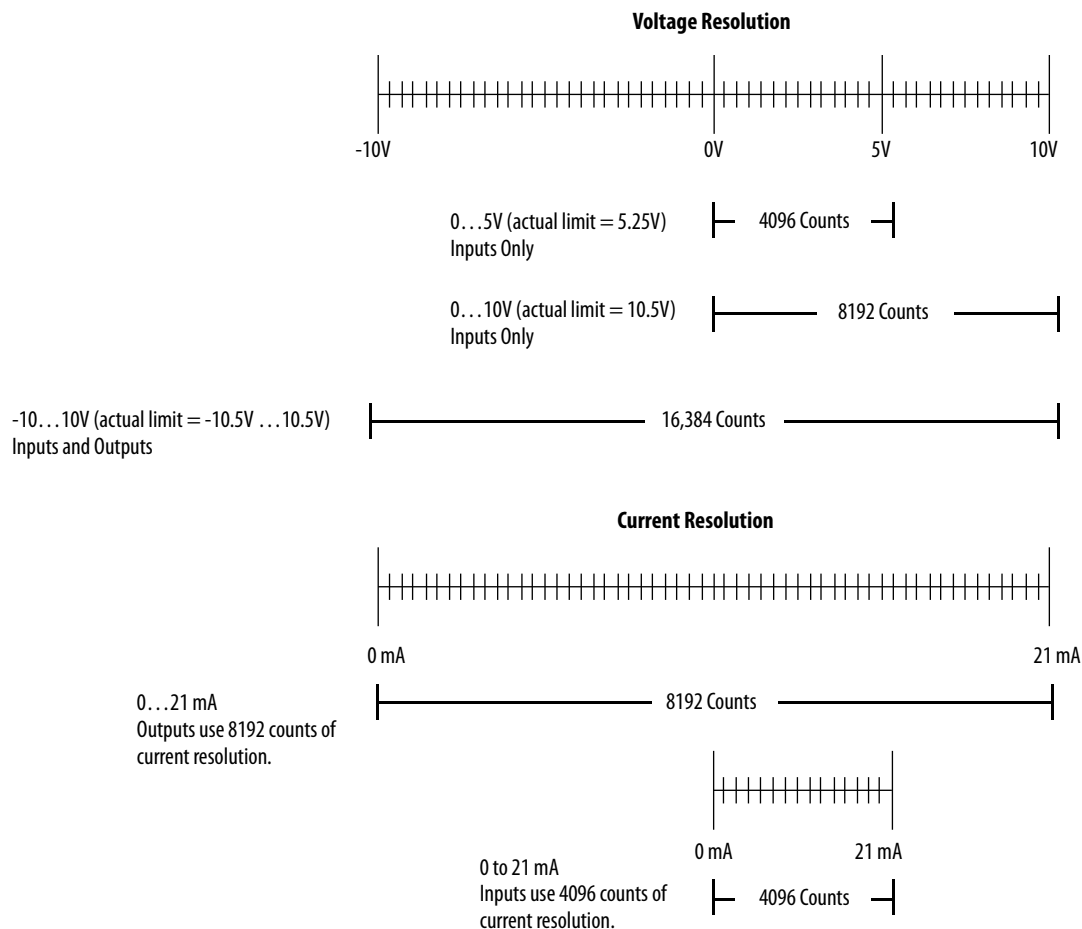
- [Module Resolution](#)
- [Scaling](#)

Module Resolution

Resolution is the smallest amount of change that the module can detect. High-speed analog I/O modules are capable of 14-bit resolution. The 14 bits represent 16,384 counts. Depending on the operating range, the available counts varies, as shown in [Figure 4](#).

IMPORTANT A module's resolution is fixed. It does not change regardless of how you decide to scale your module.

Figure 4 - Available Counts



Use [Table 3](#) to see the resolution for each module range.

Table 3 - Module Resolution Range

Input Range	Effective Bits across Range	Resolution
±10V	14 bits	1.3 mV/count
0V...10V	13 bits	1.3 mV/count
0V...5V	12 bits	1.3 mV/count
0 mA...21 mA	12 bits	5.25 µA/count
Output Range	Effective Bits across Range	Resolution
±10V	14 bits	1.3mV/count
0 mA...21 mA	13 bits	2.8µA/count

IMPORTANT Because this module must allow for possible calibration inaccuracies, resolution values represent the available analog-to-digital or digital-to-analog counts over the specified range.

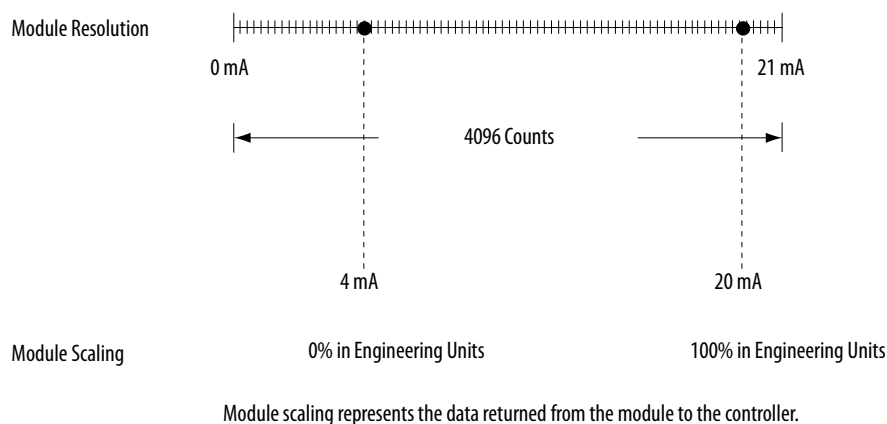
Scaling

The scaling feature provides the option to change a quantity from one notation to another. When you scale a channel, you must choose two points along the channel's operating range and apply low and high values to those points.

For example, if you use an input in Current mode, the channel maintains a 0...21 mA range capability. But your application may use a 4...20 mA transmitter. You can scale the module to represent 4 mA as the low signal and 20 mA as the high signal and scale that into engineering units of your choice.

In this case, scaling can cause the module to return data to the controller so that 4 mA returns a value of 0% in engineering units and 20 mA returns a value of 100% in engineering units.

Figure 5 - Module Resolution Compared to Module Scaling



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 4 mA...20 mA range. If an input signal beyond the low and high signals is present at the module, such as 3 mA, that data is represented in terms of the engineering units set during scaling. [Table 4](#) shows example values that may appear based the example mentioned previously.

Table 4 - Current Values Represented in Engineering Units

Current	Engineering Units Value
3 mA	-6.25%
4 mA	0%
12 mA	50%
20 mA	100%
21 mA	106.25%

Features Specific to Module Inputs

The following features are specific to high-speed analog I/O module inputs:

- [Archiving](#)
- [Multiple Input Ranges](#)
- [Underrange/Overrange Detection](#)
- [Digital Filter](#)
- [Process Alarms](#)
- [Rate Alarm](#)
- [Synchronize Module Inputs](#)

Archiving

IMPORTANT

Archiving is available only with the following:

- Module firmware revision 3.005 or later
For more information about upgrading a series A module with series B firmware, see [Appendix F](#).
 - RSLogix 5000 software version 16.03.00 or later, or the Studio 5000 environment version 21.00.00 or later
-

Archiving is an input scanning function that lets the high-speed analog module store as many as 20 input data samples for each channel in the module's on-board buffers before it sends the I/O data to the controller.

By storing the channel data until 20 samples are taken, the module lengthens the time between I/O data transfers, resulting in a better use of controller task resources by batching the samples into 1 large transfer rather than 20 small transfers.

When a Real Time Sample (RTS) period is defined during configuration, it defines the interval in which the module scans for new data from each of the input channels, for example, RTS period = one input data sample per channel.

Without archiving, the module sends this channel data at the completion of every channel scan, for example, every RTS period. Because archiving permits the module to store 20 channel scans worth of data on-board before transferring it to the controller, the system can effectively record channel data without excessively burdening the backplane or controller.

EXAMPLE

If the module is set to scan its channels at the fastest rate possible, for example, RTS = 300 μ s, rather than sending data to the controller at that frequency, the module sends data as defined by this formula:

Archive data transfer rate = 20 x RTS chosen by the user

In this case, with the RTS period for high-speed analog module = 300 μ s, the module fills its on-board buffers with data at the rate defined by that RTS, but transfers the data to the controller only every 6 ms (20 samples x 300 μ s).

IMPORTANT

The high-speed scanning that occurs when archiving applies only to the inputs on the module and not the outputs. The outputs are updated at the RPI rate.

Enable Archiving via the Communication Format

To use archiving, you must select the 1756-IF4FXOF2F/B configuration profile, and then choose the Archiving Connection communication format, as shown in [Figure 6](#).

Figure 6 - Archiving Connection Communication Format

The screenshot shows the 'New Module' dialog box. The 'Type' is '1756-IF4FXOF2F/B 4 Current/Volt Inputs/2 Current/Volt Outputs Fast Analog'. The 'Vendor' is 'Allen-Bradley'. The 'Parent' is 'Local'. The 'Name' is 'Fast_Analog' and the 'Slot' is '3'. The 'Description' field is empty. The 'Comm Format' is 'Archiving Connection'. The 'Revision' is '3' and '1'. The 'Electronic Keying' is 'Compatible Keying'. The 'Open Module Properties' checkbox is checked. The 'OK', 'Cancel', and 'Help' buttons are at the bottom right.

The Archiving Connection communication format creates two additional tags in the input structure of the module, as described below.

Table 5 - Archiving Tags

Tag	Description
I.LastUpdateIndex	Returns the number of the last archive sample performed by the module before data was sent to the controller. This tag equals 19 when the RPI is greater than (20 * RTS).
I.Input	An array that stores channel data for each of the 20 archive samples (0...19).

Determine RPI

When archiving is enabled, we recommend that you set the requested packet interval (RPI) of the module at a rate equal to or greater than 20 times the Real Time Sample (RTS) rate. You can determine the recommended RPI by using the following equation.

$$\text{RPI} = (\text{RTS} \times 20)$$

The fastest RTS rate available for use with the high-speed analog module is 300 μs . If the RTS is set at 300 μs , set the RPI to at least 6 ms or higher as shown below.

$$6 \text{ ms} = (300 \mu\text{s} \times 20)$$

For more information about determining RPI and RTS rates with archiving enabled, search the Rockwell Automation Knowledgebase for answer ID 40228.

Use Archiving

Follow these steps to use archiving.

1. Choose a Real Time Sample (RTS) period appropriate for your application.

The module supports sample periods as fast as 300 μ s. However, only RSLogix 5000 software, version 18.02.00 or later, or the Studio 5000 environment, version 21.00.00 or later, lets you enter that value in the profile during module configuration.

RSLogix 5000 software, version 17.01.02 or earlier, requires that you enter a minimum 400 μ s RTS period via the profile. You must enter a value of 0.3 in the C.RealTimeSample tag to achieve a 300 μ s RTS.

TIP The module's outputs are updated only at the defined RPI rate. Consider output behavior when choosing an RPI.

2. Calculate your RPI: Choose an RPI that is equal to 20 x RTS.

For example, if you choose a 400 μ s RTS, and then set your RPI to 8 ms, this causes the module to send data to the controller after the twentieth archive scan (I.LastUpdateIndex always equals 19).

3. Program an event task to Copy the I.Input array structure to alternate tags.

For more information, see the following:

- To trigger an event task, see [Note 2 on page 41](#).
- To program an event task, see [Appendix A](#).

IMPORTANT Keep in mind that no matter what RPI and RTS value you configure, your controller must have access to the data returned by the module faster than the net module update rate.

For example, if you specify an RTS of 500 μ s and an RPI of 11 ms, the module returns new data to the controller every 10 ms. In this example, the controller must have all of its archive-supporting programming scanned at a rate faster than 10 ms.

Table 6 - Notes for Archiving

Note		Description
1	Setting the RPI less than the recommended value	<p>If the RPI value is less than the recommended value, archiving still works, but the module performs only a limited number of archive samples before the RPI expires.</p> <p>The I.LastUpdateIndex tag contains values from 0...19 to indicate the last sample number.</p> <p>You need to take this into account and move only some of the values returned by the module.</p>
2	Using the I.RollingTimeStamp tag	<p>The RollingTimeStamp tag stores an integer value from 0...32,767 ms that increments each time the module sends new data to the controller.</p> <p>In the example used above in step 2, the I.RollingTimeStamp increments by 8 each time new data is present.</p> <p>Ladder logic associated with storing and monitoring archived data can also track the I.RollingTimeStamp tag to determine if the archive data has changed.</p> <p>A running history of I.RollingTimeStamp can also be used to verify the age of the data by subtracting the previous I.RollingTimeStamp value from the current I.RollingTimeStamp value. The difference equals either the RPI or the COS update rate of the module.</p>
3	Using the I.CSTimestamp tag	<p>This value represents the Coordinated System Time available to all modules on the backplane. By using I.CSTimestamp, you can get better resolution (± 1 RTS) and can correlate the analog values taken by the 1756-IF4XOF2F module to other events and data in your system.</p>
4	Using the module in the local chassis	<p>Use archiving only when the module is in the local chassis. Do not use archiving when the module is in a remote chassis.</p> <p>The high-speed scanning that occurs when archiving applies to only the inputs on the module and not the outputs. The outputs are updated at the RPI rate.</p>
5	Archiving channel signal data	<p>Only channel signal data is archived. General status, fault, and alarms are not included in the archive.</p> <p>If alarming is important in your application, we recommend that you latch alarm data and examine the information in the I.In tags for every archive sample to isolate when an incident occurred.</p>
6	Synchronizing the Archiving function	<p>You can synchronize the Archiving function across multiple modules in the same local chassis by checking the Synchronize Module Inputs checkbox on the Input Configuration tab of the Module Properties dialog box.</p> <p>Synchronizing inputs causes the start of each archive sample period on each module to begin within 100 μs of each other.</p>

Multiple Input Ranges

You can select from a series of operational ranges for **each input channel** on your module. The range designates the minimum and maximum signals that the module can report. The following input ranges are available on the high-speed analog I/O module:

- -10...10V
- 0...5V
- 0...10V
- 0...20 mA

For an example of how to choose an input range for your module, see [page 77](#).

You must wire the module differently, depending on what operating mode, such as current or voltage, you plan to use. For an example of how to wire the module, see [page 63](#).

Underrange/Overrange Detection

This feature detects when a high-speed analog I/O module input is operating beyond limits set by the input range. For example, if you are using the 0...10V input range and the module voltage increases to 11V, the Overrange detection feature detects this condition.

[Table 7](#) lists the available input ranges and the lowest or highest signal available in each range before the module detects an underrange or overrange condition.

Table 7 - Low and High Signal Limits on High-speed Module Inputs

Input Range	Underrange ⁽¹⁾	Overrange ⁽²⁾
±10V	-10.50V	10.50V
0...10V	0V	10.50V
0...5V	0V	5.25V
0...20 mA	0 mA	21.00 mA

(1) Underrange represents the lowest signal in the range.

(2) Overrange represents the highest signal in the range.

Digital Filter

The digital filter smooths input data noise transients for all input 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 0.0 disables the filter.

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

$$Y_n = Y_{n-1} + \frac{[\Delta t]}{\Delta t + T_A} (X_n - Y_{n-1})$$

Y_n = present output, filtered peak voltage (PV)

Y_{n-1} = previous output, filtered PV

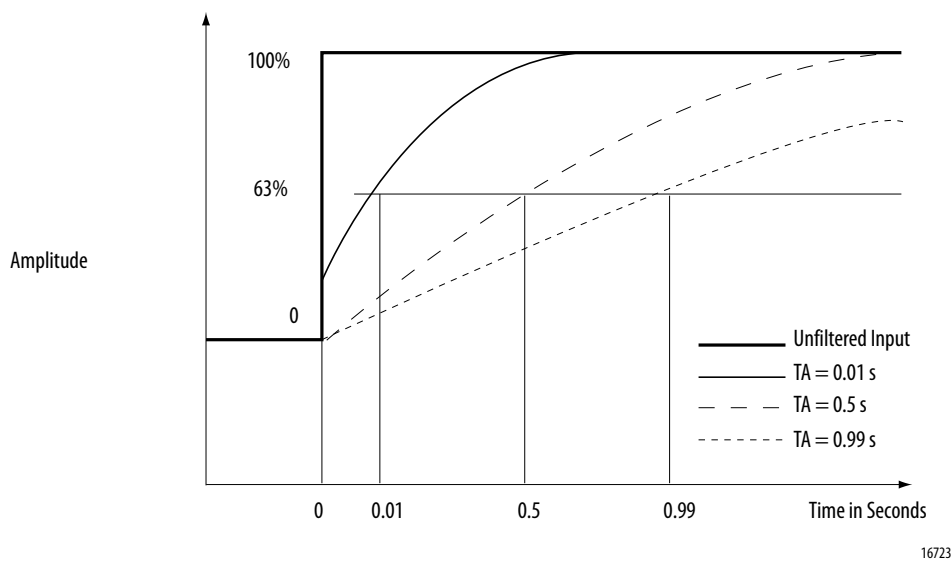
Δt = module channel update time (seconds)

T_A = digital filter time constant (seconds)

X_n = present input, unfiltered PV

Using a step input change to illustrate the filter response, as shown in [Figure 7](#), 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.

Figure 7 - Filter Response



To see how to set the digital filter, see [page 77](#).

Process Alarms

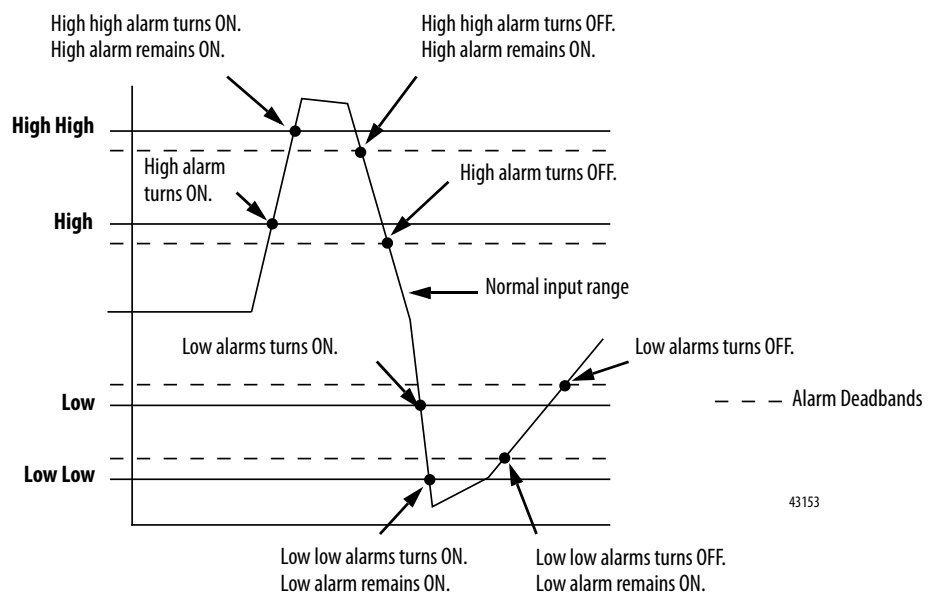
Process alarms (configured in engineering units) alert you when the module has exceeded configured high or low limits for **each input channel**. You can latch process alarms. These are set at four user configurable alarm trigger points:

- High high
- High
- Low
- Low low

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

[Figure 8](#) shows input data that sets each of the four alarms at some point during module operation. In this example, Latching is disabled; therefore, each alarm turns OFF when the condition that caused it to set ceases to exist.

Figure 8 - Process Alarms



To see how to set process alarms, see [page 77](#). To see how to set the alarm deadband, see [page 77](#).

Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each input channel** exceeds the specified trigger point for that channel. Values are configured in volts/second (V/s).

EXAMPLE If you set the module to a rate alarm of 10.0V/s, the rate alarm will only trigger if the difference between measured input samples changes at a rate greater than 10.0V/s.

If the module's RTS is 10 ms (sampling new input data every 10 ms) and at time 0, the module measures 5.0V and at time 10 ms measures 5.08V, the rate of change is $(5.08V - 5.0V) / (10 \text{ ms}) = 8.0V/s$. The rate alarm would not set as the change is less than the trigger point of 10.0V/s.

If the next sample taken is 4.9V, the rate of change is $(4.9V - 5.08V)/(10 \text{ ms}) = -18.0V/s$. The absolute value of this result is $> 10.0V/s$, 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 positive or negative.

To see how to set the rate alarm, see [page 77](#).

Synchronize Module Inputs

With the Synchronize Module Inputs feature, you can synchronize the sampling of inputs across multiple high-speed analog I/O modules in the same chassis, allowing those inputs to sample simultaneously within 100 μ s of each other. This feature lets multiple modules synchronize the start of their RTS scans, enabling their inputs to take a snapshot of an application at that user-defined interval.

For example, if you have 12 input devices connected to inputs on three high-speed analog I/O modules in the same ControlLogix chassis, you may need a snapshot of the input data available at each input terminal at a single moment in time.

While setting the RTS to the same value on all 3 modules guarantees that each module samples at the same rate, it does not guarantee that they will sample at the same time. When enabled, the Synchronize Module Inputs feature provides each module a synchronized starting point for its respective RTS scans. Because the RTS values are the same, the inputs on the modules are sampled at the same rate **and** the same time.

To use this feature, the multiple high-speed analog I/O modules must have the following:

- CST backplane master configured for the chassis, such as a controller or 1756-SYNCH module
- Same RTS rate
- Synchronize Module Inputs feature enabled (see [page 77](#))

The initial sample is delayed to synchronize with other modules, but then each module samples its input channels at the appropriate RTS interval. For example, the first sample is delayed to synchronize with the sampling of the other modules. The delay is 1 to 2 RTS worth of time. If you use an RTS = 10 ms, the first sample delays an extra 10...20 ms to achieve synchronization.

IMPORTANT When Synchronize Module Inputs is enabled, the inputs across multiple modules will be synchronized within 100 mS of each other, regardless of the RTS rate.

Features Specific to Module Outputs

The following features are specific to high-speed analog I/O module outputs:

- [Multiple Output Ranges](#)
- [Ramping/Rate Limiting](#)
- [Hold for Initialization](#)
- [Open Wire Detection—Current Mode Only](#)
- [Clamping/Limiting](#)
- [Clamp/Limit Alarms](#)
- [Output Data Echo](#)

Multiple Output Ranges

You can select from a series of operational ranges for **each output channel** on your module. The range designates the minimum and maximum signals that are detectable by the module. The following output ranges are available on the high-speed analog I/O module:

- -10...10V
- 0...20 mA

To see how to choose an output range for your module, see [page 77](#).

You must wire the module differently, depending on what operating mode (current or voltage) you plan to use. For an example of how to wire the module, see [page 63](#).

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.
- **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 communication 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 ramping and set the maximum ramp rate, see [page 78](#).

Hold for Initialization

Hold for Initialization causes outputs to hold their 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 hold when any of the three conditions occur:

- Initial connection is established after powerup.
- A new connection is established after a communication fault occurs.
- There is a transition to Run mode from Program state.

To see how to set the Hold for Initialization, see [page 77](#).

Open Wire Detection—Current Mode Only

This feature detects when current flow is not present at any output channel. At least 0.1 mA 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 49](#).

IMPORTANT This feature is only active with the 0...21 mA output range.

Clamping/Limiting

Clamping limits the data from an output so that it remains in 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. Clamping alarms can be disabled or latched on a per channel basis.

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 only applies 8V to its screw terminals.

To see how to set the clamping limits, see [page 78](#).

Clamp/Limit Alarms

The Clamp/Limit Alarms feature works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies the configured clamping limit value and sends a status bit to the controller notifying it that the value sent exceeds the clamping limits (limit alarms).

For example, 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.

To see how to set the output alarms, see [page 78](#).

Output Data Echo

Output Data Echo automatically multicasts channel data values that represent the analog signals applied to the module's screw terminals at that time. Fault and status data are also sent.

Fault and Status Reporting

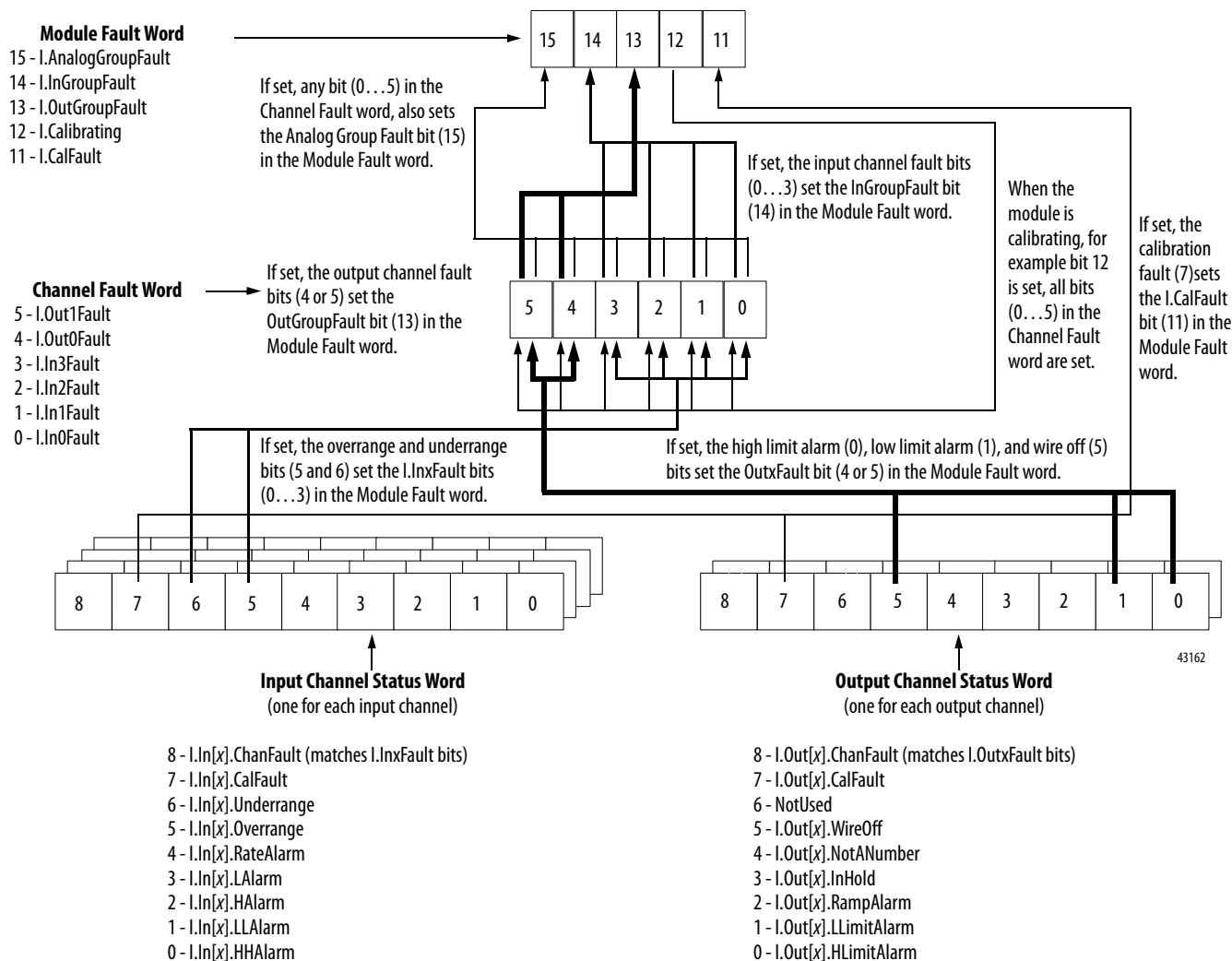
The ControlLogix high-speed analog I/O module multicasts status/fault data to the owner/listening controller with its channel data. The fault data is arranged so that users can choose the level of granularity they desire for examining fault conditions.

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

- **Module Fault word**—Provides fault summary reporting.
- **Channel Fault word**—Provides notification that a fault has occurred on individual channels.
- **Channel Status word (one for input and one for output channels)**—Provides notification of specific types of faults occurring on individual channels.

Figure 9 provides an overview of the fault reporting process in the ControlLogix high-speed analog I/O module.

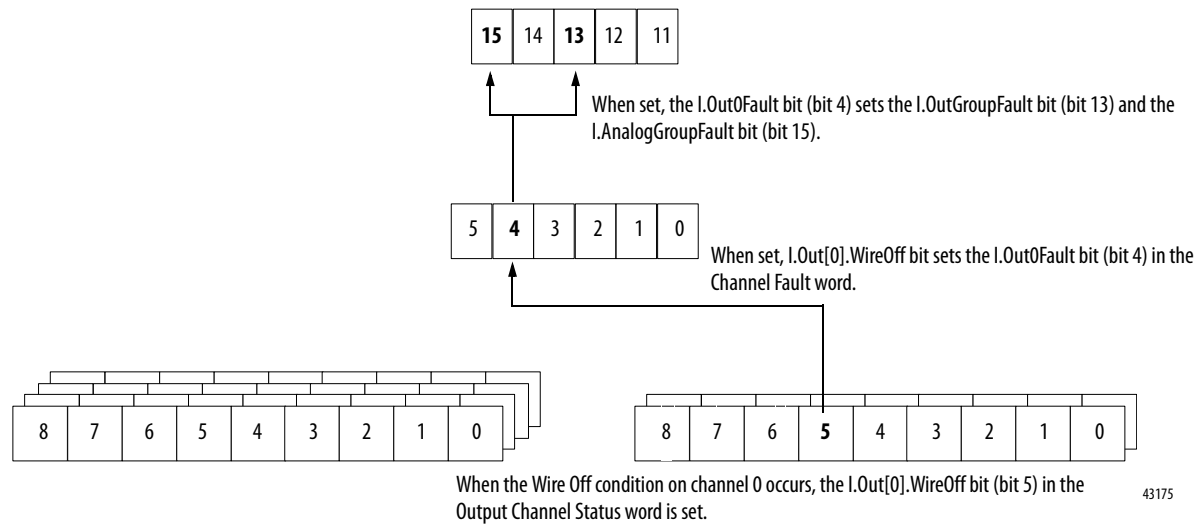
Figure 9 - Fault Reporting



Fault Reporting Example

Figure 10 shows an example of what bits are set when a ControlLogix high-speed analog I/O module reports a Wire Off condition on output channel 0. Three events occur, beginning in the Output Channel Status word.

Figure 10 - Fault Reporting for Wire Off Condition



The following sections provide a listing and explanation of the bits included in each of the module’s fault reporting words.

Module Fault Word Bits

Table 8 defines the Module Fault word bits.

Table 8 - Module Fault Word Bit Descriptions

Bit	Name	Description
Bit 15	I.AnalogGroupFault	Bit is set when any of the bits in the Channel Fault word are set.
Bit 14	I.InGroupFault	Bit is set when any of the input channel fault bits in the Channel Fault word are set.
Bit 13	I.OutGroupFault	Bit is set when any of the output channel fault bits in the Channel Fault word are set.
Bit 12	I.Calibrating	Bit is set when any of the module’s channels are being calibrated. When this bit is set, all used bits in the Channel Fault word are set.
Bit 11	I.CalFault	Bit is set when an individual channel calibration fault bit, such as I.In[0].CalFault, is set.

Channel Fault Word Bits

[Table 9](#) defines the Channel Fault word bits.

Table 9 - Channel Fault Word Bit Descriptions

Bit	Name	Description
Bit 5	I.Out1Fault	Bit is set if any of the following events occurs: <ul style="list-style-type: none"> • The module is being calibrated. • A communication fault occurs between the module and its owner-controller. • Wire off condition exists on output channel 1. • Low limit alarm is set on output channel 1. • High limit alarm is set on output channel 1.
Bit 4	I.Out0Fault	Bit is set if any of the following events occurs: <ul style="list-style-type: none"> • The module is being calibrated. • A communication fault occurs between the module and its owner-controller. • Wire off condition exists on output channel 0. • Low limit alarm is set on output channel 0. • High limit alarm is set on output channel 0.
Bit 3	I.In3Fault	Bit is set if any of the following events occurs: <ul style="list-style-type: none"> • The module is being calibrated. • A communication fault occurs between the module and its owner-controller. • An underrange condition exists on input channel 3. • An overrange condition exists on input channel 3.
Bit 2	I.In2Fault	Bit is set if any of the following events occurs: <ul style="list-style-type: none"> • The module is being calibrated. • A communication fault occurs between the module and its owner-controller. • An underrange condition exists on input channel 2. • An overrange condition exists on input channel 2.
Bit 1	I.In1Fault	Bit is set if any of the following events occurs: <ul style="list-style-type: none"> • The module is being calibrated. • A communication fault occurs between the module and its owner-controller. • An underrange condition exists on input channel 1. • An overrange condition exists on input channel 1.
Bit 0	I.In0.Fault	Bit is set if any of the following events occurs: <ul style="list-style-type: none"> • The module is being calibrated. • A communication fault occurs between the module and its owner-controller. • An underrange condition exists on input channel 0. • An overrange condition exists on input channel 0.

Input Channel Status Word Bits

[Table 10](#) defines the Input Channel Status word bits.

Table 10 - Input Channel Status Word Bit Description

Bit	Name	Description
Bit 8	I.In[x].ChanFault	This bit matches the state of I.InxFault bits (0-3) in the Channel Fault word, except when a communication fault occurs. If a communication fault occurs between the module and its owner-controller, the I.InxFault bit is set but this bit is not set. Bit is set if one of the following events occurs: <ul style="list-style-type: none"> • The module is being calibrated. • An underrange condition exists on input channel. • An overrange condition exists on input channel.
Bit 7	I.In[x].CalFault	Bit is set if an error occurs, and is not corrected, during calibration for that channel.
Bit 6	I.In[x].Underrange	Bit is set when the input signal at the channel is less than or equal to the minimum detectable signal.
Bit 5	I.In[x].Overrange	Bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal.
Bit 4	I.In[x].RateAlarm	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.
Bit 3	I.In[x].LAlarm	Bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the limit. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains set as long as the signal remains within the configured deadband.
Bit 2	I.In[x].HAlarm	Bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the limit. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains set as long as the signal remains within the configured deadband.
Bit 1	I.In[x].LLAlarm	Bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the limit. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband.
Bit 0	I.In[x].HHAlarm	Bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the limit. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband.

Output Channel Status Word Bits

[Table 11](#) defines the Output Channel Status word bits.

Table 11 - Output Channel Status Word Bit Descriptions

Bit	Name	Description
Bit 8	I.Out[x].ChanFault	This bit matches the state of I.OutxFault bits (4 & 5) in the Channel Fault word, except when a communication fault occurs. If a communication fault occurs between the module and its owner-controller, the I.OutxFault bit is set but this bit is not set. Bit is set if one of the following events occurs: <ul style="list-style-type: none"> The module is being calibrated. Low limit alarm is set on the output channel. High limit alarm is set on the output channel.
Bit 7	I.Out[x].CalFault	Bit is set if an error occurs, and is not corrected, during calibration for that channel.
Bit 5	I.Out[x].WireOff	Bit is set only if the configured Output Range is 0...20 mA, and the circuit becomes open due to a wire falling or being cut when the output being driven is above 0.1 mA. The bit will remain set until correct wiring is restored.
Bit 4	I.Out[x].NotANumber	Bit is set when the output value received from the controller is not a number (the IEEE NAN value). In this case, the output channel holds its last state.
Bit 3	I.Out[x].InHold	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.
Bit 2	I.Out[x].RampAlarm	Bit is set when the output channel's requested rate of change would exceed the configured maximum ramp rate. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it remains set until it is unlatched.
Bit 1	I.Out[x].LLimitAlarm	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 remains set until it is unlatched.
Bit 0	I.Out[x].HLimitAlarm	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 remains set until it is unlatched.

Notes:

Install the Module

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Assemble the Removable Terminal Block and the Housing	66
Install the Removable Terminal Block onto the Module	67
Remove the Removable Terminal Block from the Module	68
Remove the Module from the Chassis	69



ATTENTION: Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and may not provide adequate protection to radio communication services in such environments.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#), for additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations.	Informations sur l'utilisation de cet équipement en environnements dangereux.
<p>Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.</p>	<p>Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.</p>
<div data-bbox="164 556 258 640" data-label="Image"> </div> <p>WARNING: EXPLOSION HAZARD</p> <ul style="list-style-type: none"> Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. Substitution of components may impair suitability for Class I, Division 2. If this product contains batteries, they must only be changed in an area known to be nonhazardous. 	<p>WARNING: RISQUE D'EXPLOSION</p> <ul style="list-style-type: none"> Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. S'assurer que l'environnement est classé non dangereux avant de changer les piles.

European Hazardous Location Approval

The following applies when the product bears the Ex Marking.

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.



ATTENTION: This equipment is not resistant to sunlight or other sources of UV radiation.

**WARNING:**

- This equipment shall be mounted in an ATEX certified enclosure with a minimum ingress protection rating of at least IP54 (as defined in IEC60529) and used in an environment of not more than Pollution Degree 2 (as defined in IEC 60664-1) when applied in Zone 2 environments. The enclosure must utilize a tool removable cover or door.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 140% of the rated voltage when applied in Zone 2 environments.
- This equipment must be used only with ATEX certified Allen-Bradley® backplanes.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

Install the Module

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



WARNING: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.



WARNING: When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations.

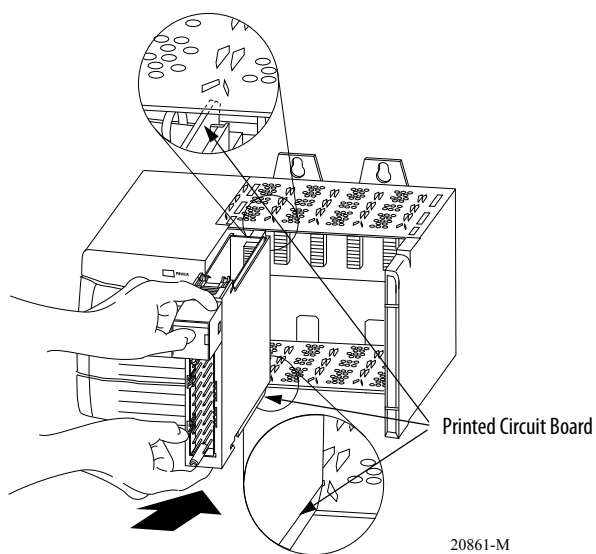
Be sure that power is removed or the area is nonhazardous before proceeding.

**ATTENTION: Prevent Electrostatic Discharge**

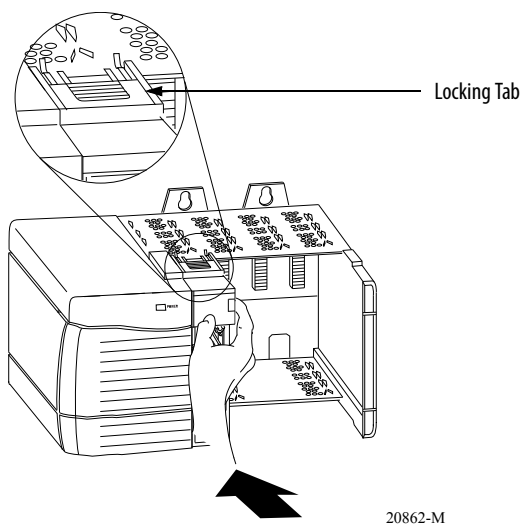
This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

1. Align the circuit board with the top and bottom chassis guides.



2. Slide the module into the chassis until module tabs click.

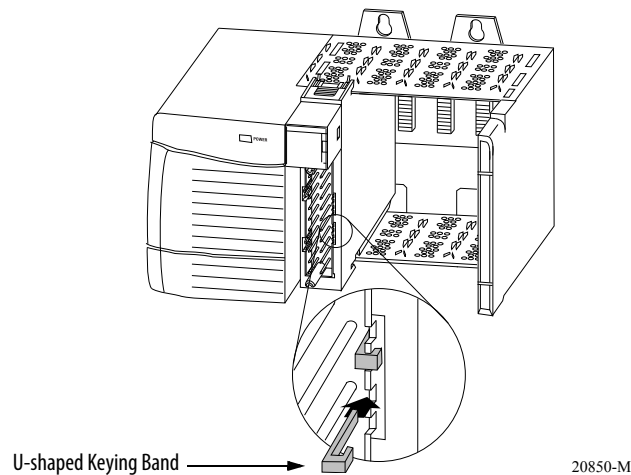


Key the Removable Terminal Block

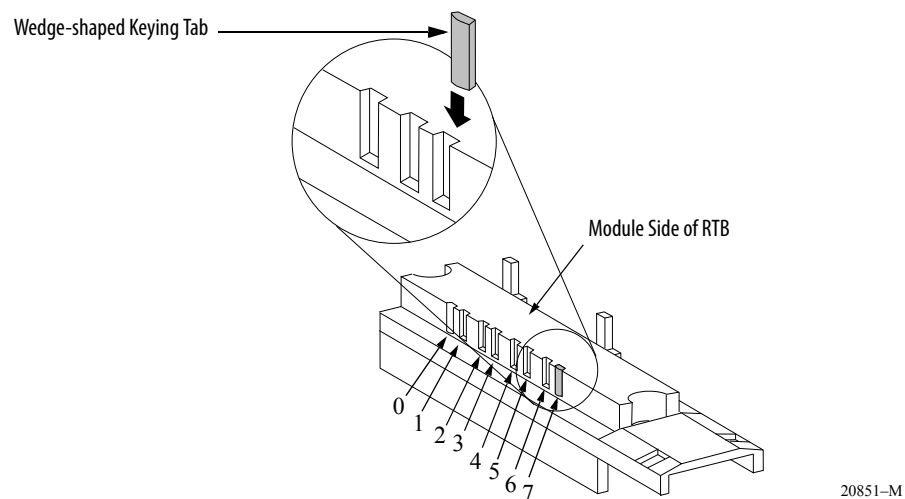
Wedge-shaped keying tabs and U-shaped keying bands came with your RTB to prevent connecting the wrong wires to your module.

Key positions on the module that correspond to unkeyed positions on the RTB. For example, if you key the first position on the module, leave the first position on the RTB unkeyed.

1. Insert the U-shaped band as shown.



2. Push the band until it snaps in place.
3. Insert the wedge-shaped tab with rounded edge first.



4. Push the tab until it stops.

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

Connect the Wiring

You can use an RTB or a Bulletin 1492 prewired Interface Module (IFM) to connect wiring to your module. 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 67](#).

If you are using an RTB, connect wiring as directed below. We recommend you use Belden 8761 cable to wire the RTB. The RTB terminations can accommodate 22...14 AWG shielded wire.

Before wiring the RTB, you must connect ground wiring.



WARNING: If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.



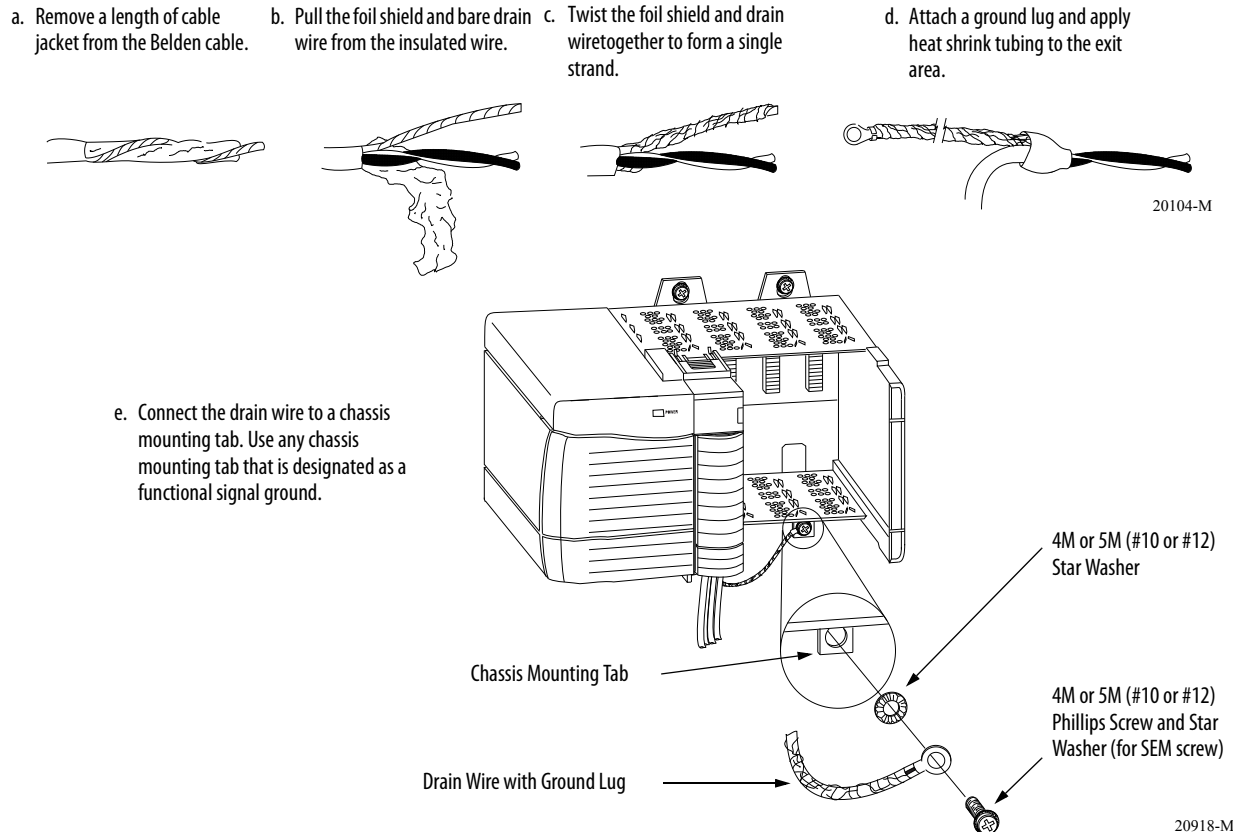
ATTENTION: When using the 1756-TBCH RTB, do not wire more than two 0.33...1.3 mm² (22...16 AWG) conductors on any single terminal. Use only the same size wires with no intermixing of solid and stranded wire types.

When using the 1756-TBS6H RTB, do not wire more than one conductor on any single terminal.

Connect the 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.

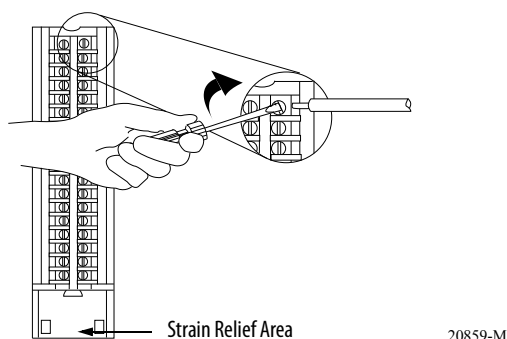
Two Types of RTBs (each RTB comes with housing)



ATTENTION: The ControlLogix system has been agency certified using only the ControlLogix RTBs (catalog numbers 1756-TBCH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods may require application specific approval by the certifying agency.

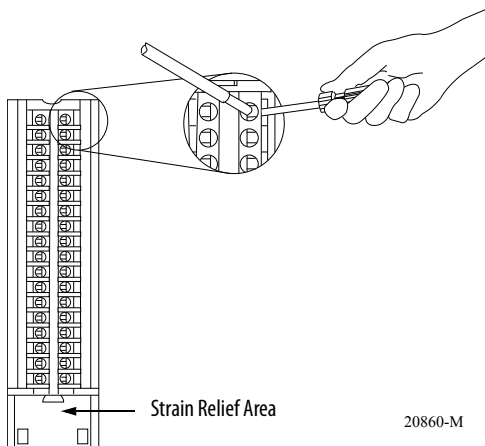
Cage Clamp - Catalog Number 1756-TBCH

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



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

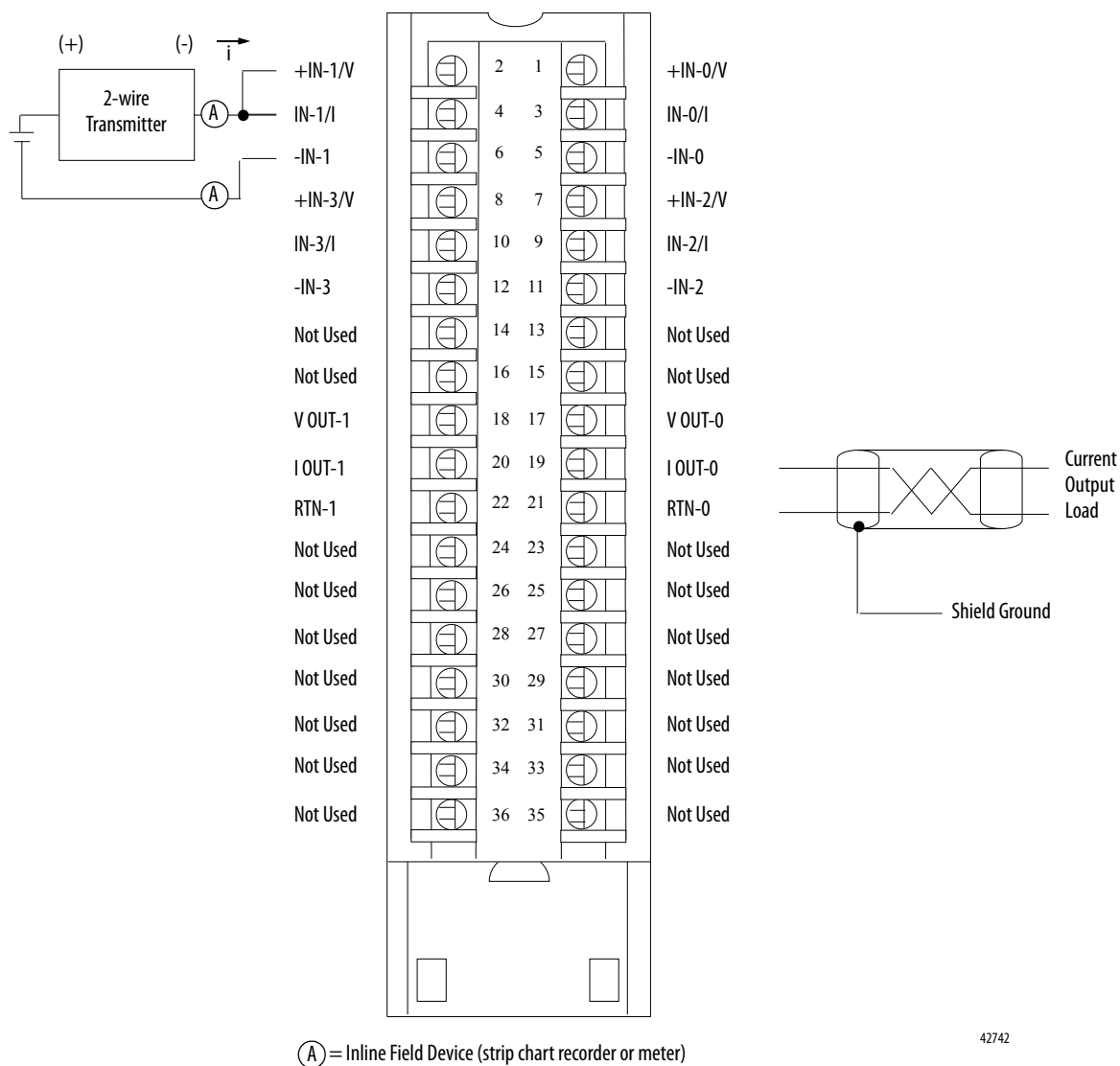
We recommend you follow these guidelines when wiring your RTB.

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 (catalog number 1756-TBE) for applications that require heavy gauge wiring.

Wire the Module

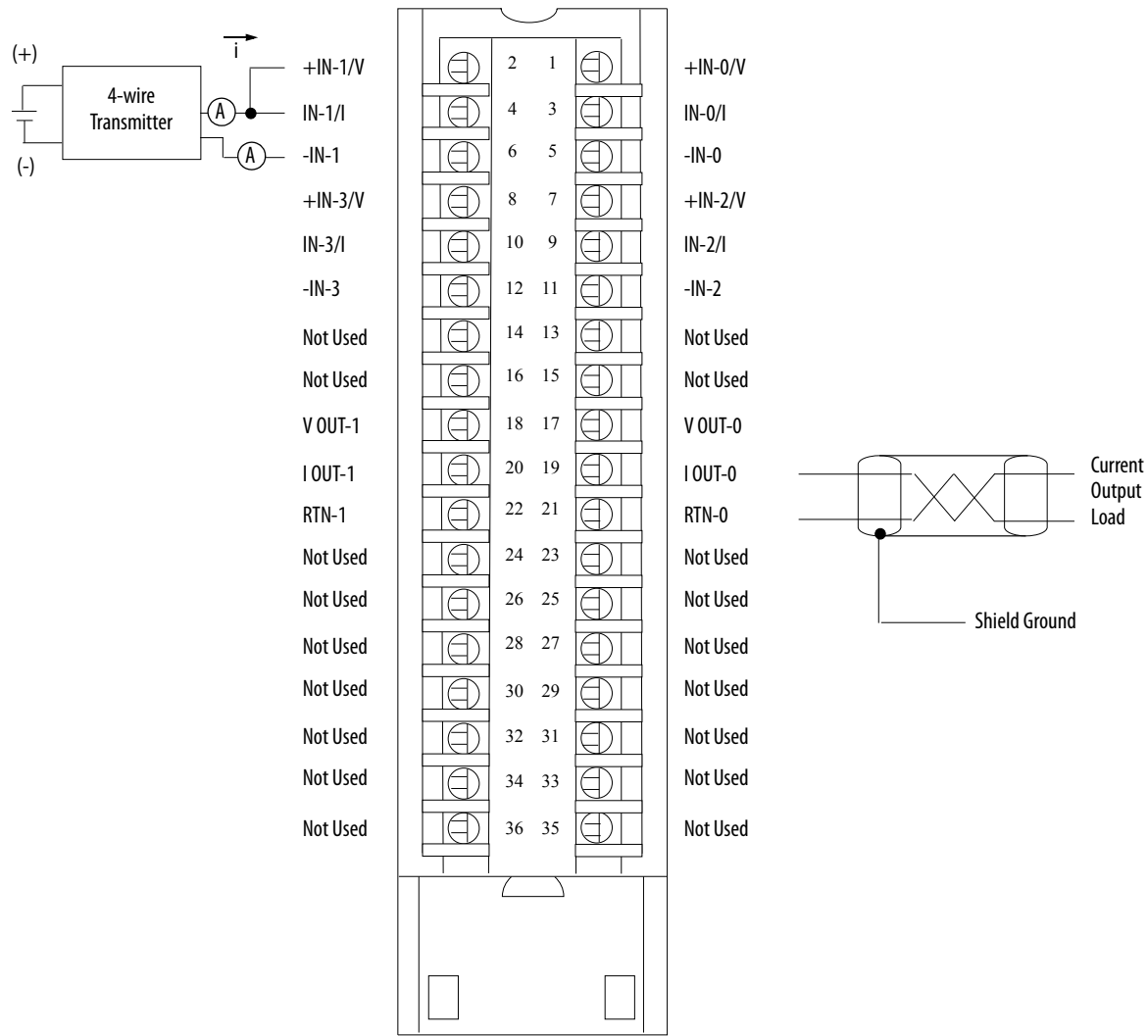
Use the wiring diagrams below to wire your ControlLogix high-speed analog I/O module.

Figure 11 - 1756-IF4FX0F2F Current Mode Wiring Diagram



42742

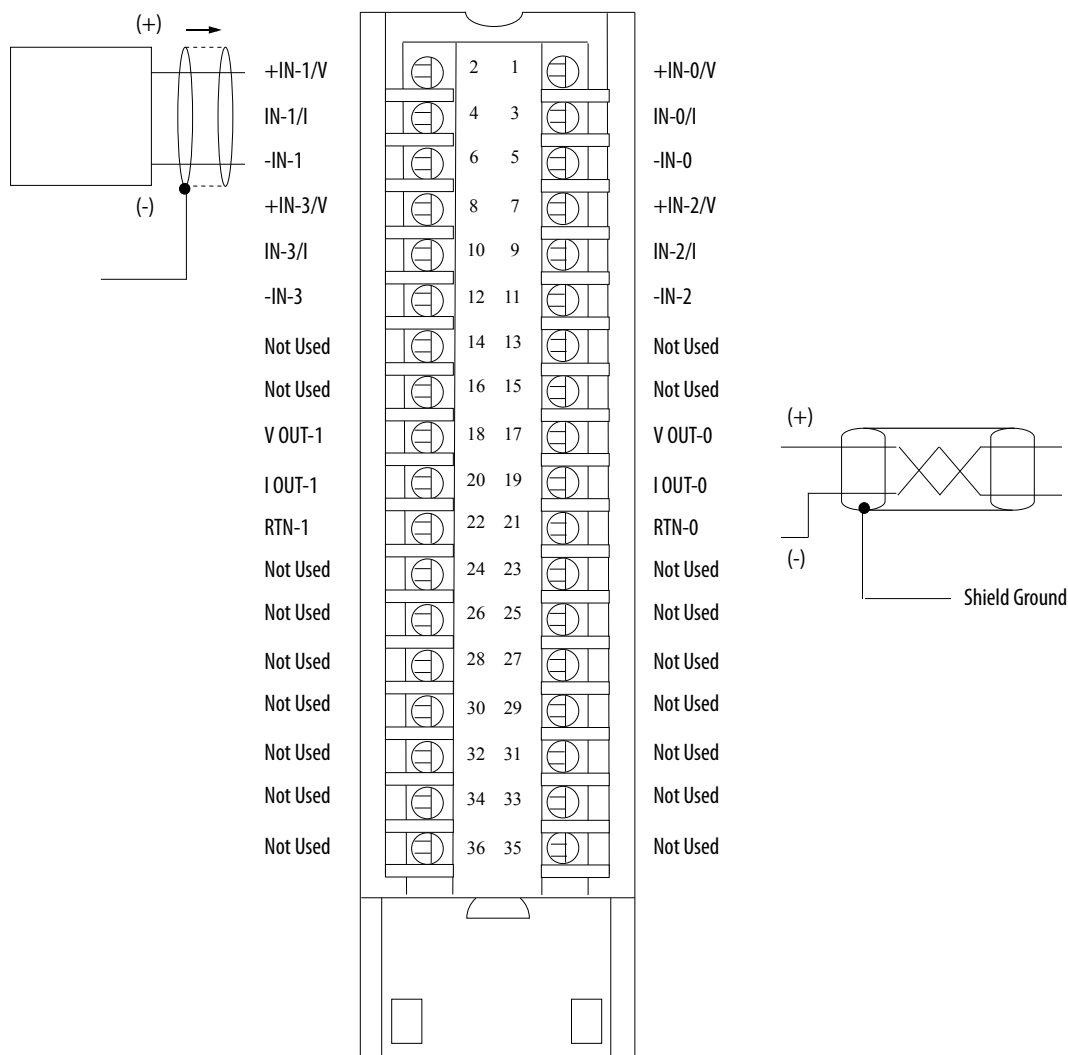
Figure 12 - 1756-IF4FX0F2F Current Mode Wiring Diagram



(A) = Inline Field Device (strip chart recorder or meter)

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Figure 13 - 1756-IF4FX0F2F Voltage Mode Wiring Diagram

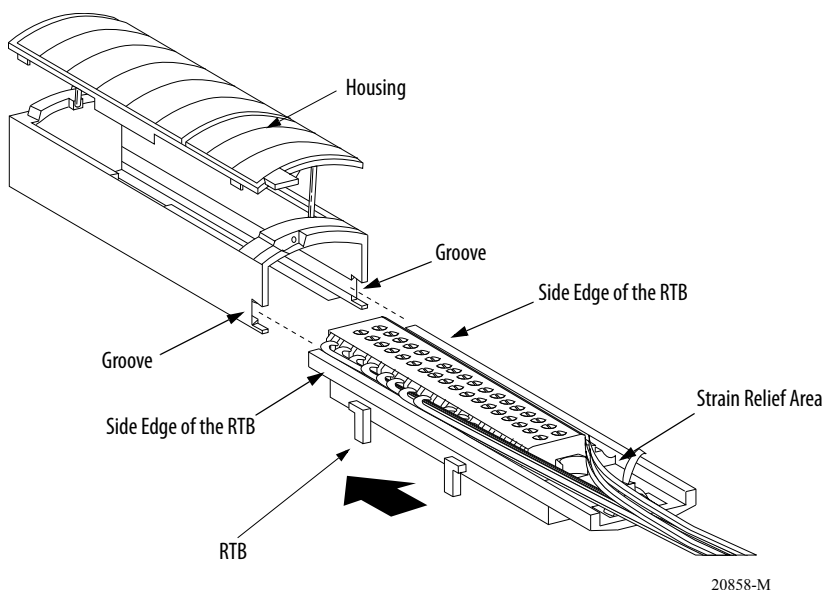


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Assemble the Removable Terminal Block and the Housing

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.



IMPORTANT If additional wire routing space is required for your application, use extended-depth housing, catalog number 1756-TBE.

Install the Removable Terminal Block onto the Module

Install the RTB onto the module to connect wiring.



ATTENTION: Be sure that power is removed or the area is nonhazardous before proceeding.

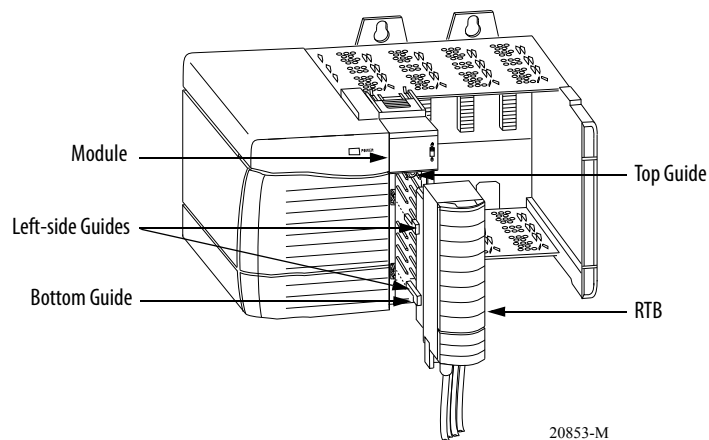


WARNING: When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations.

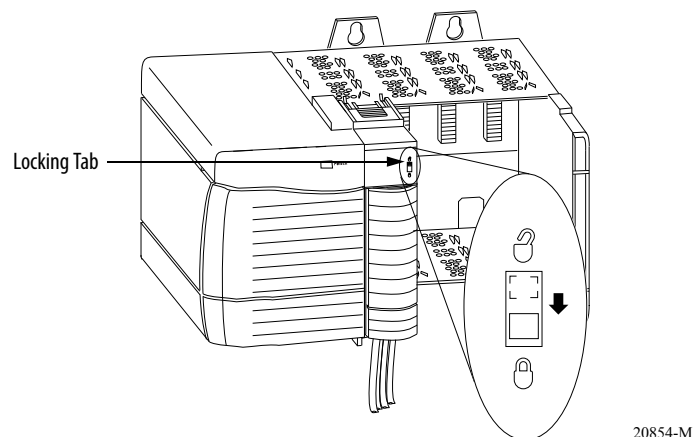
Before installing the RTB, make sure of the following:

- The 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 on 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.

Remove 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.



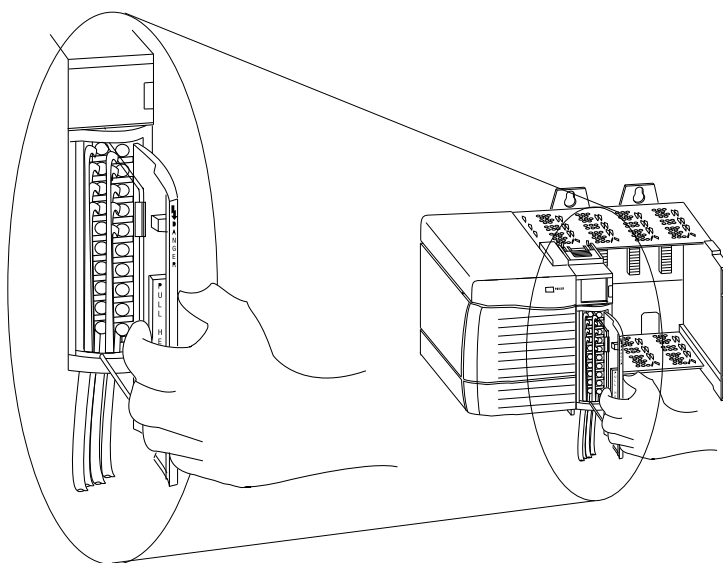
ATTENTION: Be sure that power is removed or the area is nonhazardous before proceeding.



WARNING: When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations.

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.

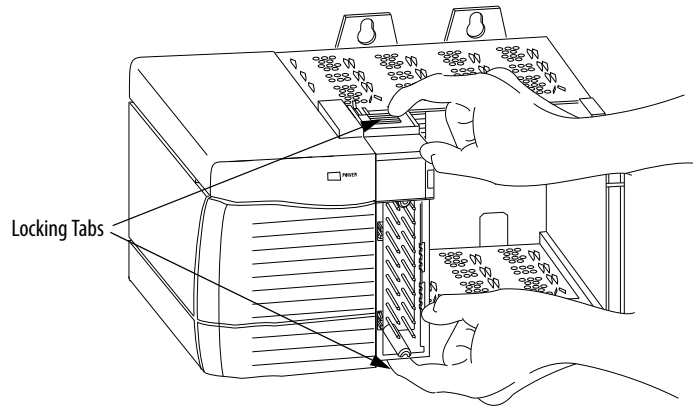
IMPORTANT Do not wrap your fingers around the entire door. A shock hazard exists.



20855-M

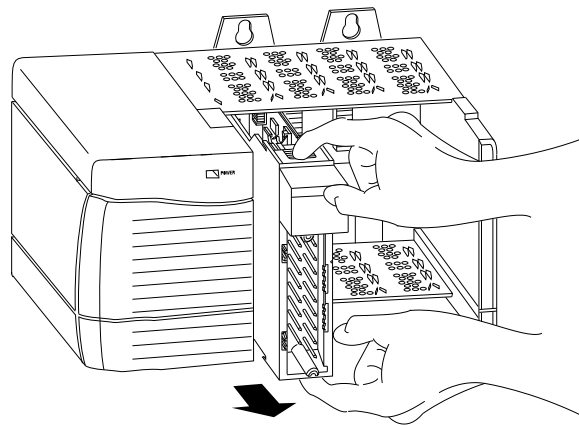
Remove the Module from the Chassis

1. Push in the top and bottom locking tabs.



20856-M

2. Pull module out of the chassis.



20857-M

Notes:

Configure the Module

Topic	Page
Overview of the Configuration Process	72
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Use the Default Configuration	75
Alter the Default Configuration	76
Download New Configuration Data	79
Edit the Configuration	80
Reconfigure Module Parameters in Run Mode	81
Reconfigure Module Parameters in Program Mode	82
View and Change Module Tags	83

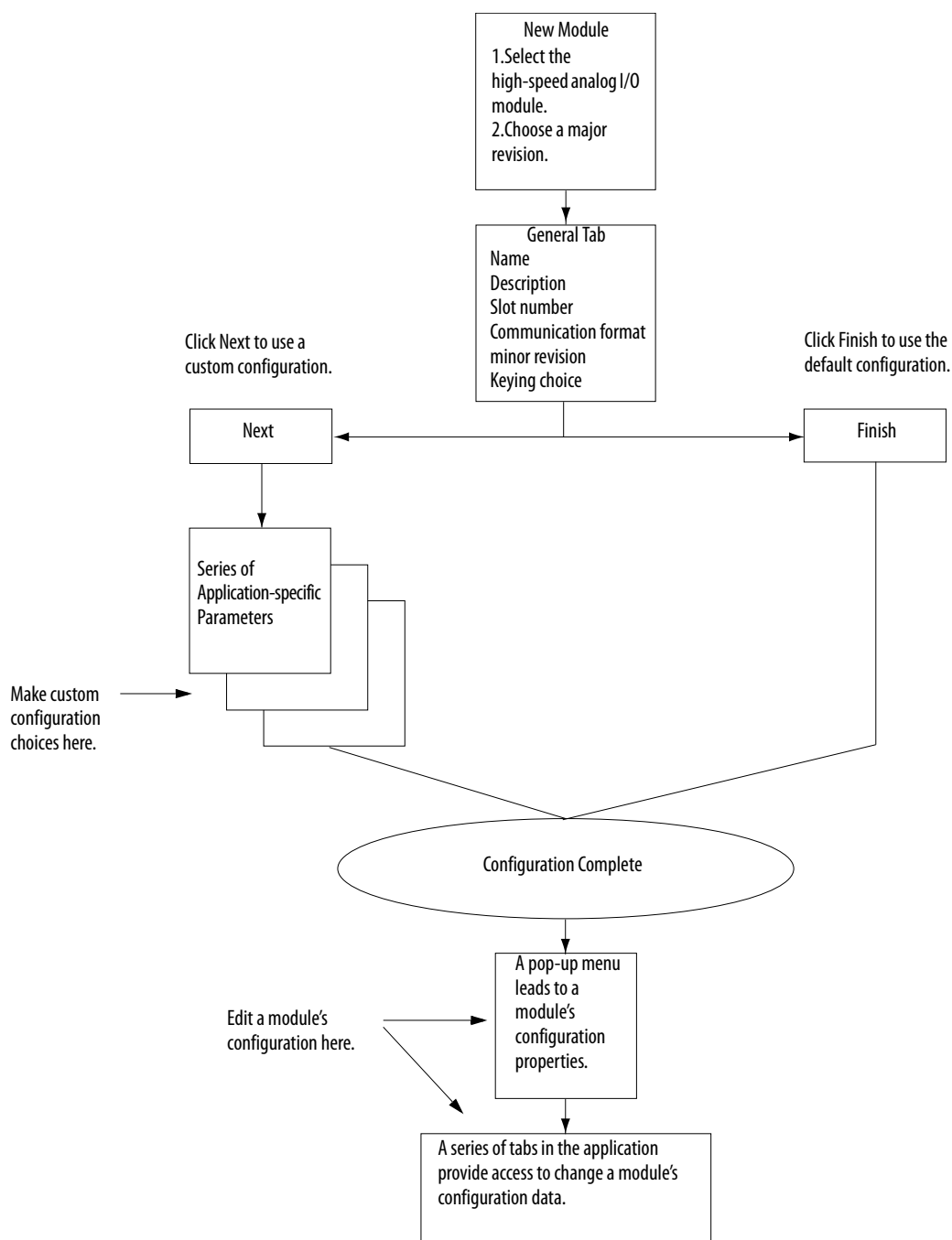
You must configure your module upon installation. The module does not work until it has been configured.

IMPORTANT This chapter focuses on configuring high-speed analog I/O modules in a local chassis. To configure high-speed analog I/O modules in a remote chassis, see [Appendix E](#).

Use the Logix Designer application to configure your ControlLogix high-speed analog I/O module. You can accept the default configuration for your module or specify a custom, point-level configuration specific to your application.

Overview of the Configuration Process

The following diagram shows an overview of the configuration process.

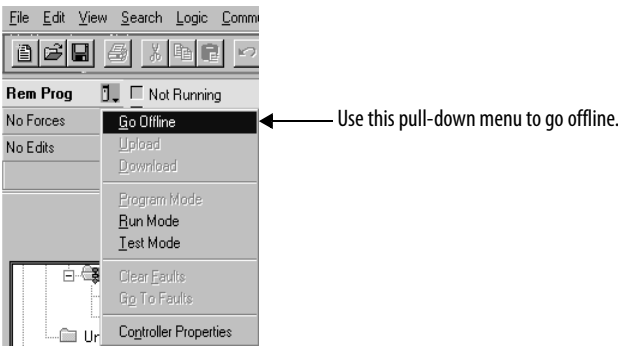


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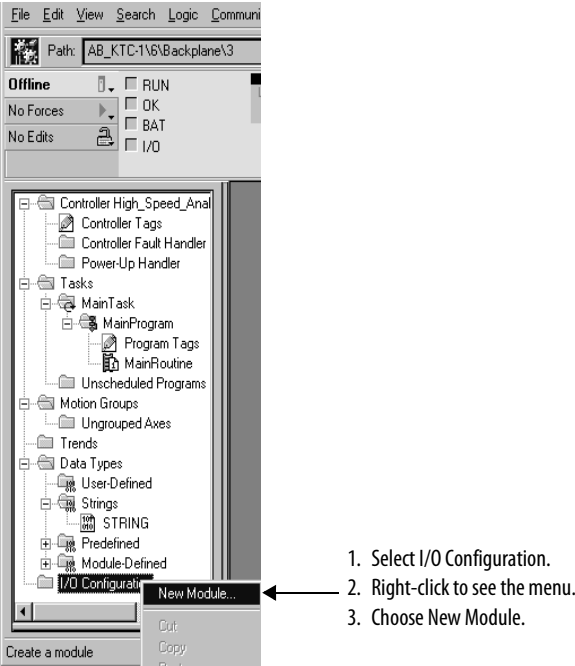
Create a New Module

After you have started the application and created a controller project, you must create a new module. The wizard lets you create a new module and configure it.

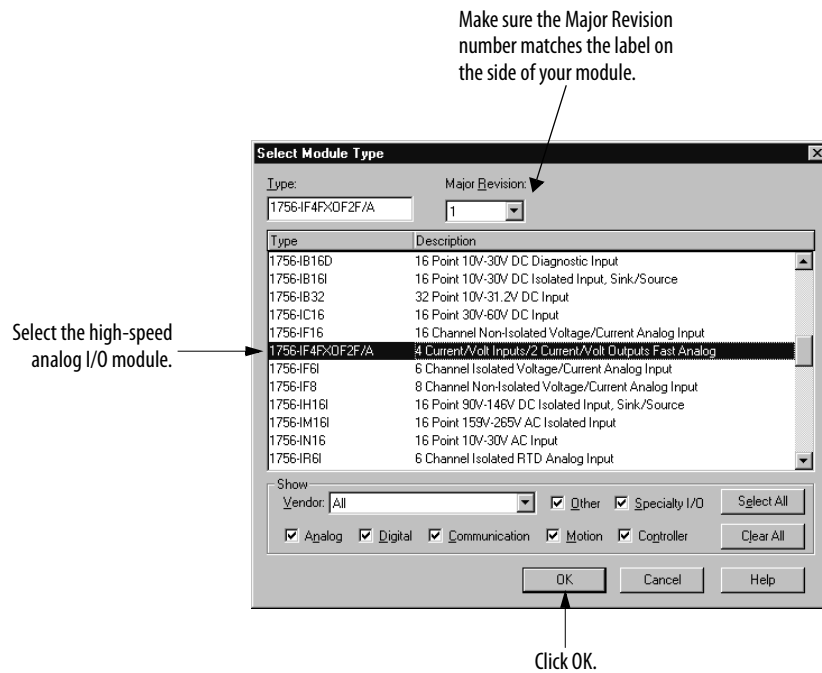
IMPORTANT You must be offline when you create a new module.



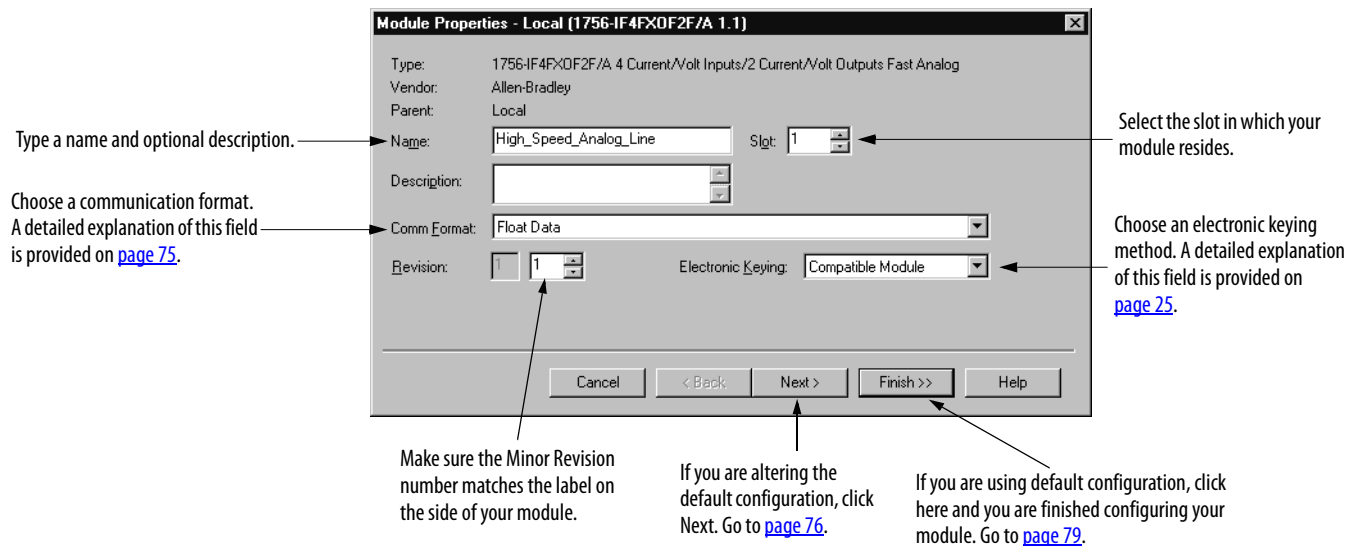
When you are offline, you must select a new module.



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



You enter the wizard on a naming page.



Communication Format

The communication format determines the following:

- Available configuration options
- Type of data transferred between the module and its owner-controller
- Tags that are generated when the configuration is complete
- Connection between the controller writing configuration and the module itself

[Table 12](#) lists the possible communication format choices. In addition to the description below, each format returns status data and rolling timestamp data.

Table 12 - Communication Formats on the High-speed Analog I/O Module

Format	Definition
Archiving Connection	Module stores 20 input data samples for each channel in the module's on-board buffers before it sends the I/O data to the controller.
Float Data	Module returns floating point data.
CST Timestamped Float Data	Module returns floating point data with the value of the system clock (from its local chassis) when the data is sampled.
Listen-only CST Timestamped Float Data	Module returns floating point data with the value of the system clock from its local chassis when the data is sampled to a controller that does not own the module.
Listen-only Float Data	Module returns floating point data to a controller that does not own the module.

IMPORTANT Once the module is created, the communication 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 following electronic keying options are available:

- Compatible Module
- Disable Keying
- Exact Match

For more information on electronic keying, see [page 25](#).

Use the Default Configuration

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

Alter the Default Configuration

You can specify a custom configuration by modifying a series of parameters on the Module Properties dialog box.

Adjust the requested packet interval ([page 19](#)).

Inhibit ([page 34](#)) the connection to the module.

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, check this checkbox.

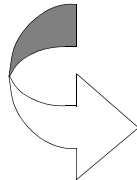
The dialog box shows the following settings:

- Requested Packet Interval (RPI): 2.0 ms (1.0 - 750.0 ms)
- ☐ Inhibit Module
- ☐ Major Fault On Controller If Connection Fails While in Run Mode
- Module Fault: (Empty text box)

Buttons at the bottom: Cancel, < Back, Next >, Finish >>, Help.

This Fault box is empty when you are offline. If a fault occurs while the module is online, the type of fault will be displayed here.

Click Next to proceed.



This information is used during online monitoring, but not initial configuration.

The dialog box shows the following information:

- Identification:
 - Vendor:
 - Product Type:
 - Product Code:
 - Revision:
 - Serial Number:
 - Product Name:
- Status:
 - Major Fault:
 - Minor Fault:
 - Internal State:
 - Configured:
 - Owned:
 - Module Identity:
- Coordinated System Time (CST):
 - Timer Hardware:
 - Timer Sync'd:

Buttons at the bottom: Cancel, < Back, Next >, Finish >>, Help. There are also Refresh and Reset Module buttons.

Click Next to proceed.

Module Properties - Local:1 (1756-IF4FX0F2F/A 1.1)

Choose an input channel. **IMPORTANT:** Set all the parameters for each channel before proceeding.

Set the scaling ([page 36](#)).

Set the RTS rate ([page 18](#)). This setting affects the entire module, not just a single channel. To use sub-millisecond values, type values with a decimal point. For example, to use 800 μ S, type 0.8.

Choose a range for the input ([page 38](#)).

Set the digital filter time ([page 43](#)).

Synchronize module inputs ([page 45](#)).

Click Next to proceed. Click Finish to accept the parameters you have configured for your module.

Module Properties - Local:1 (1756-IF4FX0F2F/A 1.1)

Choose an input channel. **IMPORTANT:** Set all the parameters for each channel before proceeding.

Set process alarms ([page 44](#)).

During module operation, the Unlatch buttons are enabled, once set. Click the button to unlatch alarms.

Disable all alarms.

Latch process alarms ([page 44](#)).

Latch the rate alarm ([page 45](#)).

Set the deadband ([page 44](#)).

Set the rate alarm ([page 45](#)).

Click Next to proceed. Click Finish to accept the parameters you have configured for your module.

Module Properties - Local:1 (1756-IF4FX0F2F/A 1.1)

Choose an output channel. **IMPORTANT:** Set all the parameters for each channel before proceeding.

Set the scaling ([page 36](#)).

Choose a range for the output ([page 46](#)).

If necessary, enable Hold for Initialization ([page 47](#)).

Click Next to proceed. Click Finish to accept the parameters you have configured for your module.

Module Properties - Local:1 (1756-IF4FX0F2F/A 1.1)

Channel: 0 1 Ramp Rate: 0.00 per Sec

Output State in Program Mode

- ☒ Hold Last State
- ☐ User Defined Value: []
- ☐ Ramp to User Defined Value

Output State in Fault Mode

- ☒ Hold Last State
- ☐ User Defined Value: []
- ☐ Ramp to User Defined Value

Communications Failure
When communications fail in Program Mode:

- ☒ Leave outputs in Program Mode state
- ☐ Change outputs to Fault Mode state

Buttons: Cancel < Back Next > Finish >> Help

Module Properties - Local:1 (1756-IF4FX0F2F/A 1.1)

Channel: 0* 1

Limits:

High Clamp: 10 Unlatch

Low Clamp: -10 Unlatch

☒ Ramp in Run Mode per Sec

Ramp Rate: 0.0 Unlatch

Alarms:

- ☐ Disable All Alarms
- ☐ Latch Limit Alarms
- ☐ Latch Rate Alarm

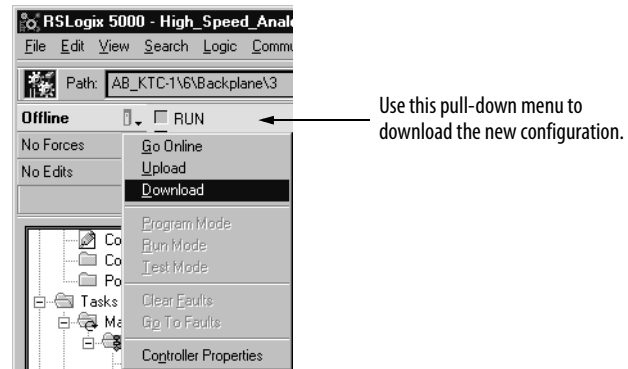
Buttons: Cancel < Back Next > Finish >> Help

Annotations:

- Choose an output channel.
- IMPORTANT:** Set all the parameters for each channel before proceeding.
- Set the Program mode output state. If you click User Defined Value, you must type a value in the box. You can also choose to ramp to the value.
- Set the output state in Fault mode.
- Set the output state if communication fails in Program mode.
- Click Next to proceed.
- Click Finish to accept the parameters you have configured for your module.
- Choose an output channel.
- IMPORTANT:** Set all the parameters for each channel before proceeding.
- Set the clamp limits (page 48). Pay attention to the clamp limits when changing a channel from current to voltage. The software does not automatically account for the mode change. You must also take into account how changes may affect your engineering units.
- If necessary, check the Ramp in Run Mode checkbox (page 47).
- If you check the Ramp in Run Mode checkbox, you must type a ramp rate (page 47).
- Disable all alarms.
- Latch limit alarms (page 48).
- Click Next to proceed.
- Click here to accept the parameters you have configured for your module

Download 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.



The software verifies the download process with the following dialog box.



This completes the download process.

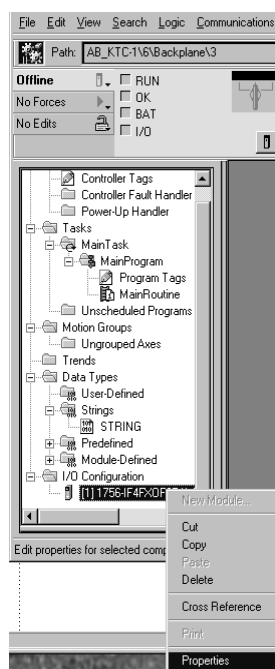
Edit the Configuration

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.

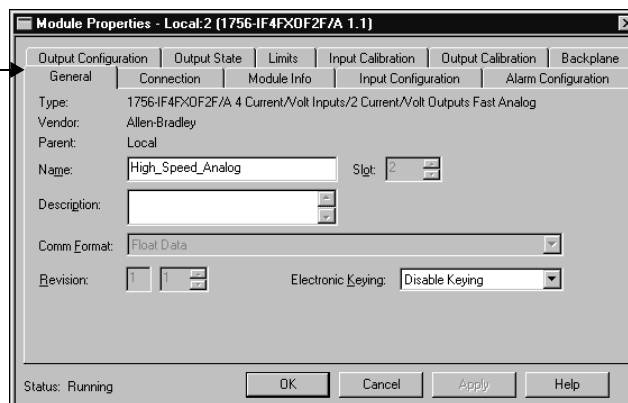
The editing process begins on the main page.



1. Select I/O Configuration.
2. Right-click to see the menu.
3. Choose Properties.

The Module Properties dialog box appears as shown below.

Click the tab associated with the parameters to view or reconfigure.



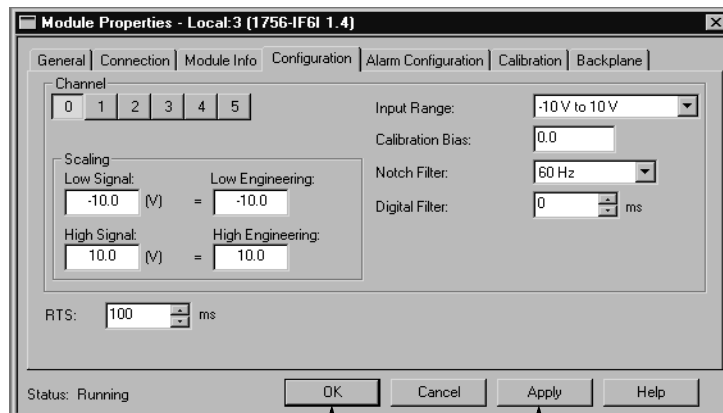
Reconfigure Module Parameters in Run Mode

Your module can operate in Remote Run mode or Run mode. You can change any configurable features that are enabled by the software only 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 example shows the configuration page while the high-speed analog module is in Run mode.

Make the necessary configuration changes. In this example, all configurable features are enabled in Run mode.



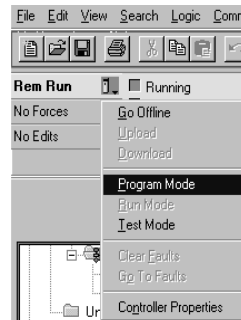
Click OK to transfer the new data and close the dialog box.

Click Apply to transfer the new data and keep the dialog box open.

Reconfigure Module Parameters in Program Mode

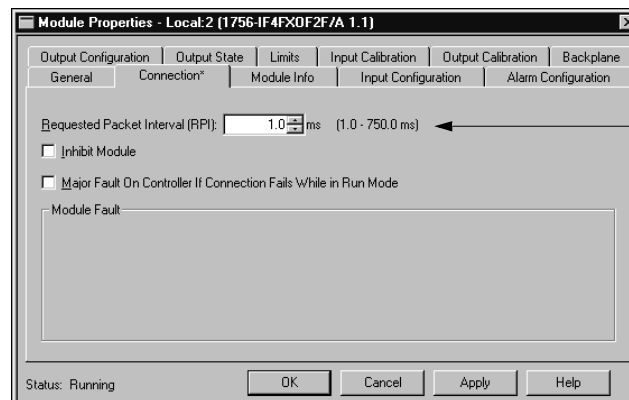
Follow these steps to change configuration in Program mode.

1. Change the module from Run mode to Program mode, if necessary.



Use this pull-down menu to switch to Program mode.

2. Make any necessary changes.

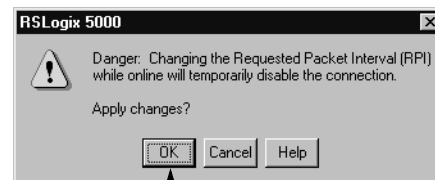


Update the RPI rate.

Click OK to transfer the new data and close the dialog box.

Click Apply to transfer the new data and keep the dialog box open.

Before the RPI rate is updated online, the software verifies your desired change.



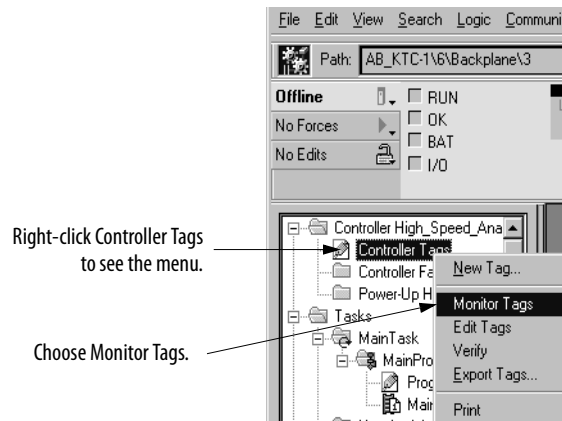
Click OK to confirm the RPI change.

The RPI is changed and the new configuration data is 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.

View and Change Module Tags

When you create a module, the application creates a series of tags in the ControlLogix system that can be viewed in the software's tag editor. 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 the software.



For more information about viewing and changing a module's configuration tags see, [Appendix B](#).

Notes:

Calibrate the Module

Topic	Page
Differences for Each Channel Type	86
Calibrate Input Channels	87
Calibrate Output Channels	90

Your ControlLogix high-speed analog I/O module comes from the factory with a default calibration. Use this chapter to recalibrate your module in the future.

You must add the module to your control program via the Logix Designer application. Also, if you want to calibrate the module outputs, you must configure an output range before calibrating the module.

To see how to add a new module to your program, see [page 73](#).

IMPORTANT	<p>ControlLogix high-speed analog I/O modules allow you to calibrate each channel individually or in groups, such as all inputs at once. Regardless of which option you choose, we recommend you calibrate all channels on your module each time you calibrate. This practice helps you maintain consistent calibration readings and improve module accuracy.</p> <p>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 calculates a linear correction factor between the measured and the ideal.</p> <p>Also, we suggest you plug the module in and let it operate for at least 30 minutes before calibration to allow components to temperature stabilize. The stability helps prevent temperature drift during operation.</p>
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Differences for Each Channel Type

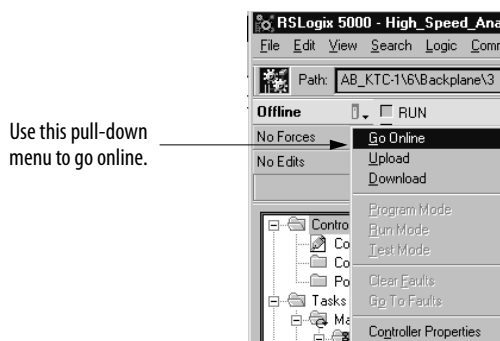
The procedures for calibrating input and output channels on the ControlLogix high-speed analog I/O module vary slightly:

- For input channels, you use a voltage calibrator to send a signal to the module to calibrate it.
- For output channels, you use a digital multimeter (DMM) to measure the signal the module is sending out.

See the recommended instruments to use for each channel below.

Channel Type	Recommended Instrument Ranges
Input	0...10.00V source $\pm 500\mu\text{V}$ voltage
Output	DMM better than 0.3 mV or 0.6 μA

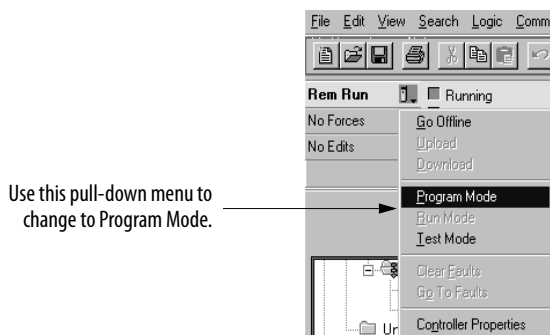
You must be online to calibrate your high-speed analog I/O module.



When you are online, you can choose either Program or Run Mode as your program state during calibration. We recommend that you change your controller to Program mode before beginning calibration.

IMPORTANT

Before beginning calibration, make sure the module is not actively controlling a process. The module freezes the state of each channel and does not update the controller with new data until after calibration ends. This could be hazardous if active control were attempted during calibration.



Calibrate Input Channels

Input calibration requires that you apply reference signals to the module's input channels and then verify the channel status. ControlLogix high-speed analog I/O modules can operate in Current or Voltage mode. For voltage applications, you need to calibrate only the -10...10V range. Calibrating to this range calibrates the module for all other voltage ranges, such as 0...5V.

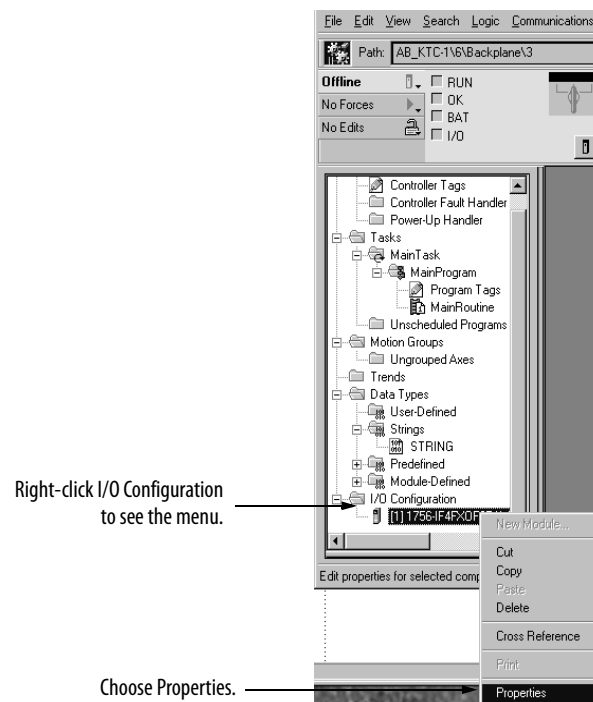
Regardless of mode, when calibrating the module's inputs, you must do the following:

- Apply a low signal to a channel (or group of channels)
- Verify the channel's low signal reference
- Apply a high signal to a channel
- Verify the channel's high signal reference

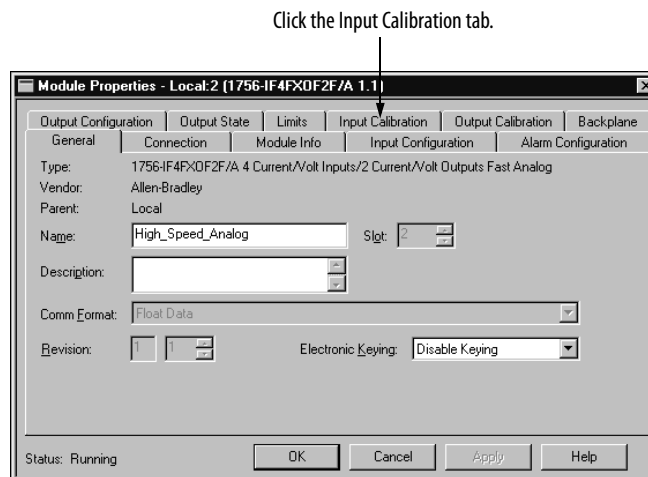
The following example shows calibration of a single input channel. We suggest you calibrate all channels each time you calibrate the module.

To calibrate the high-speed analog module's inputs, follow these steps.

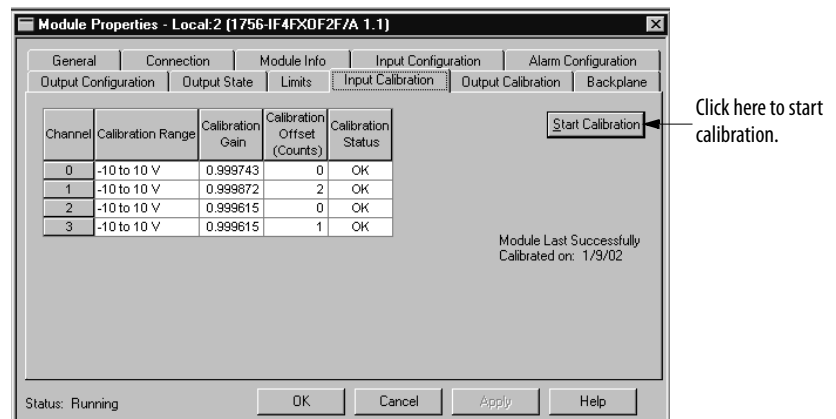
1. Connect your voltage calibrator to the module.
2. Access the module's properties page.



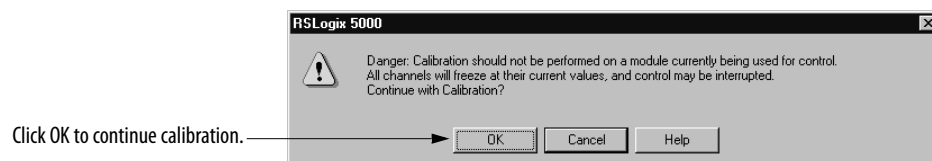
The Module Properties dialog box appears.



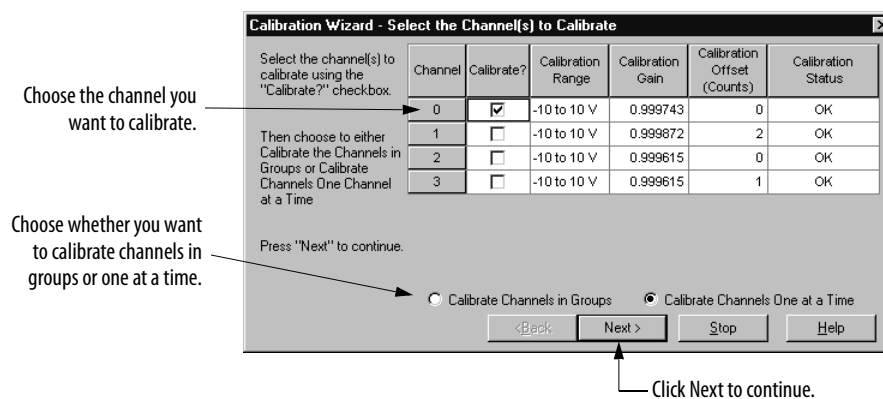
3. On the Input Calibration page, begin calibration.



The software warns you not to calibrate a module currently being used for control.



4. Set the channels to be calibrated.



The low reference parameters appear first. These parameters define which channels will be calibrated for a low reference.

Attach Low Reference signal(s) to indicated channel(s).

Channels: 0

Press "Next" to start calibration.

Channel	Calibrate?	Calibration Range	Low Reference (Volts)
0	<input checked="" type="checkbox"/>	-10 to 10 V	0.00
1	<input type="checkbox"/>		
2	<input type="checkbox"/>		
3	<input type="checkbox"/>		

<Back **Next >** Stop Help

Click Back to return to the previous parameters and make any necessary changes.

Click Next to calibrate the low reference.

5. Apply the calibrator's low reference to the module.

The following example shows the channel status after calibrating for a low reference. If the channels is OK, continue, as shown below. If any channels report an Error, retry until the status is OK.

Press "Next" to go on to High Reference test.

Channel	Calibrate?	Calibration Range	Low Reference (Volts)	Status
0	<input checked="" type="checkbox"/>	-10 to 10 V	0.00	OK
1	<input type="checkbox"/>			
2	<input type="checkbox"/>			
3	<input type="checkbox"/>			

Retry **Next >** Stop Help

Click Next to proceed.

The high reference parameters appear next. These parameters define which channels will be calibrated for a high reference.

Attach High Reference signal(s) to selected channel(s).

Channels: 0

Press "Next" to start calibration.

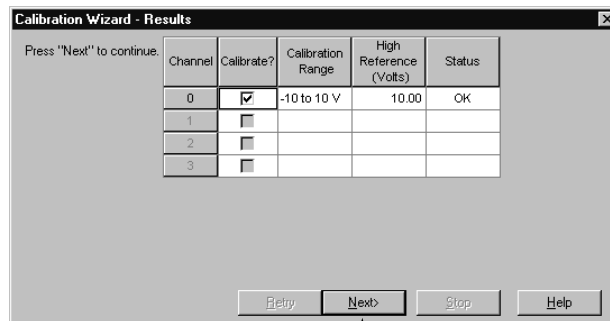
Channel	Calibrate?	Calibration Range	High Reference (Volts)
0	<input checked="" type="checkbox"/>	-10 to 10 V	10.00
1	<input type="checkbox"/>		
2	<input type="checkbox"/>		
3	<input type="checkbox"/>		

<Back **Next >** Stop Help

Click Next to proceed.

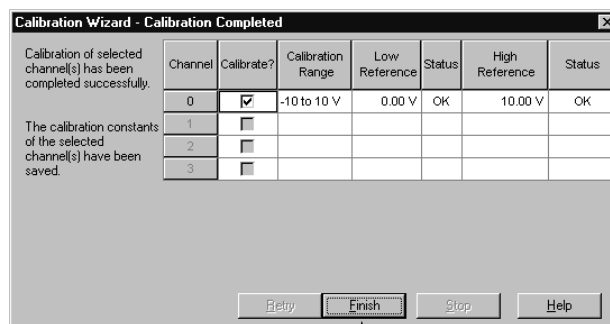
6. Apply the calibrator's high reference to the module.

The following example shows the channel status after calibrating for a high reference. If the channels is OK, continue, as shown below. If any channels report an Error, retry until the status is OK.



Click Next to calibrate the high reference.

The following parameters appear next and define the status of the low and high calibration.



Click Finish to complete calibration for the channel.

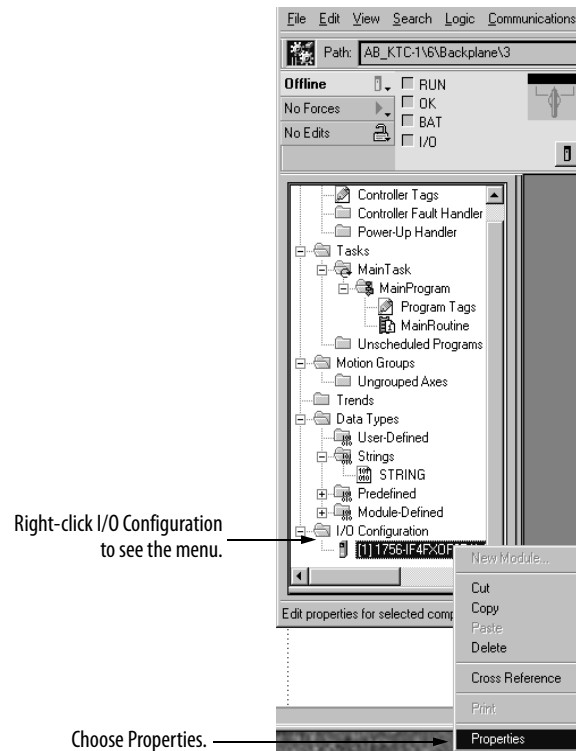
Calibrate Output Channels

Output calibration requires that you command the output channels to produce specific voltage or current levels and then measure the signal to verify that the module is working properly. This process involves these tasks:

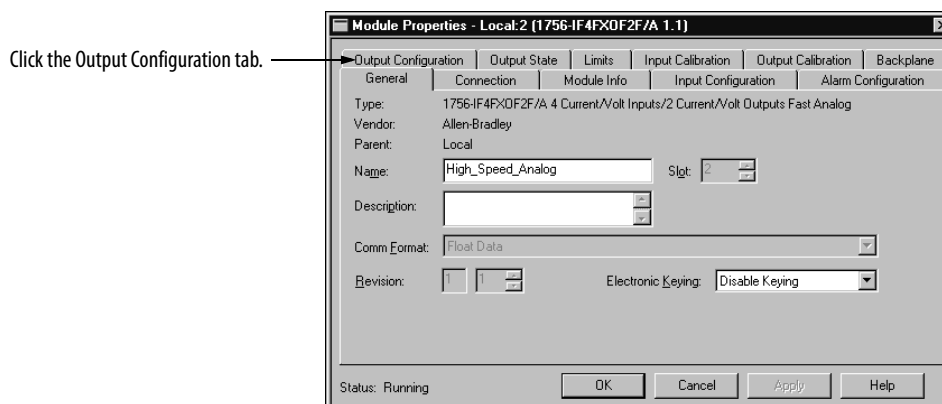
- Command the channel (or group of channels) to produce a low reference signal.
- Verify and record the channel's output.
- Command the channel (or group of channels) to produce a high reference signal.
- Verify and record the channel's output.

To calibrate the high-speed analog module's outputs, follow these steps.

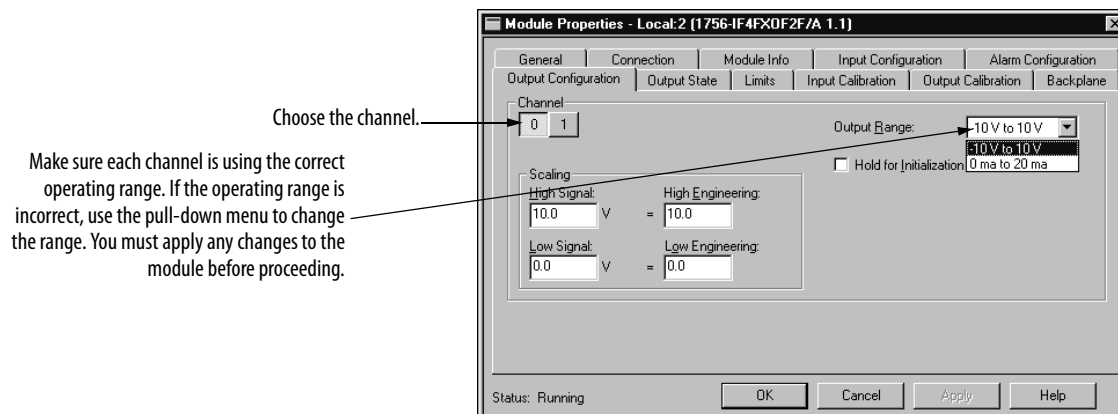
1. Connect your current or voltage meter (depending on what mode your channel is operating in) to the module. Remember, that you must wire the module differently for Current mode than for Voltage mode. To see how to wire for each mode, see [page 63](#).
2. Access the module's properties page.



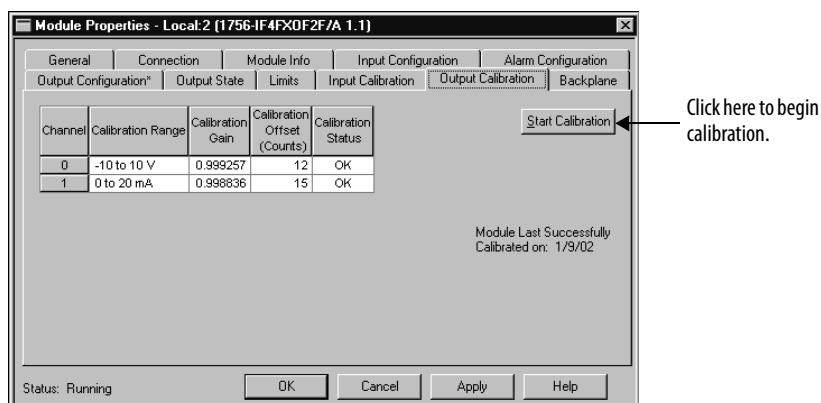
The Module Properties dialog box appears.



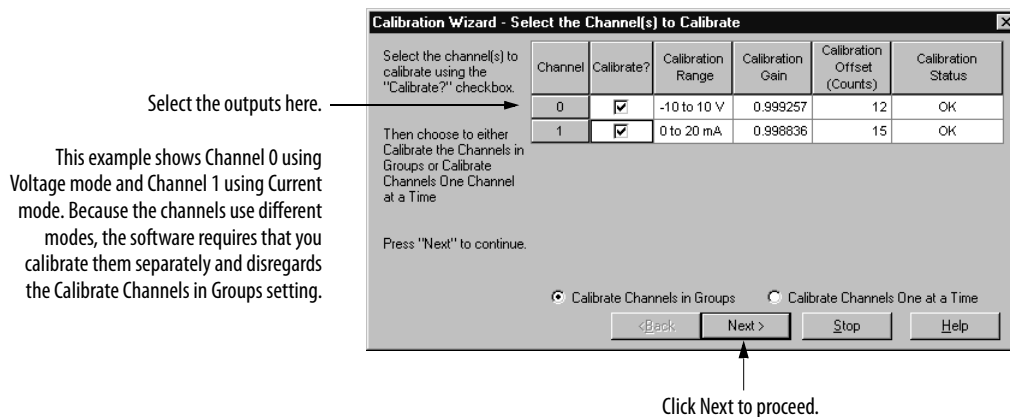
3. Verify the operating range for each channel. You must use the correct operating range for each channel being calibrated or calibration will not work. For example, if you want to calibrate channel 0 in Voltage mode, it must be set for the -10...10V range.
4. Go to the Output Calibration page to begin calibration.



This example shows the calibration range for each channel.



5. Select the output channels that you want to calibrate.



6. Command the output channel to produce a low voltage reference level.

The software commands the output channel 0 to produce a low voltage reference of 0.00V.

Press "Next" to start the selected channels producing the reference signal.

Channels: 0

Channel	Calibrate?	Calibration Range	Low Reference (Volts)
0	<input checked="" type="checkbox"/>	-10 to 10 V	0.00
1	<input checked="" type="checkbox"/>	0 to 20 mA	

<Back **Next >** Stop Help

Click Next to proceed.

7. Record the voltage measurement shown on your voltage calibrator.

We recommend you use a minimum of four digits beyond the decimal point.

Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.

Channels: 0

Enter the measured value for each channel in the "Recorded Reference" column.

Press "Next" to continue.

Channel	Calibrate?	Calibration Range	Low Reference (Volts)	Recorded Reference (Volts)
0	<input checked="" type="checkbox"/>	-10 to 10 V	0.00	
1	<input checked="" type="checkbox"/>	0 to 20 mA		

Retry **Next >** Stop Help

Click Next to proceed.

If the measurement is within an acceptable range, the channel is marked with an OK status, such as shown below. If the measurement is not within an acceptable range, the software returns you to [step 6](#) until the module produces an acceptable output low reference level.

Calibration Wizard - Results

Press "Next" to go on to High Reference test.

Channel	Calibrate?	Calibration Range	Low Reference (Volts)	Recorded Reference (Volts)	Status
0	<input checked="" type="checkbox"/>	-10 to 10 V	0.0000		OK
1	<input checked="" type="checkbox"/>	0 to 20 mA			

Buttons: Retry, Next, Stop, Help

Click Next to proceed.

8. Command the output channel to produce a high voltage reference level.

The software commands the output channel 0 to produce a high voltage reference of 10.00V.

Calibration Wizard - Output Reference Signals

Press "Next" to start the selected channels producing the reference signal.

Channels: 0

Channel	Calibrate?	Calibration Range	High Reference (Volts)
0	<input checked="" type="checkbox"/>	-10 to 10 V	10.00
1	<input checked="" type="checkbox"/>	0 to 20 mA	

Buttons: <Back, Next, Stop, Help

Click Next to proceed.

9. Record the results shown on your voltage calibrator.

Calibration Wizard - Measure and Record Values

Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.

Channels: 0

Enter the measured value for each channel in the "Recorded Reference" column.

Press "Next" to continue.

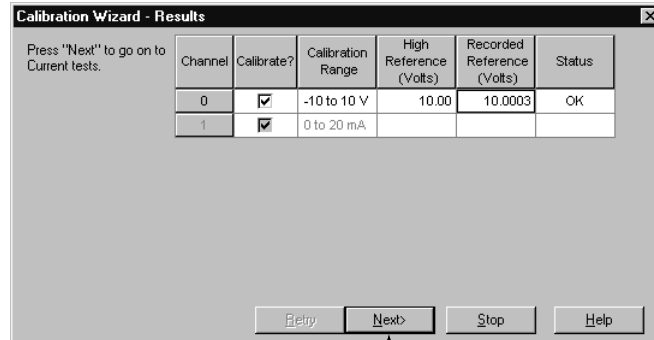
Channel	Calibrate?	Calibration Range	High Reference (Volts)	Recorded Reference (Volts)
0	<input checked="" type="checkbox"/>	-10 to 10 V	10.00	10.0003
1	<input checked="" type="checkbox"/>	0 to 20 mA		

Buttons: Retry, Next, Stop, Help

Record the voltage measurement.

Click Next to proceed.

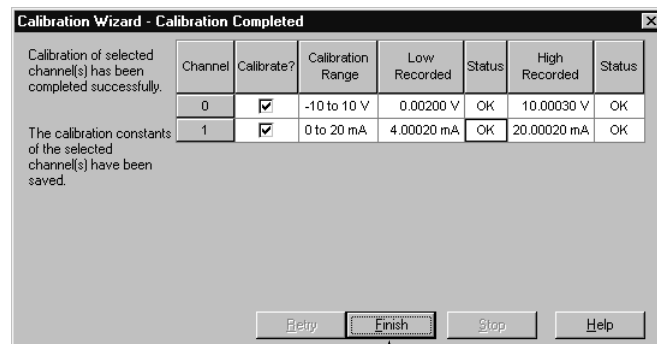
If the measurement is within an acceptable range, the channel is marked with an OK status, such as shown below. If the measurement is not within an acceptable range, the software returns you to [step 8](#) until the module produces an acceptable output low reference level.



Click Next to continue.

- Repeat [step 6](#) through [step 9](#) to calibrate output channel 1 for 0...20 mA operation.

When you have successfully calibrated both channels, the following parameters appear.



Click Finish to complete the calibration.

This completes calibration of input and output channels.

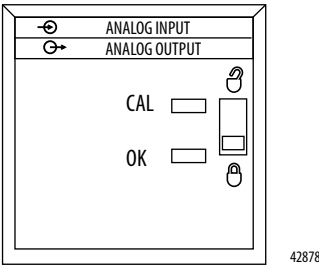
Notes:

Troubleshoot the Module

Topic	Page
Use Module Indicators to Troubleshoot	97
Use the Logix Designer Application to Troubleshoot	98

Use Module Indicators to Troubleshoot

The module uses the status indicators shown below.



Status indicators on the module provide the current status of the module, as described in [Table 13](#).

Table 13 - Status Indicators for Input Modules

Indicator	Status	Description
OK	Steady green	The inputs are being multicast and in normal operating state. The outputs are in Run mode.
OK	Flashing green	The module has passed internal diagnostics but is not currently performing connected communication or is in Program mode. Inputs are in a normal operating state. Outputs are in the configured state for Program mode.
OK	Flashing red	Previously established communication has timed out. Check controller and chassis communication.
OK	Steady red	The module must be replaced. Replace the module.
CAL	Flashing green	The module is in Calibration mode.

Use the Logix Designer Application to Troubleshoot

In addition to the status indicators on the module, the application will alert you to fault conditions. You will be alerted in one of three ways:

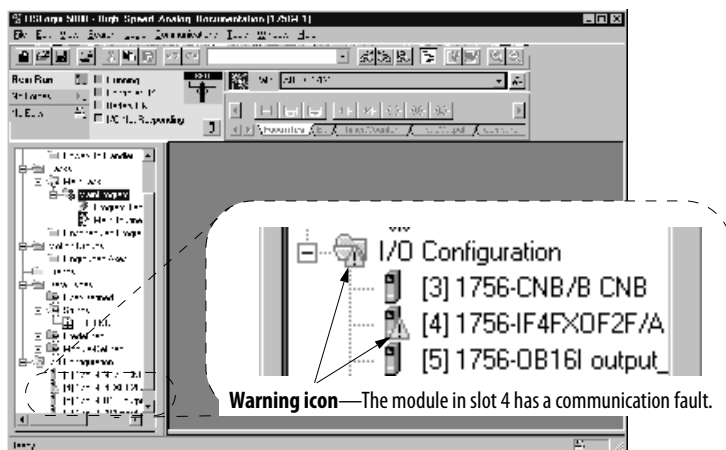
- Warning icon next to the module in the I/O Configuration tree
- Status on the Module Info page
- Fault message in the status line
- Notification in the tag editor

The examples below show fault notification. Diagnostic faults are reported only in the tag editor.

Warning Signal in I/O Configuration Tree



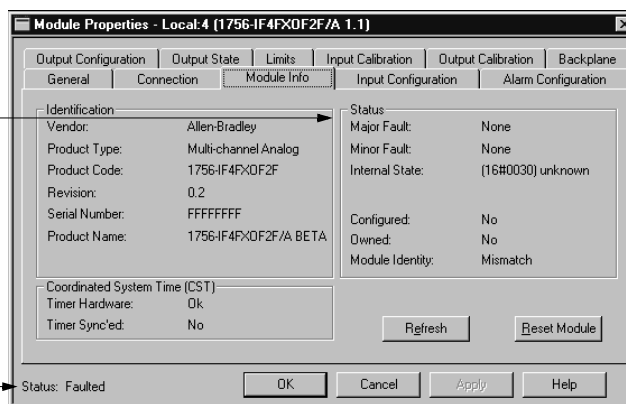
Warning icon when a communication fault occurs or if the module is inhibited.



Fault Message in Status Line

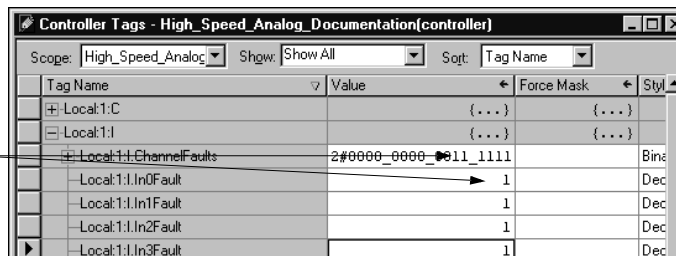
Status section lists major and minor faults and the internal state of the module.

Status line provides information on the connection to the module.



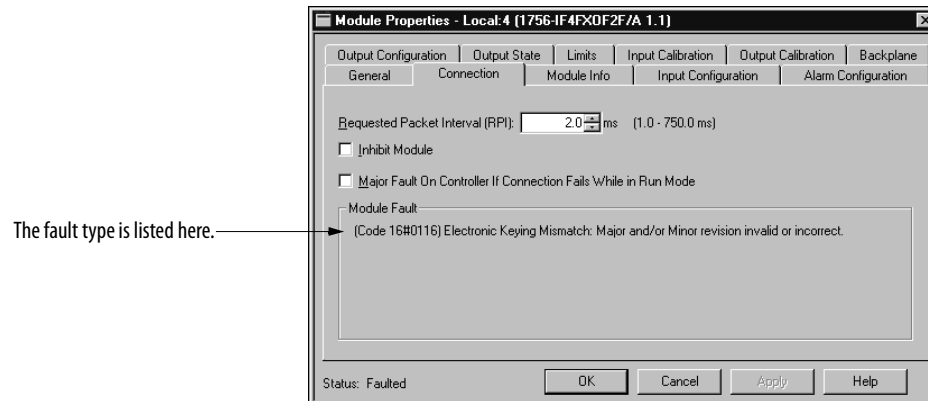
Notification in Tag Editor

A fault has occurred for any point that lists the number 1 in the Fault line.



Determine the Fault Type

When you are monitoring a module's configuration properties and receive a communication 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.

Notes:

Data Storage

Topic	Page
Timing Relationships	101
Choose a Communication Format	102
Use an Event Task to Store Module Data	104

You can store module data in controller tags by using an Event task.

Timing Relationships

This section describes the timing relationship between the module's RPI, RTS, and an Event task with a Module Input Data State Change trigger. This type of Event task monitors a module's input data and is triggered each time the input data changes.

The following information applies when the 1756-IF4FXOF2F module is in the same chassis as its owner-controller:

- **RTS**—The rate at which the module retrieves new input data samples from its channels. With each RTS, the module scans all channels. Because the module cannot scan all channels simultaneously, there is an approximate 1 μ s time gap to scan all channels. Once the module completes scanning all channels, it sends updated data across the backplane, and the Event task is triggered.
- **RPI**—The rate at which the module produces the data currently stored in on-board memory and receives data from the controller. The module's outputs are always updated at the RPI rate regardless of the RTS value.

Module Configuration	Result
RPI < RTS	<p>The module produces data at the RPI rate, but produces new data only at the RTS rate. In this scenario, RPI data is the same data produced by the previous RTS. See Figure 2 on page 20.</p> <p>The Event task is triggered only when new data is produced at the RTS rate.</p> <p>EXAMPLE: If the RPI = 8 ms and the RTS = 11 ms, the module produces data every 8 ms, but produces new data only every 11 ms. The Event task is triggered every 11 ms.</p>
RPI ≥ RTS	<p>The module produces only new data and always produces data at the RTS rate.</p> <p>The Event task is triggered only when new data is produced at the RTS rate.</p>

Regardless of the RPI and RTS rates, the module sends new input channel data to the controller only at the RTS rate, and the Event task is triggered only when the controller receives new data.

Remote Module Considerations

If the 1756-IF4FXOF2F module is not in the same chassis as its owner-controller, the following considerations apply:

- Update rates can be slower for network interface cards and network bandwidth, especially with faster RTS rates, such as less than 4 ms.
- If the remote module is on a ControlNet network, the modules still retrieves channel input data at the RTS rate, but the module produces data on the network only at the RPI rate.
- If the remote module is on the EtherNet/IP network, the module still retrieves channel input data at the RTS rate, but the module produces data on the network at a rate no faster than the RPI divided by four.

Choose a Communication Format

To determine which communication format to use for your data storage application, consider these factors:

- Whether your application requires a CST timestamp

A CST timestamp is useful in these scenarios:

- You need to know when data samples are retrieved.
- Your application has other modules or axis data that provide a CST timestamp and your application needs to establish a time relationship between the analog data and the other modules or axis.

- The rate at which your application needs to produce data samples

The combination of RTS and RPI values determines the rate at which new data is produced, as described in [Timing Relationships on page 101](#).

Table 14 - Communication Formats

CST Timestamp Required	Data Sample Rate	Recommended Communication Format	Description
Yes	Faster than 4 ms	Archiving Connection	Returns up to 20 floating-point, archived data samples for each channel. Returns a single CST and rolling timestamp. The module stores individual samples on-board until it retrieves the final sample. The module then produces all samples in one packet.
Yes	4 ms or slower ⁽¹⁾	CST Timestamped Float Data	Returns one floating-point data sample for each channel. Returns CST and rolling timestamps.
No		Float Data	Returns one floating-point data sample for each channel. Returns a rolling timestamp, but not a CST timestamp.

(1) This recommendation is based on balancing speed and controller resources. In some applications, a rate faster than 4 ms can be possible.

If you choose the Archiving Connection communication format, you receive up to 20 analog samples per update, but you receive only one CST timestamp per module update. With an archiving connection, the CST timestamp is associated with the .LastUpdateIndex sample. In a typical case, the LastUpdateIndex value is equal to 19, .Input[19] is the newest sample, and the timestamp is associated with sample Input[19]. The other samples are older than the current timestamp by approximately 1 RTS time per sample.

EXAMPLE	<p>If .LastUpdateIndex = 6, then the CST Timestamp is associated with .Input[6], and .Input[6] is the newest sample followed by the subsequent samples in the order below.</p> <p>.Input[5] is approximately 1 RTS older than the current CST Timestamp.</p> <p>.Input[4] is approximately 2 RTSs older than the current CST Timestamp.</p> <p>.Input[3] is approximately 3 RTSs older than the current CST Timestamp.</p> <p>...</p> <p>.Input[0] is approximately 6 RTSs older than the current CST Timestamp.</p> <p>.Input[19] is approximately 7 RTSs older than the current CST Timestamp.</p> <p>.Input[18] is approximately 8 RTSs older than the current CST Timestamp.</p> <p>...</p> <p>.Input[7] is approximately 19 RTSs older than the current CST Timestamp.</p> <p>In this example, .Input[7] is the oldest sample provided.</p>
----------------	--

Use an Event Task to Store Module Data

This example shows how to store module data in controller tags by using the following process.

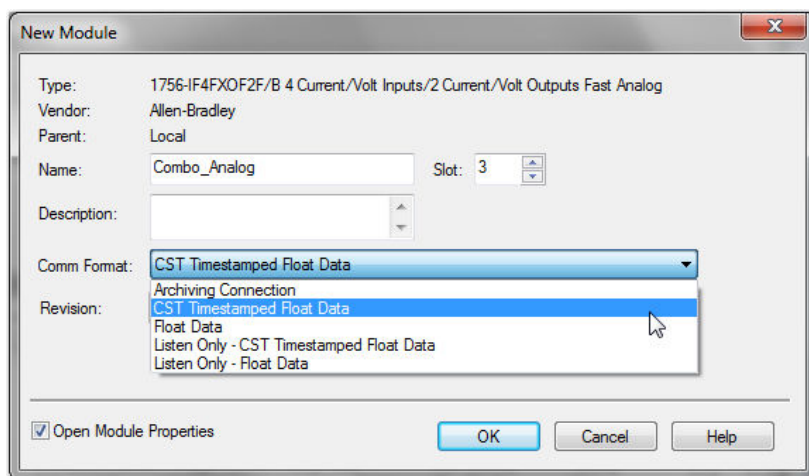
1. The module retrieves channel data.
2. The module sends the updated channel data to the controller.
3. The updated channel data triggers an Event task.
4. Event task logic stores the channel data in controller tags.

To configure the data storage process described above, follow these steps.

1. On the New Module dialog box, choose a communication format, as described in [Choose a Communication Format on page 102](#).

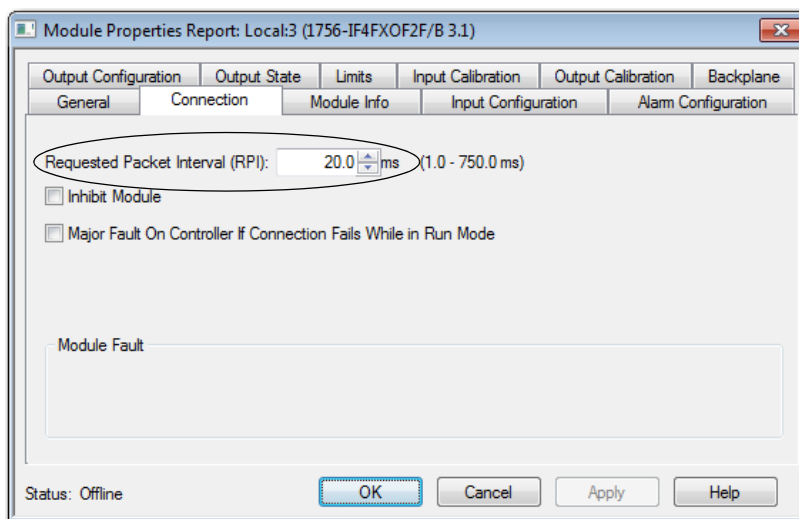
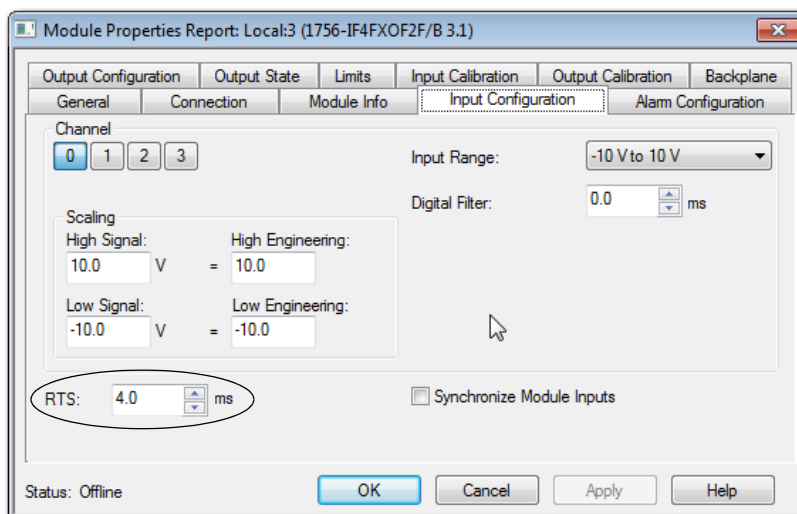
The examples shown in this procedure uses the CST Timestamped Float Data communication format. However, you can use any of the three formats with minor changes to the application logic shown in step 6.

IMPORTANT The example shown in this procedure uses Move (MOV) instructions to move data to the storage location. If you use the Archiving Connection communication format, you must move up to 20 data samples per channel with a Synchronous Copy File (CPS) instruction instead of a MOV instruction. For more information about the CPS instruction, search the Knowledgebase for answer ID 50235.



2. Enter the RPI and RTS values for your application.

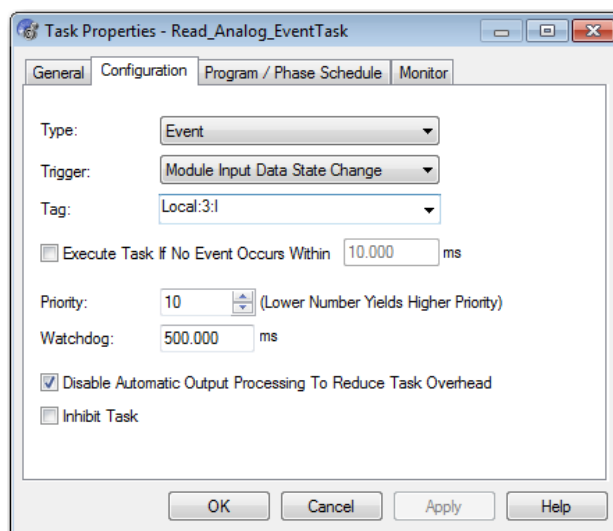
Be aware that as these values decrease, the Event task executes more frequently, and the module sends data to the controller at a faster rate. This places more demand on controller resources. For example, an RTS of 4 ms causes the Event task to trigger every 4 ms. If the amount of code the Event task executes is too great, the controller does not have enough available resources to execute other tasks, or the Event task can experience task overlaps. In typical applications with a 1756-L7x controller, an RTS of 4 ms leaves sufficient resources for other tasks.



3. Create an Event task with the values shown below.

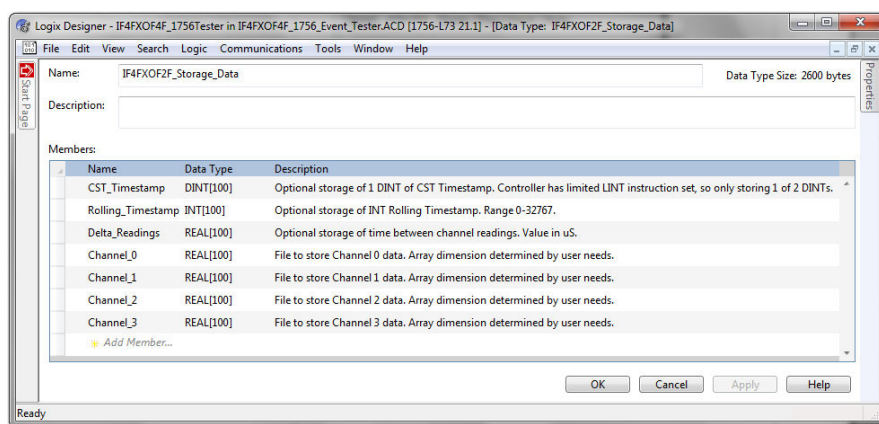
For all other fields, specify values that are specific to your application.

Field	Value
Type	Choose Event.
Trigger	Choose Module Input Data State Change.
Tag	Choose the controller input tag for the 1756-IF4XOF2F module.



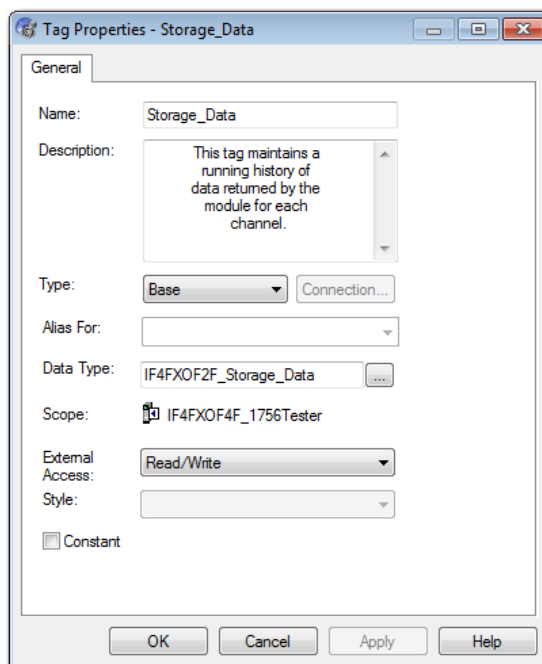
4. Create a user-defined data type to store the data.

The data type size varies by application. In this example, the data type stores 100 data samples.



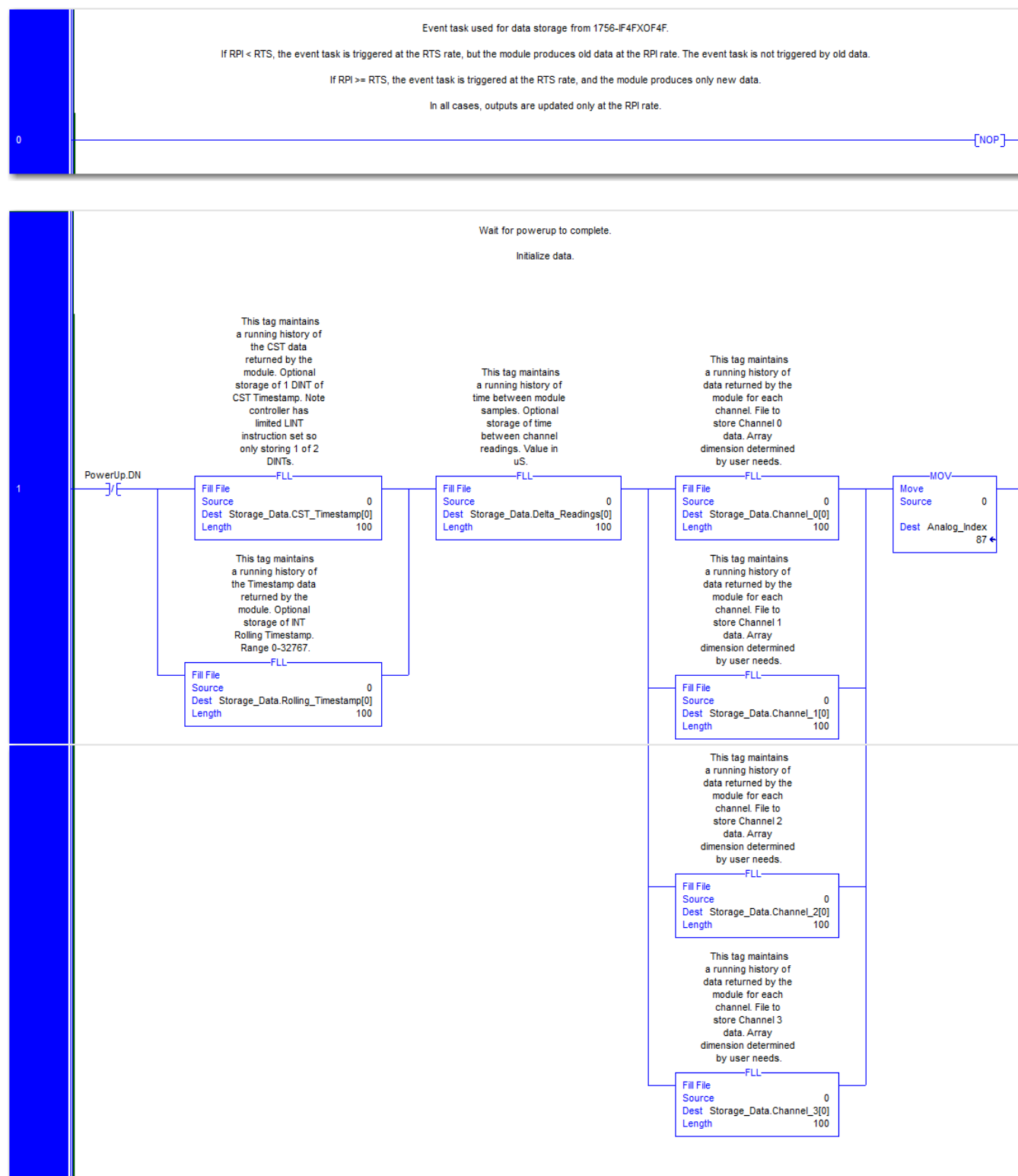
5. Create a tag to store the data:

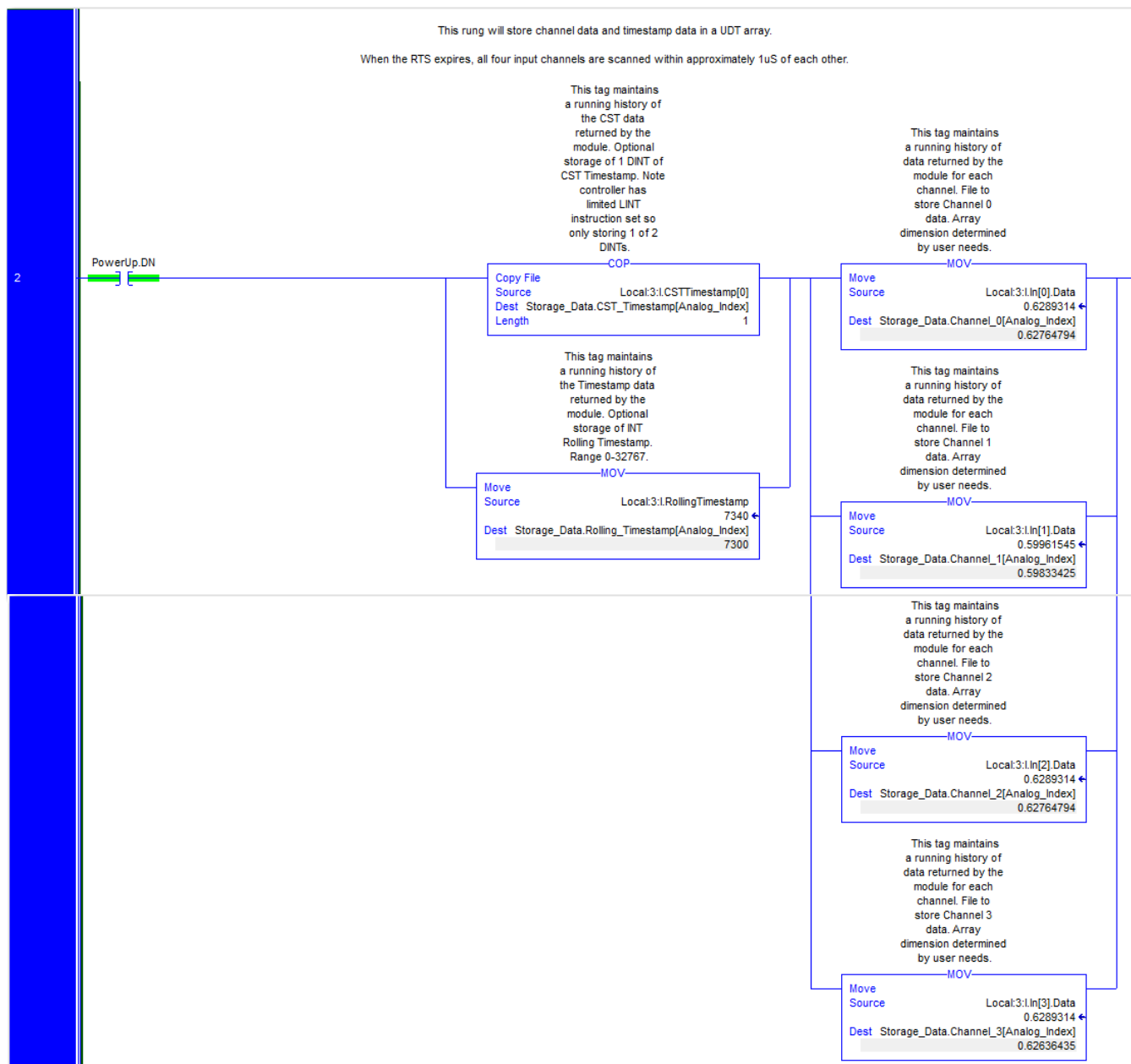
- The data type for the tag must be the user-defined data type you created in [step 4](#).
- Because the data type in this example stores 100 data samples, the new tag maintains a 100-word circular buffer of the rolling and CST timestamps. You can monitor either of the timestamps to compare data samples from one scan to the next.

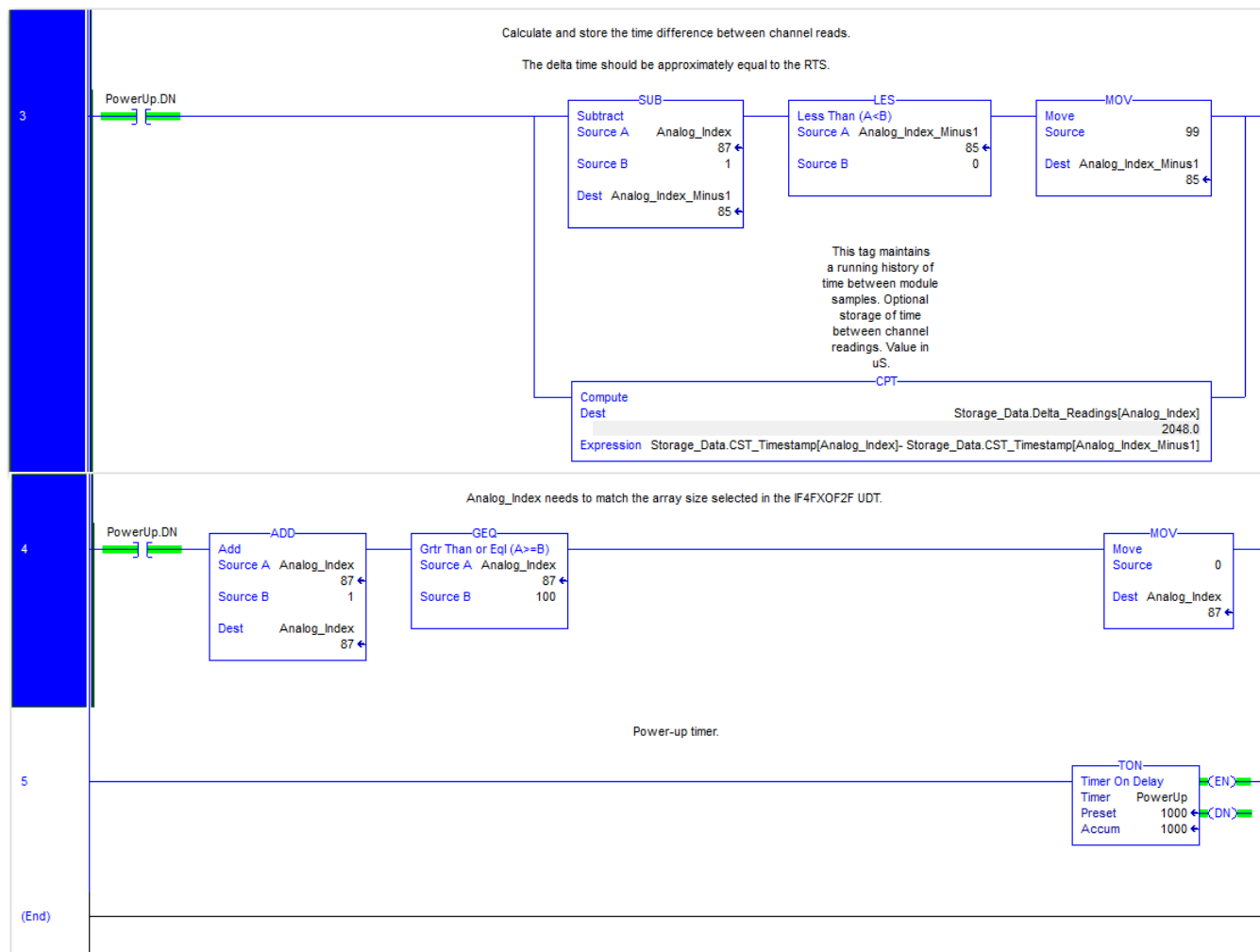


6. Create application logic for the Event task you created in [step 3](#).

The ladder logic below is an example of the type of logic you can use for the Event task. Create logic that is specific to your application.







Tag Definitions

Topic	Page
Updated Data Tag Structure	112
Data Tag Names and Definitions	113
Access Tags	119
Download New Configuration Data	120

IMPORTANT Although this appendix describes the option of changing a module’s configuration through the tag editor, we suggest that you use the Module Properties dialog box to update and download configuration changes when possible.

When you write configuration for a high-speed analog I/O module, you create tags in the tag editor. Each configurable feature on your module has a distinct tag in the controller’s ladder logic.

The following figures show the difference between latching process alarms through the Module Properties dialog box or the tag editor. Both methods perform the same function on the module.

Figure 14 - Module Properties

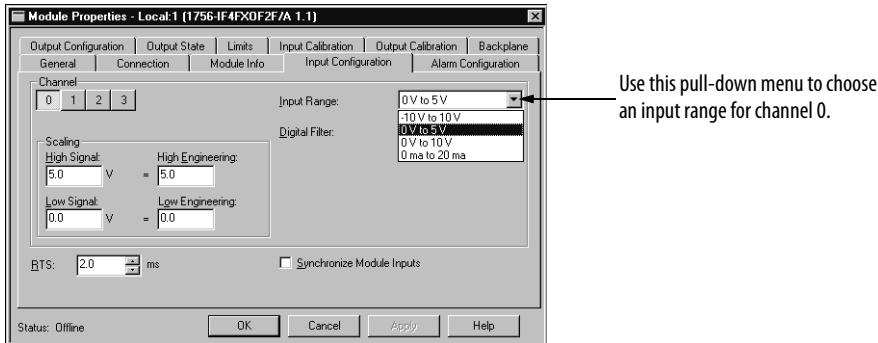
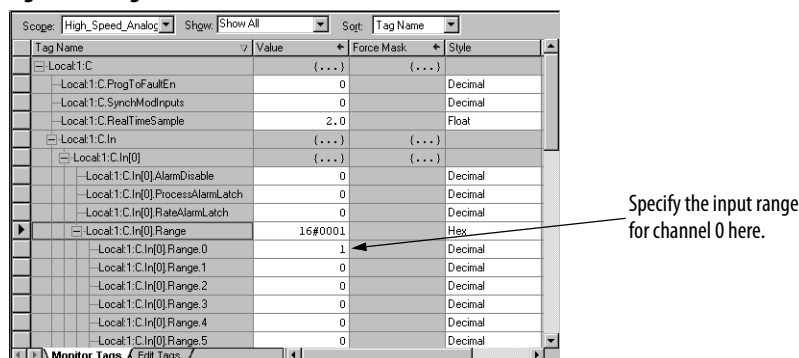


Figure 15 - Tag Editor



Updated Data Tag Structure

The tag structure for the module is different than other ControlLogix I/O modules released previously. The high-speed analog I/O module tags are listed in an array format and other I/O modules are not.

- In the array format, status and data tags for each channel are grouped together. For example, the four input channels status and data tags are listed in a manner similar to the following:

```
Local:x:I.In[0].Status
Local:x:I.In[0].Data
```

```
Local:x:I.In[1].Status
Local:x:I.In[1].Data
```

```
Local:x:I.In[2].Status
Local:x:I.In[2].Data
```

```
Local:x:I.In[3].Status
Local:x:I.In[3].Data
```

- In the non-array format, status and data tags are not listed together for each channel. Instead, they are listed together according to tag type, in a manner similar to the following:

```
Local:x:I.Ch0.Status
Local:x:I.Ch1.Status
Local:x:I.Ch2.Status
Local:x:I.Ch3.Status
```

```
Local:x:I.Ch0.Data
Local:x:I.Ch1.Data
Local:x:I.Ch2.Data
Local:x:I.Ch3.Data
```

Using the array format allows easier interrogation of module status. By simply indexing a pointer, a single instruction can examine status for all four input channels.

Data Tag Names and Definitions

The set of tags associated with your high-speed analog module depends on the communication format you choose during configuration. For each communication format, there are three sets of tags:

- [Configuration Data Tags](#)
- [Input Data Tags](#)
- [Output Data Tags](#)

Configuration Data Tags

[Table 15](#) lists the configuration data tags.

Table 15 - Configuration Data Tags

Tag Name	Data Type	Definition
C.ProgToFaultEn	BOOL	Determines how the outputs behavior if a communication fault occurs when the output module is in Program mode. When set, the bit causes the outputs to transition to their programmed fault state. If not set, outputs remain in their configured program state when the fault occurs.
C.SynchModInputs	BOOL	Enables synchronization of input sampling between multiple 1756-IF4FX0F2F/A modules in the same chassis. All modules with this feature enabled attempt to sample inputs simultaneously, based on their RealTimeSample settings.
C.RealTimeSample	REAL	Determines how often the input signal is to be sampled in milliseconds with a decimal point
C.In[0]	Struct	Master structure beneath which configuration parameters for input channel 0 are set.
C.In[0].AlarmDisable	BOOL	Disables all alarms for the channel 0 - Alarms are not disabled 1 - Alarms are disabled
C.In[0].ProcessAlarmLatch	BOOL	Enables latching for all four process alarms: <ul style="list-style-type: none"> • Low • Low low • High • High high If this feature is enabled, the triggered alarm remains latched in the set position, even if the condition causing the alarm disappears. Once an alarm is latched, you must unlatch it via the Logix Designer application or a message instruction.
C.In[0].RateAlarmLatch	BOOL	Enables latching for the rate alarm. If this feature is enabled, the triggered alarm remains latched in the set position, even if the condition causing the alarm disappears. Once an alarm is latched, you must unlatch it via the Logix Designer application or a message instruction.
C.In[0].Range	INT	Configures the channel's input range as follows: 0 = -10 ... 10V 1 = 0 ... 5V 2 = 0 ... 10V 3 = 0 ... 20 mA

Table 15 - Configuration Data Tags (continued)

Tag Name	Data Type	Definition
C.In[0].DigitalFilter	REAL	A non-zero value enables the filter. The value serves as a time constant in milliseconds that can be used in a first order lag filter to smooth the input signal
C.In[0].RateAlarmLimit	REAL	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 engineering units per second.
C.In[0].LowSignal	REAL	One of four points used in scaling. The low signal is in terms of the input signal units and corresponds to the low engineering term when scaled. The scaling equation is as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$
C.In[0].HighSignal	REAL	One of four points used in scaling. The high signal is in terms of the input signal units and corresponds to the high engineering term when scaled. The scaling equation is as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$
C.In[0].LowEngineering	REAL	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 as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$
C.In[0].HighEngineering	REAL	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 as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$
C.In[0].LAlarmLimit	REAL	The low alarm trigger point. This value causes the I.In[0].LAlarm to trigger when the input signal moves beneath the configured trigger point, in engineering units.
C.In[0].HAlarmLimit	REAL	The high alarm trigger point. This value causes the I.In[0].HAlarm to trigger when the input signal moves above the configured trigger point, in engineering units.
C.In[0].LLAlarmLimit	REAL	The low low alarm trigger point. This value causes the I.In[0].LLAlarm to trigger when the input signal moves beneath the configured trigger point, in engineering units.
C.In[0].HHAAlarmLimit	REAL	The high high alarm trigger point. This value causes the I.In[0].HHAAlarm to trigger when the input signal moves above the configured trigger point, in engineering units.
C.In[0].AlarmDeadband	REAL	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.
C.In[1]	AB:1756_IF4FXOF2F_Struct_In:C:0	Master structure beneath which configuration parameters for input channel 1 are set. This is the same set of tags as listed for input channel 0, from C.In[0].AlarmDisable to C.In[0].AlarmDeadband , except that this listing applies to channel 1.
C.In[2]	AB:1756_IF4FXOF2F_Struct_In:C:0	Master structure beneath which configuration parameters for input channel 2 are set. This is the same set of tags as listed for input channel 0, from C.In[0].AlarmDisable to C.In[0].AlarmDeadband , except that this listing applies to channel 2.
C.In[3]	AB:1756_IF4FXOF2F_Struct_In:C:0	Master structure beneath which configuration parameters for input channel 3 are set. This is the same set of tags as listed for input channel 0, from C.In[0].AlarmDisable to C.In[0].AlarmDeadband , except that this listing applies to channel 3.
C.Out	AB:1756_IF4FXOF2F_Struct_Out:C:0[2]	
C.Out[0]	AB:1756_IF4FXOF2F_Struct_Out:C:0	Master structure beneath which configuration parameters for output channel 0 are set.
C.Out[0].HoldForInit	BOOL	When this bit is set, and one of the following occurs: <ul style="list-style-type: none"> Module initial connection (powerup) Module transition from Program mode back to Run mode Module reestablishes communication after fault The bit configures the channel to hold its present state until initialized with a value within 0.1% of full scale of its current value.
C.Out[0].AlarmDisable		Disables all alarms for the channel 0 = Alarms are not disabled 1 = Alarms are disabled

Table 15 - Configuration Data Tags (continued)

Tag Name	Data Type	Definition
C.Out[0].RampAlarmLatch	BOOL	Enables latching for the ramp alarm. If this feature is enabled, the triggered alarm remains latched in the set position, even if the condition causing the alarm to occur disappears. Once an alarm is latched, you must unlatch it via the Logix Designer application or a message instruction.
C.Out[0].LimitAlarmLatch	BOOL	Enables latching for the clamp limit alarms. If this feature is enabled, the triggered alarm remains latched in the set position, even if the condition causing the alarm to occur disappears. Once an alarm is latched, you must unlatch it via the Logix Designer application or a message instruction.
C.Out[0].FaultMode	BOOL	Selects the output channel behavior if a communication fault occurs. 0 = Hold last state 1 = Go to a user-defined value (C.Out[0].FaultValue defines the value to go to on fault if the bit is set.)
C.Out[0].ProgMode	BOOL	Selects the output channel behavior when transitioned into Program mode. 0 = Hold last state 1 = Go to a user-defined value (C.Out[0].ProgValue defines the value to go to on program if the bit is set.)
C.Out[0].RampToRun	BOOL	Enables ramping of the output value during Run mode between the current output level and a newly requested output level. Ramping defines the maximum rate the output can transition at, based on the user-defined C.Out[0].MaxRampRate.
C.Out[0].RampToProg	BOOL	Enables ramping of the output value to a user-defined program value (C.Out[0].ProgValue) when set. Ramping defines the maximum rate the output can transition at, based on the user-defined C.Out[0].MaxRampRate.
C.Out[0].RampToFault	BOOL	Enables ramping of the output value to a user-defined fault value (C.Out[0].FaultValue) when set. Ramping defines the maximum rate the output can transition at, based on the user-defined C.Out[0].MaxRampRate.
C.Out[0].Range	INT	Selects Output channel operating range: 0 = -10...10V 1 = 0...20 mA
C.Out[0].MaxRampRate	INT	Configures the maximum rate (percent full-scale/second) at which the output value may change in these scenarios: <ul style="list-style-type: none"> The module transitions to C.Out[0].FaultValue if the C.Out[0].RampToFault bit is set. The module transitions to C.Out[0].ProgValue if the C.Out[0].RampToProg bit is set. The module is in Run mode and the C.Out[0].RampToRun bit is set.
C.Out[0].FaultValue	REAL	Defines the value the output uses if a communication fault occurs when the C.Out[0].FaultMode bit is set.
C.Out[0].ProgValue	REAL	Defines the value the output uses when the connection transitions to Program mode if the C.Out[0].ProgMode bit is set.
C.Out[0].LowSignal	REAL	One of four points used in scaling. The low signal is in terms of the output signal units and corresponds to the low engineering term when scaled. The scaling equation is as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$
C.Out[0].HighSignal	REAL	One of four points used in scaling. The high signal is in terms of the output signal units and corresponds to the high engineering term when scaled. The scaling equation is as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$
C.Out[0].LowEngineering	REAL	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 as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$
C.Out[0].HighEngineering	REAL	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 as follows: $\text{Data} = \frac{(\text{Signal} - \text{LowSignal})(\text{HighEngineering} - \text{LowEngineering})}{\text{High Signal} - \text{Low Signal}} + \text{Low Engineering}$

Table 15 - Configuration Data Tags (continued)

Tag Name	Data Type	Definition
C.Out[0].LowLimit	REAL	Defines the minimum value the output can use in the process. If an output beneath the low limit is requested, the C.Out[0].LLimit alarm is set and the output signal will remain at the configured low limit.
C.Out[0].HighLimit	REAL	Defines the maximum value the output can use in the process. If an output above the high limit is requested, the C.Out[0].HLimit alarm is set and the output signal will remain at the configured high limit.
C.Out[1]	AB:1756_IF4XOF2F _Struct_Out:C:0	Master structure beneath which configuration parameters for output channel 1 are set. This is the same set of tags as listed for input channel 0, from C.Out[0].HoldForInit to C.Out[0].HighLimit , except that this listing applies to channel 1.

Input Data Tags

[Table 16](#) lists the input data tags.

Table 16 - Input Data Tags

Tag Name	Data Type	Definition
I.ChannelFaults	INT	Collection of individual channel fault bits in one word. Can address individual channel fault via bit notation, such as ChannelFaults.3 for channel 3. Output channels are bits .4 and .5.
I.In0Fault	BOOL	Individual channel fault status bit that indicates a hard fault has occurred on the channel. One of the following conditions sets this bit: <ul style="list-style-type: none"> • Calibration is ongoing. • An overrange condition is present. • An underrange condition is present. • Communication is lost with the I/O module.
I.In1Fault	BOOL	Individual channel fault status bit that indicates a hard fault has occurred on the channel. One of the following conditions sets this bit: <ul style="list-style-type: none"> • Calibration is ongoing. • An overrange condition is present. • An underrange condition is present. • Communication is lost with the I/O module.
I.In2Fault	BOOL	Individual channel fault status bit that indicates a hard fault has occurred on the channel. One of the following conditions sets this bit: <ul style="list-style-type: none"> • Calibration is ongoing. • An overrange condition is present. • An underrange condition is present. • Communication is lost with the I/O module.
I.In3Fault	BOOL	Individual channel fault status bit that indicates a hard fault has occurred on the channel. One of the following conditions sets this bit: <ul style="list-style-type: none"> • Calibration is ongoing. • An overrange condition is present. • An underrange condition is present. • Communication is lost with the I/O module.
I.Out0Fault	BOOL	Individual channel fault status bit that indicates a hard fault has occurred on the channel. One of the following conditions sets this bit: <ul style="list-style-type: none"> • Calibration is ongoing. • A low clamp condition is occurring. • A high clamp condition is occurring. • Communication is lost with the I/O module.
I.Out1Fault	BOOL	Individual channel fault status bit that indicates a hard fault has occurred on the channel. One of the following conditions sets this bit: <ul style="list-style-type: none"> • Calibration is ongoing. • A low clamp condition is occurring. • A high clamp condition is occurring. • Communication is lost with the I/O module.
I.ModuleFaults	INT	Collection of all module level fault bits.

Table 16 - Input Data Tags (continued)

Tag Name	Data Type	Definition
I.AnalogGroupFault	BOOL	Indicates if a channel fault has occurred on any channel.
I.InGroupFault	BOOL	Indicates if a channel fault has occurred on any input channel.
I.OutGroupFault	BOOL	Indicates if a channel fault has occurred on any output channel.
I.Calibrating	BOOL	Indicates if a calibration is currently in progress on any channel.
I.CalFault	BOOL	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.
I.LastUpdateIndex	DINT	Returns the number of the last archive sample performed by the module before data was sent to the controller. This tag equals 19 when the RPI is greater than (20 * RTS).
I.Input	AB:1756_IF4FXOF2F_Struct_Archiving:S:0[20]	An array that stores channel data for each of the 20 archive samples (0...19).
I.In	AB:1756_IF4FXOF2F_Struct_In:I:0[2]	Input array structure.
I.In[0]	AB:1756_IF4FXOF2F_Struct_In:I:0	Channel array for input 0.
I.In[0].Status	INT	Collection of individual channel status bits.
I.In[0].ChanFault	BOOL	Copy of .In0Fault in array with other channel status bits for ease of access.
I.In[0].CalFault	BOOL	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.
I.In[0].Underrange	BOOL	Alarm bits indicating the channel's input is less than the minimum detectable input signal.
I.In[0].Overrange	BOOL	Alarms bit indicating the channel's input is greater than the maximum detectable input signal.
I.In[0].RateAlarm	BOOL	Alarm bit that sets when the input channel's rate of change exceeds the configured In[0].RateAlarmLimit. Remains set until the rate change drops below the configured limit unless latched via In[0].RateAlarmLatch in the configuration.
I.In[0].LAlarm	BOOL	Low alarm bits that sets when the input signal moves beneath the configured low alarm trigger point, In[0].LAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via In[0].ProcessAlarmLatch or the input is still within the configured alarm deadband, In[0].AlarmDeadband, of the low alarm trigger point.
I.In[0].HAlarm	BOOL	High alarm bit that sets when the input signal moves above the configured high alarm trigger point, In[0].HAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched via In[0].ProcessAlarmLatch or the input is still within the configured alarm deadband, In[0].AlarmDeadband, of the high alarm trigger point.
I.In[0].LLAlarm	BOOL	Low low alarm bit that sets when the input signal moves beneath the configured low low alarm trigger point, In[0].LLAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via In[0].ProcessAlarmLatch or the input is still within the configured alarm deadband, In[0].AlarmDeadband, of the low low alarm trigger point.
I.In[0].HHAlarm	BOOL	High high alarm bit that sets when the input signal moves above the configured high high alarm trigger point, In[0].ProcessAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched via In[0].AlarmDeadband, of the high high alarm trigger point.
I.In[0].Data	REAL	The channel input signal represented in engineering units. The input signal is measured and then scaled based on the user configuration.
I.In[1]	AB:1756_IF4FXOF2F_Struct_In:I:0	Array for input channel 1. This is the same set of tags as listed for input channel 0, from I.In[0].Status to I.In[0].Data , except that this listing applies to channel 1.
I.In[2]	AB:1756_IF4FXOF2F_Struct_In:I:0	Array for input channel 2. This is the same set of tags as listed for input channel 0, from I.In[0].Status to I.In[0].Data , except that this listing applies to channel 2.
I.In[3]	AB:1756_IF4FXOF2F_Struct_In:I:0	Array for input channel 3. This is the same set of tags as listed for input channel 0, from I.In[0].Status to I.In[0].Data , except that this listing applies to channel 3.
I.Out	AB:1756_IF4FXOF2F_Struct_In:I:0[2]	Output array structure.
I.Out[0]	AB:1756_IF4FXOF2F_Struct_In:I:0	Output channel array.
I.Out[0].Status	INT	Collection of individual channel status bits.

Table 16 - Input Data Tags (continued)

Tag Name	Data Type	Definition
I.Out[0].ChanFault	BOOL	Copy of .Out0Fault in array with other channel status bits for ease of access.
I.Out[0].CalFault	BOOL	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.
I.Out[0].WireOff	BOOL	Bit that indicates a wire has fallen off the output channel. This bit is functional only when C.Out[0].Range is set to operate in 0...20 mA mode.
I.Out[0].NotANumber	BOOL	Bit indicating the received output value from the controller (value in O.Data[0] tag) was an invalid IEEE floating point value. When an invalid value is received, the output value holds its last known valid state.
I.Out[0].InHold	BOOL	Bit that indicates if the output channel is currently holding until the Output value sent to the module (value in O.Data[0] tag) matches the current output value (value in O.Data[0] tag) within 0.1% of the channel's full scale.
I.Out[0].RampAlarm	BOOL	Alarm bit that sets when the requested output value (C.Out[0].RampToRun) is set, and the difference between the new output value requested and the current output exceeds the configured ramp limit (C.Out[0].MaxRampRate). The bit remains set until ramping ceases unless the alarm is latched via C.Out[0].RampAlarmLatch.
I.Out[0].LLimitAlarm	BOOL	Alarm bit that sets when the requested output value (O.Data[0]) is below the configured low limit (C.Out[0].LowLimit). In this case, the output stops at the configured low limit; the stop is reflected in the data echo. This bit remains set until the requested output moves above the low limit unless latched by C.Out[0].LimitAlarmLatch.
I.Out[0].HLimitAlarm	BOOL	Alarm bit that sets when the requested output value (O.Data[0]) is above the configured high limit (C.Out[0].HighLimit). In this case, the output stops at the configured high limit. The stop is reflected in the data echo. This bit remains set until the requested output moves below the high limit unless latched by C.Out[0].LimitAlarmLatch.
I.Out[0].Data	REAL	Value the channel outputs (in engineering units) based on the configured scaling for the channel.
I.Out[1]	AB:1756_IF4XOF2F_Struct_Out:I:0	Array for output channel 1. This is the same set of tags as listed for input channel 0, from I.Out[0].Status to I.Out[0].Data , except that this listing applies to channel 1.
I.CSTimestamp	Array of DINT	Timestamp taken when input data is sampled. This value is listed as a 64-bit quantity in microseconds and coordinated across the chassis. Must be addressed in 32-bit chunks as an array.
I.RollingTimestamp	INT	Timestamp taken when input data is sampled. This value is listed in milliseconds, relative solely to the individual module.

Output Data Tags

[Table 17](#) lists the output data tags.

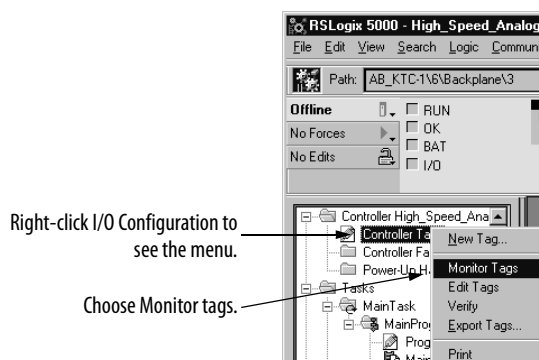
Table 17 - Output Data Tags

Tag Name	Data Type	Definition
O.Out[0].Data	REAL[2]	The channel output value in engineering units. The output value is measured and scaled, based on the configured scaling for the channel.
O.Data[0]	REAL	Output Channel 0.
O.Data[1]	REAL	Output Channel 1.

Access Tags

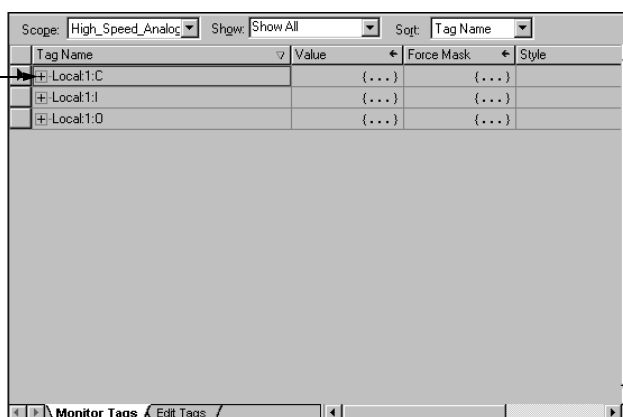
When you access tags, you have two options:

- Monitor tags—Enables you to view tags and change their values.
- Edit tags—Enables you to add or delete tags but not to change their values.

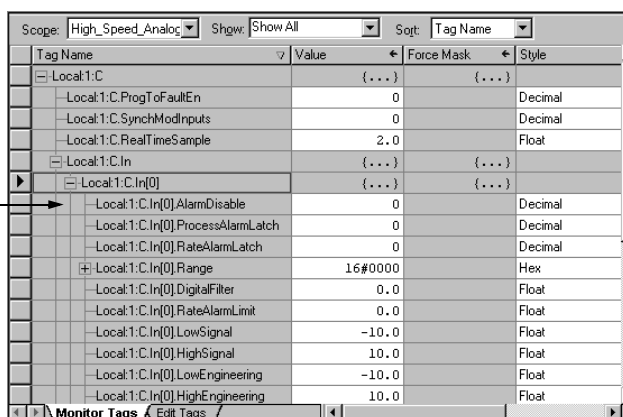


You can view tags here.

Click the + to open the tags until you access the information that needs to be changed.

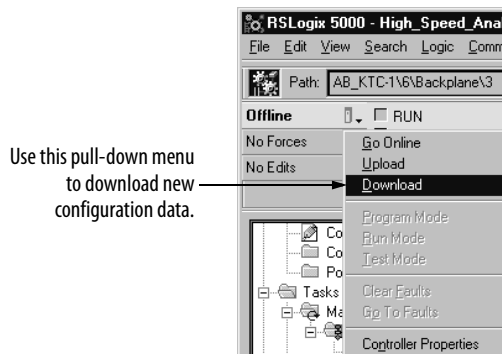


Configuration information is listed for each channel on a feature-by-feature basis.

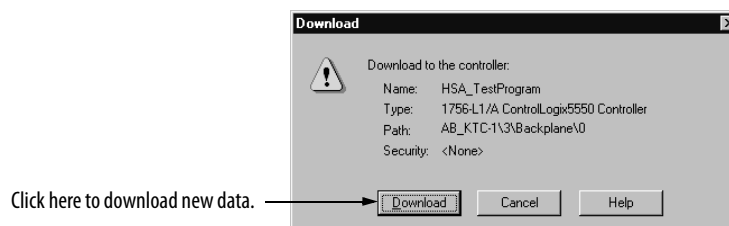


Download New Configuration Data

After you have changed the configuration data for a module, the change does not actually take affect until you download the new information.



The software verifies the download process with this message.



This completes the download process.

Use Message Instructions to Perform Run-time Services and Module Reconfiguration

Topic	Page
Message Instructions	121
Add the Message Instruction	123
Reconfigure the Module with a Message Instruction	128

IMPORTANT The enhanced message instruction is available only if you are using RSLogix 5000 software, version 10 or later.

You can use ladder logic to perform run-time services on your module. For example, [page 77](#) shows how to unlatch alarms on the high-speed analog I/O module using the module properties wizard. This appendix provides an example of how to unlatch those same alarms with ladder logic and message instructions.

In addition to performing run-time services, you can use ladder logic to change the configuration, as described in [Chapter 5](#). Some parameters may also be changed through ladder logic.

Message Instructions

When programming your ControlLogix high-speed analog I/O module, you can use message instructions to send services to the module. Message instructions send an explicit service to the module, causing specific behavior to occur, for example, unlatching an alarm.

Message instructions have the following characteristics:

- Messages use unscheduled portions of system communication bandwidth.
- One service is performed per instruction.
- Performing module services does not impede module functionality, such as sampling inputs or applying new outputs.

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.

EXAMPLE	You may want to unlatch all process alarms on an input channel, but real-time control of the process is still using data from the channel. Because this input data is critical to your application, the high-speed analog I/O module prioritizes the sampling of inputs ahead of the unlatch service request. After the module has processed the input data, it can unlatch all process alarms. 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.
----------------	---

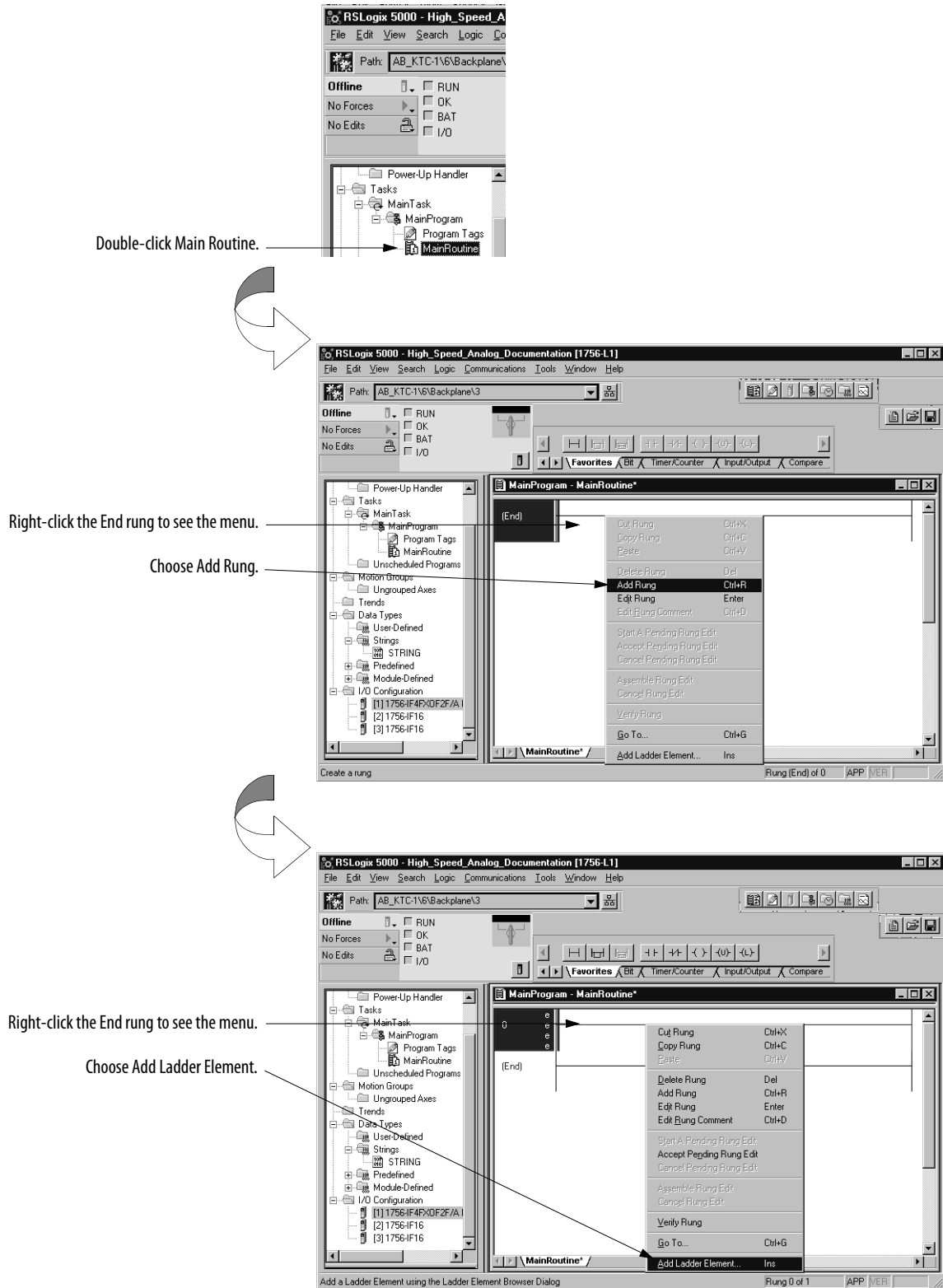
One Service Performed per Instruction

Message instructions cause a module service to be performed only once per execution. You must reexecute a message instruction to perform the service a second time.

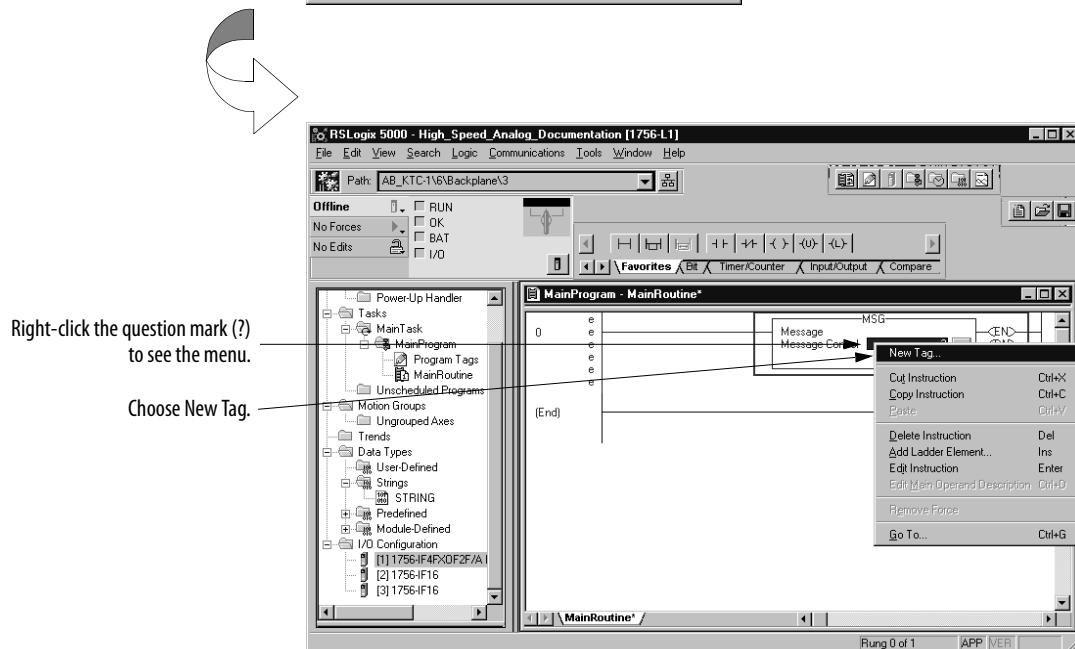
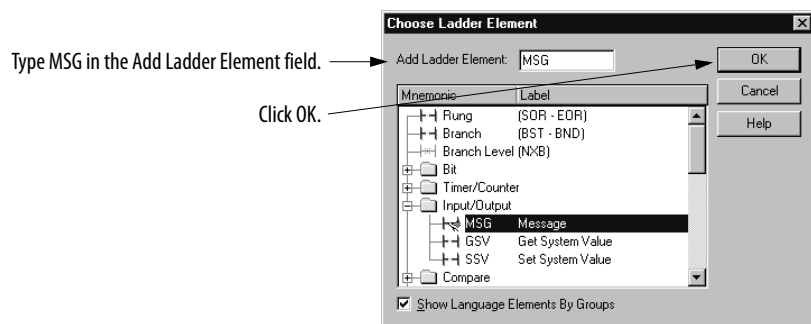
EXAMPLE	If a message instruction sends a service to the module to unlatch the high high alarm on input channel 0, that channel's high high alarm unlatches, but may be set on a subsequent channel sample.
----------------	--

Add the Message Instruction

This ladder logic is written in the Main Routine of the Logix Designer application.

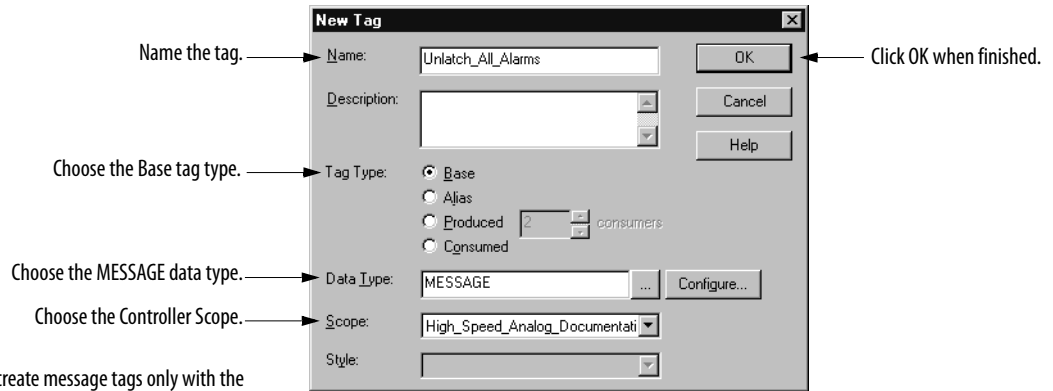


The following dialog box appears.



You must fill in the information shown below when the New Tag dialog box appears.

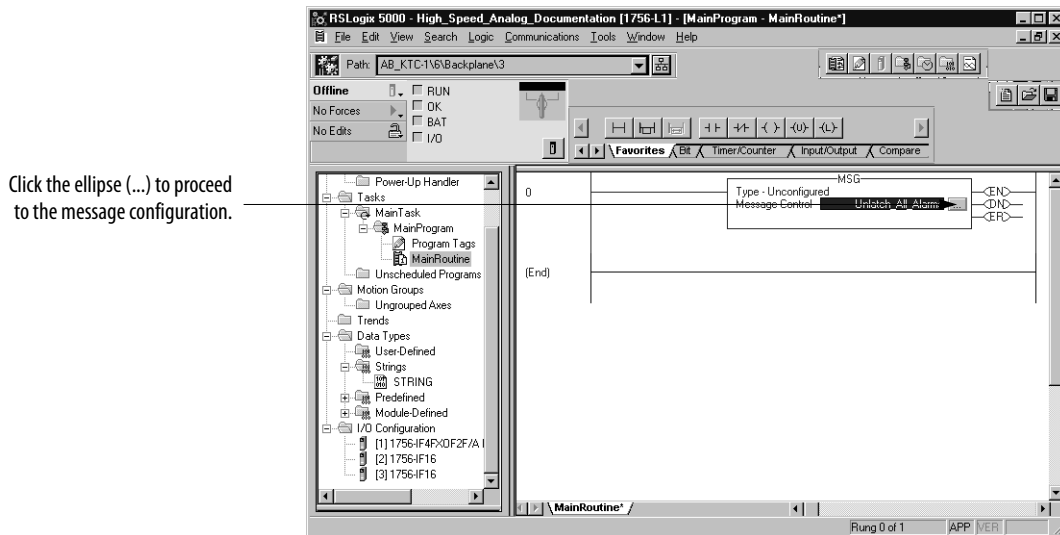
IMPORTANT We suggest you name the tag to indicate what module service is sent by the message instruction. For example, the message instruction below is used to unlatch a high alarm, and the tag is named to reflect this.



IMPORTANT: You can create message tags only with the controller scope. Use the Scope pull-down menu to choose the name of the controller project you are currently using.

Configure the Message Instruction

After creating a new tag, you must configure the message instruction.



You type message configuration on the following tabs:

- [Configuration Tab](#)
- [Communication Tab](#)

Configuration Tab

This tab provides information on what module service to perform and where to perform it. In the example below, the message instruction unlatches all input process alarms on the module.

Choose the message type.

Choose the service type.

Type the Instance value.

When you unlatch any alarm on the module, you must type in an Instance value.

Message Configuration - Unlatch_All Alarms

Configuration | Communication | Tag

Message Type: CIP Generic

Service Type: Unlatch All Alarms (I)

Service Code: 4b (Hex)

Instance: 2

Class: a (Hex)

Attribute: 0 (Hex)

Source Element:

Source Length: 0 (Bytes)

Destination:

New Tag...

☐ Enable

☐ Enable Waiting

☐ Start

☐ Done

Done Length: 0

☐ Error Code:

Extended Error Code:

☐ Timed Out

Error Path:

Error Text:

OK

Cancel

Apply

Help

IMPORTANT For some of the service types available with the ControlLogix high-speed analog I/O module, you must type values in required fields, in addition to choosing the service from the pull-down menu (as shown above). [Table 18](#) lists the services that require additional information.

Table 18 - Module Services

Service Type	Required Field	Valid Value
Device Who	Destination	Use the pull-down menu to choose a module location.
Retrieve CST	Destination	Use the pull-down menu to choose a module location.
Unlatch Alarm There are ten alarms that can be unlatched.	Instance	Number of the channel where a service is performed + 1. For example, if you want a service performed on input channel 2, you must use an Instance = 3.

Communication Tab

This tab provides information on the path of the message instruction.

Message Configuration - Unlatch_All_Alarms

Configuration* Communication* Tag

Path: Browse...

Communication Method:

☒ CIP ☐ DH+ Channel: Destination Link:

☐ CIP With Source ID Source Link: Destination Node: (Data)

☐ Connected ☒ Cache Connections

☐ Enable ☐ Enable Waiting ☐ Start ☐ Done Done Length: 0

☐ Error Code: Extended Error Code: ☐ Timed Out

Error Path:
Error Text:

OK Cancel Apply Help

Click Browse to choose the module where the message instruction service is performed. The dialog box below shows an example of available modules.

Message Path Browser

Path: High_Speed_Analog_Line

High_Speed_Analog_Line

I/O Configuration

- 1] 1756-IF4X0F2F/A High_Speed_Analog_Line
- 2] 1756-IF16
- 3] 1756-IF16

OK Cancel Help

Choose the module.

Click OK.

Message Configuration - Unlatch_All_Alarms

Configuration Communication* Tag

Path: High_Speed_Analog_Line High_Speed_Analog_Line

Communication Method:

☒ CIP ☐ DH+ Channel: Destination Link:

☐ CIP With Source ID Source Link: Destination Node: (Data)

☐ Connected ☒ Cache Connections

☐ Enable ☐ Enable Waiting ☐ Start ☐ Done Done Length: 0

☐ Error Code: Extended Error Code: ☐ Timed Out

Error Path:
Error Text:

OK Cancel Apply Help

Click OK to complete message configuration.

Reconfigure the Module with a Message Instruction

You can use the Module Reconfigure message type to change the functional operation of a high-speed analog I/O. With this message type, you make sure changes in the process dictate when the reconfiguration takes place rather than performing that function manually.

Considerations with the Module Reconfigure Message Type

Remember the following when using this method of module reconfiguration:

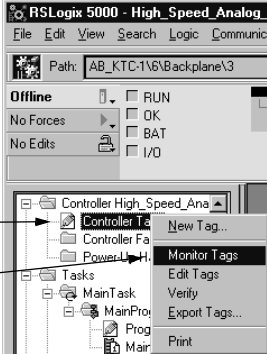
- All connections between the high-speed analog I/O module and any Logix controllers (either the owner-controller or listen-only controllers) remain open during the module reconfiguration.
- The module processes data during reconfiguration. If data changes occur during reconfiguration, such as if the module receives new input data, the application of that data is dependent on when it was received in the reconfiguration process.
- Because the receipt of new data may occur at any point, the application may occur according to parameters defined by the old configuration or the new configuration.
- Changes to output parameters take place the first time new data is applied to the outputs.

To perform a module reconfiguration with the Module Reconfigure message type, follow these steps.

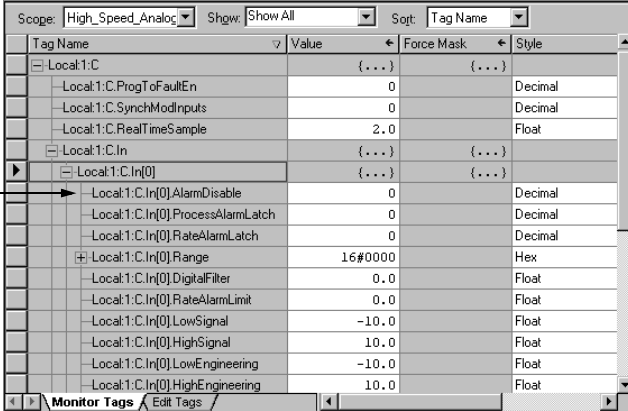
1. Change module configuration in the tag editor.

Right-click I/O Configuration to see the menu.

Choose Monitor Tags.



Change the configuration.



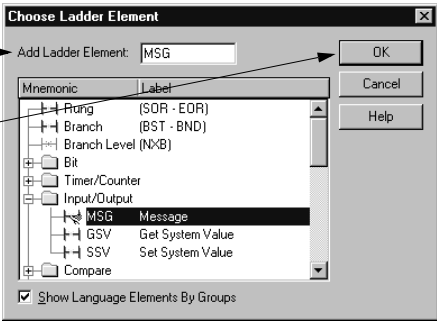
Tag Name	Value	Force Mask	Style
Local1:C	{...}	{...}	
Local1:C.ProgToFaultEn	0		Decimal
Local1:C.SynchModInputs	0		Decimal
Local1:C.RealTimeSample	2.0		Float
Local1:C.In	{...}	{...}	
Local1:C.In[0]	{...}	{...}	
Local1:C.In[0].AlarmDisable	0		Decimal
Local1:C.In[0].ProcessAlarmLatch	0		Decimal
Local1:C.In[0].RateAlarmLatch	0		Decimal
Local1:C.In[0].Range	16#0000		Hex
Local1:C.In[0].DigitalFilter	0.0		Float
Local1:C.In[0].RateAlarmLimit	0.0		Float
Local1:C.In[0].LowSignal	-10.0		Float
Local1:C.In[0].HighSignal	10.0		Float
Local1:C.In[0].LowEngineering	-10.0		Float
Local1:C.In[0].HighEngineering	10.0		Float

2. Add a rung of ladder logic with a ladder element as shown on [page 123](#).

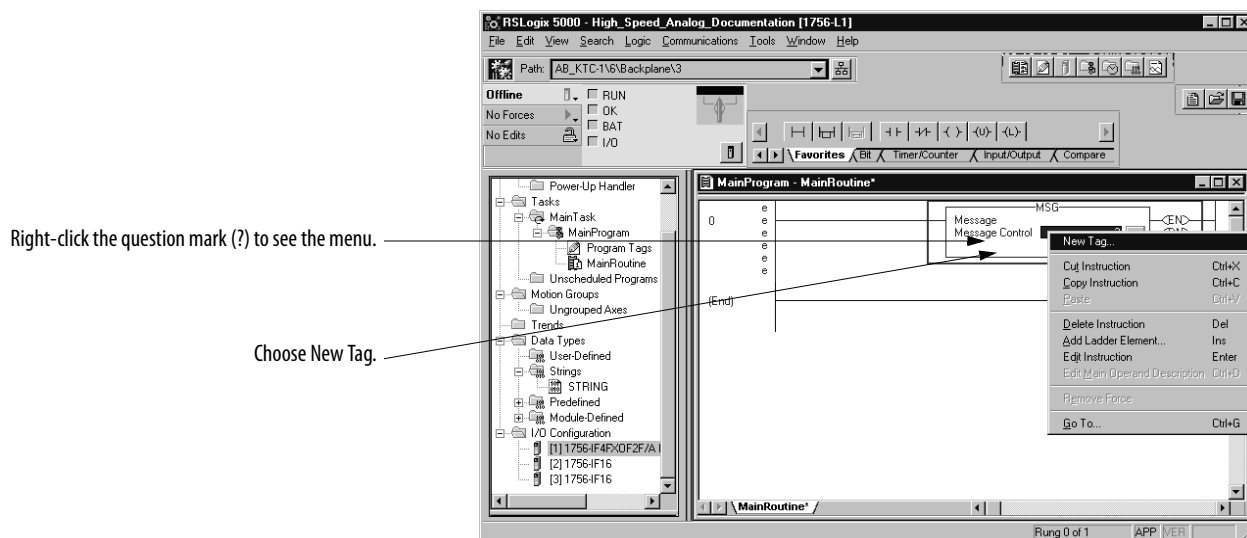
The following dialog box appears.

Type MSG in the Add Ladder Element field.

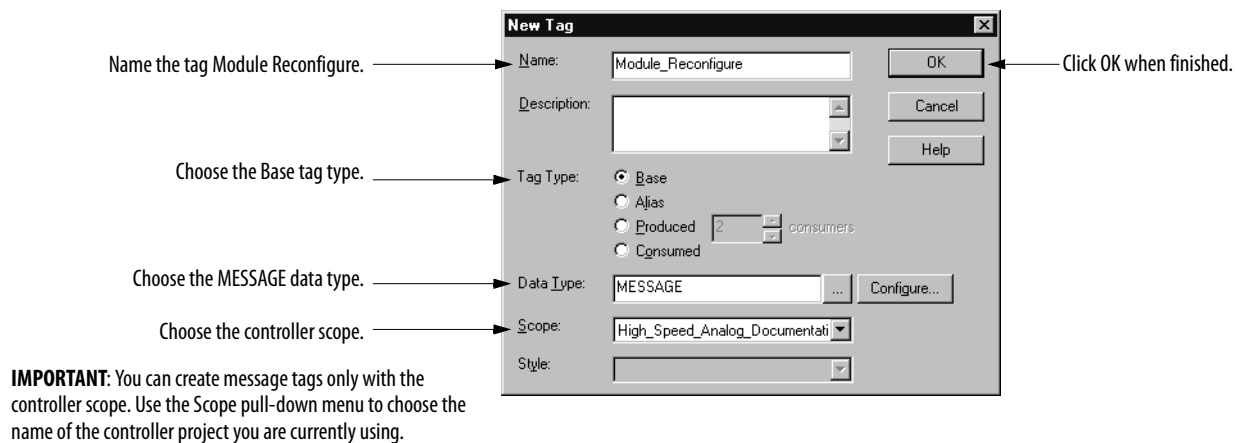
Click OK.



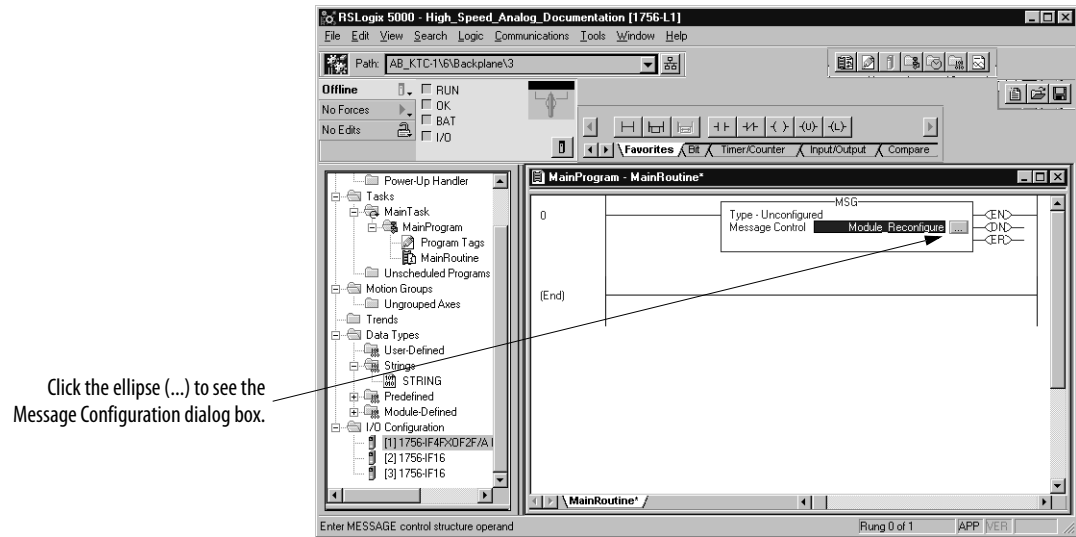
3. Create a New Tag for the Module Reconfigure service.



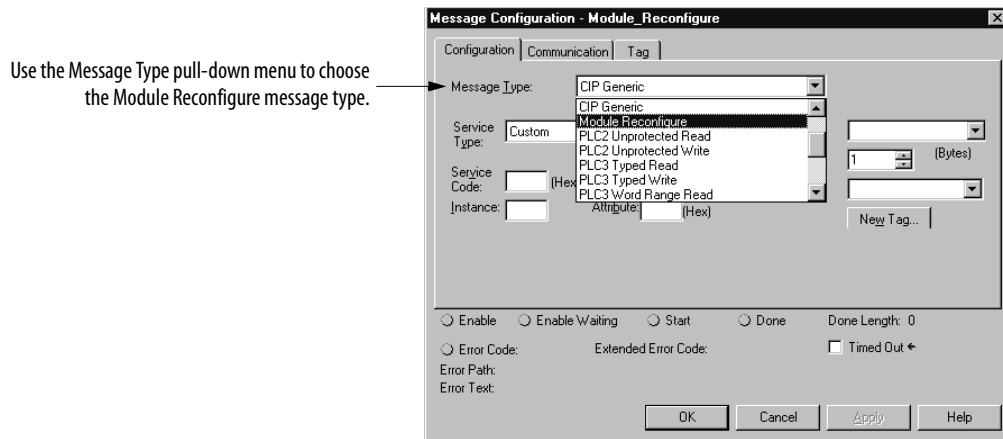
4. Complete the following information.



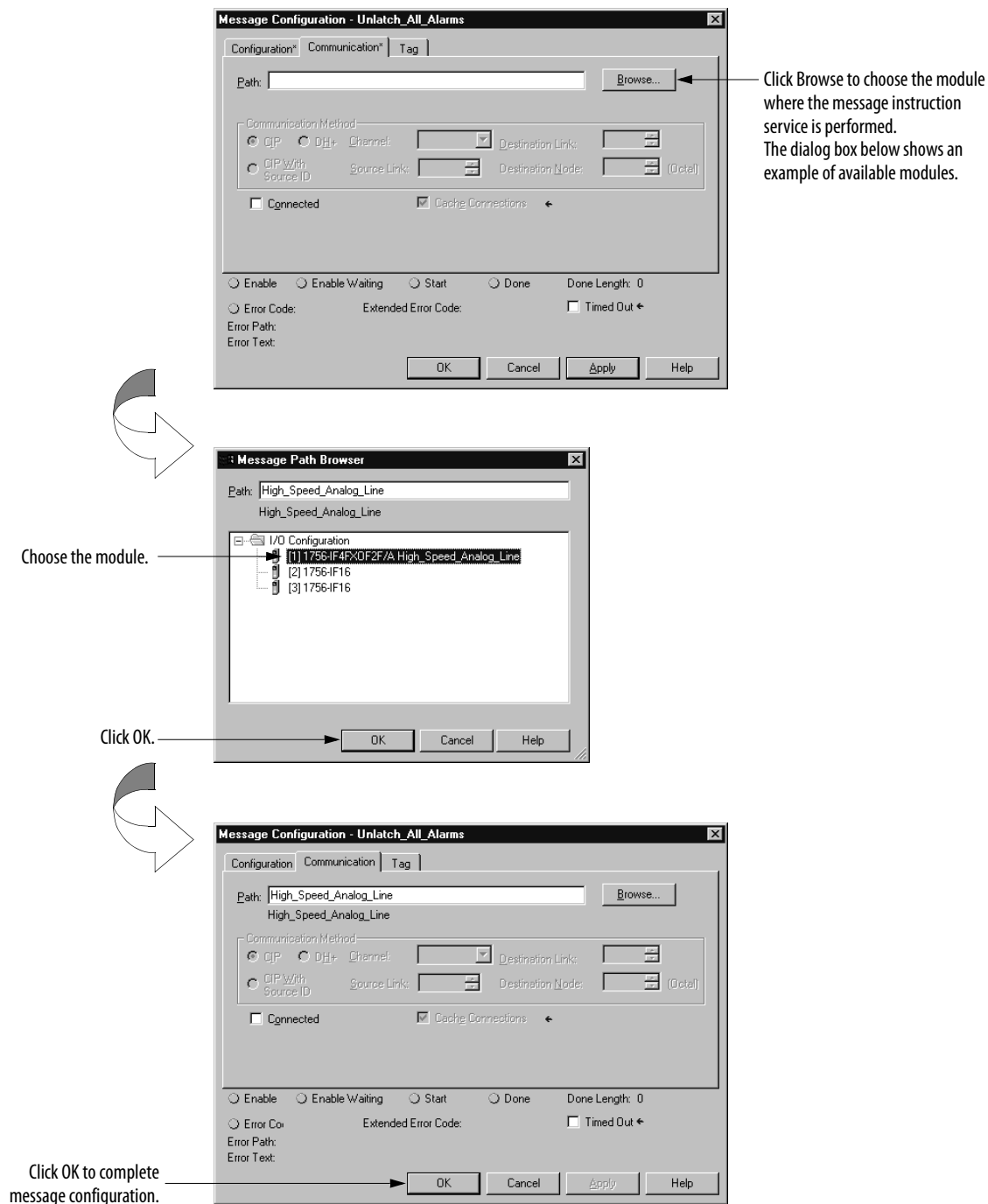
5. Enter the Message Configuration dialog box.



6. Choose the Module Reconfigure message type.



The Communication tab provides information on the path of the message instruction.

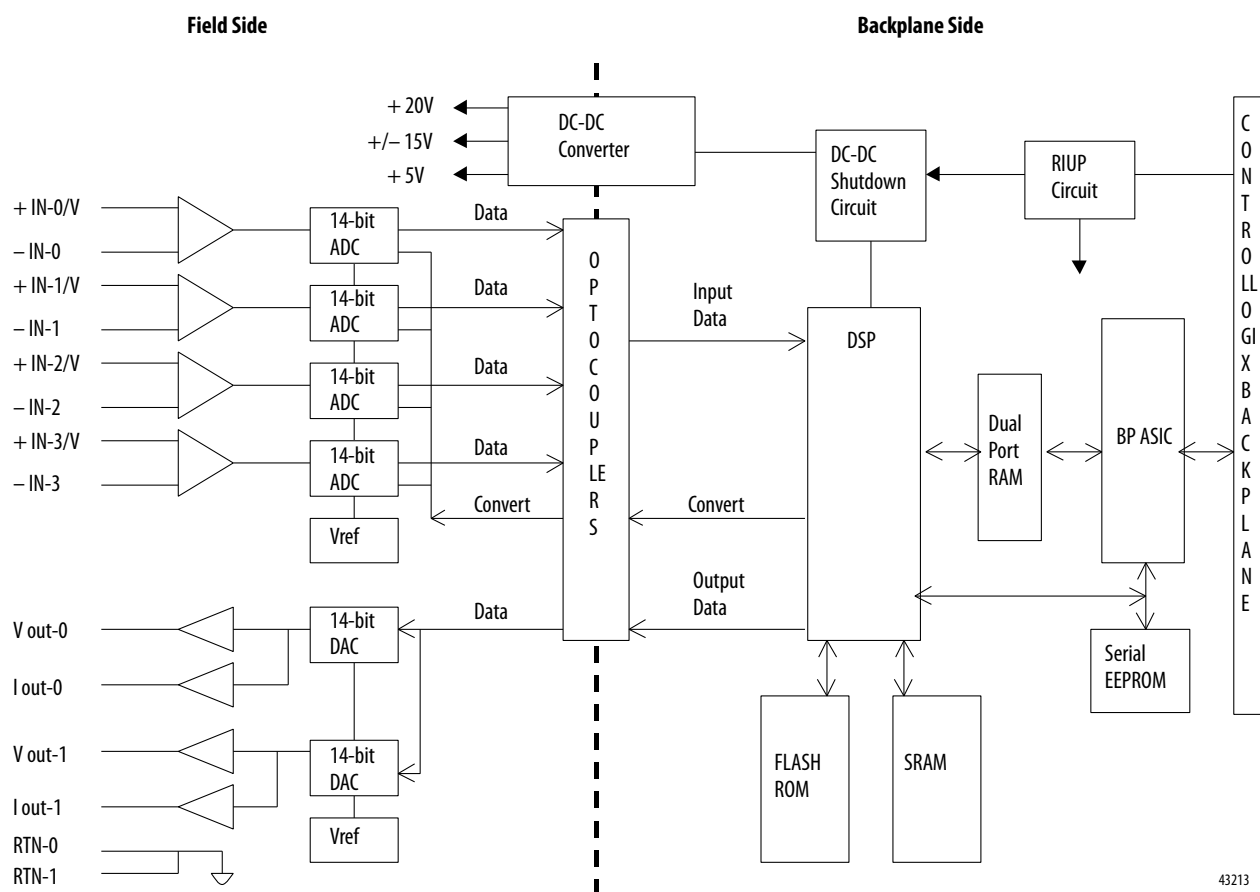


Simplified Circuit Schematics

Topic	Page
Module Block Diagram	133
Input Channel Circuits	134
Output Channel Circuits	135

Module Block Diagram

The figure below shows a block diagram for the ControlLogix high-speed analog I/O module.

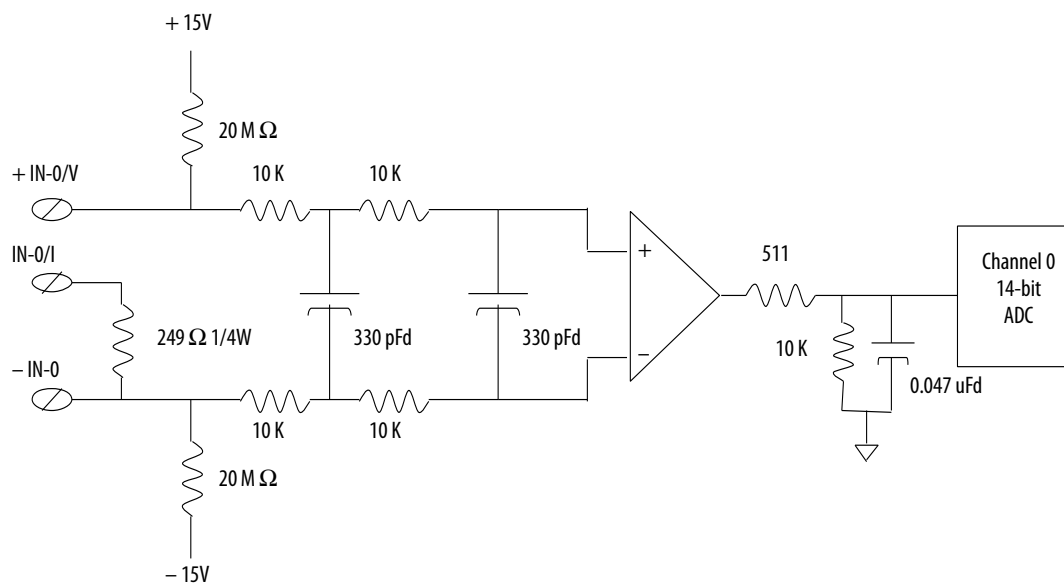


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Input Channel Circuits

The ControlLogix high-speed analog I/O module uses four input channels (0...3). The figure below shows the simplified schematic for each input channel.

IMPORTANT The figure shows the circuit for input channel 0. Input channels 1...3 are exactly the same with the exception that the terminals on the left side of the circuit are labelled for each specific channel. For example, channel 1 uses + IN-1/V, IN-1/I and – IN-1.

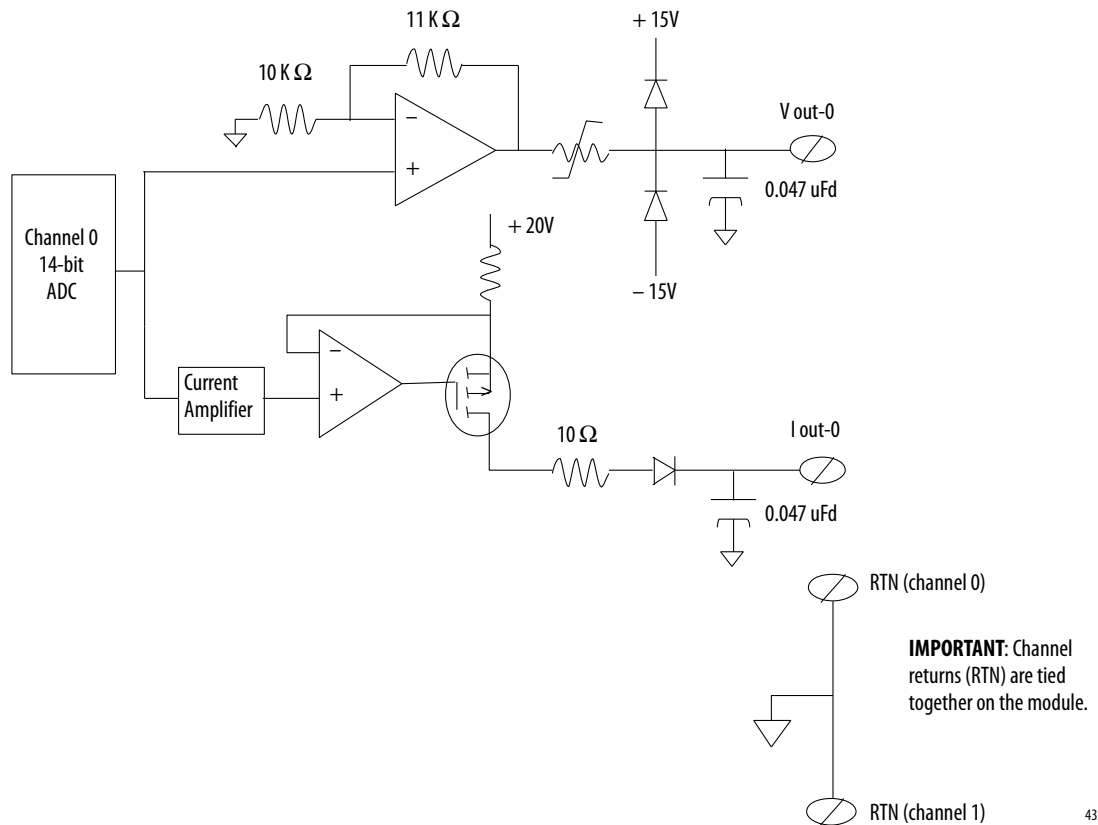


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Output Channel Circuits

The ControlLogix high-speed analog I/O module uses two output channels (0...1). The figure below shows the simplified schematic for each output channel.

IMPORTANT The figure shows the circuit for output channel 0. Output channel 1 is exactly the same with the exception that the terminals on the left side of the circuit are labelled for each specific channel. For example, channel 1 uses V out-1 and I out-1.



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Notes:

Module Operation in a Remote Chassis

Topic	Page
Remote Modules Connected via the ControlNet Network	137
Use RSNetWorx Software and Logix Designer Application	140
Configure High-speed Analog I/O Modules in a Remote Chassis	141

Remote Modules Connected via the ControlNet Network

If a high-speed analog I/O module resides in a remote chassis, the role of the RPI and the module's RTS behavior change slightly with respect to sending input data to the owner.

IMPORTANT

The performance of a high-speed analog I/O module is limited in a remote chassis. The network cannot effectively accommodate the fastest module update rates because the size of the data broadcast requires a large portion of the network's bandwidth. For maximum module performance, we recommend you use it in a local chassis.

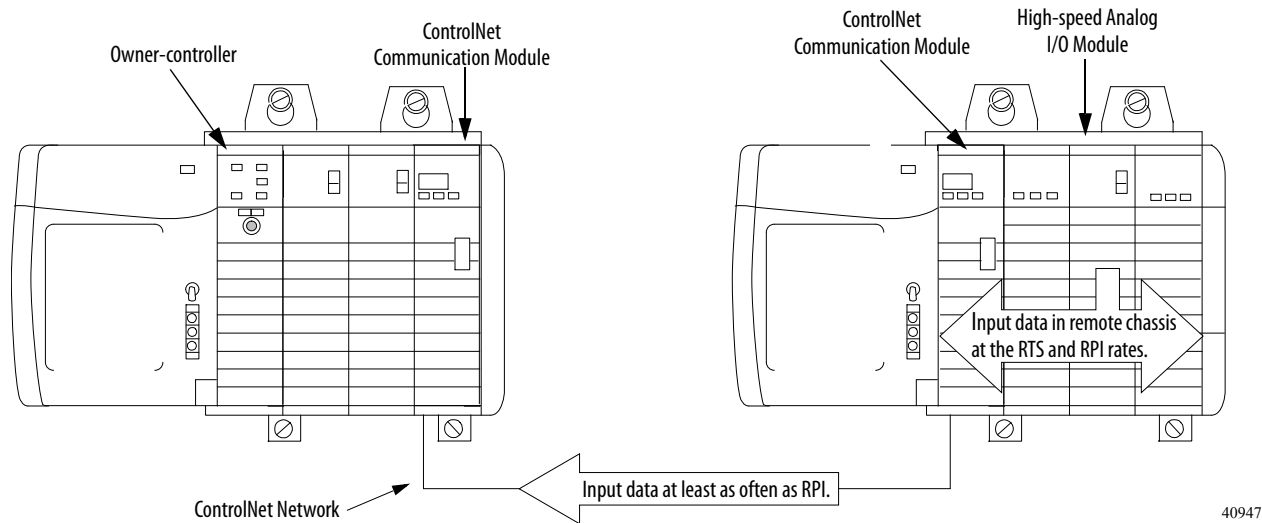
Also, when you use a ControlLogix high-speed analog I/O module in a remote chassis, you must use RSNetWorx™ for ControlNet software to configure the ControlNet network. For more information on how to use RSNetWorx for ControlNet software, see [page 140](#).

In a local chassis, the RPI and RTS rates define when a module multicasts input data as described in [Chapter 2](#). If the module is located in a remote chassis, however, the value of the RPI determines how often the owner-controller receives it over the network.

When an RPI value is specified for a high-speed analog I/O module in a remote chassis, in addition to instructing the module to multicast input 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 guarantees that the owner-controller receives data **at least as often** as the specified RPI.

Figure 16 - Owner-controller Receives Input Data from Remote Chassis



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 receives updated channel data from the module in a remote 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 does not receive data until the next scheduled network slot.

TIP

Because it is the RPI and not the RTS that dictates when the module's data is sent over the network, we recommend the following:

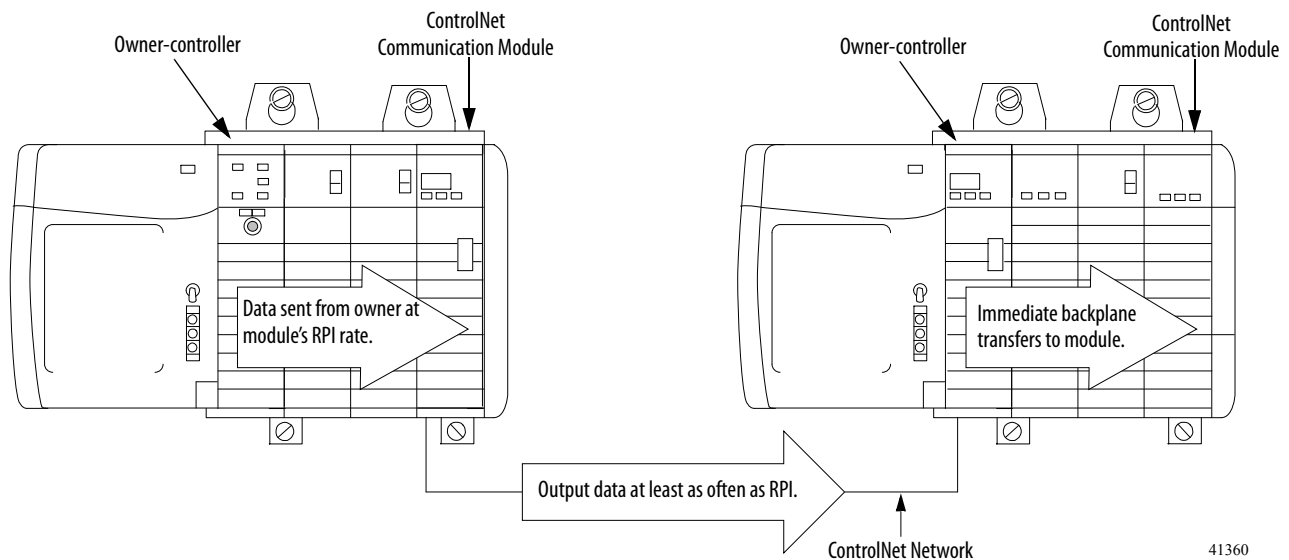
- If you want to receive every sample, set the $RPI < RTS$.
- If you want fresh data each time the owner-controller receives a sample, set the $RTS < RPI$.

If the high-speed analog I/O module resides in a remote chassis, the role of the RPI changes slightly with respect to getting data from the owner-controller.

When an RPI value is specified for a 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 guarantees that the output module receives data **at least as often** as the specified RPI.

Figure 17 - Owner-controller Sends Output Data to Remote Chassis



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 receives the output data from the controller in a remote 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 is not 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.

Use RSNetWorx Software and Logix Designer Application

The I/O configuration portion of the Logix Designer application generates the configuration data for each high-speed analog I/O module in the control system, whether the module is located in a local or remote chassis. A remote chassis contains the module but not the module's owner-controller.

You must use the configuration dialog boxes in the application to configure the module. Configuration data is transferred to the owner-controller during the program download and subsequently transferred to the appropriate modules in the local chassis. However, you must run RSNetWorx for ControlNet software to enable modules in the remote chassis.

When you run the software, it transfers configuration data to remote modules and establishes a Network Update Time (NUT) for the ControlNet network. The NUT is compliant with the desired communication options specified for each module during configuration. Anytime a controller references an I/O module in a remote chassis, you must run RSNetWorx software to configure the ControlNet network.

Follow these steps when configuring high-speed analog I/O modules in a remote chassis.

1. Configure all modules for the controller.
2. Download configuration information to the controller.
3. Run RSNetWorx for ControlNet software.

IMPORTANT You must run RSNetWorx for ControlNet software whenever a new module is added to a remote chassis. When a module is permanently removed from a remote chassis, we recommend that you run RSNetWorx software to optimize the allocation of network bandwidth.

Configure High-speed Analog I/O Modules in a Remote Chassis

ControlLogix ControlNet interface modules (catalog numbers 1756-CNB or 1756-CNBR) are required to communicate with a ControlLogix high-speed analog I/O module in a remote chassis. You must configure the communication module in the local chassis and the remote chassis before adding new high-speed analog I/O modules.

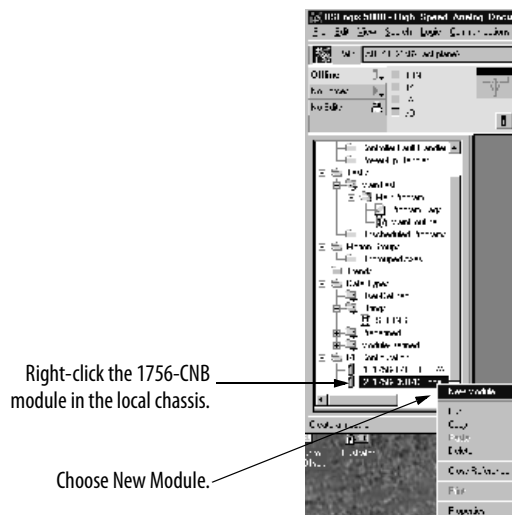
IMPORTANT Although a high-speed analog I/O module works in a remote chassis, it reaches maximum data production rates only in the local chassis.

For example, if use a ControlLogix high-speed analog I/O module in a local chassis, the minimum RPI rate = 300 μ s. However, when the module is used in a remote chassis connected by ControlNet, you must account for the NUT. The minimum ControlNet NUT = 2 ms. In this case, the fastest time to receive data from a high-speed analog I/O module is doubled when compared to a local chassis.

1. Configure a communication module for the local chassis.

This module handles communication between the controller's local chassis and the remote chassis. Add a 1756-CNB or 1756-CNBR module to the local chassis using the steps on [page 73](#).

2. Configure a communication module for the remote chassis.



3. Choose a 1756-CNB or 1756-CNBR module and configure it.

IMPORTANT Be aware of the two communication format choices available for 1756-CNB modules. For more information on the differences between Rack Optimization and Listen-only Rack Optimization, see the ControlLogix Digital I/O Modules User Manual, publication [1756-UM058](#).

You can now configure remote I/O modules by adding them to the remote communication module. Follow the same procedures as explained earlier in this chapter for configuring local I/O modules.

Notes:

Module Revision History

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Series A versus Series B Firmware

If you have a series A module, you can upgrade the module's firmware to install the same features that are available on the series B module. Any module that uses firmware revision 3.005 and later has a series B designator. Series A modules that are upgraded to revision 3.005 or later also have a series B designator.

Archiving Enhancement with Revision 3.005 and Later

Archiving is provided in firmware revision 3.005 and later. Because it is not dependent on specialized module hardware, any high-speed analog module can be updated to perform this function. For more information about this function, see [Archiving on page 38](#).

Corrected Anomaly with Revision 3.005 and Later

The following anomaly is corrected in firmware revision 3.005 and later.

CORRECTED: When the high-speed analog module, series A, is used in a system where its connection is through a 1756-EN2T module, I/O connections cannot complete.

Upgrade the high-speed analog module to series B, firmware revision 3.005, to enable the proper I/O connection.

Series B Modules as Direct Replacements for Series A Modules

You can use a 1756-IF4FXOF2F/B module, firmware revision 3.005 or later, as a direct replacement for a 1756-IF4FXOF2F/A module. When you insert a series B module into a series A slot, the series A configuration profile works with the series B module as long as electronic keying is not set to Exact Match.

If Exact Match keying is required in your application, you must remove the series A module from the I/O Configuration tree and reconfigure it with the series B profile. The series B module will operate identically to the series A module as long as the Archiving Connection communication format is not selected.

TIP

Both series A and series B profiles for the 1756-IF4FXOF2F module will remain in the software. If you are using a series A module and do not need to use archiving, then you can continue to use the series A profile:

- If you do not need to use archiving, you can upgrade the module to series B firmware and use the series B profile by choosing any communication format other than Archiving Connection.
- If your application requires that replacement modules be the identical hardware/firmware series, you can downgrade a series B module to series A firmware available at <http://www.rockwellautomation.com/support/>.

Install Series B Firmware

For you to have the corrected anomaly and the archiving enhancement for a series A module, you must install series B firmware, revision 3.005, or later.

If you need to upgrade your existing module, download the firmware and related files from <http://www.rockwellautomation.com/support/> and use ControlFLASH™ software to upgrade the firmware.

After you have upgraded the firmware, configure the module. If you do not intend to use the archiving function, no further action is required. To configure the module for archiving, see [Archiving on page 38](#).

In most cases, a series B module can be used as a direct replacement for a series A module. Direct replacement of a high-speed analog module at series A with a module at series B does not require a change to the module's configuration **except** if electronic keying is set to Exact Match. If electronic keying is set to Exact Match, complete one of the following.

If your application	Then
Does not require replacement modules to have identical hardware and firmware series	Change electronic keying from Exact Match to Compatible Keying. <ol style="list-style-type: none"> Open the Module Properties dialog box. From the Electronic Keying pull-down menu, choose Compatible Keying.
Requires replacement modules to have identical hardware and firmware series	Downgrade the series B module to series A firmware available at http://www.rockwellautomation.com/support/ .

Broadcast	Data transmissions to all addresses.
Communication 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 . In this case, the minor 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 that is kept synchronized for all modules within a single ControlBus chassis. The CST is a 64-bit number with μ s 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 that 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 and minor .
Field side	Interface between user field wiring and I/O module.
Inhibit	A ControlLogix process that lets 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	A module that is updated any time there is a functional change to the module resulting in an interface change with software.

Minor	A module that is updated any time there is a change to the module that does not affect its function or software user interface.
Multicast	Data transmissions that 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 2 ms to 100 ms using RSNetWorx software.
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 that defines when the module will multicast data.
Run mode	In this mode, the controller program is executing. Inputs are actively producing data, and 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.

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Publication 1756-UM005B-EN-P - January 2013

Supersedes Publication 1756-UM005A-EN-P - April 2002

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