User Manual

Allen-Bradley

ControlLogix HART Analog I/O Modules

Catalog Numbers 1756-IF8H, 1756-IF16H, 1756-OF8H

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

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

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

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

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

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

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.

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

New and Updated Information

This table contains the changes made to this revision.

Topic	Page
Additional Input Data tag, Analog and HART by Channel, is available for the 1756-IF8H and 1756-OF8H analog I/O modules.	54, 80
Power supply wiring diagrams are available for the 1756-IF8H analog input module.	61
Unicast connection to streamline EtherNet/IP network broadcast traffic is available for the 1756-IF8H and 1756-OF8H analog I/O modules.	51, 93
Additional device diagnostics are available on the HART Device Info tab.	111
Tag definitions are updated for the 1756-IF8H and 1756-OF8H analog I/O modules.	163
Manufacturer identification codes are updated.	205

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Tag Definitions

This manual describes how to install, configure, and troubleshoot ControlLogix highway addressable remote transducer (HART) analog I/O modules.

Audience

You must be able to program and operate a Rockwell Automation ControlLogix controller to efficiently use your analog I/O modules. In this manual, we assume that you know how to do this. If you do not, before attempting to use this module, refer to the Logix5000 controller documentation, as listed in the related table.

Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
ControlLogix HART Analog I/O Modules Release Notes, publication 1756-RN636	Contains release information about the ControlLogix analog modules with HART protocol.
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides access to a collection of programming manuals that describe procedures that are common to all Logix5000 controller projects.
ControlLogix System User Manual, publication 1756-UM001	Provides configuration and operational procedures for ControlLogix controllers.
1756 ControlLogix I/O Modules Specifications Technical Data, publication 1756-TD002	Publication provides specifications for the 1756-IF8H and 1756-OF8H analog I/O modules.
Industrial Automation Wiring and Grounding Guidelines, publication1770-4.1	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 Rockwell Automation distributor or sales representative.

Notes:

ControlLogix HART Analog I/O Modules

Introduction

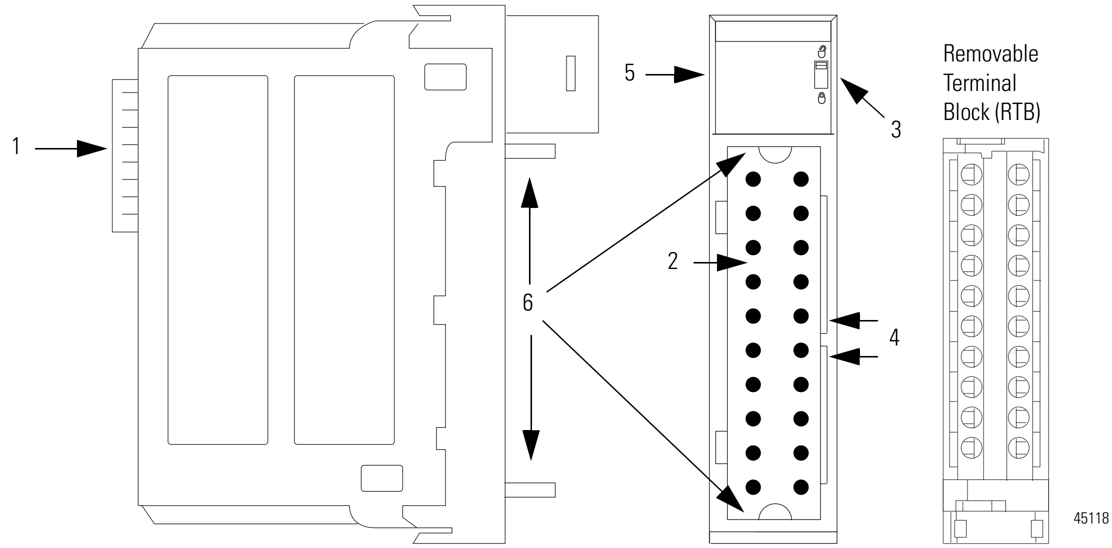
ControlLogix HART analog I/O modules connect a Logix controller to your process. 1756-IF8H and 1756-IF16H input modules receive the signals from process value transmitters and convert them to temperature, flow, pressure, pH, and other measurements for use in the Logix controller. By using 1756-OF8H HART output modules, the controller adjusts the setting of valves and other devices to keep your process running as desired.

Using instruments that support the HART protocol allows measuring several process parameters with a single field device, provides enhanced status and diagnostics, and allows remote configuration and troubleshooting.

The table explains the topics discussed in this chapter.

Module Components

This figure shows the physical features of the ControlLogix analog I/O modules.



#	Physical Feature	Description
1	Backplane connector	The backplane connector interface for the ControlLogix system connects the module to the ControlBus backplane.
2	Connector pins	Input/output, power, and grounding connections are made to the module through these pins with the use of a removable terminal block (RTB) or interface module (IFM).
3	Locking tab	The locking tab anchors the RTB or IFM cable on the module, maintaining wiring connections.
4	Slots for keying	Mechanically keys the RTB to prevent inadvertently making the wrong wire connections to the module.
5	Status indicators	Indicators display the status of communication, module health, and input and output devices. Use these indicators to help in troubleshooting.
6	Top and bottom guides	Guides provide assistance in seating the RTB or IFM cable onto the module.

HART Communication

The HART field communication protocol is widely accepted in industry as a standard for digitally enhanced 4…20 mA communication with smart (microprocessor-based) field devices. A digital signal is superimposed onto the 4…20 mA current loop to provide two means of communication from the device. The 4…20 mA analog channel lets a single process variable be communicated at the fastest possible rate while the digital channel provides access to multiple process variables, data quality, and device status information. The HART protocol lets these simultaneous communication channels be used in a complementary fashion.

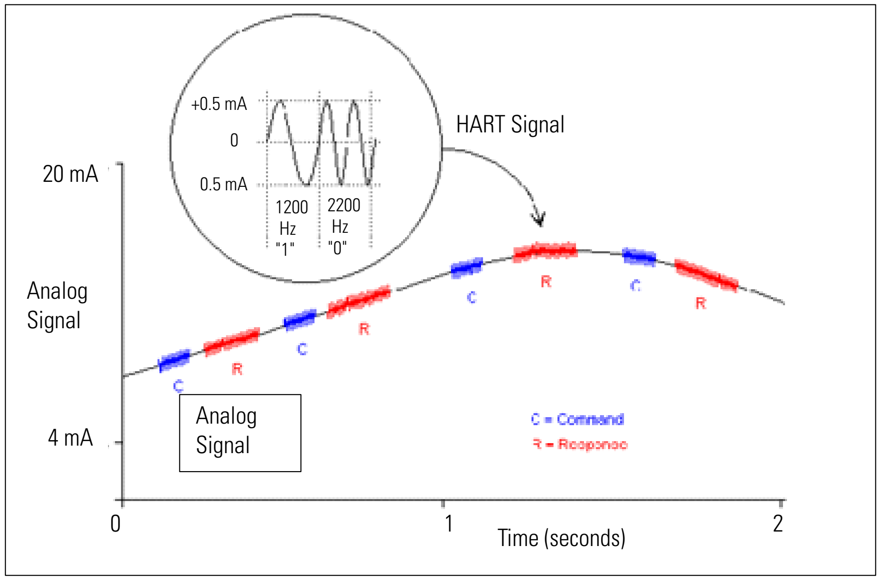
The modules support the HART protocol and perform these distinct operations:

- Convert to or from 4…20 mA analog signals and digital numeric values in engineering units used in the Logix controller.
- Collect dynamic process data automatically from the connected HART field device, such as temperature, pressure, flow, or valve position.
- Configure and troubleshoot the HART Field Device by using FactoryTalk AssetCentre service from your control room.

The Highway Addressable Remote Transducer (HART) protocol supports two-way digital communication, complements traditional 4…20 mA analog signals, and includes the following features:

- Predefined commands
  - Common practice
  - General purpose
  - Device specific
- Large installed base
- Worldwide support

See the figure[1] that shows information about the HART protocol.

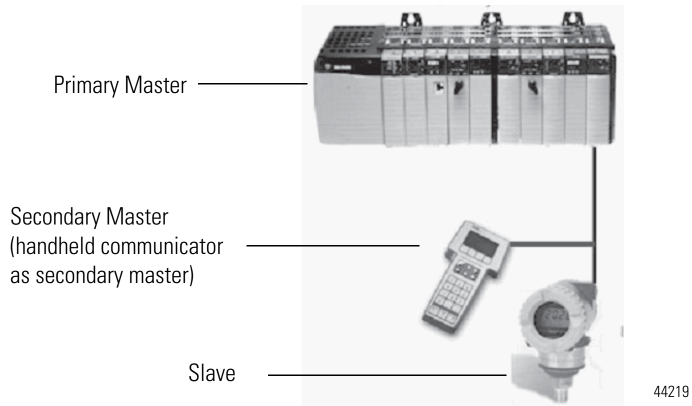


With the ControlLogix HART analog I/O modules, field device data can be accessed by both the controller and device maintenance and management software.

The ControlLogix HART analog I/O modules support Command-response communication protocol and point-to-point wiring architecture.

(1) The figure is from the HART Communication Protocol Specifications, April, 2001, Revision 6.0, HART Communication Foundation, All Rights Reserved.

Commands can be accepted from either of two master devices. The controller is one of the master devices and continuously obtains information from the field device. The second master can typically be device maintenance, for example a handheld communicator, as shown below.



Integrated HART Networks

Most transmitters are available with a HART protocol interface. The type of data available is dependent on the type of instrument.

An example application is a smart mass flowmeter. By using just the standard mA signal from the flowmeter it provides one field measurement - flow. By using the mA signal with HART provides additional process information. The mA signal representing flow is still available. The HART configuration of the flowmeter can be set for primary value (PV) being mass flow, secondary value (SV) being static pressure, third value (TV) being temperature, and fourth value (FV) being a digital representation of the mA signal.

In addition to these additional process variables, device status is also provided via HART. Instead of one process variable, the controller sees four process variables, has a check on the mA signal, and has a reading of device status. HART connectivity provides all this with no changes to the existing 4…20 mA wiring.

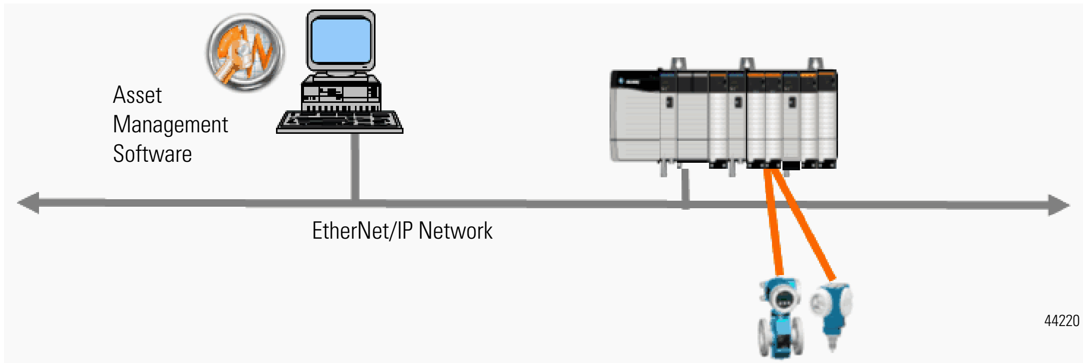
This HART connectivity also provides remote configuration and troubleshooting of field devices by using software, such as FactoryTalk AssetCentre or Endress+Hauser FieldCare software.

HART-enabled I/O Modules

The ControlLogix HART analog I/O modules have HART modems built in, so there is no need to install external HART multiplexors or clip on HART modems.

Asset Management Software

You can use the modules with asset management software. The following figure shows the use of asset management software, such as FactoryTalk AssetCentre software or Endress+Hauser FieldCare software.



Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the RSLogix 5000 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
- Disable 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.

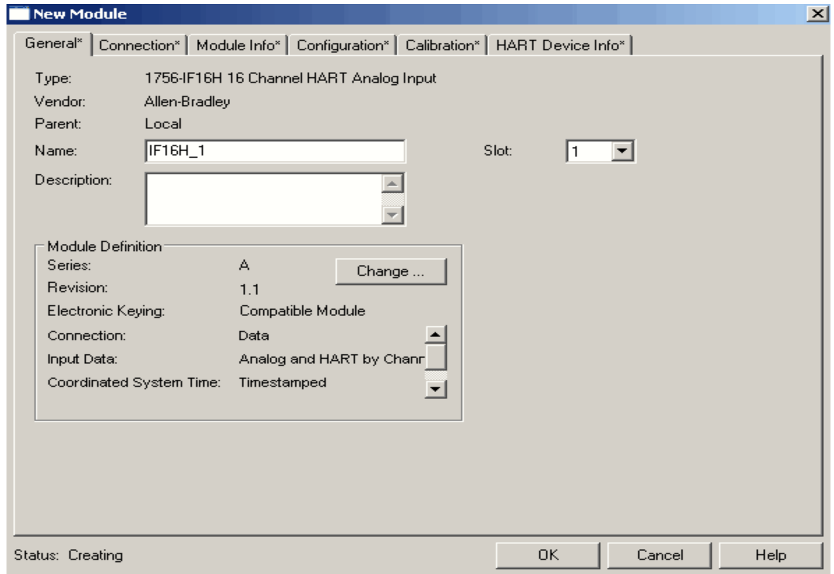
Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

Table 1 - 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-IB16I.
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 1 - 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.

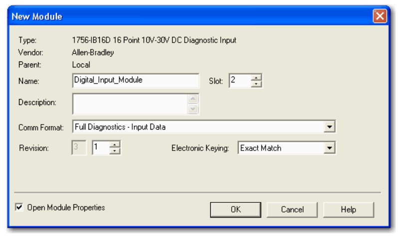
Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic Firmware Update for the module via the Firmware Supervisor feature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

EXAMPLE

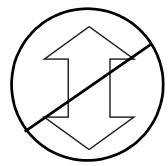
In the following scenario, **Exact Match keying prevents I/O communication**.

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.

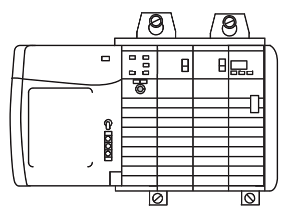
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 1



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.

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. 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.

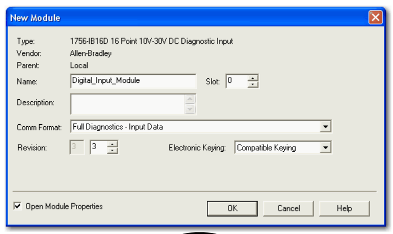
Release notes for individual modules indicate the specific compatibility details.

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 the module by 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.

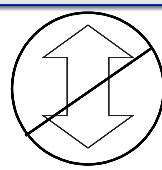
EXAMPLE In the following scenario, **Compatible keying prevents I/O communication**:

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.

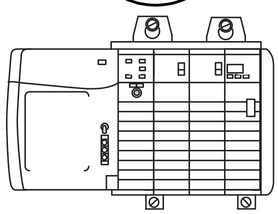
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 3



Communication is prevented.



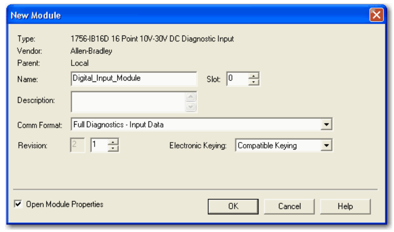
Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



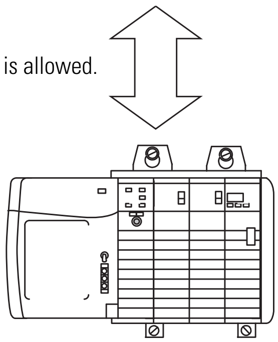
EXAMPLE In the following scenario, **Compatible keying allows I/O communication**:

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.

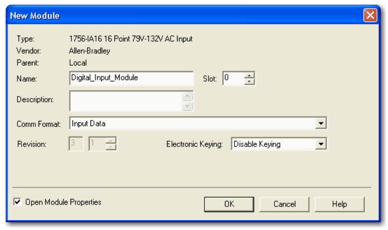
If you use Disabled keying, you must take full responsibility for understanding whether the module that is being used can fulfill the functional requirements of the application.

EXAMPLE

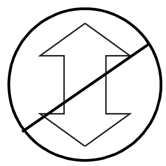
In the following scenario, **Disable keying prevents I/O communication**:

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**.

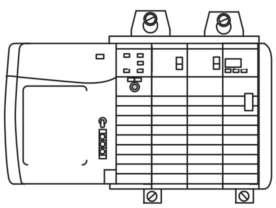
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 3
Minor Revision = 1



Communication is prevented.



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

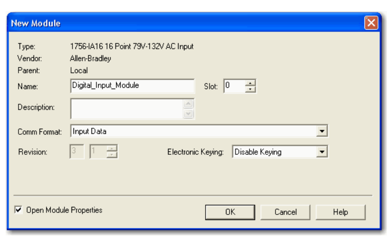


EXAMPLE

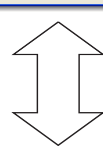
In the following scenario, **Disable keying allows I/O communication**:

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.

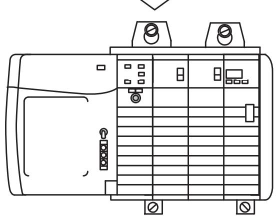
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 2
Minor Revision = 1



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.

Timestamping

Controllers within the ControlLogix chassis maintain a system clock. This clock is also known as the coordinated system time (CST). You can configure your analog I/O modules to access this clock and timestamp input data or output echo data when the module multicasts to the system.

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

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

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

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

Module Scaling

When using scaling, you change a quantity from one notation to another.

To scale a channel, choose two points along the module's operating range and apply corresponding low and high unit values to those points.

Scaling lets you configure the module to return data to the controller in units that match the quantity being measured. For example, the analog input module can provide the temperature in degrees Celsius or the pressure in mbar. An analog output module might have commanded values represented in % of stroke of a valve. This makes it easier to use the values in your control program than by using the raw signal value in mA.

Units like gallons, percent, mbar, psi, celsius, liters, and liters/minute are referred to as Engineering Units.

For more information about scaling, see Scaling to Engineering Units on page 98.

Module Installation

Introduction

The 1756-IF8H, 1756-OF8H, and 1756-IF16H analog modules use the HART protocol with eight and 16 channels, respectively. This chapter describes basic installation procedures.

The table explains the topics discussed in this chapter.

Environment and Enclosure

ATTENTION: 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 considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

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, V2, V1, V0 (or equivalent) if non-metallic. 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

Preventing Electrostatic Discharge

ATTENTION: 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.

European Hazardous Location Approval

European Zone 2 Certification
(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.

WARNING:

- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- 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 40% when applied in Zone 2 environments.
- This equipment must be used only with ATEX certified Rockwell Automation 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.

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:
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.	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.
EXPLOSION HAZARD • 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.	**RISQUE D'EXPLOSION** • 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.

Removal and Insertion Under Power (RIUP)

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.

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

Before You Begin

IMPORTANT Before you install your module, you should have already:

- Installed and grounded a 1756 chassis and power supply.
- Ordered and received a removable terminal block (RTB) or 1492 interface module (IFM) and its components for your application.

Module Accessories

These modules mount in a ControlLogix chassis and use a separately-ordered removable terminal block (RTB) or a 1492 interface module (IFM) to connect all field-side wiring.

The ControlLogix HART analog modules use one of the following RTBs and support these IFMs.

Module	RTBs(1)	IFMs(2)
1756-IF8H	• 1756-TBCH 36-position cage clamp RTB • 1756-TBS6H 36-position spring clamp RTB	• 1492-ACABLE*x*UD (current) • 1492-ACABLE*x*UC (voltage)
1756-IF16H	• 1756-TBCH 36-position cage clamp RTB • 1756-TBS6H 36-position spring clamp RTB	• 1492-ACABLE*x*UB
1756-OF8H	• 1756-TBNH 20-position NEMA RTB • 1756-TBSH 20-position spring clamp RTB	• 1492-ACABLE*x*WB (current) • 1492-ACABLE*x*WA (voltage)

(1) Use an extended-depth cover (1756-TBE) for applications with heavy gauge wiring or requiring additional routing space.

(2) See the IFMs for the respective modules on page 192. Consult the documentation that came with it to connect all wiring.

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.

Power Requirements

ATTENTION: To comply with the CE low voltage directive (LVD), all connected I/O must be powered from a source compliant with safety extra low voltage (SELV) or protected extra low voltage (PELV).

WARNING: Use supply wires suitable for 30 °C (86 °F) above surrounding ambient.

These modules receive power from the 1756 chassis power supply and require these two sources of power from the backplane.

Module	Power Requirements, max
1756-IF8H	• 300 mA at 5.1V DC • 135 mA at 24V DC
1756-IF16H	• 200 mA at 5.1V DC • 125 mA at 24V DC
1756-OF8H	• 200 mA at 5.1 V DC • 230 mA at 24 V DC

IMPORTANT The 1756-OF8H module requires more power than the standard 1756-OF8 module. You can have a maximum of 12 1756-OF8H modules per chassis.

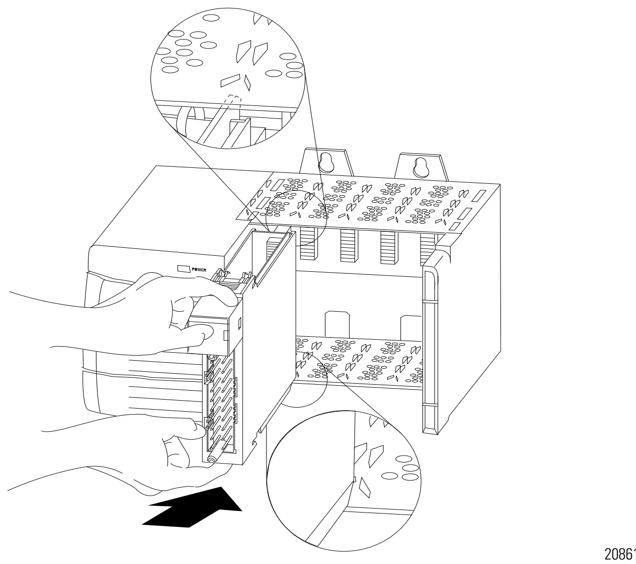
ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

Install the Module

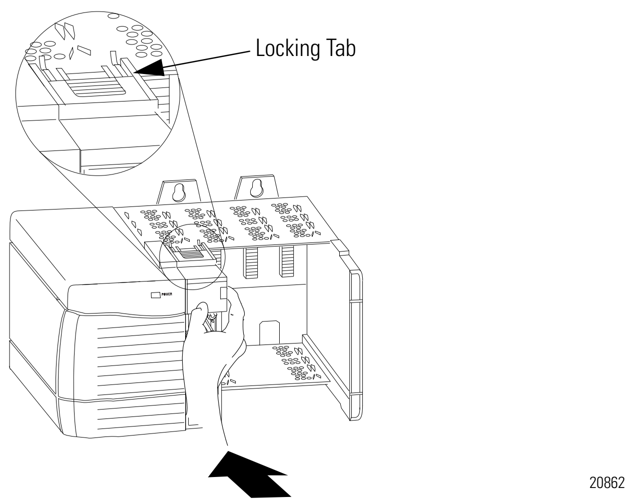
You can install or remove the module while chassis power is applied.

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

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



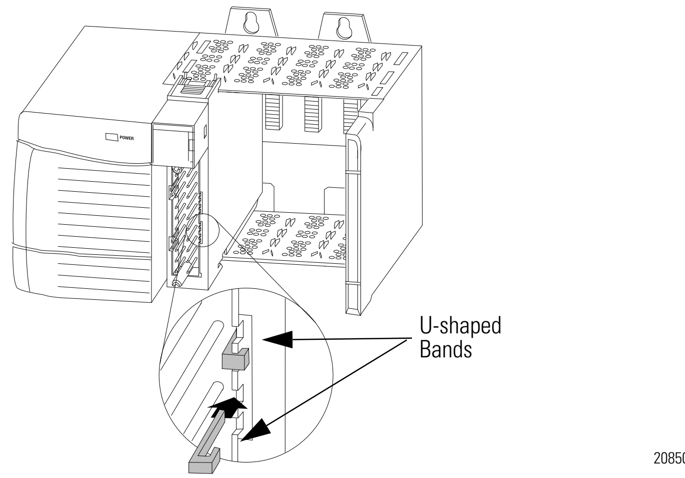
2. Slide the module into the chassis until the module locking tabs click.



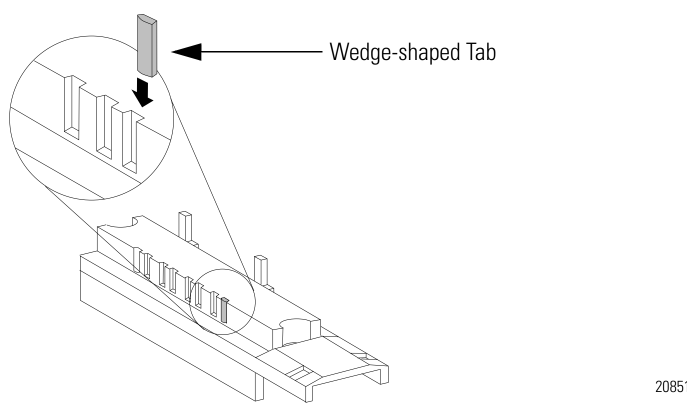
Key the Removable Terminal Block/Interface Module

Wedge-shaped keying tabs and U-shaped keying bands come with your RTB to prevent connecting the wrong wires to your module. Key the 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. To key the module, insert the U-shaped band and push the band until it snaps into place.



2. To key the RTB/IFM, insert the wedge-shaped tab with the rounded edge first and push the tab until it stops.



You can reposition the tabs to re-key future module applications.

Wire the Removable Terminal Block

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.

Wire the RTB with a 3.3 mm (0.13 in.) screwdriver before installing it onto the module. Shielded cable is required when using this module. We recommend using Belden 8761 cable to wire the RTB. The RTB terminations can accommodate 2.1…0.25 mm^2 (14…22 AWG) shielded wire and a torque of 0.5 N•m (4.4 lb•in.).

ATTENTION: When using the 1756-TBCH RTB, do not wire more than two 0.33…1.3 mm^2 (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 1 conductor on any single terminal.

Ground the Module

Use the following information to ground the module.

Connect the Grounded End of the Cable

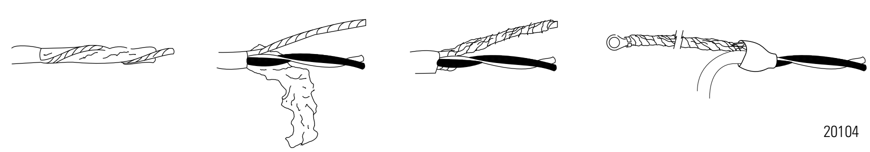
1. Ground the drain wire.

a.Remove a length of cable jacket from the connecting cable.

b.Pull the foil shield and bare the drain wire from the insulated wire.

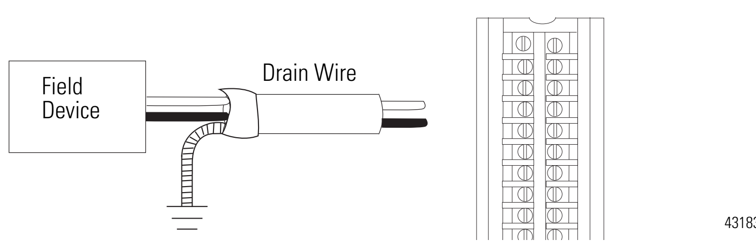
c.Twist the foil shield and drain wire together to form a single strand.

d.Attach a ground lug and apply heat shrink tubing to the exit area.



IMPORTANT We recommend grounding 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.

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

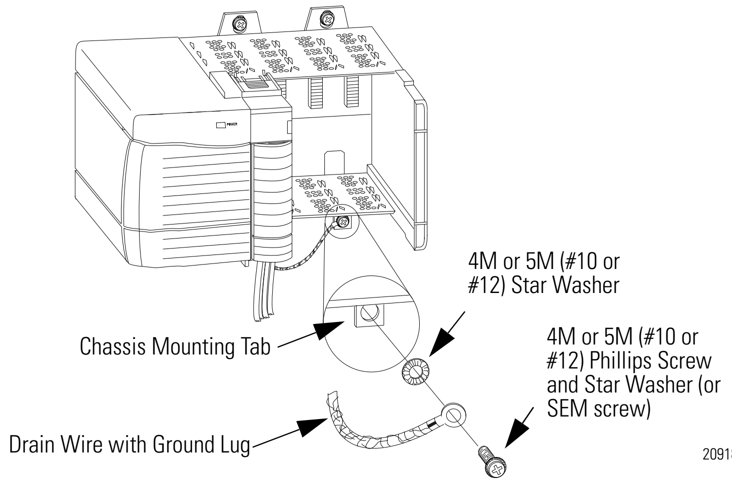


If you cannot ground at the field device, follow these steps.

1. Prepare one end of the cable as shown in step 1 on page 32.

   Ground at an earth ground on the chassis.

   Connect the drain wire to a chassis mounting tab. Use any chassis mounting tab that is designated as a functional signal ground.



2. Connect the insulated wires to the field device.

Connect the Ungrounded End of the Cable

Follow these steps to connect the ungrounded end of the cable to the clamp.

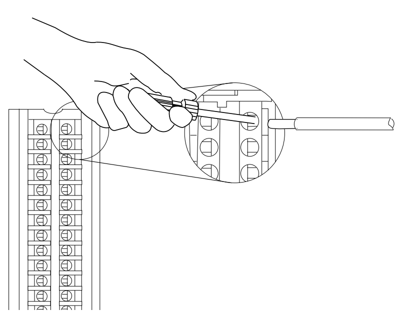
1. Cut the foil shield and drain wire back to the cable casing and apply shrink wrap.
2. Connect the insulated wires to the RTB.

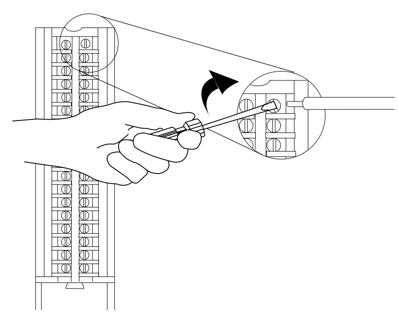
Spring Clamp RTB

a. Strip 10 mm (0.4 in.) maximum length of wire.
b. Insert the screwdriver into the inner hole of the RTB.
c. Insert the wire into the open terminal and remove the screwdriver.

Cage Clamp RTB

a. Strip 8.3 mm (0.33 in.) maximum length of wire.
b. Insert the wire into the open terminal.
c. Turn the screw clockwise to close the terminal on the wire.





Wire the Module

Refer to the individual module chapters for wiring information.

For this module	Page
1756-IF8H	60
1756-IF16H	72
1756-OF8H	83

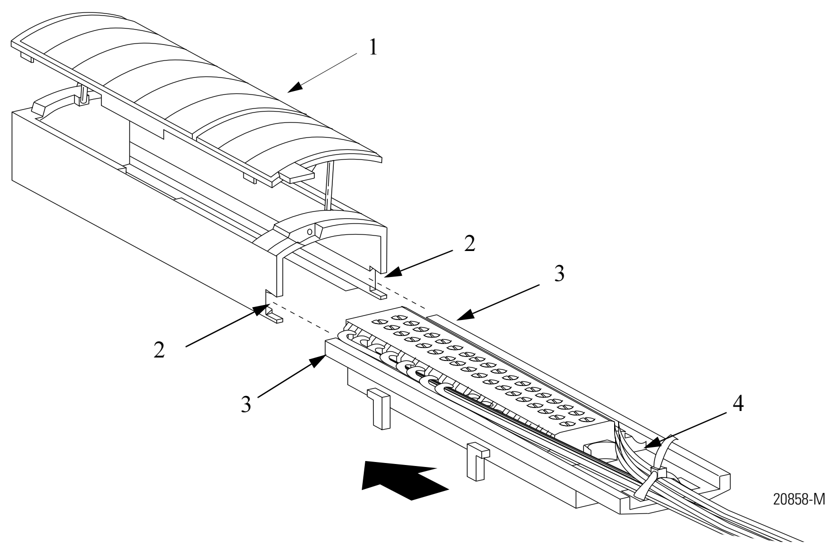
Removal Terminal Block Assembly and Installation

The following sections describe the steps needed to assemble and install the RTB.

Assemble the Removable Terminal Block and the Housing

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.



Item	Description
1	Housing cover
2	Groove
3	Side edge of RTB
4	Strain relief area

Install the Removable Terminal Block

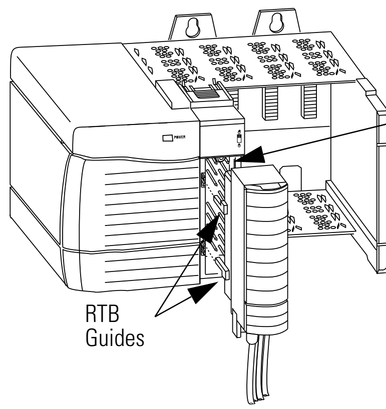
WARNING: When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations.

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

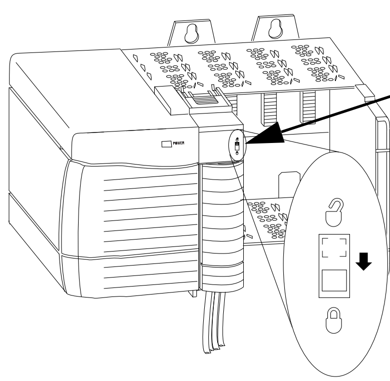
Before installing the RTB, make certain of the following items:

- The field-side wiring of the RTB has been completed.
- The RTB housing is snapped into place on the RTB.
- The RTB housing is closed.
- The locking tab at the top of the module is unlocked.
- The power is removed or the area is nonhazardous.

1. Align the side, top, and bottom RTB guides with the side, top, and bottom module guides.



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



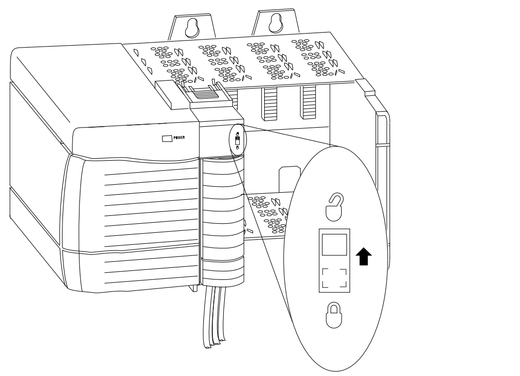
3. Slide the locking tab down to lock the RTB onto the module.

Remove the Removable Terminal Block

> ⚠ **ATTENTION:** The RTB is designed to support removal and insertion under power (RIUP). However, when you remove or insert an RTB with field-side power applied, unintended machine motion or loss of process control can occur. Exercise extreme caution when using this feature. We recommended that field-side power be removed before removing the module.

Before removing the module, you must remove the RTB.

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



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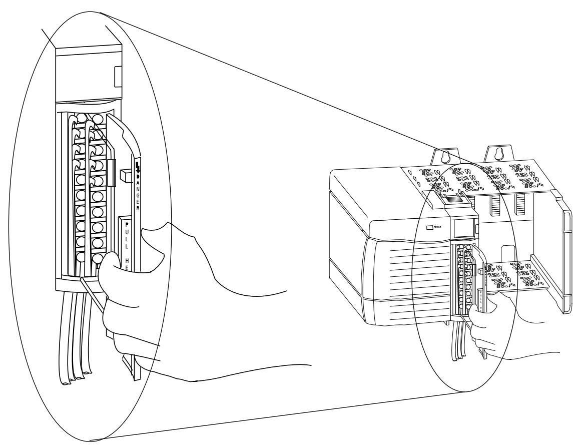
2. Open the RTB door and pull the RTB off the module.



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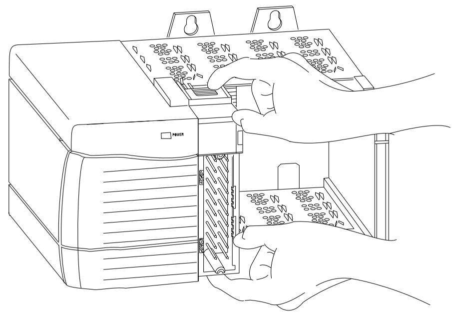
Remove the Module

Do these steps to remove a module.

1. Push in the top and bottom locking tabs.



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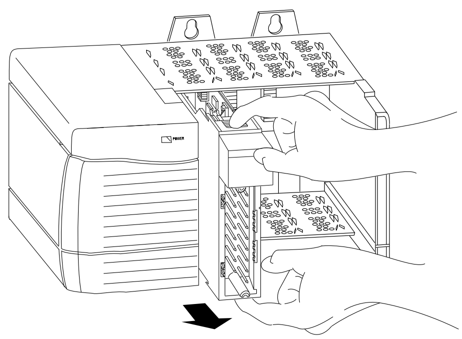
2. Pull the module out of the chassis.



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Notes:

ControlLogix Module Operation

Introduction

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

Typically, each module in the system has only one owner. Input modules can have more than one owner. Output modules are limited to a single owner.

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

For example, an input module produces data and any number of controllers can consume the data at the same time. This eliminates the need for one controller to send the data to another controller.

The table explains the topics discussed in this chapter.

Direct Connections

A direct connection is a real-time data transfer link between the controller and the device that occupies the slot that the configuration data references. ControlLogix analog I/O modules use direct connections only.

When module configuration data is downloaded to an owner-controller, the controller attempts to establish a direct connection to each of the modules the data references.

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 first 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 code displays in the software. For example, a module's configuration data can be appropriate except for a mismatch in electronic keying that prevents normal operation. For more information about error codes, see Module Configuration Errors on page 160.

The controller maintains and monitors its connection with a module. Any break in the connection, such as removal of the module from the chassis while under power, causes the controller to set fault status bits in the data area associated with the module. You can use ladder logic to monitor this data area and detect module failures.

Input Module Operation

In the ControlLogix system, the owner-controller does not poll analog input modules after a connection is established. The modules multicast their data periodically. Multicast frequency depends on the options chosen during configuration and where in the control system that input module physically resides.

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

Input Modules in a Local Chassis

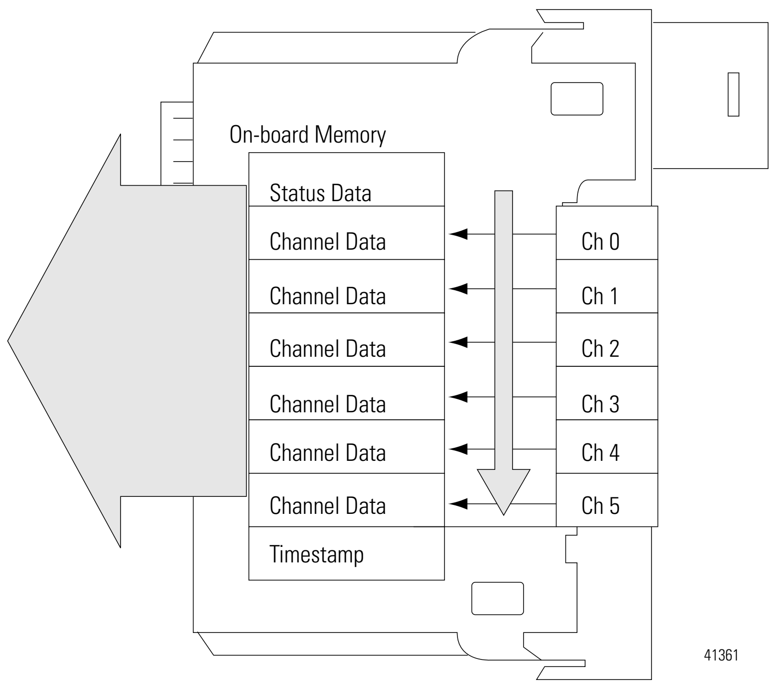
When a module resides in the same chassis as the owner-controller, the following configuration parameters affect how and when the input module multicasts data:

- Real-time sample
- Requested packet interval

Real Time Sample (RTS)

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

- Scan all of its input channels and store the data into on-board memory.
- Multicast the updated channel data (as well as other status data) to the backplane of the local chassis.



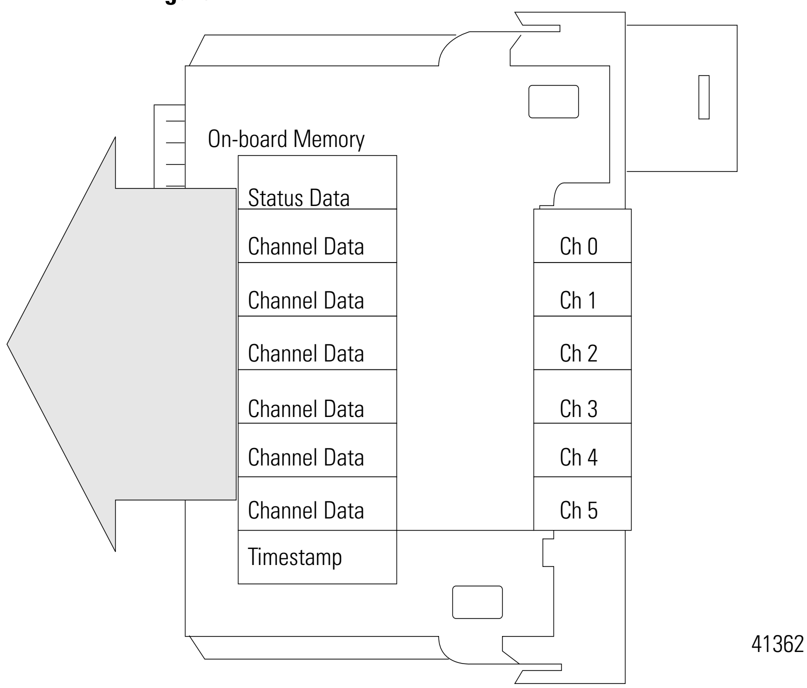
IMPORTANT	The real time sample value is set during the initial configuration using RSLogix 5000 software. This value can be adjusted anytime.

Requested Packet Interval (RPI)

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

The requested packet interval instructs the module to multicast the **current contents** of its on-board memory when the requested packet interval expires (the module does not update its channels prior to the multicast).

Figure 2 -

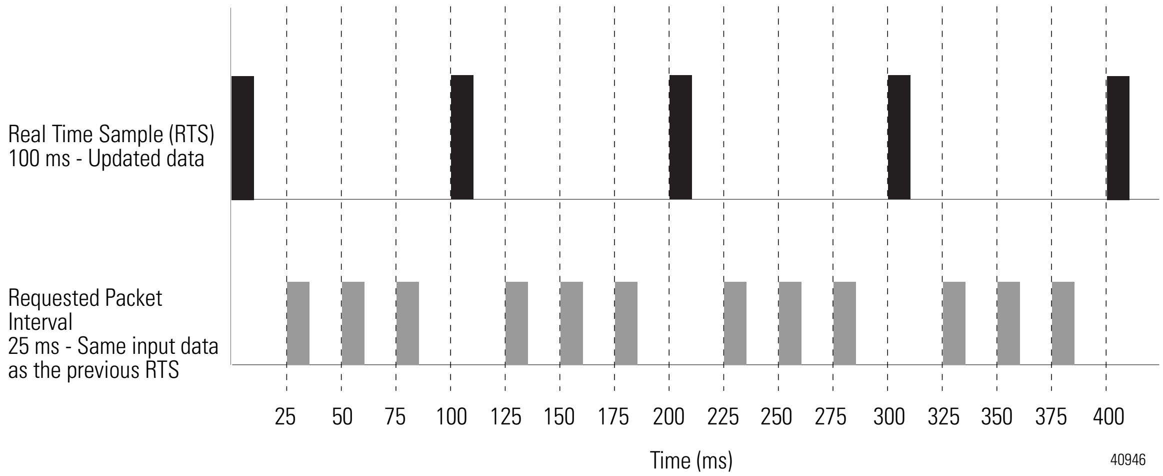


IMPORTANT	The requested packet interval value is set during the initial module configuration using RSLogix 5000 software. This value can be adjusted when the controller is in Program mode.

If the real time sample value is less than or equal to the requested packet interval, each multicast of data from the module has updated channel information. In effect, the module is only multicasting at the real time sample rate.

If the real time sample value is greater than the requested packet interval, the module multicasts at both the real time sample rate and the requested packet interval rate. Their respective values dictate how often the owner-controller receives data and how many multicasts from the module contain updated channel data.

In the example below, the real time sample value is 100 ms and the requested packet interval value is 25 ms. Only every fourth multicast from the module contains updated channel data.



Trigger Event Tasks

When configured to do so, ControlLogix analog input modules can trigger an event task. The event task offers ControlLogix controller users a task that executes a section of logic immediately when an event (receipt of new data) occurs.

Your ControlLogix analog I/O module can trigger event tasks every real time sample, after the module has sampled and multicast its data. Events tasks are useful for synchronizing process variable (PV) samples and proportional integral derivative (PID) calculations.

IMPORTANT	ControlLogix analog I/O modules can trigger event tasks at every real time sample, but not at the requested packet interval. For example, in the figure, an event task can be only triggered every 100 ms.

Input Modules in a Remote Chassis

If an input module resides in a remote chassis, the role of the requested packet interval and the module's real time sample behavior change slightly with respect to getting data to the owner-controller, depending on what network type you are using to connect to the modules.

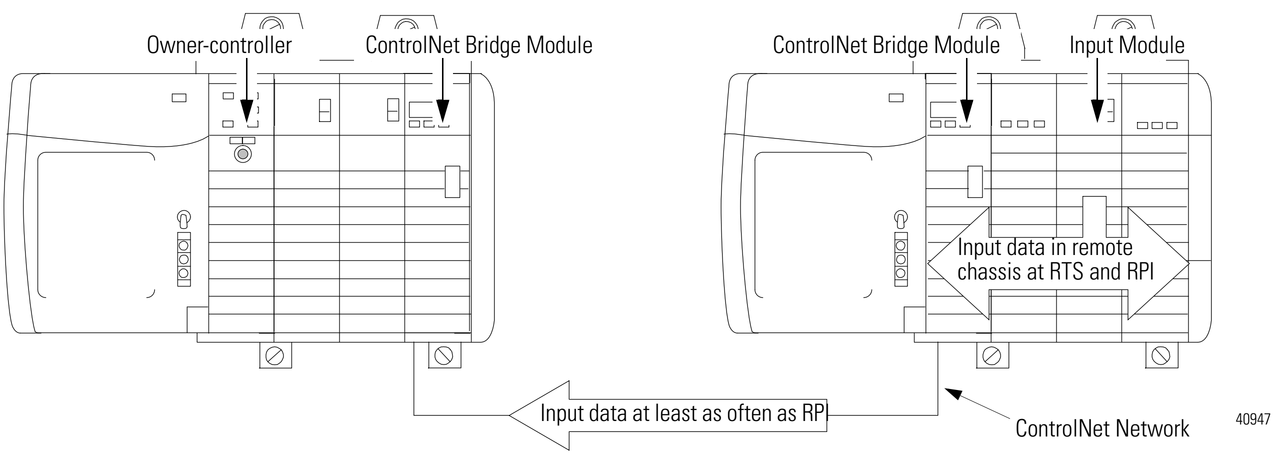
Remote Input Modules Connected Via ControlNet Network

When remote analog I/O modules are connected to the owner-controller via a scheduled ControlNet network, the requested packet interval and real time sample intervals still define when the module multicasts data **within its own chassis**. However, only the value of the requested packet interval determines how often the owner-controller receives it over the network.

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

The timing of this reserved spot does not coincide with the exact value of the requested packet interval, but the control system guarantees that the owner-controller receives data at least as often as the specified requested packet interval.

Input Module in Remote Chassis with Requested Packet Interval Reserving Spot in Flow of Data



The reserved spot on the network and the module's real time sample 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 networked chassis.

Best Case Scenario - Real Time Sample

In the best case scenario, the module performs a real time sample multicast with updated channel data just before the reserved network slot is made available. In this case, the remotely-located owner-controller receives the data almost immediately.

Worst Case Scenario - Real Time Sample

In the worst case scenario, the module performs a real time sample multicast just after the reserved network slot has passed. In this case, the owner-controller does not receive updated data until the next scheduled network slot.

Because it is the requested packet interval and not the real time sample that dictates when the module's data is sent over the network, we recommend the requested packet interval value be set less than or equal to the real time sample to make sure that updated channel data is received by the owner-controller with each receipt of data.

Remote Input Modules Connected Via EtherNet/IP Network

When remote analog input modules are connected to the owner-controller via an EtherNet/IP network, data is transferred to the owner-controller in the following way:

- At the RTS or RPI (whichever is faster), the module broadcasts data within its own chassis.
- The 1756 Ethernet bridge module in the remote chassis immediately sends the module's data over the network to the owner-controller as long it has not sent data within a time frame that is one-quarter the value of the analog input module's RPI.

  For example, if an analog input module uses an RPI = 100 ms, the Ethernet module sends module data immediately on receiving it if another data packet was not sent within the last 25 ms.

  The Ethernet module will either multicast the module's data to all devices on the network or unicast to a specific owner-controller depending on the setting of the Unicast box, as shown on page 93.

TIP For more information, see the Guidelines to Specify an RPI Rate for I/O Modules section in the Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

Output Module Operation

The requested packet interval parameter governs exactly when an analog output module receives data from the owner-controller and when the output module echoes data. An owner-controller sends data to an analog output module **at the period specified in the requested packet interval**. Data is not sent to the module at the end of the controller's program scan.

When an analog output module receives **new data** from an owner-controller (every requested packet interval), the module automatically multicasts or echoes a data value that corresponds to the analog signal present at the output terminals to the rest of the control system. This feature, called **Output Data Echo**, occurs whether the output module is local or remote.

TIP If the output module is not responding according to how it has been programmed, it could be for one of the following reasons:

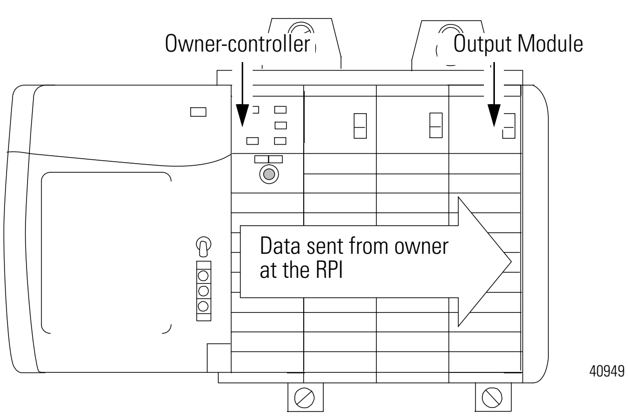
- The commanded value falls outside the Configured Limits and is thus being clamped.
- The commanded value changed faster than the configured max Rate Limit, and is being clamped.
- The module is in Start-up Hold mode, following a connection break or Run mode transition waiting for the control system to synchronize with the prevailing setting to facilitate a bumpless startup.

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

When the requested packet interval is less than the program scan length, the controller effectively lets the module's output channels change values multiple times during a single program scan because the output module is not dependent on reaching the end of the program to send data.

Output Modules in a Local Chassis

When specifying a requested packet interval value for an analog output module, you instruct the controller when to broadcast the output data to the module. If the module resides in the same chassis as the owner-controller, the module receives the data almost immediately after the controller sends it.



Output Modules in a Remote Chassis

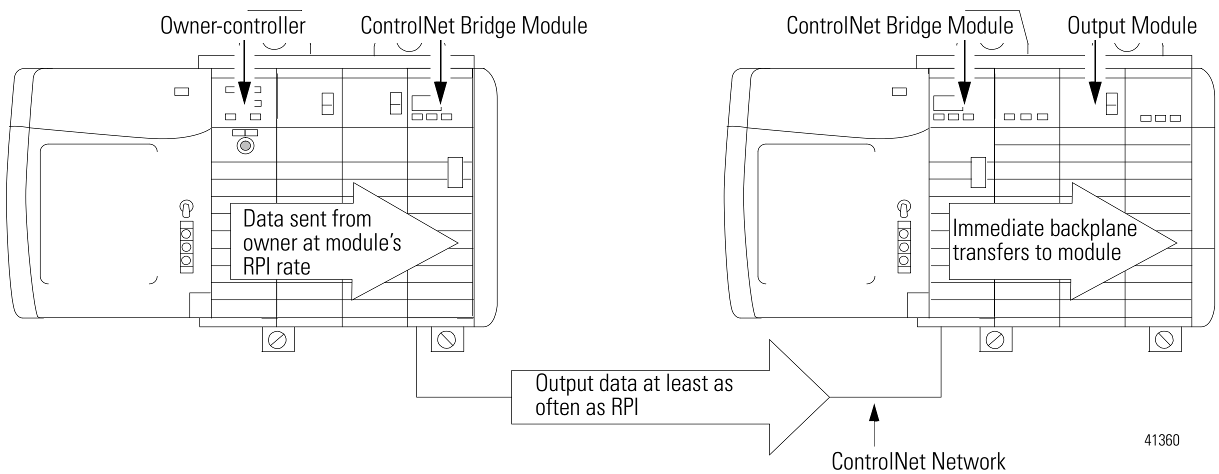
If an output module resides in a remote chassis, the role of the requested packet interval changes slightly with respect to getting data from the owner-controller, depending on what network type you are using to connect to the modules.

Remote Output Modules Connected Via ControlNet Network

When remote analog output modules are connected to the owner-controller via a scheduled ControlNet network, in addition to instructing the controller to multicast the output data within its own chassis, the requested packet interval also reserves a spot in the stream of data flowing across the ControlNet network.

The timing of this reserved spot does or does not coincide with the exact value of the requested packet interval, but the control system will guarantee that the output module will receive data **at least as often** as the specified requested packet interval.

Output Module in Remote Chassis with Requested Protocol Interval Reserving a Spot in Flow of Data



The reserved spot on the network and when the controller sends the output data are asynchronous to each other. This means there are best and worst case scenarios as to when the module receives the output data from the controller in a networked chassis.

Best Case Scenario - Requested Packet Interval

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 Scenario - Requested Packet Interval

In the worst case scenario, the controller sends the data just after the reserved network slot has passed. In this case, the module does not receive the data 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. The scenarios 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 requested protocol interval.

Remote Output Modules Connected Via EtherNet/IP Network

When remote analog output modules are connected to the owner-controller via an EtherNet/IP network, the controller multicasts data in the following way:

- At the RPI, the owner-controller multicasts data within its own chassis.
- The 1756-ENBT module in the local chassis immediately sends the data over the network to the analog output module as long as it has not sent data within a time frame that is 1/4 the value of the analog module's requested protocol interval.

Listen-only Mode

Any controller in the system can listen to the data from any I/O module (that is, input data or 'echoed' output data) even if the controller does not own the module. In other words, the controller does not have to own a module's configuration data to listen to it.

During the I/O configuration process, you can specify a 'Listen-Only' mode in the Connection box of the Module Definition section on the Module Properties dialog box. See page 91 for more details.

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

IMPORTANT	If a 'Listen-Only' connection is being used by any controller to the module, any connections over the Ethernet network cannot use the Unicast option. See the Unicast box on page 93. The 'Listen-Only' controller continues to receive multicast data from the I/O module as long as a connection between an owner-controller and I/O module is maintained. If the connection between all owner-controllers and the module is broken, the module stops multicasting data and connections to all Listening controllers are also broken.

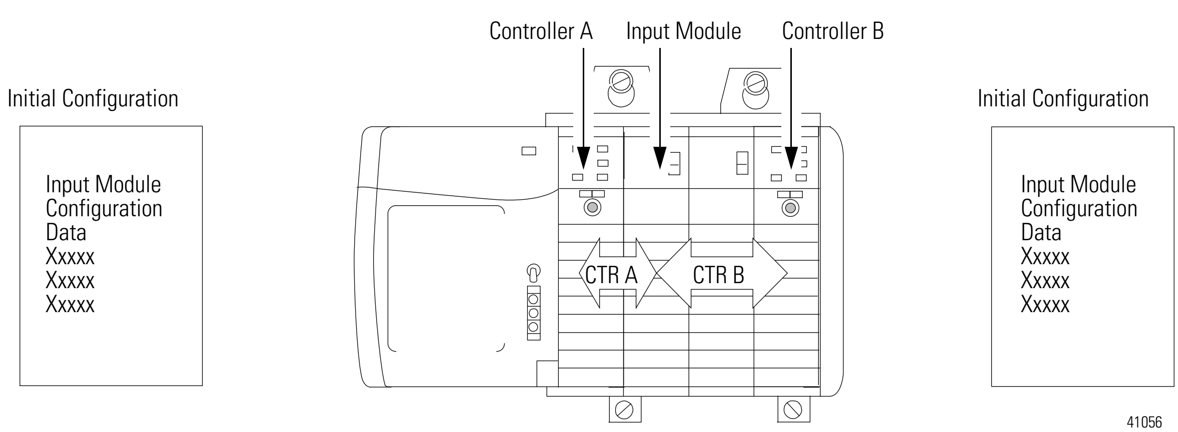
Multiple Owners of Input Modules

Because listening controllers lose their connections to modules when communication with the owner stop, the ControlLogix system lets you define more than one owner for input modules.

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

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

Figure 3 - Multiple Owners with Identical Configuration Data



When multiple controllers are configured to own the same input module, the following events occur:

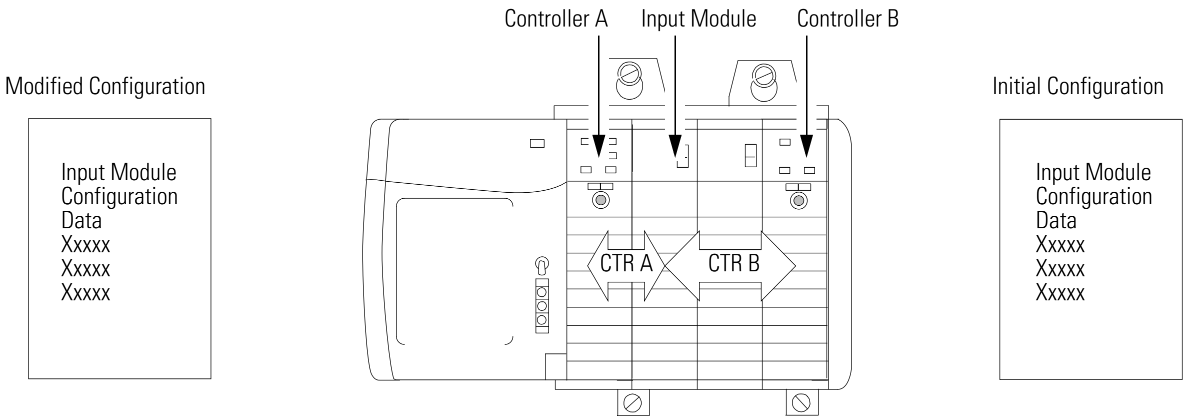
- When the controllers begin downloading configuration data, both try to establish a connection with the input module.
- Whichever controller's data arrives first establishes a connection.
- When the second controller's data arrives, the module compares it to its current configuration data (the data received and accepted from the first controller).
  - If the configuration data sent by the second controller matches the configuration data sent by the first controller the connection is also accepted.
  - If any parameter of the second configuration data is different from the first, the module rejects the connection; RSLogix 5000 software alerts you to the rejected connection through an error message.

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

Configuration Changes in an Input Module with Multiple Owners

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

Multiple Owners with Changed Configuration Data



Controller B is unaware that changes were made by Controller A.

IMPORTANT	A dialog box in RSLogix 5000 software alerts you to the possibility of a multiple owner situation and lets you inhibit the connection before changing the module's configuration. When changing configuration for a module with multiple owners, we recommend the connection be inhibited. To prevent other owners from receiving potentially erroneous data, you must follow these steps when changing a module's configuration in a multiple owner scenario while online: • For each owner-controller, inhibit the controller's connection to the module, either in the software on the Connection tab or the dialog box warning of the multiple owner condition. • Make the appropriate configuration data changes in the software, as described in the RSLogix 5000 software section of this manual. • Repeat steps 1 and 2 for all owner-controllers, making the same changes in all controllers. • Disable the Inhibit box in each owner's configuration.

Unicast Communication

Use unicast EtherNet/IP communication to reduce broadcast network traffic. Some facilities block multicast Ethernet packets as part of their network administration policy. You can configure multicast or unicast connections for I/O modules by using RSLogix 5000 software, version 18 or later.

Unicast connections do the following:

- Allow I/O communication to span multiple subnets
- Reduce network bandwith
- Simplify Ethernet switch configuration

Notes:

1756-IF8H HART Analog Input Module

Introduction

This chapter describes the features of the 1756-IF8H ControlLogix HART analog input module.

The table explains the topics discussed in this chapter.

Module Features

The 1756-IF8H module has the following features:

- Choice of three data formats

IMPORTANT	The Analog and HART by Channel data type is available **only** for 1756-IF8H firmware revision 2.1

- Multiple current and voltage input ranges
- Module filter
- Real time sampling
- Underrange and overrange detection
- Process alarms
- Rate alarm
- Wire-off detection
- Highway addressable remote transducer (HART) communication

Data Formats

Data format determines which values are included in the Input tag of the module and the features that are available to your application. Select the data format on the General tab in RSLogix 5000 software. The following data formats are available for the 1756-IF8H module.

		Description			
		Analog signal values	Analog status	HART secondary process variables and device health	HART and Analog data for each channel grouped together in tag
Format	Analog Only	X	X		
	Analog and HART PV	X	X	X	
	Analog and HART by Channel(1)	X	X	X	X

(1) Available only for 1756-IF8H firmware revision 2.1.

- Choose Analog and HART PV if you prefer the members of your tag to be arranged similar to non-HART analog input modules, with the analog values for all channels grouped together near the end of the tag. This makes it easy to view all eight analog values at once.
- Choose Analog and HART by Channel if you prefer Status, Analog Value, and Device Status for each channel to be together in the tag. This makes it easier to view all of the data related to one field device.

Input Ranges

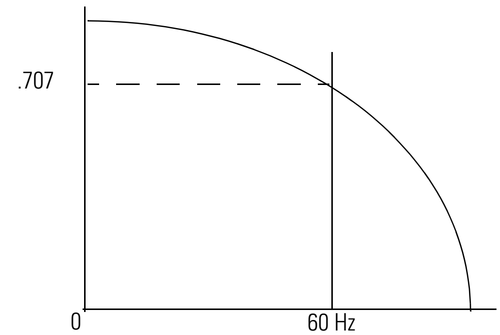
You can select from a series of operational ranges for each channel on the module. The range designates the minimum and maximum signals that are detectable by the module. Possible ranges include the following:

- -10…10V
- 0…5V
- 0…10V
- 0…20 mA
- 4…20 mA (HART instruments use this range.)

Module Filter

The module filter attenuates the input signal beginning at the specified frequency. This feature is applied on a module-wide basis, affecting all channels.

The module attenuates the selected frequency by approximately -3 dB or 0.707 of the applied amplitude. An input signal with frequencies above the selected frequency is attenuated more while frequencies below the selection receive no attenuation.



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

IMPORTANT	60 Hz is the default setting for the module filter. Do not use the 1000 Hz module filter with HART instruments.

Use the following table to choose a module filter setting.

Table 2 - Module Filter Selections with Associated Performance Data

Module Filter Setting (-3 dB)(1)	**10 Hz**	**15 Hz**	**20 Hz**	**50 Hz**	**60 Hz**	**100 Hz**	**250 Hz**	**1000 Hz**
Minimum Sample Time (ms) (RTS)	488	328	248	88	88	56	28	18
Effective Resolution (+/-10V range)	17 bits	17 bits	17 bits	16 bits	16 bits	15 bits	14 bits	12 bits
	0.16 mV	0.16 mV	0.16 mV	0.31 mV	0.31 mV	0.62 mV	1.25 mV	5.0 mV
Effective Resolution (0…10V range)	16 bits	16 bits	16 bits	15 bits	15 bits	14 bits	13 bits	11 bits
	0.16 mV	0.16 mV	0.16 mV	0.31 mV	0.31 mV	0.62 mV	1.25 mV	5.0 mV
Effective Resolution (0…5V, 0 …20 mA, 4…20 mA range)	15 bits	15 bits	15 bits	14 bits	14 bits	13 bits	12 bits	10 bits
	0.16 mV 0.63 µA	0.16 mV 0.63 µA	0.16 mV 0.63 µA	0.31 mV 1.25 µA	0.31 mV 1.25 µA	0.62 mV 2.5 µA	1.25 mV 5.0 µA	5.0 mV 20.0 µA
-3 dB Frequency	7.80 Hz	11.70 Hz	15.60 Hz	39.30 Hz	39.30 Hz	65.54 Hz	163.9 Hz	659.7 Hz
50 Hz Rejection	95 dB	85 dB	38 dB	4 dB	4 dB	2 dB	0.5 dB	0.1 dB
60 Hz Rejection	97 dB	88 dB	65 dB	7 dB	7 dB	2.5 dB	0.6 dB	0.1 dB

(1) Worst case settling time to 100% of a step change is double the real time sample time.

Real Time Sampling

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

During module configuration, you specify a real time sampling (RTS) period and a requested packet interval (RPI) period. Both of these features instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For more RTS information, see Real Time Sample (RTS) on page 41.

Underrange and Overrange Detection

The module detects when it is operating beyond limits of the input range. This status indication tells you that the input signal is not being measured accurately because the signal is beyond the measuring capability of the module. For example, the module cannot distinguish between 10.25V and 20V.

The following table shows the input ranges of the 1756-IF8H module and the lowest and highest signal available in each range before the module detects an underrange and overrange condition.

Table 3 - Low and High Signal Limits on the 1756-IF8H Module

Input Module	Available Range	Lowest Signal in Range	Highest Signal in Range
1756-IF8H	-10…10V 0…10V 0…5V 0…20 mA 4…20 mA	-10.25V 0V 0V 0 mA 3.42 mA	10.25V 10.25V 5.125V 20.58 mA 20.58 mA

Digital Filter

The digital filter smooths input data noise transients. This feature is applied on a **per channel** basis.

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

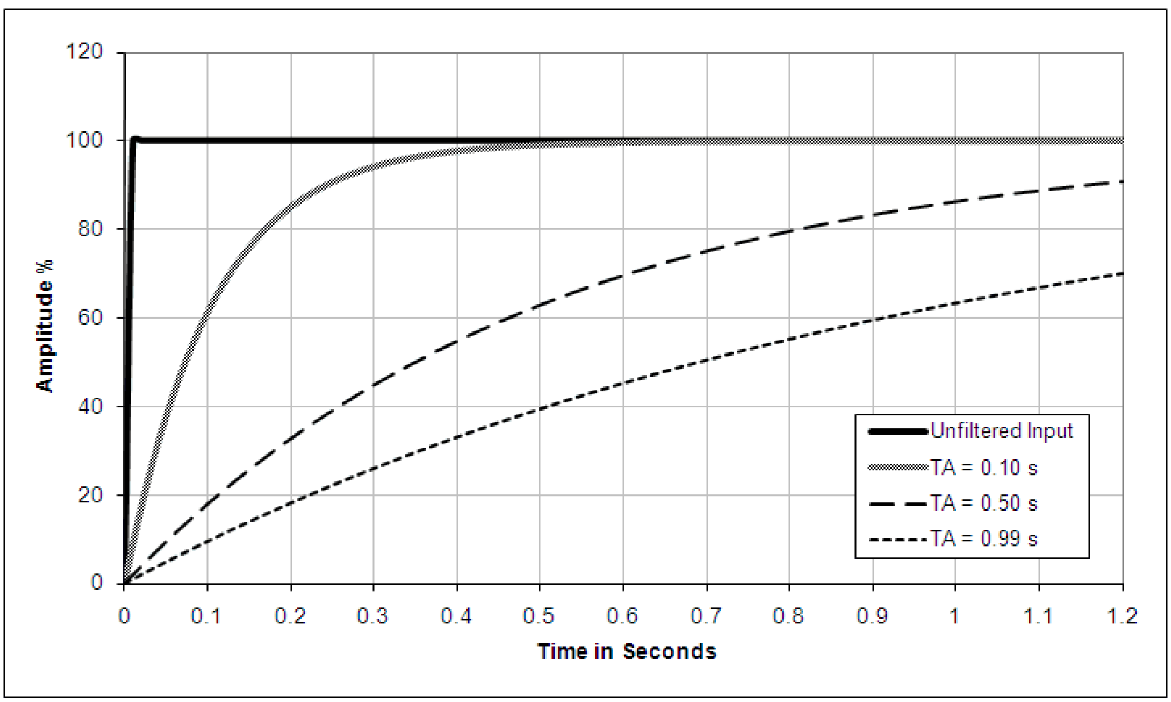
The digital filter equation is a classic first order lag equation.

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

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

Using a step input change to illustrate the filter response, as shown in the figure, 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 4 - Filter Response



Process Alarms

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

- High high
- High
- Low
- Low low

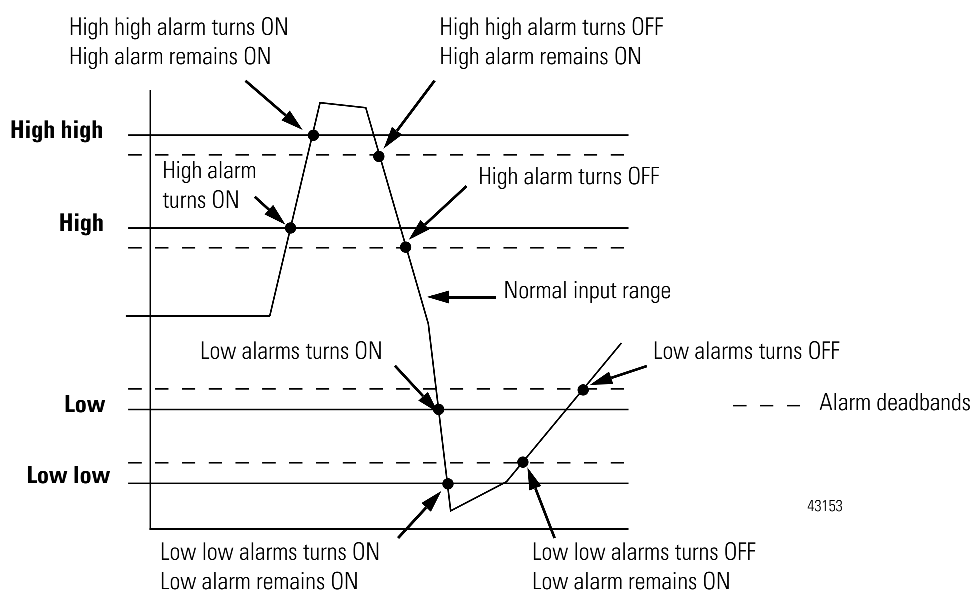
The values for each limit are entered in scaled engineering units.

Alarm Deadband

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

The figure below shows input data that sets each of the 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 returns to normal.

Table 4 - Input Data That Sets Each Of the Alarms



Rate Alarm

The value for the Rate Alarm Limit is entered in scaled engineering units per second. The rate alarm triggers if the rate of change between input samples for each channel exceeds the specified rate-alarm trigger point for that channel. Rate Alarm uses the signal value after filtering by the Module Filter and before the Digital Filter is applied.

Wire-off Detection

The 1756-IF8H modules alert you when a signal wire is disconnected from one of its channels or the RTB is removed from the module. When a wire-off condition occurs for this module, two events occur:

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

Because 1756-IF8H modules can be applied in voltage or current applications, differences exist as to how a wire-off condition is detected in each application.

Table 5 identifies the conditions that are reported in the input tag when a wiring anomaly is detected.

Table 5 - Wire-off Detection

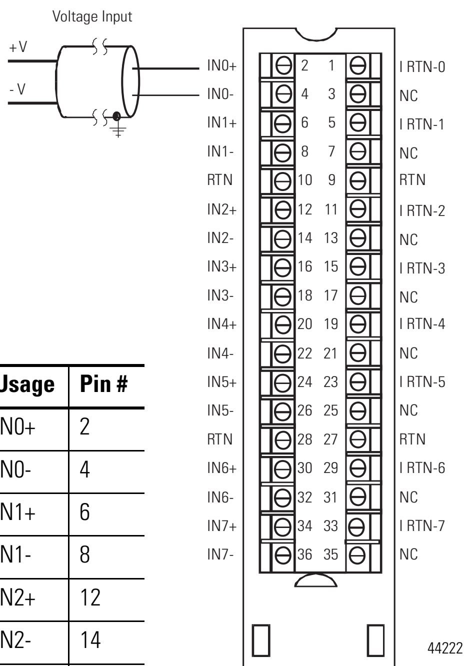
	Input Range	Wiring Problem	Condition Reported in Input Tag			
			Input Data changes to	ChXOverrange	ChXBrokenWire	ChXUnderrange
Voltage	-10 V…+ 10 V 0 V …+5 V 0 V…+10 V	INx or INx removed	Maximum scaled value (overrange value)	1	1	
Current	0 …20 mA	RTB removed or INx and I RTN-x jumper removed	Maximum scaled value (overrange value)	1	1	
		Only INx removed (jumper in place)	Minimum scaled value (underrange value)		0	1
		Only jumper removed	Maximum scaled value (overrange value)	1	1	
	4…20 mA	RTB removed or INx and I RTN-x jumper removed	Maximum scaled value (overrange value)	1	1	
		Only INx removed (jumper in place)	Minimum scaled value (underrange value)		1	1
		Only jumper removed	Maximum scaled value (overrange value)	1	1	

Wiring Diagrams

See the figures and tables that show how to wire the module for voltage and current inputs. HART communication is active with current inputs only.

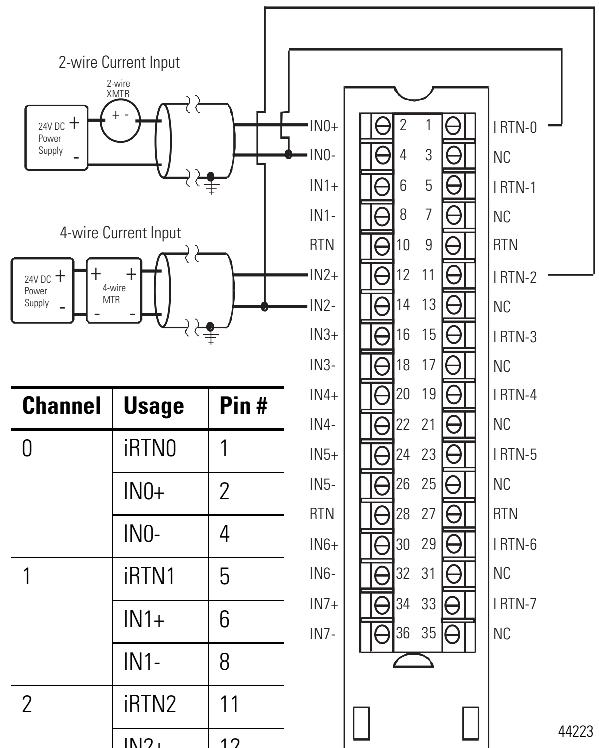
Figure 5 - Voltage and Current Inputs

Voltage Inputs



Channel	Usage	Pin #
0	IN0+	2
	IN0-	4
1	IN1+	6
	IN1-	8
2	IN2+	12
	IN2-	14
3	IN3+	16
	IN3-	18
4	IN4+	20
	IN4-	22
5	IN5+	24
	IN5-	26
6	IN6+	30
	IN6-	32
7	IN7+	34
	IN7-	36

Current Inputs

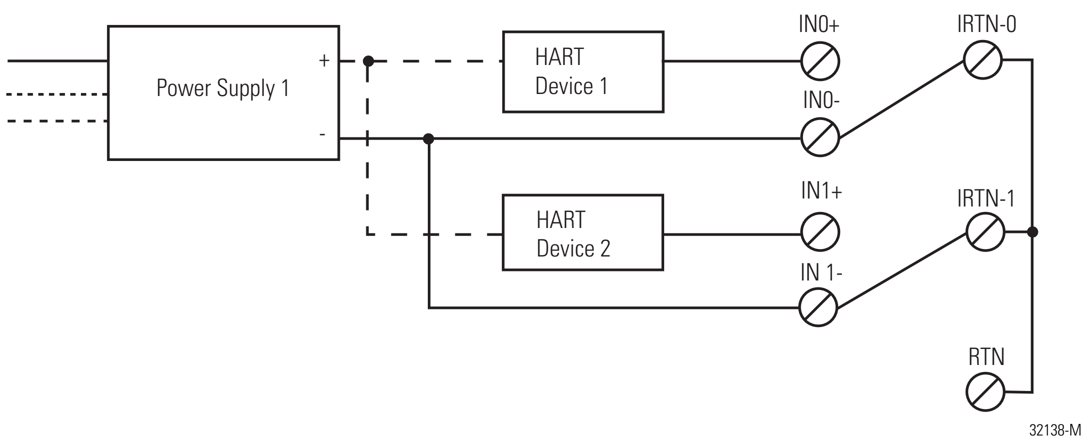


Channel	Usage	Pin #
0	iRTN0	1
	IN0+	2
	IN0-	4
1	iRTN1	5
	IN1+	6
	IN1-	8
2	iRTN2	11
	IN2+	12
	IN2-	14
3	iRTN3	15
	IN3+	16
	IN3-	18
4	iRTN4	19
	IN4+	20
	IN4-	22
5	iRTN5	23
	IN5+	24
	IN5-	26
6	iRTN6	29
	IN6+	30
	IN6-	32
7	iRTN7	33
	IN7+	34
	IN7-	36

The 1756-IF8H is a differential input module. However, there are limitations on its use in Differential mode. Any time the low ends of the terminal block pins are connected together, they must also be jumpered to the RTN pin on the terminal block. There are two scenarios in which this happens.

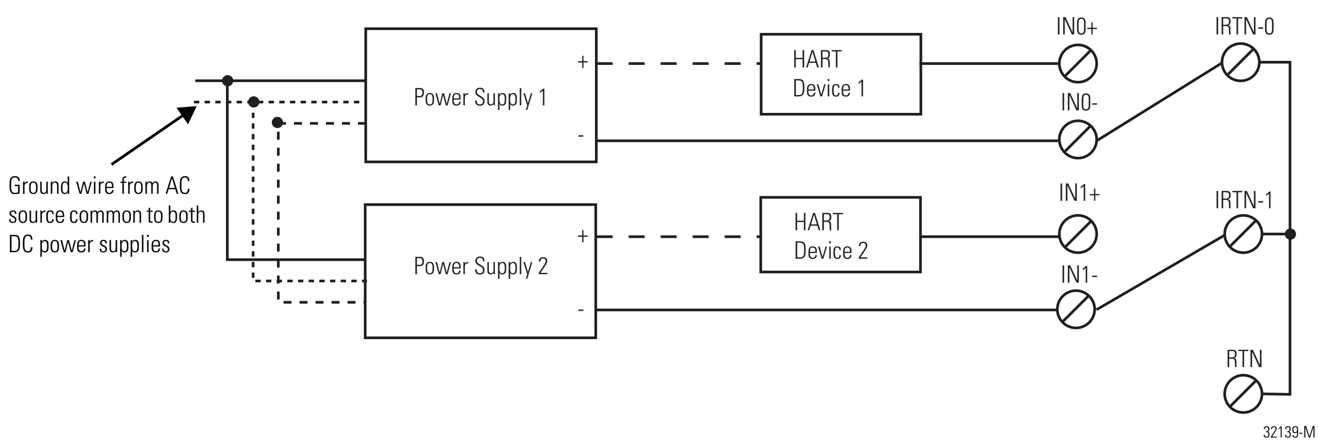
First, if a single power supply is used for multiple devices, then the low end from each channel is connected together and connected to the ground return of the power supply. See the following diagram.

Figure 6 - Single Power Supply with Multiple HART Devices



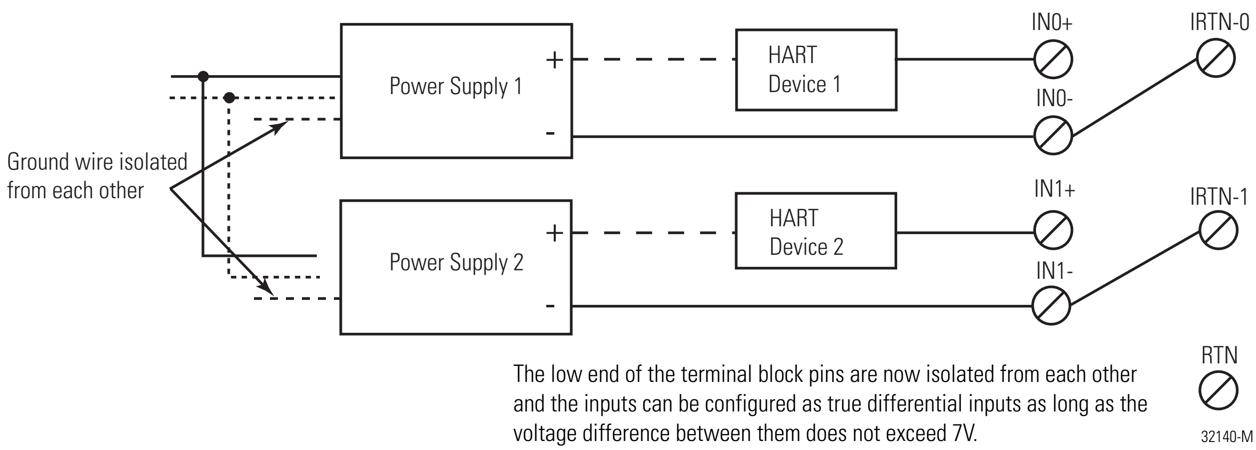
The second way for channels to share a ground is to have multiple power supplies hooked to the same ground. In this case the low ends of the channels are effectively connected together by the common grounds of the power supplies.

Figure 7 - Multiple Power Supplies with a Common Ground



For devices powered by individual supplies, when the ground potential of the supplies is expected to differ, Differential mode is recommended. This prevents ground loop currents from flowing between the supplies. However, the potential difference allowable between the supplies must remain within the specified limits.

Figure 8 - Power Supplies with Isolated Grounds



Some devices, such as AC powered four-wire devices, are recommended to be used in Differential mode only. It is best if differential and single-ended input types are not combined onto the same terminal block, that is, all should be single-ended or all should be differential.

Circuit Diagrams

This section shows the 1756-IF8H module's input circuit diagrams.

Figure 9 - Simplified 1756-IF8H Current Input Circuit

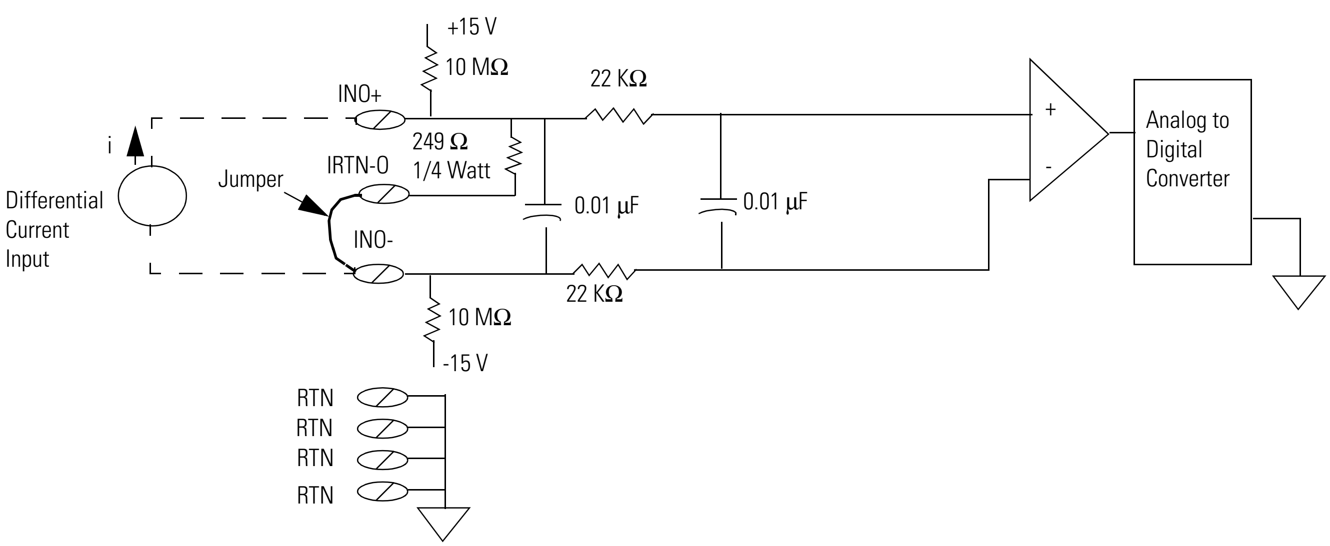
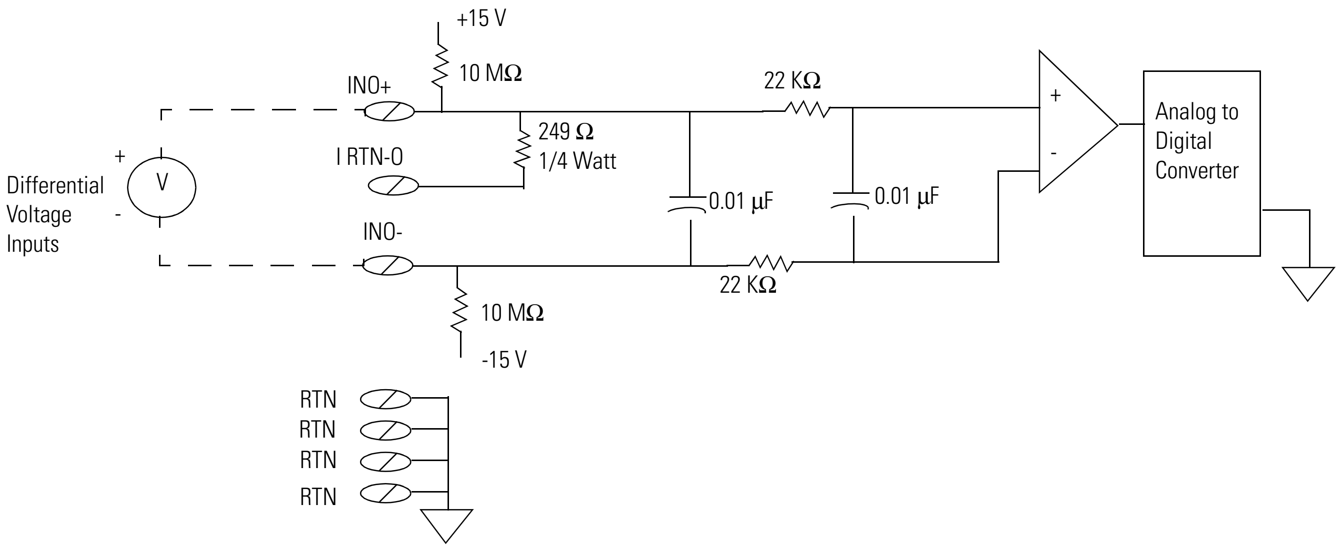


Figure 10 - Simplified 1756-IF8H Voltage Input Circuit



1756-IF8H Module Fault and Status Reporting

The 1756-IF8H module multicasts status/fault data to the controller with its channel data. The fault data is arranged to let you choose the level of granularity you 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.

Table 6 lists tags you can examine in ladder logic to indicate when a fault has occurred.

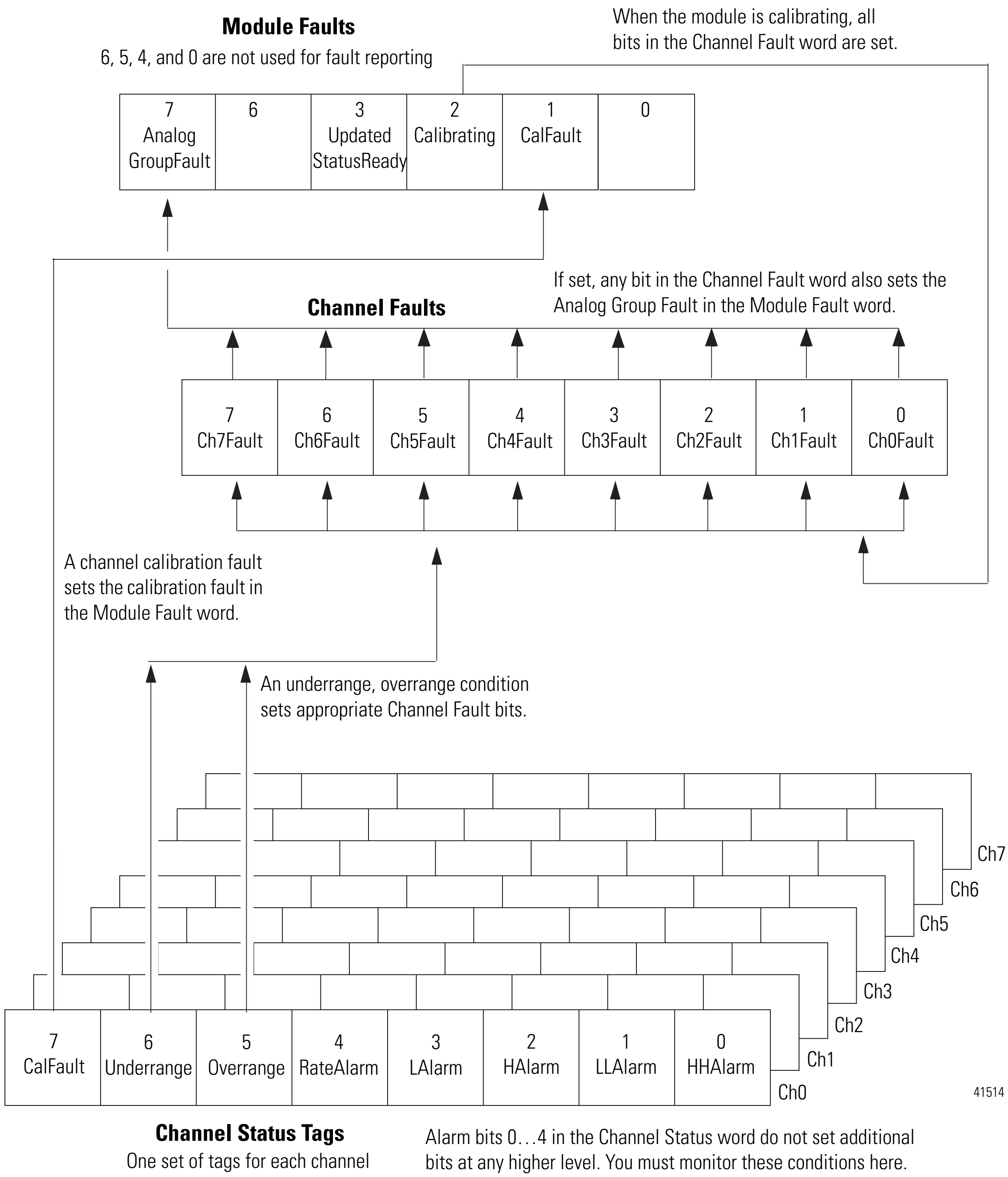
Table 6 - Tags That Can Be Examined in Ladder Logic

Tag	Description	Tag Name Analog and HART PV	Tag Name Analog and HART by Channel(1)
Module Fault Word	This word provides fault summary reporting.	ModuleFaults	ModuleFaults
Channel Fault Word	This word provides underrange, overrange, and communication fault reporting.	ChannelFaults Ch*x*Fault	ChannelFaults Ch*x*Fault
Channel Status Word	These words provide individual channel underrange and overrange fault indications and reporting for process alarms, rate alarms, and calibration faults.	Ch*x*Status	Ch*x*.DeviceStatus Ch*x*.DeviceStatus.AlarmStatus
HART Faults	This provides HART communication status.	HARTFaults, Ch*x*HARTFault	Ch*x*.DeviceStatus.HARTFault
HART Device Status	This provides HART field device health.	HART.Ch*x*Device Status	Ch*x*.DeviceStatus.FieldDeviceStatus

(1) Available only for 1756-IF8H firmware revision 2.1.

1756-IF8H Fault Reporting

The graphic below offers an overview of the fault reporting process for the 1756-IF8H module.



1756-IF8H Module Fault Word Bits

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further to isolate the fault. Table 7 lists tags that can be examined in ladder logic to indicate when a fault has occurred.

Table 7 - Tags That Can Be Examined in Ladder Logic

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

1756-IF8H Channel Fault Tags

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

Table 8 lists the conditions that set **all** Channel Fault word bits.

Table 8 - Conditions That Set All Channel Fault Word Bits

This Condition Sets All Channel Fault Word Bits	And Causes the Module to Display the Following in the Channel Fault Word Bits
A channel is being calibrated	16#00FF
A communication fault occurred between the module and its owner-controller	16#FFFF

1756-IF8H Channel Status Tags

Table 9 describes the channel status tags.

Table 9 - Tags That Show Channel Status

Tag	Bit	Description
ChxCalFault	7	This bit is set if an error occurs during calibration for Channel *x*, causing a bad calibration. Also sets CalFault in the Module Faults.
ChxUnderrange	6	This bit is set when the analog signal is less than or equal to the minimum detectable signal. Because the signal cannot be measured, it may be significantly below the minimum value. Also sets Ch*x*Fault in the Channel Faults.
ChxOverrange	5	This bit is set when the analog signal is greater than or equal to the maximum detectable signal. Because the signal cannot be measured, it may be significantly above the maximum value. Also sets Ch*x*Fault in the Channel Faults.
ChxRateAlarm(1)	4	This bit is set when the rate of change between input samples for each channel exceeds the specified rate-alarm trigger point for the channel. Both positive and negative changes can cause this alarm.
Ch*x*LAlarm	3	This bit is set when the requested input value is less than the configured low limit value. It remains set until the requested input is greater than the low limit. If the bit is latched, it remains set until it is unlatched.
Ch*x*HAlarm	2	This bit is set when the requested input value is greater than the configured high limit value. It remains set until the requested input is less than the high limit. If the bit is latched, it remains set until it is unlatched.
Ch*x*LLAlarm	1	This bit is set when the requested input value is less than the configured low low limit value. It remains set until the requested input is greater than the low low limit. If the bit is latched, it remains set until it is unlatched.
Ch*x*HHAlarm	0	This bit is set when the requested input value is greater than the configured high high limit value. It remains set until the requested input is less than the high high limit. If the bit is latched, it remains set until it is unlatched.

(1) Alarm bits 0…4 in the Channel Status word do not set additional bits at any higher level.

Specifications and Certifications

See the 1756 ControlLogix I/O Modules Specifications Technical Data, publication 1756-TD002, for specific module specifications and certifications.

1756-IF16H HART Analog Input Module

Introduction

This chapter describes the features of the 1756-IF16H ControlLogix HART analog current input module.

The table explains the topics discussed in this chapter.

Module Features

The 1756-IF16H module has the following features:

- Choice of three data formats
- 0…20 mA or 4…20 mA input ranges
- Module filter
- Real time sampling
- Underrange and overrange detection
- Wire-off detection
- Highway addressable remote transducer (HART) communication

Data Formats

Data format determines which values are included in the Input tag of the module and the features that are available to your application. Select the data format on the General tab in RSLogix 5000 software. The following data formats are available for the 1756-IF16H module.

		Description			
		Analog signal values	Analog status	HART secondary process variables and device health	HART and Analog data for each channel grouped together in tag
Format	Analog Only	X	X		
	Analog and HART PV	X	X	X	
	Analog and HART by Channel	X	X	X	X

- Choose Analog and HART PV if you prefer the members of your tag to be arranged similar to non-HART analog input modules, with the analog values for all channels grouped together near the end of the tag. This makes it easy to view all 16 analog values at once.
- Choose Analog and HART by Channel if you prefer Status, Analog Value, and Device Status for each channel to be together in the tag. This makes it easier to view all of the data related to one field device.

Input Ranges

Two operational ranges are available for each channel on the module. The range designates the minimum and maximum signals that are detectable by the module. The two ranges are:

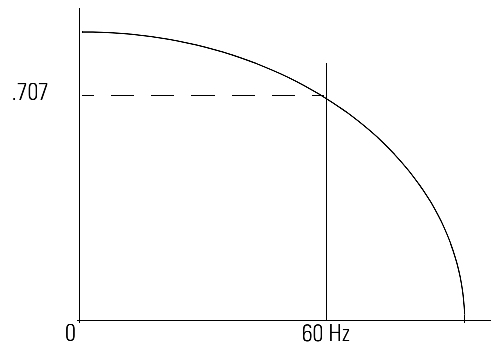
- 0…20 mA
- 4…20 mA (HART instruments use this range.)

Module Filter

The module filter attenuates the input signal beginning at the specified frequency. This feature is applied on a module-wide basis, affecting all channels.

The module attenuates the selected frequency by approximately -3 dB or 0.707 of the applied amplitude.

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



In addition to frequency rejection, a by-product of the filter selection is the minimum sample rate (RTS) that is available. For example, the 1000 Hz selection does not attenuate any frequencies less than 1000 Hz, and provides for sampling of all 16 channels within 18 ms. The 15 Hz selection attenuates all frequencies above 15 Hz and provides only for sampling all 16 channels within 328 ms.

IMPORTANT	Do not use the 1000 Hz module filter with HART instruments.

IMPORTANT	60 Hz is the default setting for the module filter. This setting provides approximately 3 dB of attenuation of a 60 Hz input.

Use the following table to choose a module filter setting.

Table 10 - Module Filter Selections with Associated Performance Data

Module Filter Selection (-3dB) (1)	15 Hz	20 Hz	50 Hz	60 Hz	100 Hz	250 Hz	1000 Hz
Minimum Sample Time (RTS)	328 ms	275 ms	115 ms	115 ms	61 ms	25 ms	11 ms
Effective Resolution	18 bits	18 bits	17 bits	17 bits	16 bits	16 bits	15 bits
	0.08 μA	0.08 μA	0.16 μA	0.16 μA	0.32 μA	0.32 μA	0.64 μA
50 Hz Rejection	74 dB	48 dB	6 dB	6 dB	1 dB	0.1 dB	N/A
60 Hz Rejection	74 dB	97 dB	9 dB	9 dB	2 dB	0.2 dB	N/A

(1) Worst case settling time to 100% of a step change is double the real time sample time.

Real Time Sampling (RTS)

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

During module configuration, you specify a real time sampling (RTS) period and a requested packet interval (RPI) period. Both of these features instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

Underrange and Overrange Detection

The module detects when it is operating beyond limits of the input range. This status indication tells you that the input signal is not being measured accurately because the signal is beyond the measuring capability of the module. For example, the module cannot distinguish between 20.5 mA and 22 mA

The following table shows the input ranges of the 1756-IF16H module and the lowest and highest signal available in each range before the module detects an underrange and overrange condition.

Table 11 - Low and High Signal Limits on the 1756-IF16H Module

Module	Available Range	Lowest Signal in Range	Highest Signal in Range
1756-IF16H	0…20 mA 4…20 mA	0 mA 3.42 mA	20.58 mA 20.58 mA

Digital Filter

The digital filter smooths input data noise transients. This feature is applied on a **per channel** basis.

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

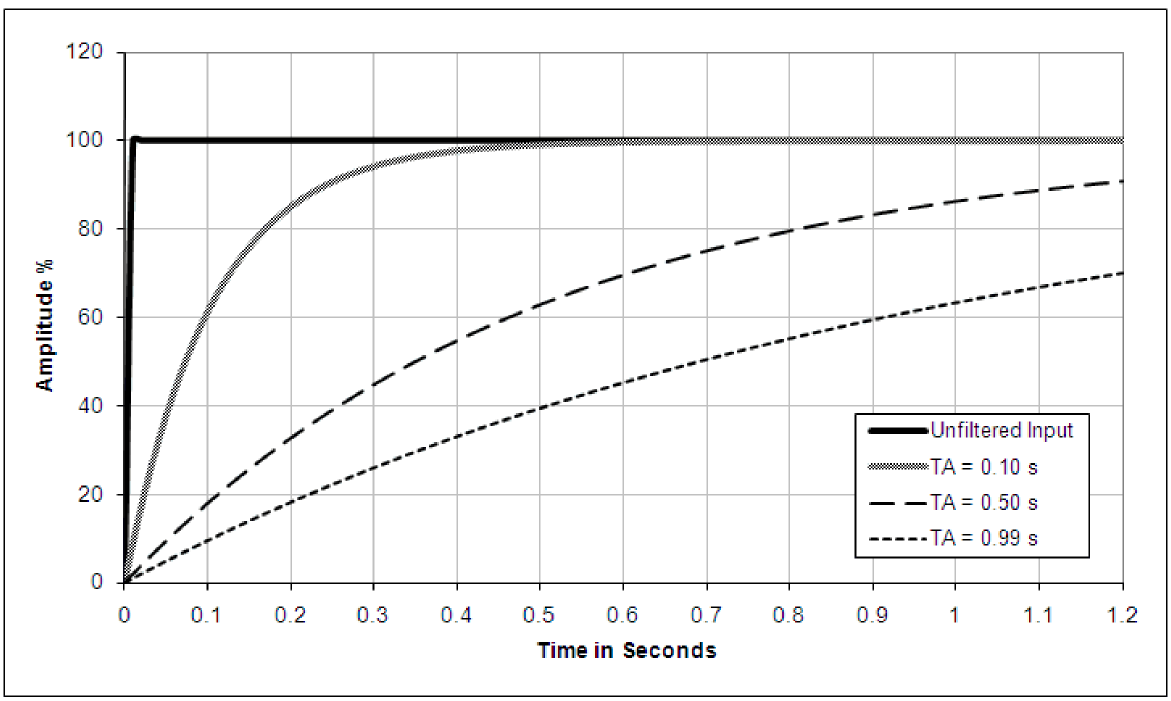
The digital filter equation is a classic first order lag equation.

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

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

Using a step input change to illustrate the filter response, as shown in the figure, 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 11 - Filter Response



Wire-off Detection

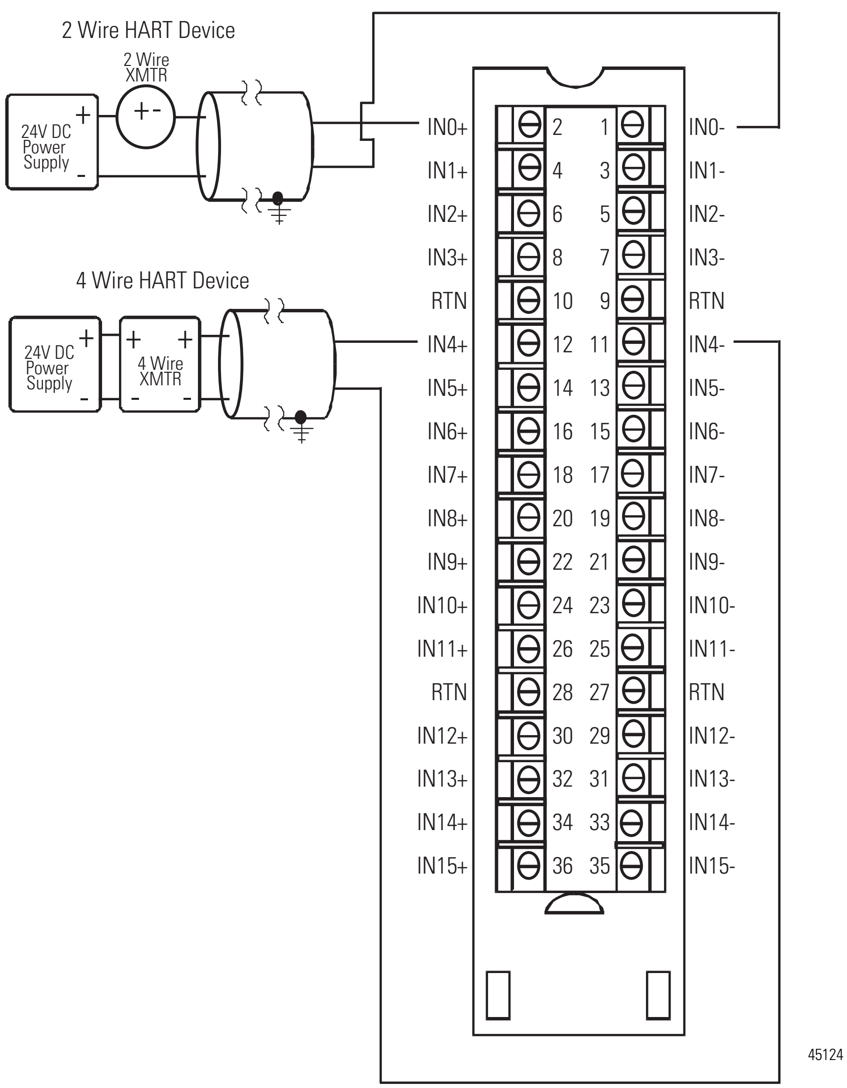
The 1756-IF16H module alerts you when a signal wire is disconnected from one of its channels or the RTB is removed from the module if the channel is configured for 4…20 mA range. When a wire-off condition occurs for this module, two events occur:

- Input data for that channel changes to the scaled value corresponding to the Underrange condition.
- A fault bit is set in the input tag (Ch*xx*Underrange and Ch*xx*BrokenWire tags are set to 1), which may indicate the presence of a wire-off condition.

Wiring Diagram

Use this information to wire the current inputs.

Figure 12 - Current Inputs

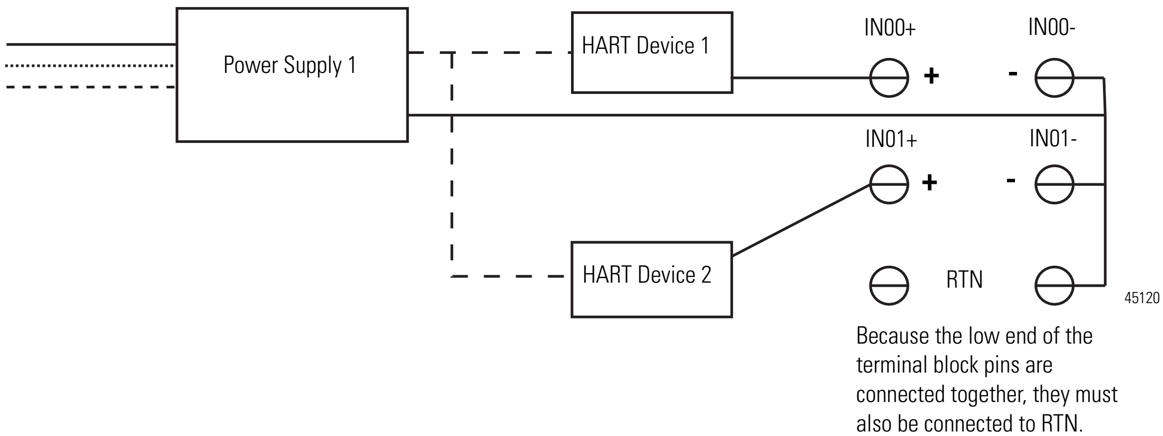


Channel	Pin #	Usage	Usage	Pin #
00	2	IN00+	IN00-	1
01	4	IN01+	IN01-	3
02	6	IN02+	IN02-	5
03	8	IN03+	IN03-	7
	10	RTN	RTN	9
04	12	IN04+	IN04-	11
05	14	IN05+	IN05-	13
06	16	IN06+	IN06-	15
07	18	IN07+	IN07-	17
08	20	IN08+	IN08-	19
09	22	IN09+	IN09-	21
10	24	IN10+	IN10-	23
11	26	IN11+	IN11-	25
	28	RTN	RTN	27
12	30	IN12+	IN12+	29
13	32	IN13+	IN13+	31
14	34	IN14+	IN14+	33
15	36	IN15+	IN15+	35

The 1756-IF16H is a differential input module. However there are limitations on its use in differential mode. Any time the low ends of the terminal block pins are connected together they must also be jumpered to the RTN pin on the terminal block. There are two scenarios in which this happens.

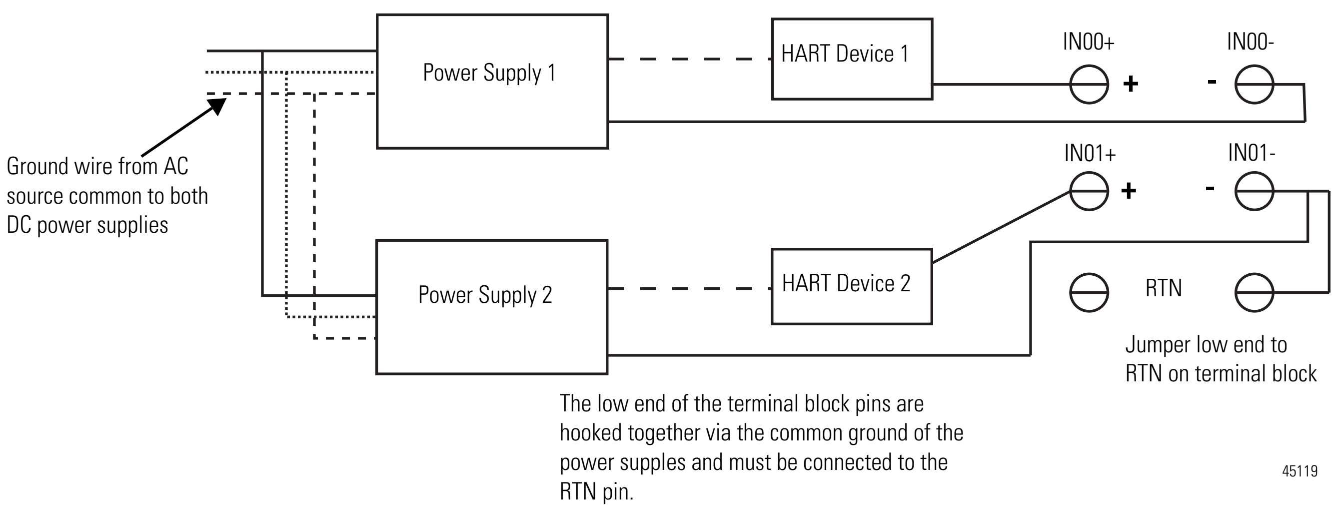
First, if a single power supply is used for multiple devices then the low end from each channel is connected together and connected to the ground return of the power supply. See the following diagram.

Figure 13 - Single Power Supply with Multiple HART Devices



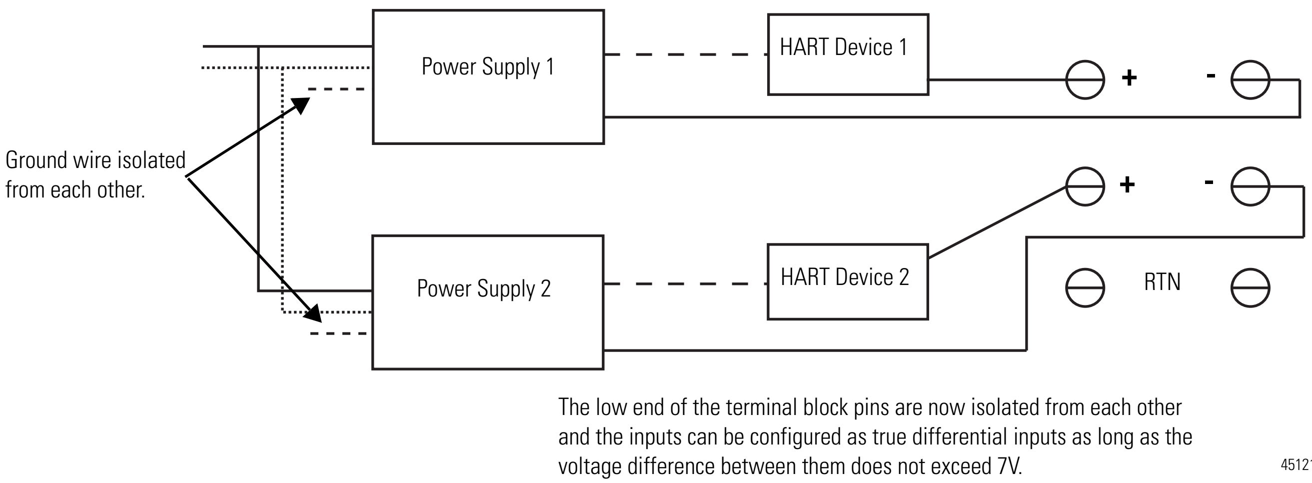
The second way for channels to share a ground is to have multiple power supplies hooked to the same ground. In this case the low ends of the channels are effectively connected together by the common grounds of the power supplies.

Figure 14 - Multiple Power Supplies with a Common Ground



For devices powered by individual supplies, when the ground potential of the supplies is expected to differ, differential mode is recommended. This prevents ground loop currents from flowing between the supplies. However, the potential difference allowable between the supplies must remain within the specified limits.

Figure 15 - Power Supplies with Isolated Grounds

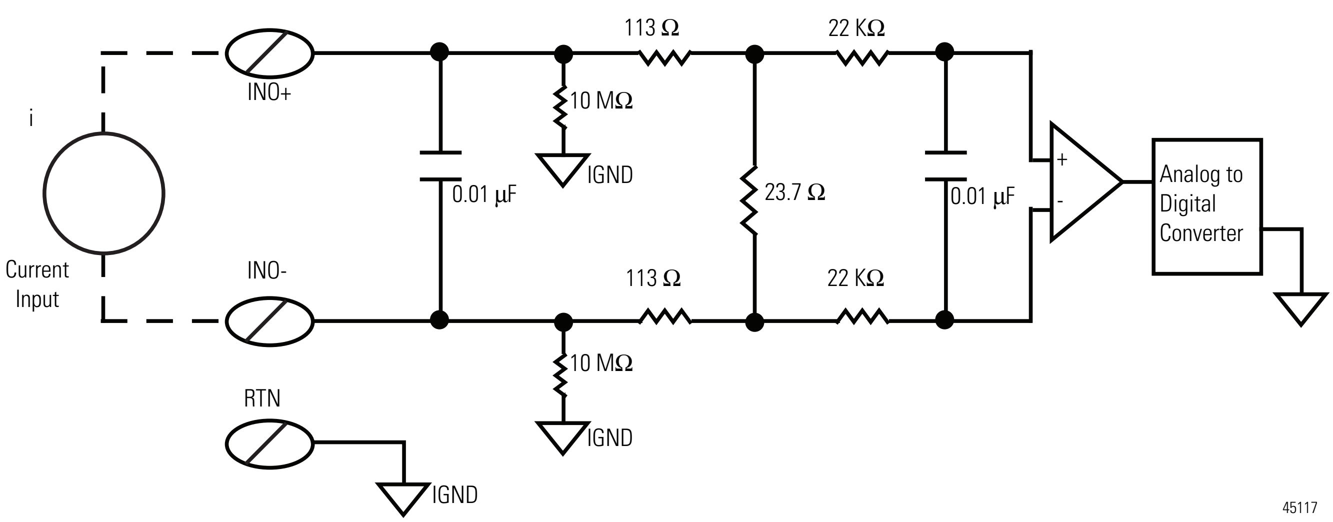


Some devices ,such as AC powered four wire devices, are recommended to be used in differential mode only. Combinations of differential and single-ended configurations are allowed but care must be taken to insure that the differential input grounds really are isolated from the single-ended inputs.

Circuit Diagram

This figure is a simplified input circuit diagram for the 1756-IF16H module.

Figure 16 - 1756-IF16H Simplified Current Input Circuit



1756-IF16H Module Fault and Status Reporting

The 1756-IF16H module sends status/fault data to the controller with its channel data. The fault data is arranged to let you choose the level of granularity you 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.

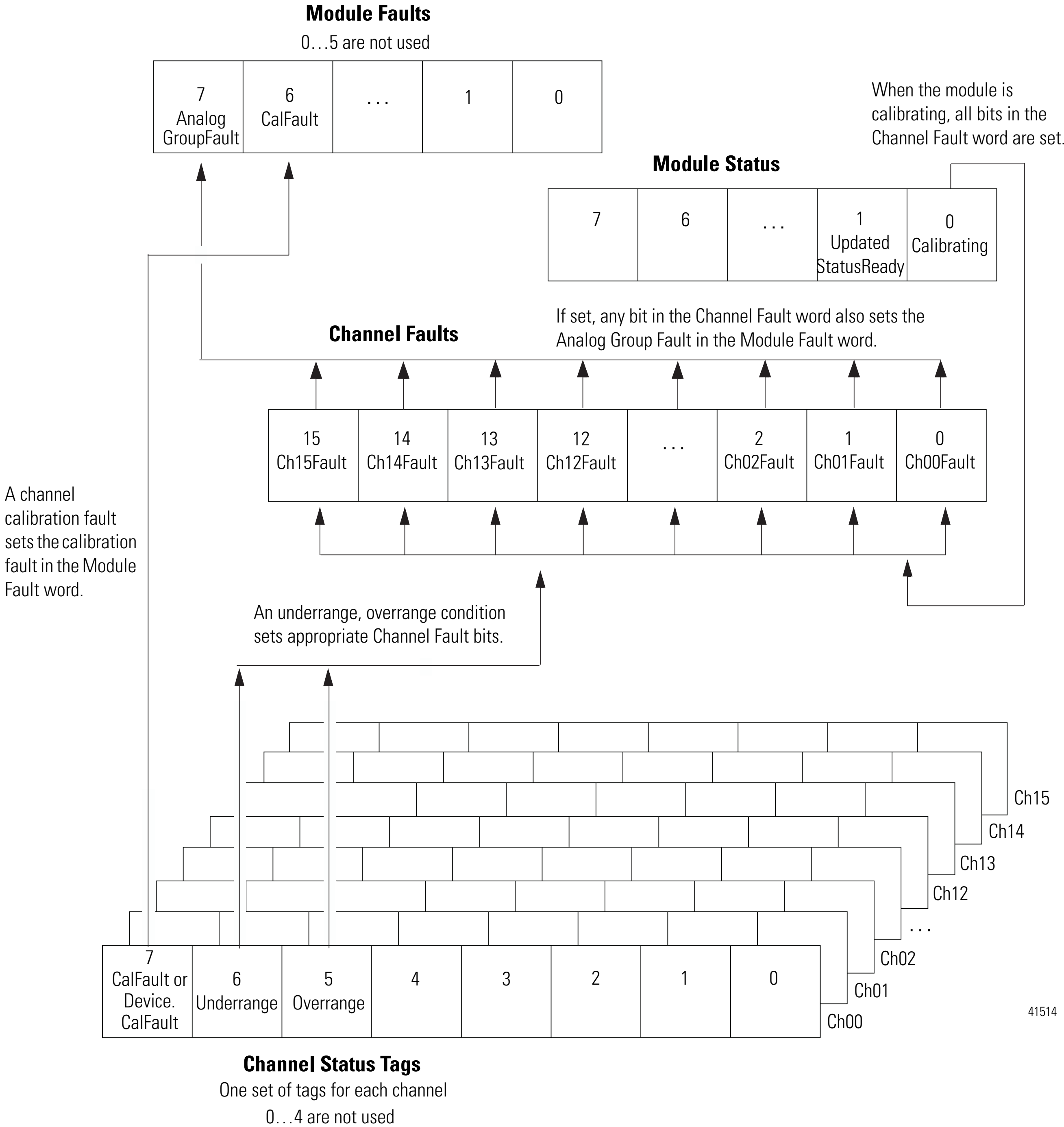
Table 12 shows the tags that can be examined in ladder logic to indicate when a fault has occurred.

Table 12 - Tags That Can Be Examined in Ladder Logic

Tag	Description	Tag Name Analog and HART PV	Tag Name Analog and HART by Channel
Module Fault Word	This word provides fault summary reporting.	ModuleFaults	ModuleFaults
Channel Fault Word	This word provides clamp and communication fault reporting.	ChannelFaults Ch*xx*Fault	ChannelFaults Ch*xx*Fault
Channel Status Tags	These words provide individual channel limit, hold, open wire, ramp status, and calibration faults.	Ch*xx*Status	Ch*xx*.Device Status Ch*xx*.DeviceStatus.AlarmStatus
HART Faults	This provides HART communication status.	HARTFaults, Ch*xx*HARTFault	Ch*xx*.DeviceStatus.HARTFault
HART Device Status	This provides HART field device health.	HART.Ch*xx*Device Status	Ch*xx*.DeviceStatus.FieldDeviceStatus

1756-IF16H Fault Reporting

This graphic offers an overview of the fault reporting process for the 1756-IF16H module.



1756-IF16H Module Fault Word Bits

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further to isolate the fault. Table 13 lists tags that can be examined in ladder logic to indicate when a fault has occurred.

Table 13 - Tags That Can Be Examined in Ladder Logic

Tag	Description
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault.
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalFault.

1756-IF16H Channel Fault Tags

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

Channel Fault bits for all channels are also set (16#FFFF) if calibration is being performed or a communication fault has occurred between the module and its owner controller.

1756-IF16H Channel Status Tags

Table 14 describes the channel status tags.

Table 14 - Tags That Show Channel Status(1)

Tag	Bit	Description
Ch*x*CalFault	7	This bit is set if an error occurs during calibration for Channel *x*, causing a bad calibration. Also sets CalFault in the Module Faults.
Ch*x*Underrange	6	This bit is set when the analog signal is less than or equal to the minimum detectable signal. Because the signal cannot be measured, it may be significantly below the minimum value. Also sets Ch*xx*Fault in the Channel Faults.
Ch*x*Overrange	5	This bit is set when the analog signal is greater than or equal to the maximum detectable signal. Because the signal cannot be measured, it may be significantly above the maximum value. Also sets Ch*xx*Fault in the Channel Faults.

(1) Bits 0…4 are not used.

Specifications and Certifications

See the 1756 ControlLogix I/O Modules Specifications Technical Data, publication 1756-TD002, for specific module specifications and certifications.

Notes:

1756-OF8H HART Analog Output Module

Introduction

This chapter describes features of the 1756-OF8H ControlLogix HART analog output module.

The table explains the topics discussed in this chapter.

Module Features

The 1756-OF8H module has the following features:

- Choice of three data formats

IMPORTANT	The Analog and HART by Channel data type is available **only** for 1756-OF8H firmware revision 2.1

- 15 or 16 bit resolution
- Ramping and rate limiting
- Hold for initialization
- Open wire detection
- Clamping and limited
- Clamp and limit alarms
- Data echo

Data Formats

Data format determines which values are included in the Input tag of the module and the features that are available to your application. Select the data format on the General tab in RSLogix 5000 software. The following data formats are available for the 1756-IF8H module.

		Description			
		Analog signal values	Analog status	HART secondary process variables and device health	HART and Analog data for each channel grouped together in tag
Format	Analog Only	X	X		
	Analog and HART PV	X	X	X	
	Analog and HART by Channel[(1)]	X	X	X	X

(1) Available only for 1756-OF8H firmware revision 2.1.

- Choose Analog and HART PV if you prefer the members of your tag to be arranged similar to non-HART analog input modules, with the analog values for all channels grouped together near the end of the tag. This makes it easy to view all eight analog values at once.
- Choose Analog and HART by Channel if you prefer Status, Analog Value, and Device Status for each channel to be together in the tag. This makes it easier to view all of the data related to one field device.

Resolution

The output module is capable of 15 or 16 bit resolution.

Number of Significant Bits	Range	Resolution
16 bits	+/- 10.4V	320 µV
15 bits	0…20 mA 4…20 mA	0.65 µA

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**.

Table 15 describes the types of ramping that are possible.

Table 15 - Ramping Types

Ramping Types	Description
Run mode ramping	This type of ramping occurs when the module is in Run mode and limits the rate at which the output changes from one commanded value to another.
Ramp-to-Program mode	This type of ramping occurs when the controller is placed in the Program mode. The present output value changes to the Program Value. If the connection to the module is inhibited, the Program mode value and ramp rate are applied.
Ramp-to-Fault mode	This type of ramping occurs when there is a communication or controller fault. The output signal 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**.

For additional information about ramp rate, see Chapter 7, Configuring the Modules, which describes how you can set Ramp Rate on the output Limits dialog box.

Hold for Initialization

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

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

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

Open Wire Detection

This feature detects when current flow is not present at any channel. The 1756-OF8H module must be configured for 0…20 mA or 4…20 mA operation to use this feature. 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 named ChxOpenWire is set for that channel.

Clamping and Limiting

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

Once clamps are set for a channel, any data received from the controller that exceeds those clamps sets a limit alarm and transitions the output to that limit but not beyond the configured clamp value. For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals. The signal value actually applied is reflected in the Input Tag ChxData field.

Clamping limits are entered in engineering units.

Clamp and Limit Alarms

This function works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies the clamping limit to the signal value and sends a status bit to the controller, notifying it that the commanded output data value exceeds the clamping limits.

Using the example, if a channel 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 channel's clamping limits.

Clamping alarms can be disabled or latched on a per channel basis. Clamping limits are entered in engineering units.

Data Echo

Data Echo automatically multicasts channel data values that match the analog value that was applied to the module's screw terminals at that time.

Fault and status data are also sent. If selected in the Input Data format, HART secondary process variables and device health are also sent.

An example is that I.ChxData is the echo of O.ChxData. They might be different due to Ramp, Clamp, or Hold for Initialization.

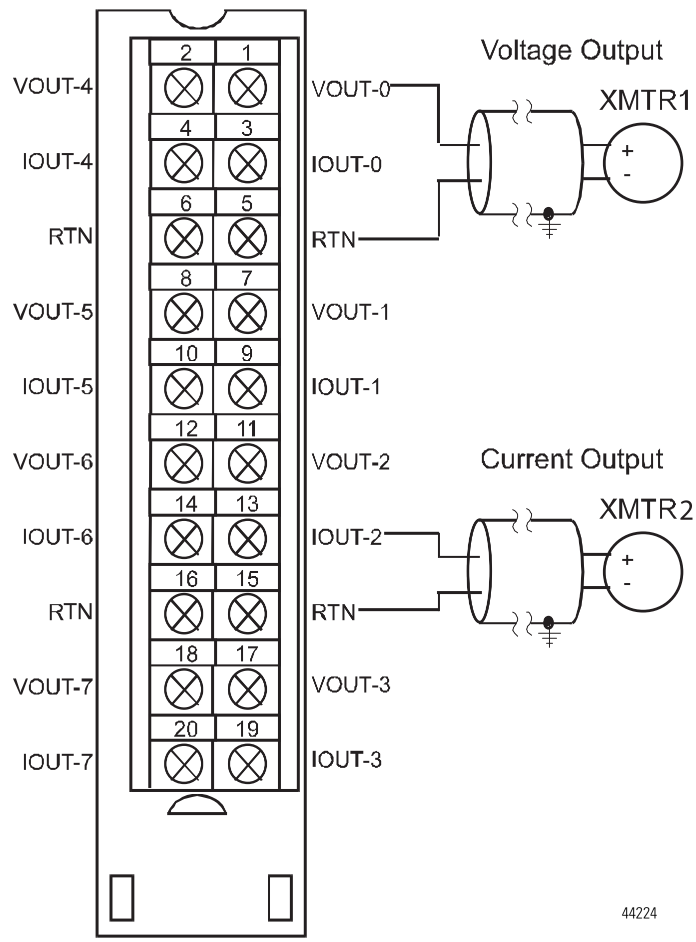
The echo value is the current level being attempted. If the wire is off or damaged, the actual current might be 0.

Wire the Module

Use Figure 17 to wire the module. Voltage outputs use the terminal block pins labelled VOUT-# and RTN. Current outputs use the terminal block pins labelled IOUT-# and RTN.

HART communication is active with current outputs only.

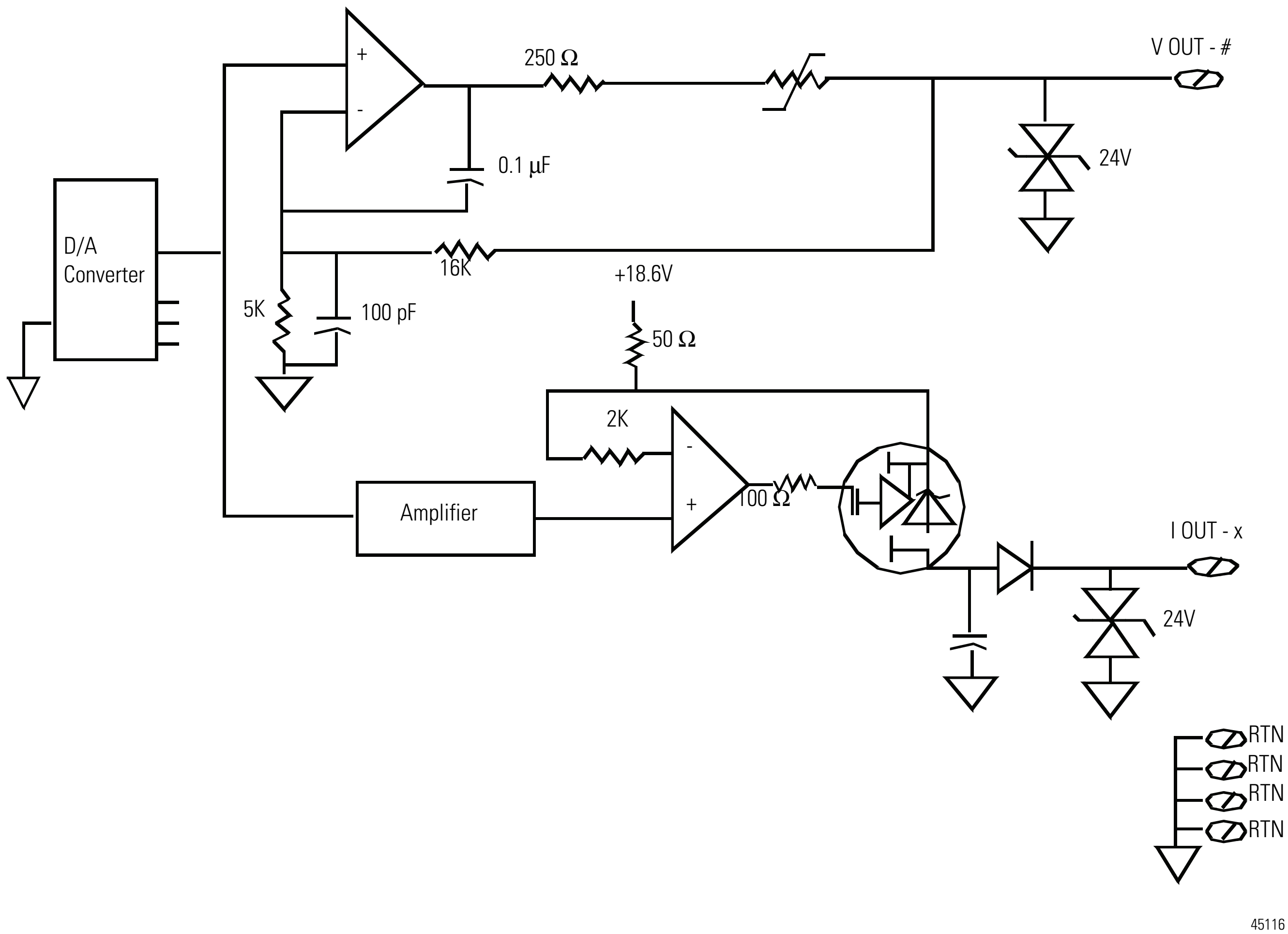
Figure 17 - Wiring Diagram for the 1756-OF8H Module



Use Module Block and Output Circuit Diagrams

This section shows the module output circuit diagram.

Figure 18 - 1756-OF8H Output Circuit Diagram



1756-OF8H Module Fault and Status Reporting

The 1756-OF8H modules multicast status and fault data to the controller with their channel data. The fault data is arranged to let you choose the level of granularity you desire for examining fault conditions.

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

Table 16 lists tags that you can examine in ladder logic to indicate when a fault occurred.

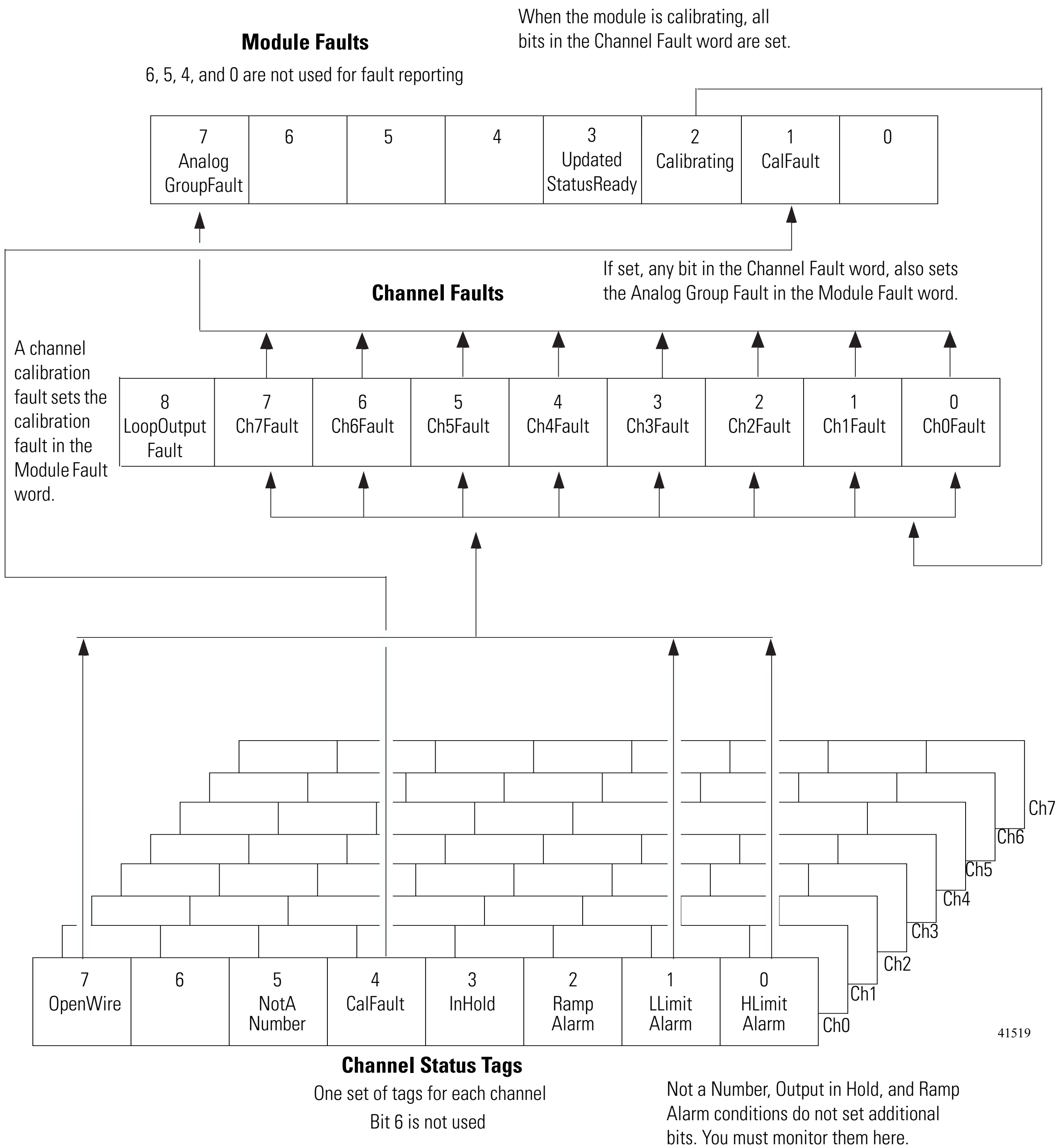
Table 16 - Tags That Can Be Examined in Ladder Logic

Tag	Description	Tag Name Analog and HART PV	Tag Name Analog and HART by Channel[1]
Module Fault Word	This word provides fault summary reporting.	ModuleFaults	ModuleFaults
Channel Fault Word	This word provides clamp and communication fault reporting.	ChannelFaults Ch*x*Fault	ChannelFaults Ch*x*Fault
Channel Status Tags	These words, one per channel, provide individual channel limit, hold, open wire, ramp status, and calibration faults.	Ch*x*Status	Ch*x*.DeviceStatus Ch*x*.DeviceStatus.AlarmStatus
HART Faults	This provides HART communication status.	HARTFaults, Ch*x*HARTFault	Ch*x*.DeviceStatus.HARTFault
HART Device Status	This provides HART field device health.	HART.Ch*x*Device Status	Ch*x*.DeviceStatus.FieldDeviceStatus

(1) Available only for 1756-OF8H firmware revision 2.1.

1756-OF8H Fault Reporting

The graphic below offers an overview of the fault reporting process.



Module Fault Word Bits

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

Table 17 lists tags that are found in the Module Fault word.

Table 17 - Tags Found in the Module Fault Word

Tag	Description	Tag Name
Analog Group Fault	This bit is set when any bits in the Channel Fault word are set.	AnalogGroupFault
Calibrating	This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set.	Calibrating
Calibration Fault	This bit is set when any of the individual Channel Calibration Fault bits are set.	CalFault

Channel Fault Word Bits

During normal module operation, Channel Fault word bits are set if any of the respective channels has a High or Low Limit Alarm or an Open Wire condition (0…20 mA or 4…20 mA configurations only). When using the Channel Fault Word, the 1756-OF8H module uses bits 0…7. Checking this word for a nonzero condition is a quick way to check for these conditions on a channel.

Table 18 lists the conditions that set **all** Channel Fault word bits.

Table 18 - Conditions That Set All Channel Fault Word Bits

This Condition Sets All Channel Fault Word Bits	And Causes the Module to Display the Following in the Channel Fault Word Bits
A channel is being calibrated	16#00FF
A communication fault occurred between the module and its owner-controller	1#FFFF

Your logic should monitor the Channel Fault bit for a particular output, if you either enable output clamping, if you are checking for an open wire condition (0…20 mA configuration only), or if you need to know if the output module is not communicating with the controller.

Your logic can use the bit in Channel Faults, for example, Ch2Fault, to take failure recovery action, such as signaling CVFault on a PIDE function block.

Channel Status Tags

Any of the channel status words (eight words for 1756-OF8H modules), one for each channel, display a nonzero condition if that particular channel has faulted. Some of these bits set bits in other Fault words.

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

When the Calibration Fault bit (CalFault) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word. Table 19 lists the conditions that set each of the word bits.

Table 19 - Conditions That Set Each of the Word Bits(1)

Tag (status words)	Bit	Event That Sets This Tag
Ch*x*OpenWire Ch*x*.DeviceStatus.OpenWire	7	This bit is set only if the configured Output Range is 0…20 or 4…20 mA and the circuit becomes open due to a wire falling off or being cut when the output being driven is above 0.1 mA. The bit remains set until correct wiring is restored.
Ch*x*NotaNumber(2) Ch*x*.DeviceStatus.NotANumber	5	This bit is set when the output value received from the controller is NotANumber (the IEEE NaN value). The output channel holds its last state.
Ch*x*CalFault Ch*x*.DeviceStatus.CalFault	4	This bit is set when an error occurred when calibrating. This bit also sets the appropriate bit in the Channel Fault word.
Ch*x*InHold(2) Ch*x*.DeviceStatus.InHold	3	This bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value.
Ch*x*RampAlarm(2) Ch*x*.DeviceStatus.RampAlarm	2	This bit is set when the output channel's requested rate of change would exceed the configured maximum ramp rate requested parameter. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it remains set until it is unlatched.
Ch*x*LLimitAlarm Ch*x*.DeviceStatus.LLimitAlarm	1	This bit is set when the requested output value is beneath the configured low limit value. It remains set until the requested output is above the low limit. If the bit is latched, it remains set until it is unlatched.
Ch*x*HLimitAlarm Ch*x*.DeviceStatus.HLimitAlarm	0	This bit is set when the requested output value is above the configured high limit value. It remains set until the requested output is below the high limit. If the bit is latched, it remains set until it is unlatched.

(1) Bit 6 is not used.

(2) This bit does not set additional bits at any higher level.

Specifications and Certifications

See the 1756 ControlLogix I/O Modules Specifications Technical Data, publication 1756-TD002, for specific module specifications and certifications.

Configure the Modules with RSLogix 5000 Software

Introduction

The information in this chapter describes how to configure the ControlLogix HART analog I/O modules with RSLogix 5000 software.

The table explains the topics discussed in this chapter.

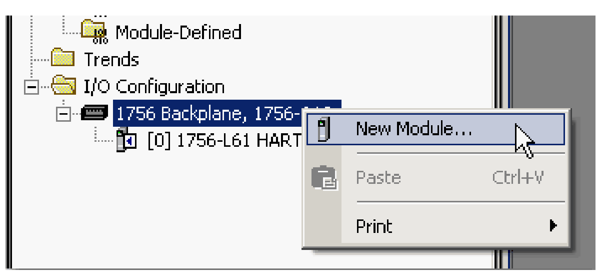
Create a New Module

Do these steps to add a ControlLogix HART analog I/O module to your RSLogix 5000 project.

The screen facsimiles show examples for the 1756-IF8H module, but the procedures are the same for the 1756-IF16 H and 1756-OF8H modules.

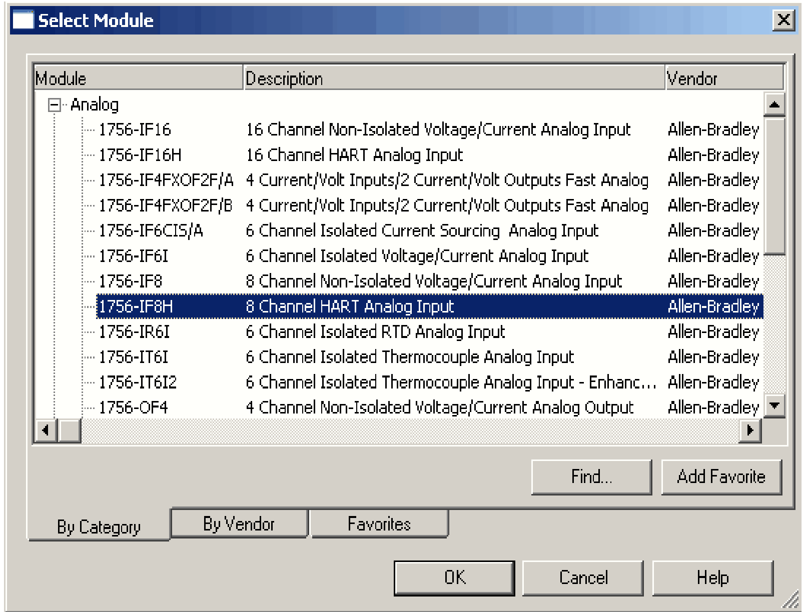
IMPORTANT	You cannot make changes to any field in these tabs if you are in Hard Run mode. Hard Run mode means that the keyswitch is in the Run position.

1. From the I/O Configuration tree, right-click the 1756 backplane and choose New Module.



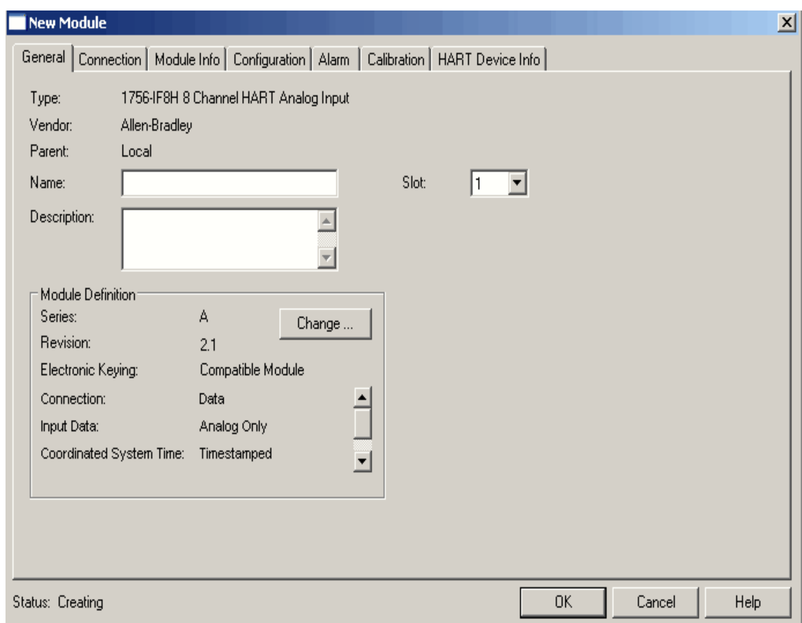
The Select Module window appears.

2. Expand the Analog modules and select your module .



3. Click OK.

The New Module dialog box appears.

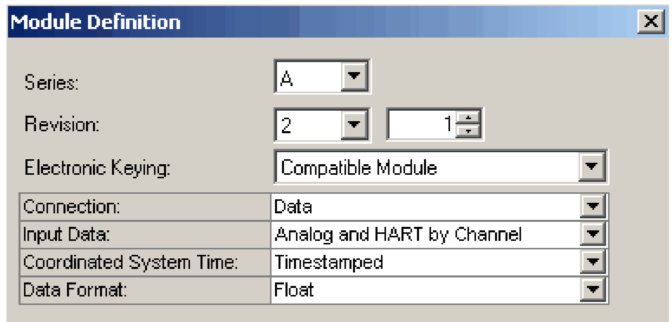


General Tab

Complete the se instructions for a general configuration.

1. On the General tab, do these steps:
   a. Type a name for the module.
   b. Type an optional description for the module.
   c. Select the slot number for the module.
2. On the Module Definition box, click Change.

   The Module Definition dialog box appears.



3. Complete these actions:

Parameter	Action	Values
Series	Displays the series letter that matches your module's series	N/A
Revision	Choose the revision number that matches the label on the side of your module, be sure that the minor revision number also matches	N/A
Electronic Keying	Choose the electronic keying method See Electronic Keying on page 17 for more information	• Exact Match • Compatible Module (default) • Disable Keying
Connection	Choose the connection type	• Data - has more tabs on the Module Properties dialog box than Listen-only because of configuration settings for alarms, calibration • Listen-only - has no configuration data, does not send output data (1756-OF8H module) See Listen-only Mode on page 49 for more information.
Input Data	Choose the input data mode	• Analog Only • Analog and HART PV • Analog and HART by Channel (available only for firmware revision 2.1) See HART Configuration for more information.
Coordinated System Time	Not configurable	Timestamped
Data Format	Not configurable	Float

HART Configuration

The Input Data formats on the General tab let you access HART field device data through automatic collection of the HART Field Device Process Variables and Health information.

You can also access HART field device data with pass-through messages. See Getting HART Data By Using CIP MSG on page 121 and HART Modules Used with Asset Management Software on page 141 for more information.

Table 20 shows which configuration options provide HART data in the input tag and which provide pass-through message access.

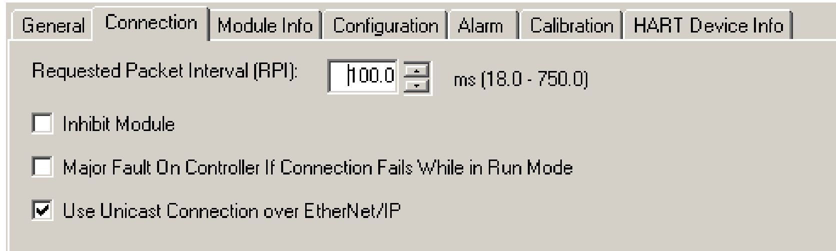
Table 20 - HART Data Configuration Options

Input Data Format	Enable HART Checkbox	HART Data Input Tag Present?	Pass-through Message Access for MSG or Asset Management
Analog only	Not checked	No	No
	Checked		Yes
Analog and HART PV	Not checked	Fields present in tag, but data for this channel not valid	No
	Checked	Yes	Yes
Analog and HART by Channel	Not checked	Fields present in tag, but data for this channel not valid	No
	Checked	Yes	Yes

Even if you are not enabling HART on all channels, the Analog and HART PV input tag includes space for the data, but it will be marked with a HARTFault to indicate it is not valid. This lets you add HART instruments later without disturbing the tag layout.

Connection Tab

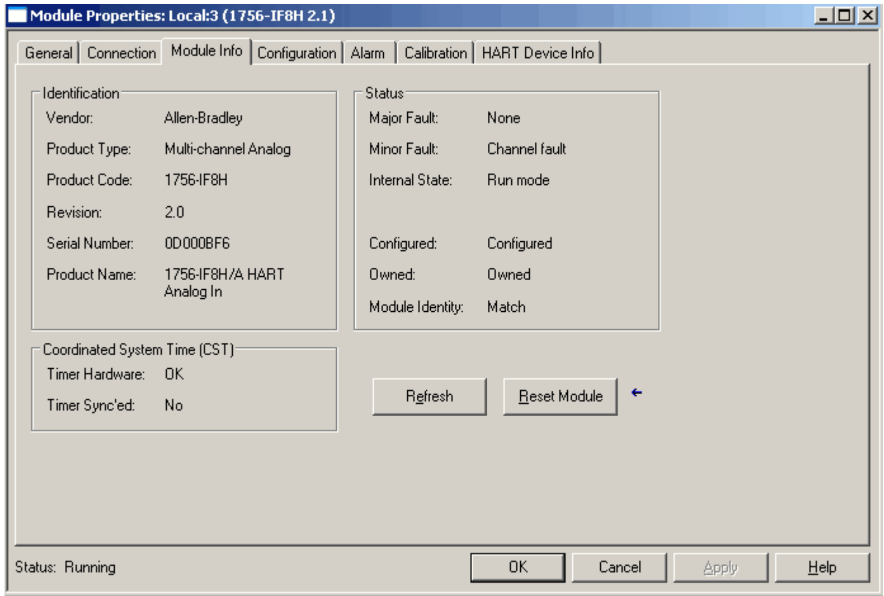
Use the following information to make selections on the Connection tab.



Parameter	Description
Requested Packet Interval	Defines when the module multicasts its data onto the local chassis backplane.
Inhibit Module	Prevents connection to the module. Use only if you do not want the module put into service.
Major Fault on Controller If Connection Fails While in Run Mode	The Logix controller performs a major fault if communication to this I/O module fails.
Use Unicast Connection over EtherNet/IP	Appears only for HART analog modules using RSLogix 5000 software version 18 or later in a remote EtherNet/IP chassis. Use the default checkbox if there are no other controllers in 'Listen-Only' mode. Clear the box if there are other 'listening' controllers in the system.

Module Info Tab

The Module Info tab displays module and status information. This tab is populated with data that comes directly from the module. The information on this window is displayed when the project is online.



Status

The Status box in the right-hand column of the Module tab displays the module's current operational state. See the descriptions in the following table.

<table>
<tr><th>Parameter</th><th colspan="2">Description</th></tr>
<tr><td>Major Fault</td><td colspan="2">None, Unrecoverable, or Recoverable.</td></tr>
<tr><td>Minor Fault</td><td colspan="2">None, Unrecoverable, or Recoverable.
Recoverable might mean you have a channel fault such as wire off.</td></tr>
<tr><td>Internal State</td><td colspan="2">Indicates the module's mode.</td></tr>
<tr><td>Configured</td><td colspan="2">Indicates if the module was configured by an owner controller connected to it. Once a module is configured, it stays configured until the module is reset or power cycled, even if the owner drops connection to the module.(1)</td></tr>
<tr><td>Owned</td><td colspan="2">Indicates if an owner controller is currently connected to the module.(1)</td></tr>
<tr><td rowspan="4">Module Identity</td><td colspan="2">Displays Match or Mismatch as described below. This field does not take into account the Electronic Keying or Minor Revision selections for the module as specified on the General tab.</td></tr>
<tr><td>Displays</td><td>If the Physical Module</td></tr>
<tr><td>Match</td><td>Agrees with what is specified on the General tab. For the Match condition to exist, all of the following must agree:
• Vendor
• Module type (the combination of product type and product code for a particular vendor)
• Major revision</td></tr>
<tr><td>Mismatch</td><td>Does not agree with what is specified on the General tab.</td></tr>
</table>

(1) This information applies to the I/O module only and does not apply to adapters, scanners, bridges, or other communication modules.

Coordinated System Time (CST)

The CST box in the lower, left-hand column of the Module tab provides the following information.

Parameter	Description
Timer Hardware	Displays OK or faulted for the timer's hardware.
Timer Sync'ed	Displays yes if the module's timer is coordinated with the master. Display no if it is not. This indicates if a CST master is providing a time reference to the module. Configure a controller to be the CST Time Master using the Controller Properties tab.

Refresh or Reset Module

Click Refresh to refresh the information or click Reset Module to reset the module to its power-up state.

IMPORTANT	Resetting the module breaks connections and restores output signals to default conditions.

Applying Changes

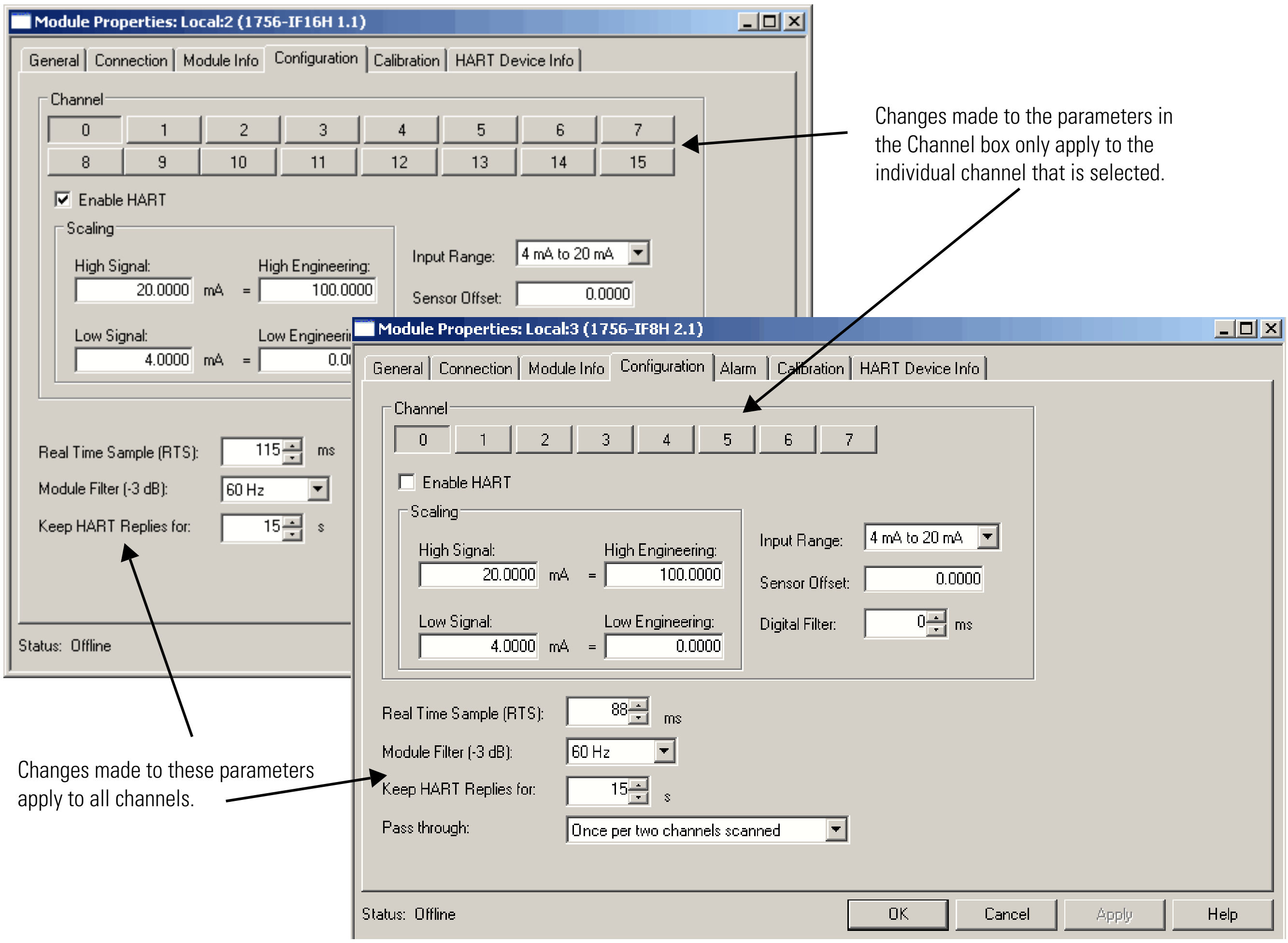
If all of the following conditions exist when you click Apply or OK, the information is automatically sent to the controller:

- you are online in Program, Remote Program, or Remote Run mode, and
- this controller is the owner controller, and
- you have changed the module's configuration in the software.

The controller tries to send the information to the module (if the module's connection is not inhibited). If you do not click OK or Apply, your changes are not sent to the controller.

Configuration Tab - Input Modules

The following information describes how to configure the module's input channels. Differences in the modules are noted.



Configure the Individual Channels

With an individual channel button selected, use this table to configure the parameters in the Channel box that apply to the individual channels.

Parameter	Action	Notes	Available in Hard Run Mode?
Enable HART	Check or uncheck for the 1756-IF8H and 1756-OF8H modules. Defaults checked for the 1756-IF16H module.	• Input range must be 0…20 mA or 4…20 mA. • When a channel is not enabled: – HART messages are not sent on this channel. – HART pass-through messages are not sent. – HART data for this channel is not updated in the input tag. • If you select a HART PV or HART by Channel input tag on the General tab, process data (PV, SV, TV, and FV) from the HART instrument is included in the input tag. If you selected Analog only, the additional process data is not included in the input tag. • Regardless of the choice of input tag, HART communication can be enabled for each channel to provide pass-through HART message access. If Enable HART is not checked, this pass-through message access is not available. • We recommend you Enable HART for any channel that has a HART device connected so that information can be displayed on the HART Device Info tab and accessed by AssetCentre. • You can check Enable HART on some channels and not on others if only some channels have HART field devices attached. • Because the HART modem is shared by all the channels, HART response time is better if you enable only the needed HART channels on the 8-channel modules.	No
Scaling	Enter scaling values for High Signal, Low Signal, High Engineering, and Low Engineering.	See Scaling to Engineering Units on page 98 for more information.	No
Input Range	Choose a value from the drop-down menu.	0…20 mA or 4…20 mA is required for HART.	No
Sensor Offset	Enter a value from -9,999,999…99,999,999 (float).	• The default value is 0.00. • The offset value is in engineering units. • The Sensor Offset is added to the data value to determine signal level.	No
Digital Filter	Select a filter time constant value from 0…20100 ms.	This field is a first-order lag filter that smooths input transitions. It is called a digital filter because it is calculated in the software by the module, not by a hardware filter. The digital filter is applied to each channel individually, but the module filter applies to all channels, so each channel can have a different digital filter setting to accommodate the specific device attached to that channel.	No
For descriptions of the other boxes, such as Real Time Sample (RTS), see Configure All Channels on page 101.			

Scaling to Engineering Units

Channel data values in the output tag can be in engineering units such as kg, m, or percent. To configure the relationship between engineering units and the physical signal in volts or mA, set the Low and High Signal and the Low and High Engineering values.

For example, if you have a temperature transmitter on channel 3 that produces 4 mA current at -180 °C (-292 °F) and 20 mA of current at 750 °C (1,382 °F), and you want to use °C in your control program, then configure the values as in the following table.

	Signal	Engineering
High	20	750
Low	4	-180

If you are using HART field devices, we recommend setting Engineering High and Low to the field device's Upper Range Value and Lower Range Value so that the field device uses the same engineering units as the 1756-IF8H module. If online, these values are displayed on the HART Device Info tab.

See the Scaling Example on page 99 for more information.

Scaling High and Low Signal

Set the High and Low Signal values for the module. The High Signal value must be greater than the Low Signal value. See the following table for the bounds of these signals.

Range	Low Limit	High Limit
-10…10V	-10.00	10.00
0…20 mA	0.00	20.00
4…20 mA	4.00	20.00
0…5V	0.00	5.00
0…10V	0.00	10.00

Scaling High Engineering

Set the High Engineering value for the module. The High Engineering value must not equal the Low Engineering value. This is the value in engineering units that corresponds with a signal value equal to the High signal.

Valid values are in the range of -10,000,000…100,000,000. The default value is 100.00.

Scaling High Engineering appears dimmed in Hard Run mode.

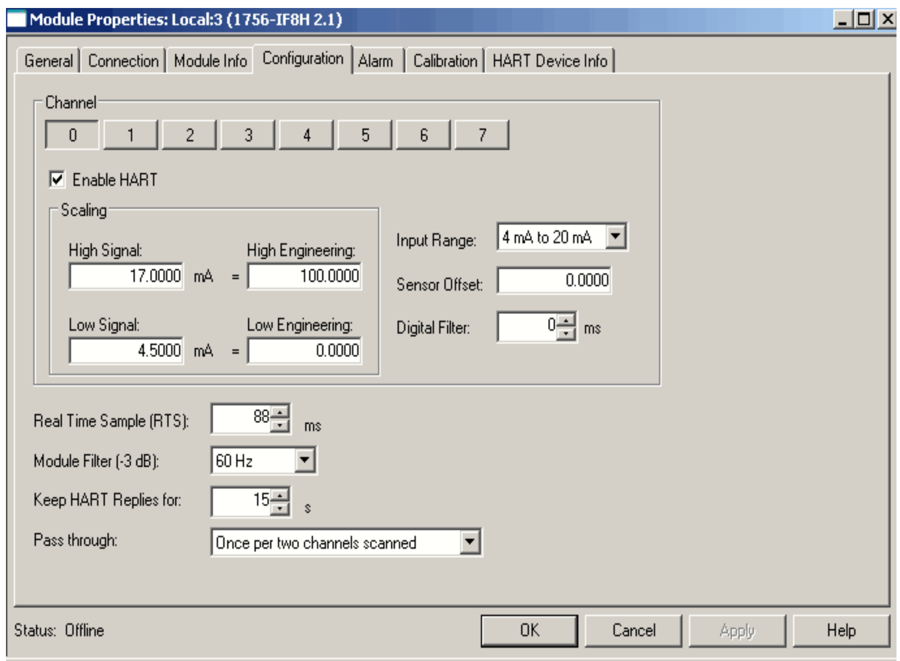
Scaling Low Engineering

Set the Low Engineering value for the module. The Low Engineering value must not equal the High Engineering value. This is the value in engineering units that corresponds with a signal value equal to the Low signal.

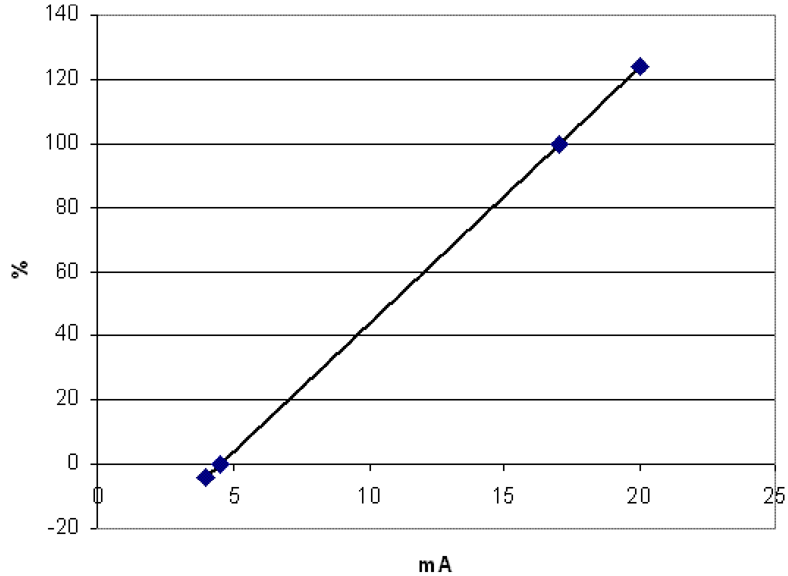
Valid values are in the range of -10,000,000…100,000,000. The default value is 0.00.

Scaling Example

If you would like the module to tell you how full a tank is, you configure the scaling to give you 0% when the tank is empty and 100% when the tank is full. Suppose your sensor that measures the tank signals 4.5 mA when the tank is empty and 17 mA when the tank is full. You would configure scaling like this:

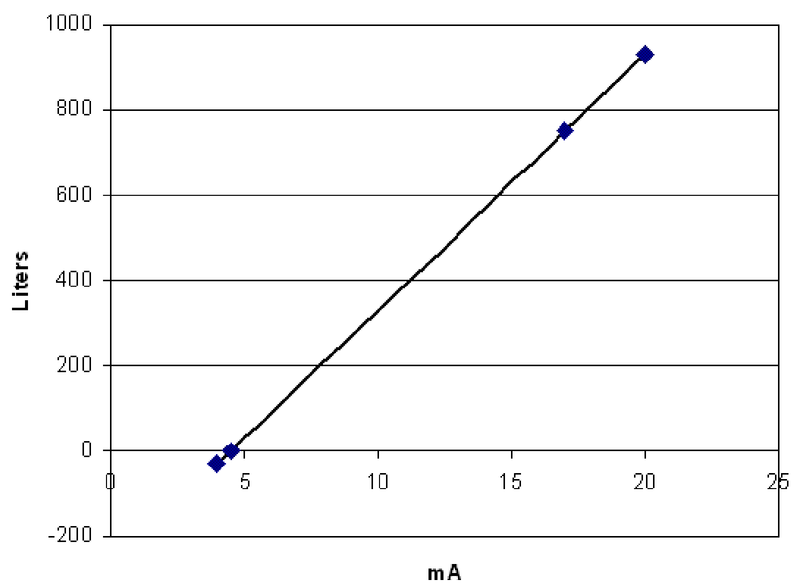


This sets up a relationship between the electrical signal generated by your tank gauge and the number sent to the Logix Controller for use in your control system. Graphically, this relationship looks like this:



Note that the module can measure signals slightly higher and lower than the sensor will provide for this tank. Setting the High or Low Engineering Units will not limit the values to within that range. The module will still measure signals all the way from 4…20 mA. In this example, if the module senses 20 mA, it will report the tank is 124% full. A signal of 0 mA will be reported as -4% full, or 'less than empty'.

To have the tank level reported in liters instead of percent, put the capacity of the tank as the High Engineering value. If you have a 750 liter tank, in the example above put 750 instead of 100, and you will get the scaling relationship shown by this graph:



Configure All Channels

Use this table to configure the parameters on the Configuration tab that apply to all the channels..

Parameter	Action	Notes	Available in Hard Run mode?
Real Time Sample (RTS)	Choose a value from 0…10,000.	• Determines the interval of time at which updated information is supplied to the controller. • The default is 88. • See Real Time Sample (RTS) on page 41 for more information. • Refer to the Real Time Sample Values table on page 101 for RTS choices available for each Module Filter setting.	No
Module Filter (-3 dB)	Choose a value from the pull-down menu.	• Because the digital HART communication signals are in the 1200…2400 Hz range, the module filter can not be set to 1000 Hz if HART is enabled. • Refer to the Module Filter Values table on page 103 to choose a value. • See Module Filter on page 55 for more information.	No
Keep HART Replies	Choose a value from 1…255 s.	• HART replies that are received from the Field Device in response to pass-through messages you have sent are kept for this long. You must retrieve them within this time or the module discards them. • The default is 15. **IMPORTANT** We do not recommend a value of less than 15 s. • See Getting HART Data By Using CIP MSG on page 121 for more information.	No
Pass through (1756-IF8H module only)	Choose a value from the pull-down menu.	• Determines how often pass-through messages occur. – Once per two channels scanned (default)- After 2 channels have PVs scanned to the input tag, a pass-through message is sent (if one is pending). – Once per module scan - Choose this value if you want to minimize the impact pass-through message clients have on reading the PVs into the input tag. – Once per channel scan - After each channel has its PVs scanned to the input tag, a pass-through message is sent (if one is pending). Choose this value if you want to give pass-through messages from clients, such as FactoryTalk AssetCentre, higher priority than reading PV, SV, TV, FV and field device health into the input tag. See the Pass-through Setting, Ratio, and Priority table on page 101 for more information.	No

Table 21 - Real Time Sample Values

Module Filter, Hz	Low Limit	High Limit
10	488	10000
15	328	
20	248	
50	88	
60	88	
100 (default)	56	
250	28	
1000	18	

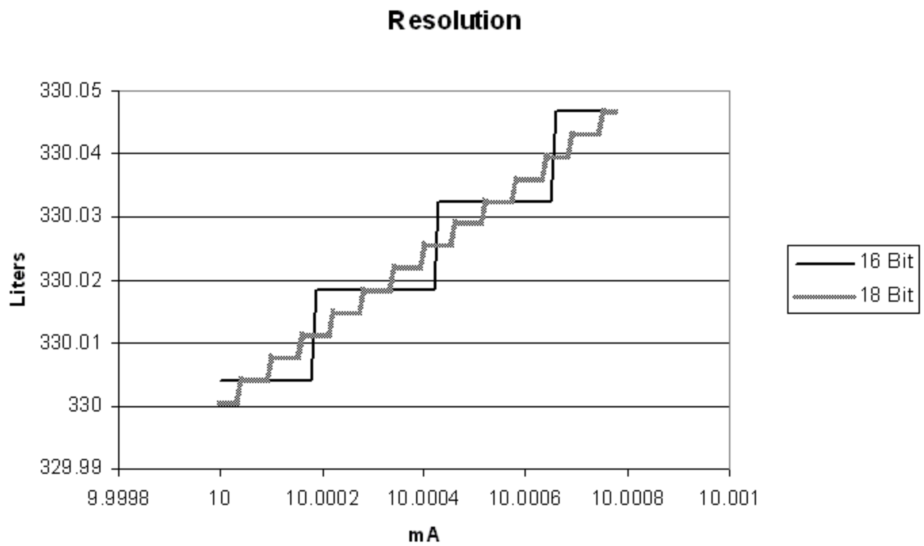
Table 22 - Pass-through Setting, Ratio, and Priority

Setting	Scan:Pass-through ratio	Gives priority to
Once per channel scan	1:1	Asset management
Once per two channels scanned	1:2	Default setting
Once per module scan	1:8	Input tag scan

Module Resolution

Resolution is the smallest amount of change that the module can detect.

Resolution is sometimes expressed in bits. If 16 bits of resolution are available, the module can detect 65536 different signal values. If configured for 4 …20 mA, it could discern the difference between 10 mA and 10.0003 mA, but it would not distinguish 10 mA from 10.0002 mA.



Resolution affects how the module measures analog signals and scaling converts that to an Engineering Unit for convenience in your control system. In the 16 bit example above and the 750 liter tank example in the previous section, you would have a resulting resolution of 0.0146 liters. As the tank fills, you might see the volume jump from a reading of 250 liters to 250.015 liters without seeing any values between. Note that because of sampling, filtering, and RPI, you might see intermediate values or it might jump over even more values, depending on the fill rate.

The resolution of analog input modules depends on the module and the filter configuration. To measure a rapidly changing signal, a configuration with less resolution is used. For information about the resolution available, see the following locations.

For this Module's Available Resolution	Page
1756-IF8H	55
1756-IF16H	69
1756-OF8H	80

IMPORTANT	Because these modules must provide for possible calibration inaccuracies, resolution values represent the available analog-to-digital or digital-to-analog counts over the selected range, including a small amount of Overrange and Underrange.

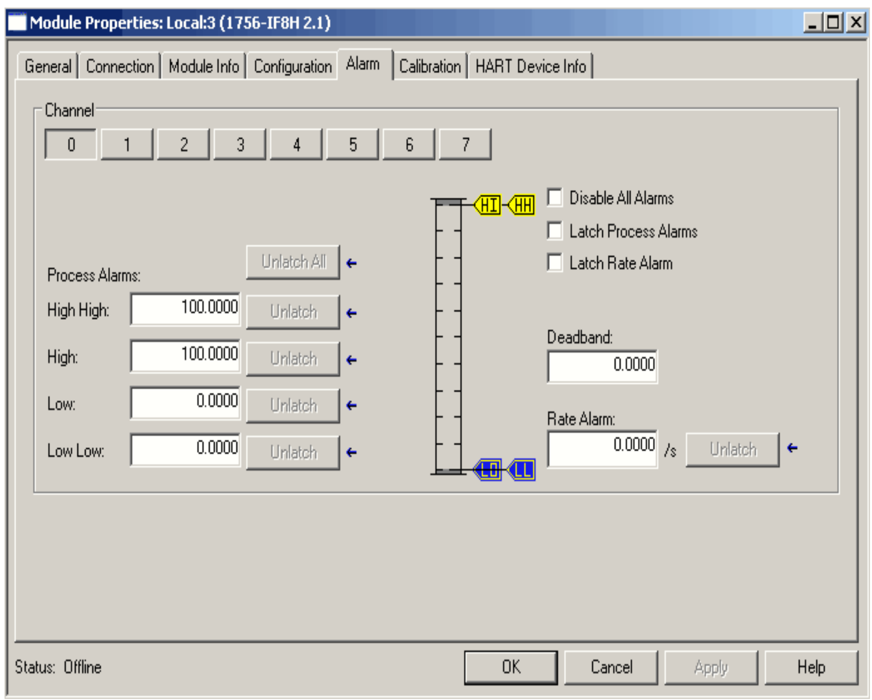
Table 23 - Module Filter Values

Module Filter, Hz	C.ModuleFilter
10(1)	0
15	7
20	6
50	1
60 (default)	2
100	3
250	4
1000(2)	5

(1) 10 Hz not supported in the 1756-IF16H module.
(2) Do not choose 1000 with HART enabled.

Alarm Tab - 1756-IF8H Module

The following information describes how to configure the parameters on the Alarm tab for the 1756-IF8H module. For more information, see Process Alarms on page 58 and Rate Alarm on page 59.



With an individual channel button selected, use these parameter descriptions to configure the alarms.

Table 24 - Alarm Tab Parameters

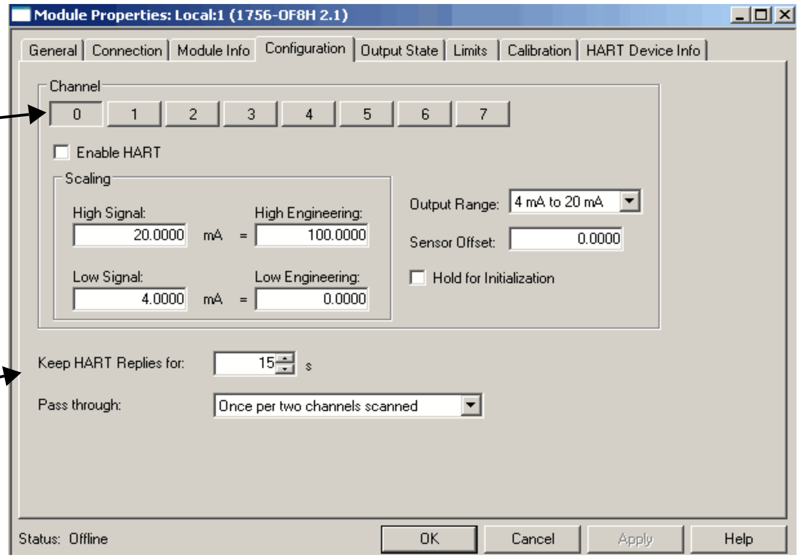
Parameter	Action	Notes	Available in Hard Run Mode?
Process Alarms	Enter values or drag the corresponding flags on the slider bar to set the values.	• The maximum and minimum values for these alarms are set by the High Engineering and Low Engineering parameters on the Configuration tab. • Alarm thresholds are in engineering units. • To change the trigger points by whole numbers only, hold down the shift key while dragging the flag on the slider bar. • A deadband appears around each value.	No
High High (HH)		• Sets the level of input to a channel that causes the module to set the High High alarm. • The alarm remains active until the input returns below this level by more than the deadband. • If Latch Process Alarms is checked, the ChXHHAlarm indication remains set until explicitly cleared.	
High (HI)		• Sets the level of input to a channel that causes the module to set the High alarm. • The alarm remains until the input returns below this level by more than the deadband. • If Latch Process Alarms is checked, the ChXLAlarm indication remains set until explicitly cleared.	
Low (LO)		• Sets the level of input on a channel that causes the module to set the Low alarm. • The alarm remains until the input returns above this level by more than the deadband. • If Latch Process Alarms is checked, the ChXLAlarm indication remains set until explicitly cleared.	
Low Low (LL)		• Set the level of input to a channel that causes the module to set a Low Low alarm. • The alarm remains until the input returns above this level, more than the deadband. • If Latch Process Alarms is checked, the ChXLLAlarm indication remains set until explicitly cleared.	
Disable All Alarms	Check	Disables all alarms for a channel.	No
Latch Process Alarms	Check	Maintains an alarm triggered condition for any of the process alarms, even after the condition ceases. The alarm unlatches only with an explicit message acknowledging the alarm.	No
Latch Rate Alarm	Check	When enabled, a Rate Alarm indication remains set, even when the alarm condition returns to normal. This latch lets you maintain the alarm even after the condition ceases. The alarm unlatches only with an explicit message acknowledging the alarm.	No
Deadband	Enter a value from 0.00…99,999,999.	• Select a value at which an alarm, once set, will not disable as long as the input value remains within the deadband range of the alarm trigger point. (This value in combination with the process alarms creates the range.) This prevents the alarm from cycling on and off if the process value hovers near the alarm threshold. • The alarm deadband can be only half the distance between high and low alarm limits. • The default is 0.00 • For related information, see Alarm Deadband on page 58.	No
Rate Alarm	Enter an alarm limit value from 0.00…99,999,999.	• Enter a Maximum Ramp Rate value to trigger a Rate Alarm when the input signal rate of change exceeds the setpoint. • This is useful for detecting rapid process changes. • The default is 0.00 • Set this alarm in engineering units/second.	No
Unlatch All	Click	• Unlatches all alarms. • Is not available when the project is offline.	Yes
Unlatch	Click	• Unlatches the adjacent alarm condition. • Is not available when the project is offline.	Yes

Configuration Tab - Output Module

The following information describes how to configure the module's input channels.

Changes made to the parameters in the Channel box only apply to the individual channel that is selected.

Changes made to these parameters apply to all channels.



Configure Individual Channels

With an individual channel button selected, use this table to configure the parameters in the Channel box that apply to the individual channels.

Table 25 - Configuration Tab Parameters

Parameter	Action	Notes	Available in Hard Run Mode?
Enable HART	Check or uncheck.	• Unchecked by default. • Output range must be 0…20 mA or 4…20 mA. • When a channel is not enabled: – HART messages are not sent on this channel. – HART pass-through messages are not sent. – HART data for this channel is not updated in the input tag. • If you selected a HART PV or HART by Channel input tag input tag on the General tab, process data (PV, SV, TV, and FV) from the HART instrument is included in the input tag. If you selected Analog only, the process data is not included in the input tag. • Regardless of the choice of input tag, HART communication can be enabled for each channel to provide pass-through HART message access. If Enable HART is not checked, this pass-through message access is not available. • We recommend you Enable HART for any channel that has a HART device connected so that information can be displayed on the HART Device Info tab. • One reason to disable HART communication is that each channel that is enabled requires time to scan, so enabling unnecessary channels reduces performance on the others.	No
Scaling	Enter scaling values for High Signal, Low Signal, High Engineering, and Low Engineering.	See Scaling to Engineering Units on page 98 for more information.	No

Table 25 - Configuration Tab Parameters

Parameter	Action	Notes	Available in Hard Run Mode?
Output Range	Chose a value from the drop-down menu.	0…20 mA or 4…20 mA is required for HART.	No
Sensor Offset	Enter a value from -9,999,999…99,999,999 (float).	• The default value is 0.00. • The offset value is in engineering units. • The Sensor Offset is added to the data value to determine signal level.	No
Hold for Initialization	Check or uncheck	• Check this box to cause the module to hold the output signal unchanged until the output value received from the controller in the ChxData field is within 0.1% of full scale of the value being held. The output holds when the following occurs: – Powerup occurs (holds at zero) – A new connection is established (brings it out of fault state and it holds at the fault value from the previous configuration). – The controller returns to Run mode after Program mode (continues to hold at the configured value that was held in Program mode, see the Output State tab). • The output channel holding lets the controller synchronize with the output, enables smooth output transitions and avoids rapid transients when control resumes from an interruption. • The output can be ramping to the configured hold value when the transition occurs. In this case, it continues the ramp until it completes or until the output value from the controller is within the 0.1% of the output signal. When the Hold for Initialization box is not checked, the output switches as quickly as possible to the first value commanded by the controller.	No

Configure All Channels

Use this table to configure the parameters on the Configuration tab that apply to all the channels.

Table 26 - All Channels Configuration Parameters

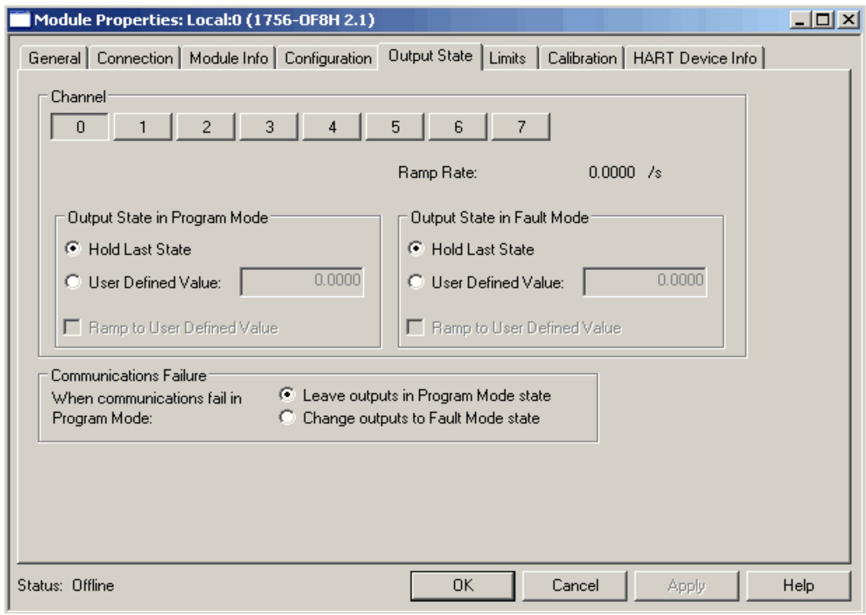
Parameter	Action	Notes	Available in Hard Run Mode?
Keep HART Replies	Select a value from 1 to 255 s.	• HART pass-through message replies are kept for this time. HART replies that are received from the Field Device in response to pass-through messages you have sent are kept for this long. You must retrieve them within this time or the module discards them. • The default is 15. **IMPORTANT** We do not recommend a value of less than 15 s.	No
Pass through	Choose a value from the pull-down menu.	• Determines how often pass-through messages occur. – Once per two channels scanned (default)- After 2 channels have PVs scanned to the input tag, a pass-through message is sent (if one is pending). – Once per module scan - Choose this value if you want to minimize the impact pass-through message clients have on reading the PVs into the input tag. – Once per channel scan - After each channel has its PVs scanned to input tag, a pass-through message is sent (if one is pending). Choose this value if you want to give pass-through messages from clients such as FactoryTalk AssetCentre higher priority than reading PV, SV, TV, FV and field device health into the input tag. See the Pass -through Setting, Ratio, and Priority table on page 107 for more information.	No

Table 27 - Pass -through Setting, Ratio, and Priority

Setting	Scan:Pass-through ratio	Gives priority to
Once per channel scan	1:1	Asset management
Once per two channels scanned	1:2	Default setting
Once per module scan	1:8	Input tag scan

Output State Tab - Output Module

Use the following information to configure the parameters on the Output State tab.



With an individual channel button selected, use this information to configure the parameters in the Channel box that apply to the individual channels.

Ramp Rate

The ramping rate, which is set up on the Limits tab, limits the speed at which an analog output signal can change. This prevents fast transitions in output from damaging equipment that the output controls.

This feature is available in Hard Run mode.

Output State in Program Mode

These parameters are not available in Hard Run mode.

Selecting	Configures the Output Channel for the Following When the Controller Transitions from Run to Program Mode
Hold Last State	Leave the current output at its last value.
User Defined Value	Go to the specific value when the owner controller is switched into Program mode. If you select this, enter a value from 9,999,999…99,999,999, default is 0.
Ramp to User Defined Value	If Hold Last State - this field is disabled. User Defined Value - check if you want the output to ramp to the user-defined value at the specified ramp rate. The ramp rate is selected from the output Limits tab. If unchecked, output signal steps to the User Defined Value immediately on entering Program mode.

Output State in Fault Mode

These parameters are not available in Hard Run mode.

The module enters Program mode state if the Connection from Logix is inhibited. If communication subsequently fails, all channels of the module remain in Program mode.

Select	To configure the output module to one of these
Hold Last State	Leave the output signal at its last value.
User Defined Value	Go to a specific value if a fault occurs. If you click this button, enter a value from -9,999,999…99,999,999, default is 0.
Ramp to User Defined Value	If Hold Last State - This field is disabled. If User Defined Value - You can check this if you want the output to ramp to the user-defined value at the specified ramp rate. The ramp rate is selected on the output Limits tab. If unchecked, the output signal steps to the user-defined value immediately on entering Fault mode.

The output signal goes to Fault mode when the controller faults or when communication between an output module and its controller is lost. Output State in Fault Mode appears dimmed in Hard Run mode.

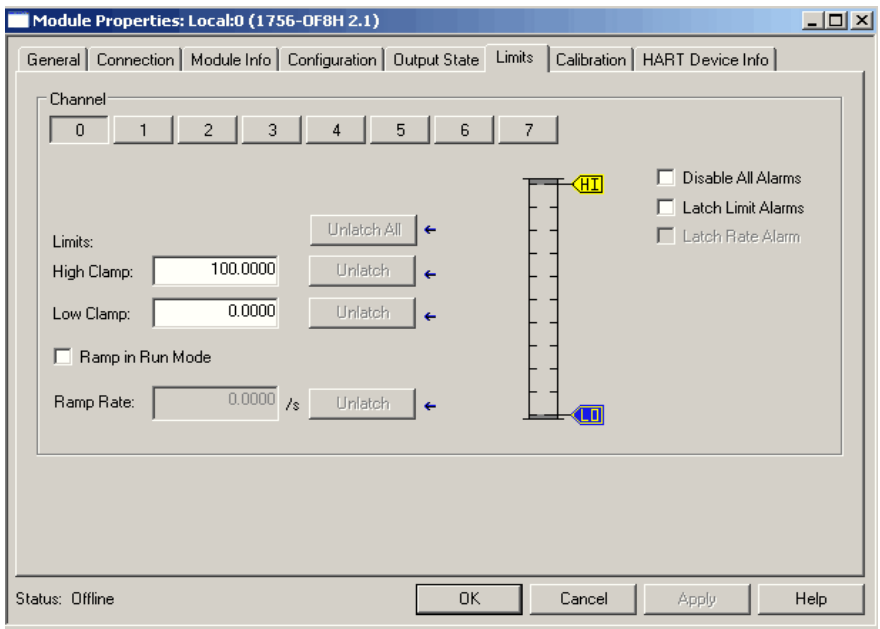
Communication Failure

If communication fails while in Run mode, the output signal goes to its Fault Mode state. If communication fails while in Program mode, the output signal behaves as follows.

Select	To
Leave outputs in Program mode state	Leave output signal at the configured Program mode value
Change output to Fault mode state	Change output signal at configured Fault mode value if a communication fails (connection from controller breaks)

Limits Tab - Output Module

Use this information to configure the parameters on the Limits tab.



With an individual channel button selected, use these parameter descriptions to configure the alarms.

Table 28 - Alarm Tab Parameters

Parameter	Action	Notes	Available in Hard Run Mode?
Limits	Enter values or drag the corresponding flags on the slider bar to set the values.	• The maximum and minimum values for these alarms are set by the High Engineering and Low Engineering parameters on the Configuration tab. • Clamp limits are in engineering units. • To change the trigger points by whole numbers only, hold down the shift key while dragging the flag on the slider bar. • See the Limit Example on page 110.	No
High Clamp (HI)		• The highest value an output channel can reach in the control process. • -9,999,999…99,999,999, default is 100.00.	
Low Clamp (LO)		• The lowest value an output channel can reach in the control process. • -9,999,999…99,999,999, default is 0.	

Table 28 - Alarm Tab Parameters (Continued)

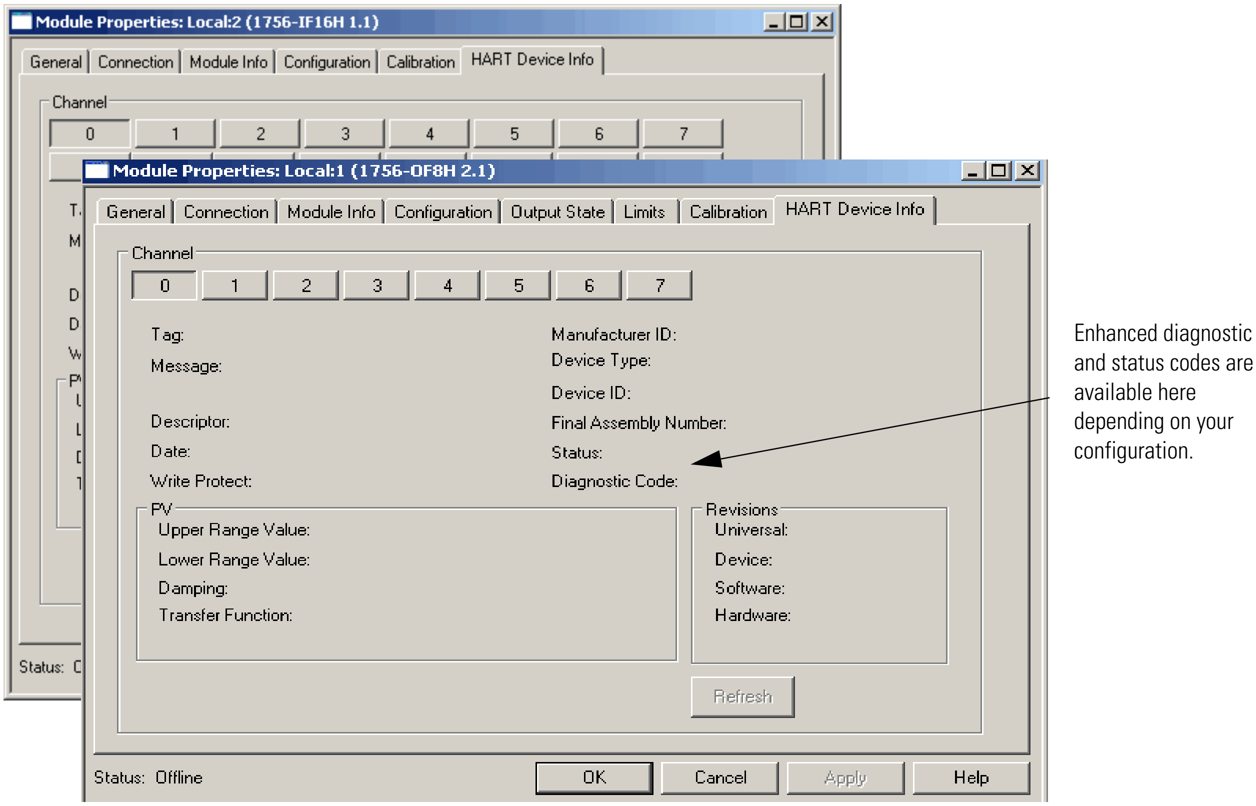
Parameter	Action	Notes	Available in Hard Run Mode?
Ramp in Run Mode	Check	• Enables ramping in Run mode. • Ramping occurs between the current output level and any new output value received. • If ramping is enabled, the output only can change at the configured ramp rate limit.	No
Ramp Rate	Enter a value from 9,999,9999 to 999,999,999, default is 0.	• Defines the maximum rate of change an output can make in engineering units/second. • Serves as a trigger point for a Ramp Rate Limit alarm when the Ramp in Run mode is selected. • Can also be uses to ramp a user-defined value in Program or Fault mode. • A non-editable copy of Ramp Rate is shown on the Output State tab.	No
Unlatch All	Click	• Unlatches all alarms. • Is not available when the project is offline.	Yes
Unlatch	Click	• Unlatches the adjacent alarm condition. • Is not available when the project is offline.	Yes
Disable All Alarms	Check	Disables all alarms for a channel.	No
Latch Limit Alarms	Check	Maintains the high and low limit alarms even after the condition ceases. The high and low limit alarm is set if the requested output is beyond the clamp limit (>High or <Low). This is useful if you want to detect a transient alarm condition and preserve its indication until the alarm is explicitly unlatched. Click Unlatch to unlatch an alarm, or send a Common Industrial Protocol (CIP) message using the MSG instruction.	No
Latch Rate Alarm	Check	When enabled, a Rate Alarm indication remains set, even when the alarm condition returns to normal. This latch lets you maintain the alarm even after the condition ceases. The alarm unlatches only with an explicit message acknowledging the alarm.	No

Limit Example

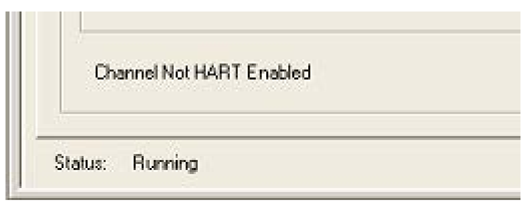
If your output controls a valve positioner that is configured to use Percent of Stroke for engineering units, and you don't want the valve to be over 62% open at any time for any reason, then you can enter 0 as the Low Clamp and 62 for High Clamp. Even if a PIDE instruction calculates the valve should be open more to achieve process Setpoint, the output module clamps it to 62% open.

HART Device Info Tab

The HART Device Info tab displays information about the attached HART field device that is collected by the HART module.



- If you selected a Listen-Only communication format when you created the module, this tab is not available.
- If HART is not enabled for this channel, Channel Not HART Enabled is displayed.



- If HART is enabled, but the HART Field Device is not responding, HART initializing is displayed.

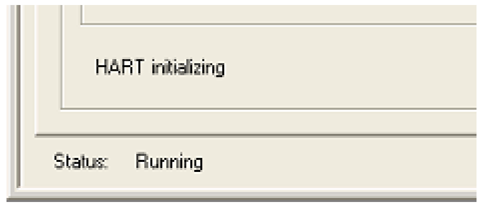


Table 29 - HART Device Info Tab

Parameter	Description
Channel	Click a channel to display the parameters for the corresponding channel.
Refresh	Click to update all attributes displayed on this tab for the corresponding channel.
Tag	Displays the tag name of the HART Field Device. The tag name is entered into the Field Device to indicate its location and purpose in the plant.
Message	Displays the text that was entered in the Message parameter of the HART Field Device. The use of this parameter can vary. One possible use is to store information such as who last calibrated the device, or reference to documentation.
Descriptor	Displays the Descriptor field from the HART Field Device. The Descriptor is a text message that can be stored in the device to help identify the device or it can be used for other plant specific purposes.
Date	Displays the date entered in the device. This date is often used to record the last calibration date, but it is up to the end user to maintain it. It is displayed in the format selected for your computer using the Regional and Language settings on the Control Panel.
Write Protect	Displays a Yes or No indicating if the HART Field Device is write protected. If a device is write protected, some parameters cannot be changed via HART communication. Note that sometimes devices do not indicate that the configuration changed when their write-protect setting changes. This causes the previous value to remain displayed here. You can inhibit/uninhibit the HART module to refresh this.
Manufacturer ID	Displays the manufacturer name (for example, Allen-Bradley or Endress + Hauser) or the numeric value for the manufacturer. Use the Company Identification Code table as a guide, as shown in Appendix E.
Device Type	Displays the device type for Endress + Hauser devices or a numeric value for all other manufacturer devices. Device type indicates the manufacturer's type of the device, or product name. For example, Cerabar S pressure transmitters from Endress + Hauser have Device Type 7.
Device ID	Displays a number that represents the device ID. Device ID is a serial number assigned by the manufacturer that is unique among all devices produced by that manufacturer.
Final Assembly Number	Displays a number that represents the final assembly number. The Final Assembly Number is used for identifying the materials and electronics that comprise the field device. It is normally changed when electronics or other components are upgraded in the field. In some instances, this number references a drawing number.
Status	Channel status is available only for 1756-IF8H, 1756-IF16H, and 1756-OF8H modules with firmware revision 2.1.
Diagnostic Code	Device status is available only for 1756-IF8H, 1756-IF16H, and 1756-OF8H modules with firmware revision 2.1.

Table 29 - HART Device Info Tab

Parameter	Description
PV	In HART, the Primary Variable (PV) is signaled on the 4… 20 mA analog channel. It can also be read back using HART messages. In many HART devices, the relationship between the PV and the analog signal can be adjusted. This area displays the following Process Variable attributes: • Upper Range Value - to use the same engineering units in your Logix controller as in the Field Device, enter this value in High Engineering on the Configuration tab. • Lower Range Value - to use the same engineering units in your Logix controller as in the Field Device, enter this value in Low Engineering on the Configuration tab. • Damping • Transfer Function - describes how the HART field device transforms the signal on its transducer to the PV. Usually Linear, but sometimes Square Root (for example, for flow), or other relationships.
Revision	Displays the following revision attributes. • Universal - this denotes the version of the HART specification to which the device conforms. • Device • Software • Hardware

Data in the Input Tags

When HART data is included in the input tag and a channel has HART enabled, the ControlLogix HART I/O module automatically collects HART data and places the most common Dynamic Process Data and Device Health information directly in the input tag.

See Appendix A for a complete listing of the fields in the input, output, and configuration tags.

An overview of the HART data includes the following:

- HART Faults - At the beginning of the input tag included even if you click Analog Only input data tag format. These faults indicate that HART communication is not successful or that the field device is reporting a problem such as Device Malfunction, Loop Current Saturated or PV out of Limit. For example, Ch0HARTFault is set if Ch0Config.HARTEn is 0 or if no HART Field Device is attached.
- HART Device Status - A collection of status indicators that reflect the HART communication details and overall device health.
  - Init - Module is searching for a HART device.
  - Fault - HART communication is not successful. If this is 1 and Initializing is 0, probable cause is HART is not enabled on this channel.
  - Message Ready - A HART pass-through message reply is ready to be collected by using the Pass-through Query CIP message. See Chapter 8 for information on using CIP MSGs to access HART data.

- Current Fault - The analog current doesn't match the readback of the current received over the HART communication. This might be caused by an inaccurate field device, faulty wiring, or water in the conduit. Sometimes a rapid change in the signal results in a transient current fault as the analog and digital representations are sampled at slightly different times and at different places in the signal path.
- Configuration Changed - The Field Device configuration has changed and new Field Device configuration information can be obtained from the module via CIP MSG GetDeviceInfo, which will clear this bit.
- ResponseCode - HART Communication Status or Response Code. 0 means success. See Appendix C for details.
- FieldDeviceStatus - HART device health, such as PV out of range or device malfunction. See Appendix C for details.
- UpdatedStatusReady - indicates new device diagnostic information is available, which can be obtained by sending a CIP Message with Service 4C.

HART Dynamic Variables

Most HART devices are capable of measuring several different process characteristics or of deriving other measurements from directly sensed measurements. For example, many differential pressure transmitters can also sense the process temperature and can calculate the flow, or they might calculate the volume in a tank based on a measurement of its head pressure and knowledge of tank geometry and product density.

The most important of these direct or derived measurements is assigned to the PV (Primary Variable) and the analog signal will represent its value. Additional measurements can be read from the HART field device over the HART communication protocol. HART provides a standard message for reading four of the dynamic variables, called PV, SV, TV, and FV (sometimes called QV). These four dynamic variables are the four measurements of interest to a controller.

These four dynamic variables - PV, SV, TV, and FV - are automatically collected from the HART field device and placed in the module's input tag in HART.ChxPV (for Analog and HART PV data format) or Chxx.PV (for Analog and HART by Channel data format). In some HART devices, the choice of which of the available measurements to assign to PV, SV, TV, and FV can be changed via configuration. In other more simple devices, the assignment is done at the factory and cannot be changed.

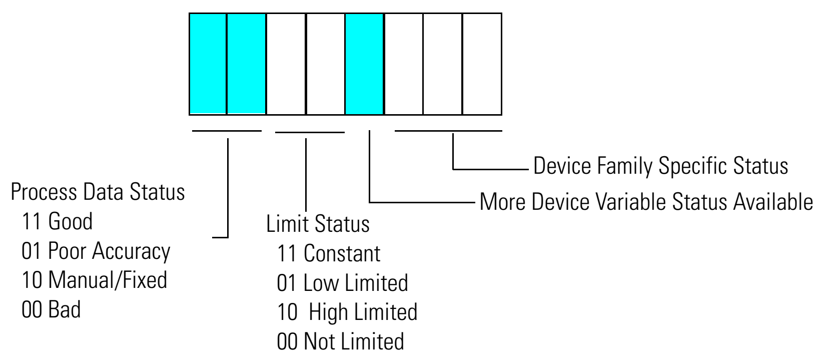
An example for a Flow Meter might be:

- PV - Primary Variable. Flow Rate in Liters per Minute.
- SV - Secondary Variable. Process Temperature in °C.
- TV - Third or Tertiary Variable. Product Density in Grams per Cubic Centimeter.
- FV - Fourth or Quaternary Variable

An example for a Valve Positioner might be:

- PV - Primary Variable. Commanded position in %.
- SV - Secondary Variable. Actual position in %.
- TV - Third or Tertiary Variable. Air Pressure in PSI.
- FV - Fourth or Quaternary Variable. Loop current in mA.

In addition to the measurement value, HART devices can provide status information that indicates the quality of the measurement.



For example, if a valve positioner cannot open any further, it should set its HART.ChxSVStatus to 2#11100000 to indicate that the actual position value in the SV is Good (accurately measured) but is the subject of a High Limit. This status information can be used for windup control in PID loops and for other diagnostic purposes.

The module collects the PV, SV, TV, and FV data as described in Table 30.

Table 30 - Dynamic Variable Assignment(1)

HART Version	HART Device Reports PV, SV, TV, FV Assignments in Command 50	HART Command Used by 1756 Module to Collect PV, SV, TV, FV	Device Variable Codes Used in Command 9 for PV, SV, TV, FV
5	N/A	3	N/A
6	No	3	N/A
	Yes	9	As Reported in Command 50
7 or later	No	9	246, 247, 248, 249
	Yes		As Reported in Command 50

(1) Table does not apply to the 1756-IF8H and 1756-OF8H modules, version 1.*x* , and the 1756-IF16H module, version 1.1

Command 3 does not provide PVStatus, SVStatus, TVStatus, or FVStatus, so HART devices that indicate Command 3 as shown in Table 30 will have their Dynamic Variable Status values reported based on the communication status with the HART field device. If the Dynamic Variables are being collected without communication error, the Status value is 16#C0 (2#11000000), which means good. Otherwise, it is 0, meaning bad.

Some devices don't have four dynamic variables. In this case, they can report a NaN value to indicate they have no valid value for that parameter.

The dynamic variables do not update as fast as the analog signal. The actual rate depends on the number of channels configured for HART (for the 8-channel modules), the number of pass-through message commands, the presence of handheld communicators or other secondary masters, and the response speed of the field device.

When eight channels are in use on the 8-channel modules, the HART update rate is in the **10-second range**.

IMPORTANT Verify that the actual HART update rate is appropriate for your application. Remember that pass-through message traffic, additional status information, secondary masters, and communication errors can delay the update rate. Note that on the 8-channel modules, because the HART modem is shared by all channels, increased delay on one channel affects other channels also.

IMPORTANT Verify that HART data is valid by checking ChxFault, HARTFault, and values such as PVStatus and SVStatus.

How the Module Automatically Collects Data

The ControlLogix HART analog module automatically sends HART messages to characterize the HART field device and collect the dynamic variables. It also collects additional status information when the device indicates it is available. When the device indicates its configuration has changed, HART messages are sent to reread the configuration information so that a current copy is cached in the modules.

The diagram on page 118 shows the general flow of the start-up characterization, response to a new configuration, and cyclic scanning of dynamic variables. Not shown are periodic checks of the current and reading the additional status information.

In addition to the HART activities outlined in the diagram, if there are HART pass-through messages to send, they are interleaved in the auto scanning. Logix controllers can send pass-through messages using CIP MSG instructions, and Asset Management systems can send them. See Chapter 8 for more information.

HART messages are only sent on one channel at a time when you are using the 1756-IF8H or the 1756-OF8H modules. When you are using the 1756-IF16H module, messages are sent on all channels simultaneously.

If the HART field device configuration is changed—from a handheld, asset management, or device faceplate—cyclic reading of the Dynamic Variables pauses briefly while the configuration changes are assimilated. The HART.ChxDeviceStatus.ConfigurationChanged status is set when the updated configuration is retrieved from the HART field device and stored in the module to indicate that new data is available for GetDeviceInfo CIP MSG.

See Getting HART Data By Using CIP MSG on page 121 for more information, and specifically page 133 for HART pass-through schedule choices.

Figure 19 - 1756-IF8H and 1756-OF8H Flow Chart

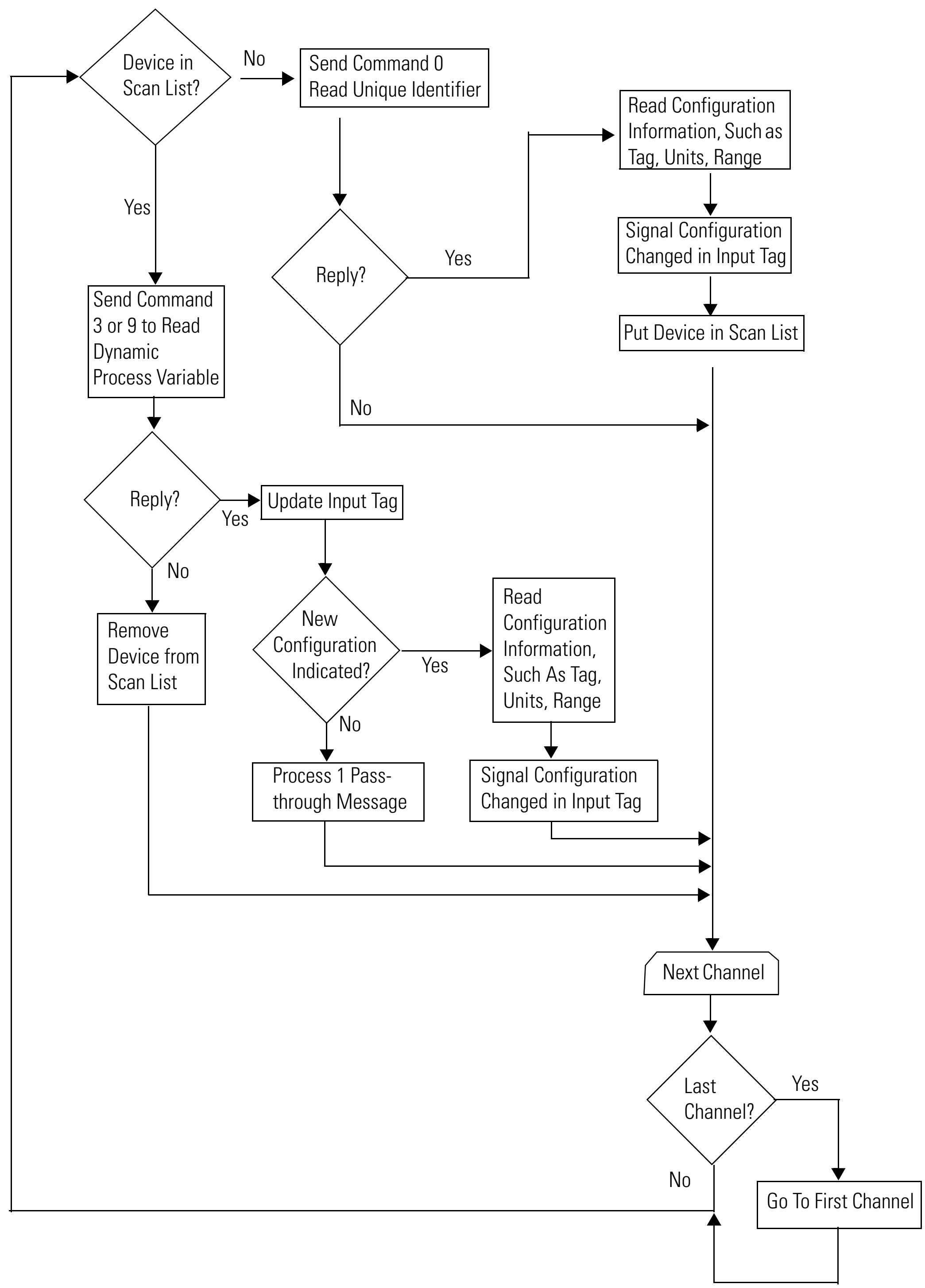
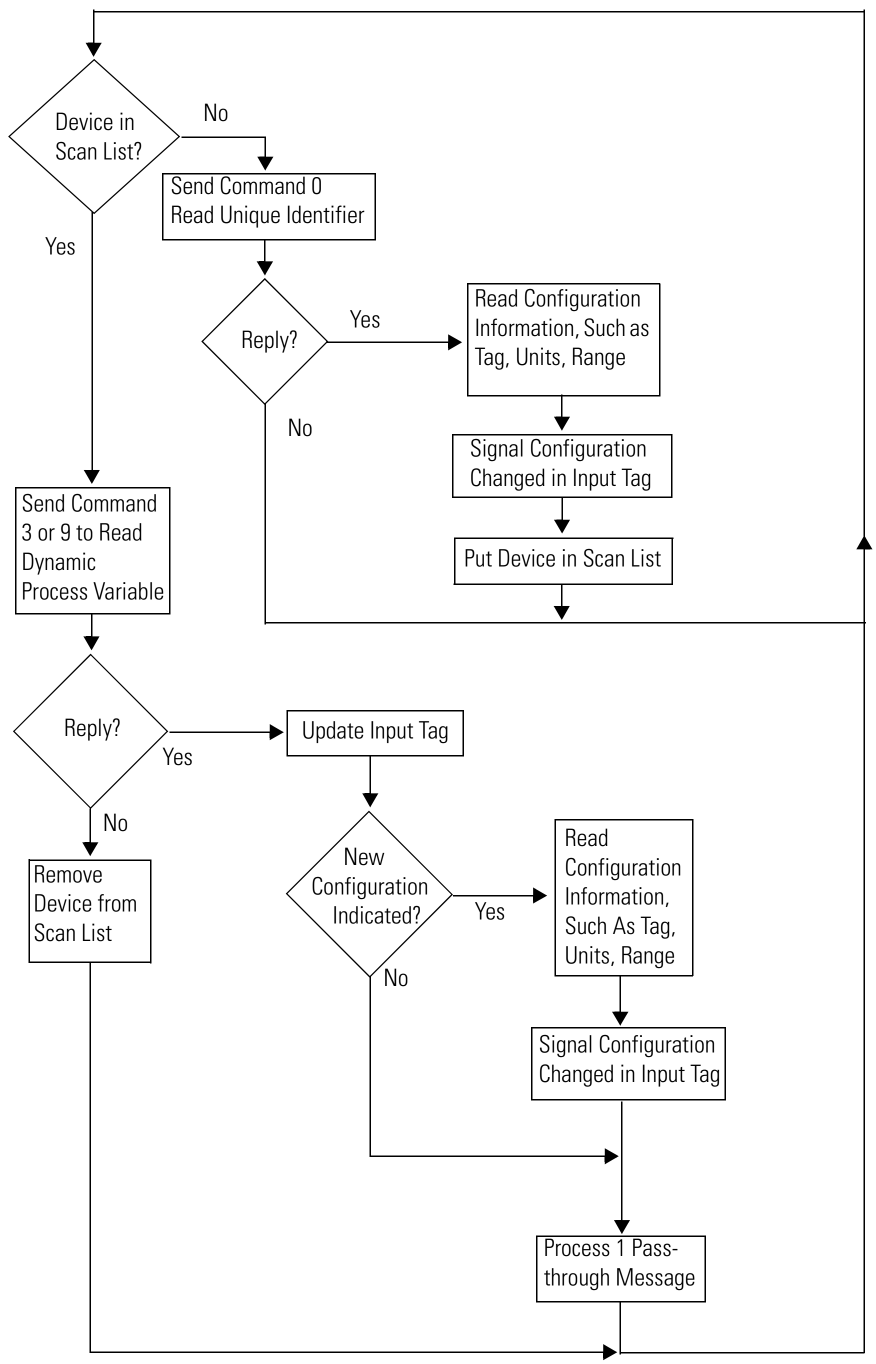


Figure 20 - 1756-IF16H Flow Chart



Notes:

Getting HART Data By Using CIP MSG

Introduction

This chapter shows you how to use HART data in your Logix controller via MSG instructions. You might do this because you need the following:

- Only occasional access to the data, and don't want to use the extra network capacity and memory for the larger Analog with HART PV or Analog and HART by Channel input tags.
- Additional information, such as device tag, ranges, or manufacturer-specific information.
- To send a manufacturer-specific command to the HART device.

Usually, everything you need to use your HART instrument is automatically collected and placed in your input tag, and these CIP MSG instructions are not needed.

The 1756 ControlLogix HART analog modules support these broad categories of MSG-based HART access:

- CIP formatted messages to retrieve common HART data cached in the module.
- CIP messages containing HART formatted commands that are passed directly to the HART field device for processing. These are called pass-through messages.

By using these mechanisms your Logix controller has easy access to some commonly used data and with some extra effort, access to any HART feature.

The features described in this chapter use MSG instructions. For more information and examples about MSG instructions, refer to Chapter 10, which explains how to use MSG instructions to unlatch alarms or reconfigure modules.

This chapter also contains these topics as shown in the table.

Using MSG Instructions to Access the HART Object

Both categories of MSG are handled by the HART Object contained in the module. There is one HART Object for each channel. Some CIP messages can be sent to the Class Instance or Instance 0 of the HART object. Most MSGs are sent to a specific instance of the HART object associated with a particular channel.

This table shows channel and instance correspondence.

Channel	Instance
0	1
1	2
2	3
3	4
…	…
15	16

These tables show service codes for CIP services.

Class	Service Code	Function
16#35D	16#4B	Read Dynamic Variables
	16#4C	Read Additional Status
	16#4D	Get HART Device Information

Class	Service Code	Pass-through Messages
16#35D	16#4E	Init
	16#4F	Query
	16#50	Flush Queue

TIP The 16# means this number is Hex display style.

CIP Services to Access Common HART Data

You can get the following kinds of HART data easily from the HART object:

- HART field device information - Similar to that displayed on the Module Properties HART Device Info tab of RSLogix 5000 software.
- Additional status - HART devices that support extended diagnostics can indicate in their Field Device Status that some additional diagnostic information is available.
- Dynamic variables - The same PV, SV, TV, FV that are in the input tag. The mapped Device Variable Code and the engineering units are included.

The data in these commands is returned in the format used by Logix controllers, so it is very easy to use in your control program. HART data is natively in a different format, called big-endian, but the module converts the values in these messages for you.

See the tables that list the data in the CIP messages and the example of getting the Device Info.

In the following sections the definition CMD#0 byte 3, for example, means HART command 0, byte 3. If your field device user manual includes information about HART command responses, this information will be helpful to you. Consult the HART protocol specification for further information on HART commands. See Appendix C on page 193 for more information.

Read Dynamic Variables (Service Code = 16#4B)

These tables show the request and reply packet structures for the Read Dynamic Variables service.

Table 31 - Request Packet

Offset	Field	Data Type	Definition
			No request data
Request size = 0 bytes			

Table 32 - Reply Packet - Request Failed

Offset	Field	Data Type	Definition
0	Status	USINT	Command status
1	Pad		Pad byte
Reply size = 2 bytes			
Request Failed			

See Appendix E on page 213 for an explanation of the engineering unit code numbers.

Table 33 - Reply Packet - Request Succeeded

Offset	Field	Data Type	Definition
0	Status	USINT	Command status
1	HARTCommandStatus		HART Device reply Status Byte # 1 (response code)
2	HARTFieldDeviceStatus		HART Device reply Status Byte # 2
3	HARTExtDevice Status		Status Byte returned from Cmd 9 or 0 for 5.x rev HART devices
4…7	PV	REAL	HART Primary variable
8…11	SV		HART Secondary variable
12…15	TV		HART Third variable
16…19	FV		HART Fourth variable
20	PV Units	USINT	Primary variable unit code
21	SV Units		Secondary variable unit code
22	TV Units		Third variable unit code
23	FV Units		Fourth variable unit code
24	PV Assignment Code		Primary variable assignment code
25	SV Assignment Code		Secondary variable assignment code
26	TV Assignment Code		Third variable assignment code
27	FV Assignment Code		Fourth variable assignment code
28	PV Status		1 byte status from Cmd 9(Rev 6.x) or if Rev 5.x device: 16#C0 = Connected 16#00 = Not Connected
29	SV Status		1 byte status from Cmd 9 or if Rev 5.x device: 16#C0 = Connected and Device provides this value in CMD 3 (that is, does not truncate) 16#00 = Not Connected
30	TV Status		1 byte status from Cmd 9 or if Rev 5.x device: 16#C0 = Connected and Device provides this value in CMD 3 (that is, does not truncate) 16#00 = Not Connected
31	FV Status		1 byte status from Cmd 9 or if Rev 5.x device: 16#C0 = Connected and Device provides this value in CMD 3 (that is, does not truncate) 16#00 = Not Connected
32…35	Loop Current	REAL	Device reported digital loop current value. (Value from Cmd 3 for Rev 5.x devices or Cmd 2 if Rev 6.x device)
Reply Size = 36 bytes			

Read Additional Status (Service Code = 16#4C)

These tables show the request and reply packet structures for the Read Additional Status service. Reply Size = 2…224 bytes.

Table 34 - Request Packet

Offset	Field	Data Type	Definition
			No request data
Request size = 0 bytes			

Table 35 - Reply Packet - Request Failed

Offset	Field	Data Type	Definition
0	Status	USINT	Command status
1	Pad		Pad byte
Reply size = 2 bytes			
Request Failed			

Table 36 - Reply Packet - Request Succeeded

Offset	Offset	Data Type	Definition
0	Status	USINT	Command status
1	Count		Number of Ext Status bytes available
2…26	Ext Status Bytes		Extended Status bytes returned by CMD48
7	Pad		Pad type
Reply Size = Instance 1…8: 2…28 bytes; Instance 0: 224 bytes. If sent to Instance 0, all channels of the module will be included in the response, resulting in 28 bytes per channel (27 bytes of response to the HART Read Additional Status plus 1 byte of pad to align the data to a 32 bit boundary.)			

Get Device Information (Service Code = 16#4D)

These tables show the request and reply packet structures for the Get Device Information service.

Table 37 - Request Packet

Offset	Field	Data Type	Definition
			No request data
Request size = 0 bytes			

Table 38 - Reply Packet - Request Failed

Offset	Field	Data Type	Definition
0	Status	USINT	Command status
1	Pad		Pad byte
Reply size = 2 bytes			

Table 39 - Reply Packet - Request Succeeded

Offset	Field	Data Type	Definition[1]
0	Status	SINT	Command status
1	Manufacturer ID		CMD#0, Byte 1 If this byte is ≥ 16#E0, refer to byte offset 10 and 11 for the extended manufacturer identification.
2	Device Type		CMD#0, Byte 2
3	Preamble		CMD#0, Byte 3
4	Universal Command Code		CMD#0, Byte 4
5	Transducer Spec Code		CMD#0, Byte 5
6	Software Revision		CMD#0, Byte 6
7	Hardware Revision		CMD#0, Byte 7
8	Flags		CMD#0, Byte 8
9	Pad_1 for 16 bit alignment		
10…11	Extended Manufacturer ID		CMD#0, Byte 1 if HART revision is < 7 CMD#0, Bytes 17…18 if HART revision is ≥ 7
12…15	Device ID Number	DINT	CMD#0, Bytes 9…11
16…27	Tag	HARTTag	CMD#13, Bytes 0…5 See HARTTag on page 130 for more information.
28…47	Descriptor	HARTDescriptor	CMD#13, Bytes 6…17 See HARTDescriptor on page 130 for more information.
48	DateDay	SINT	CMD#13, Byte 18
49	DateMonth		CMD#13, Byte 19
50…51	DateYear	INT	CMD#13, Byte 20 (+ 1900)
52…55	Final AssemblyNumber	DINT	CMD#16, Bytes 0…2

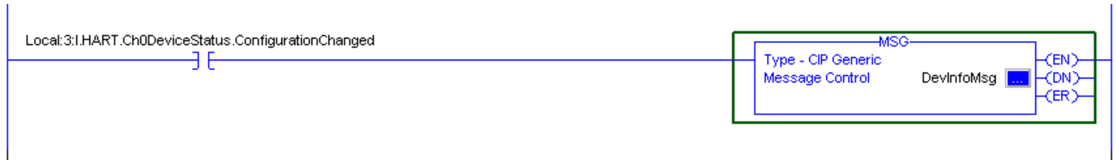
Table 39 - Reply Packet - Request Succeeded

Offset	Field	Data Type	Definition(1)
56…91	Message	HARTMsg	CMD#12, Bytes 0…23 See HARTMsg on page 130 for more information.
92	PVCode	SINT	CMD#50, Bytes 0, 16#ff if not supported
93	SVCode		CMD#50, Bytes 1, 16#ff if not supported
94	TVCode		CMD#50, Bytes 2, 16#ff if not supported
95	FVCode		CMD#50, Bytes 3, 16#ff if not supported
96	PVUnits		CMD#3, Byte 4
97	SVUnits		CMD#3, Byte 9, 0 if not present
98	TVUnits		CMD#3, Byte 14, 0 if not present
99	FVUnits		CMD#3, Byte 19, 0 if not present
100	TransferFunction		CMD#15, Byte 1
101	RangeUnits		CMD#15, Byte 2
102…103	Expanded Device Type Code		CMD#0, Byte 2 if HART revision is < 7 CMD#0, Bytes 1…2 if HART revision is ≥ 7
104…107	PVLowerRange	REAL	CMD#15, Bytes 3…6
108…111	PVUpperRange		CMD#15, Bytes 7…10
112…115	DampingValue		CMD#15, Bytes 11…14
116	WriteProtectCode	SINT	CMD#15, Byte 15
117	Pad_8 for 32 bit alignment		
118…119	Private Label Manufacturer 16 bit		CMD#0, Byte 2 if HART revision is < 7 CMD#0, Bytes 19…20 if HART revision is ≥ 7
Reply Size = 120 bytes			

(1) See Appendix C on page 193 for related information.

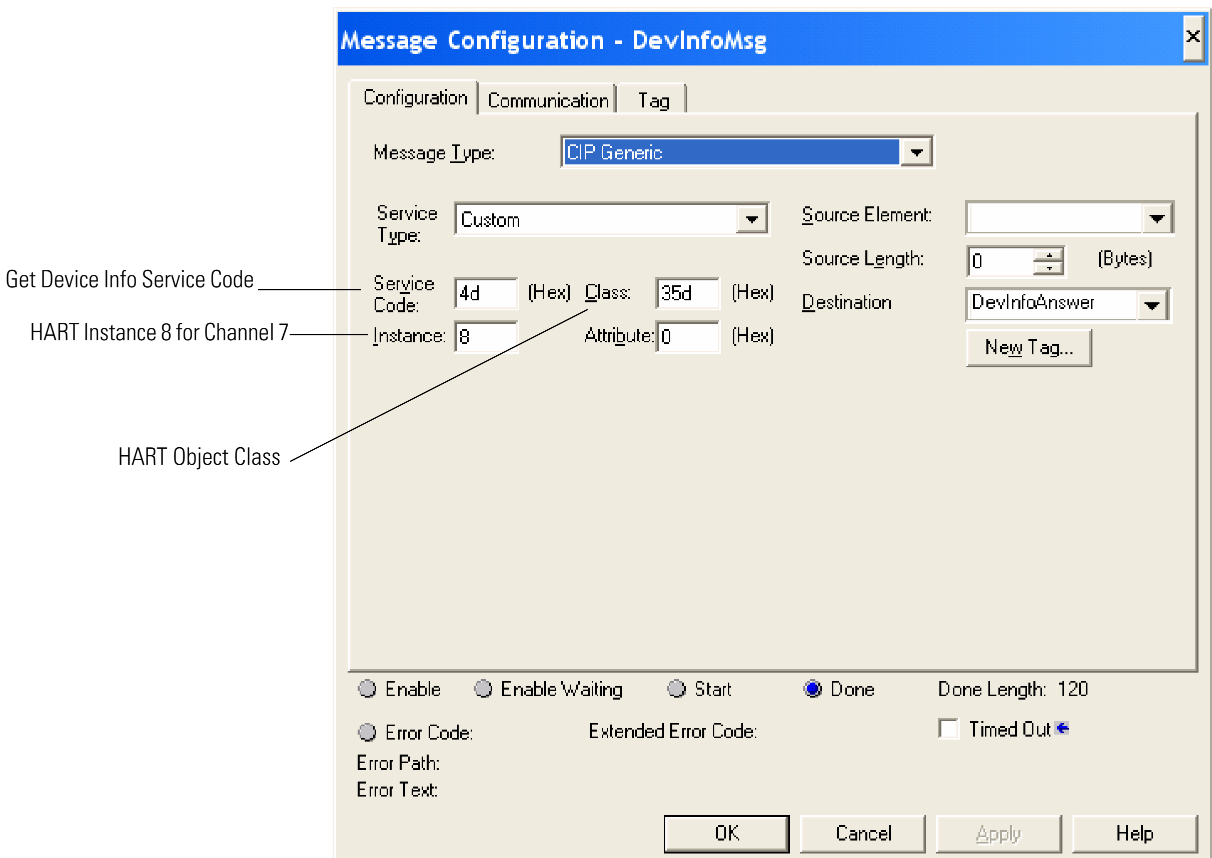
Getting HART Device Information By Using CIP Generic MSG

For an example, this rung of ladder logic retrieves fresh HART device information whenever the 1756-IF8H or 1756-OF8H module indicates new configuration is available.



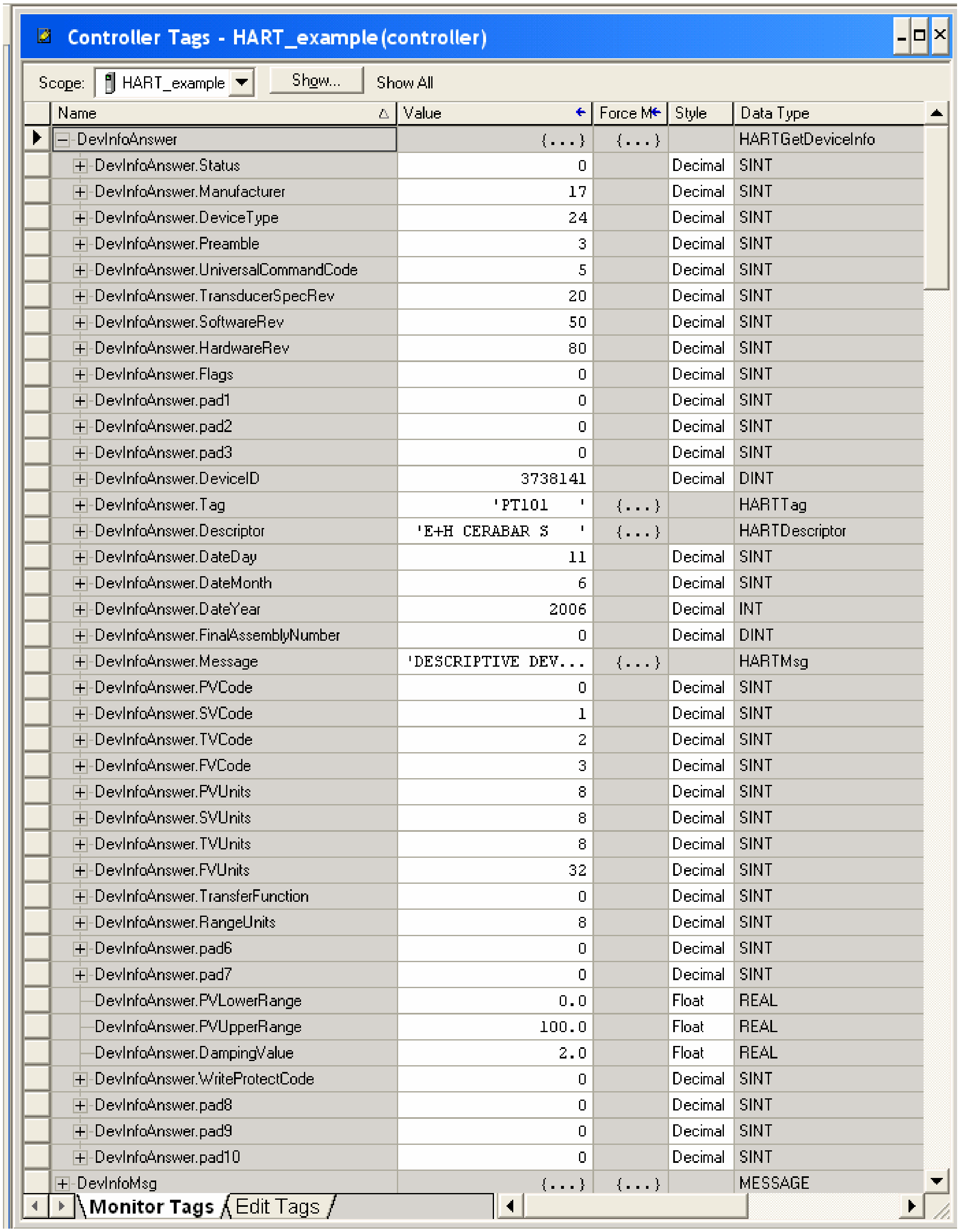
Note that if the Device Information is critical to your application, be sure to check for .ER errors and implement a recovery strategy.

This is the Message Configuration dialog box.



The device information for the HART Device on channel 7 is read and put in DevInfoAnswer.

The Destination tag is as shown in the Controller Tags dialog box.



Controller Tags - HART_example(controller)

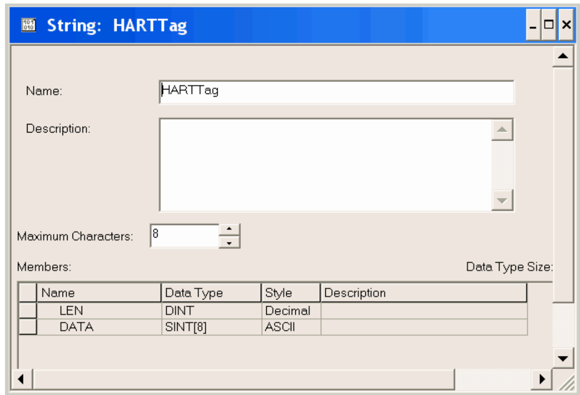
Scope: HART_example Show... Show All

Name	Value	Force Mask	Style	Data Type
DevInfoAnswer	{...}	{...}		HARTGetDeviceInfo
DevInfoAnswer.Status	0		Decimal	SINT
DevInfoAnswer.Manufacturer	17		Decimal	SINT
DevInfoAnswer.DeviceType	24		Decimal	SINT
DevInfoAnswer.Preamble	3		Decimal	SINT
DevInfoAnswer.UniversalCommandCode	5		Decimal	SINT
DevInfoAnswer.TransducerSpecRev	20		Decimal	SINT
DevInfoAnswer.SoftwareRev	50		Decimal	SINT
DevInfoAnswer.HardwareRev	80		Decimal	SINT
DevInfoAnswer.Flags	0		Decimal	SINT
DevInfoAnswer.pad1	0		Decimal	SINT
DevInfoAnswer.pad2	0		Decimal	SINT
DevInfoAnswer.pad3	0		Decimal	SINT
DevInfoAnswer.DeviceID	3738141		Decimal	DINT
DevInfoAnswer.Tag	'PT101 '	{...}		HARTTag
DevInfoAnswer.Descriptor	'E+H CERABAR S '	{...}		HARTDescriptor
DevInfoAnswer.DateDay	11		Decimal	SINT
DevInfoAnswer.DateMonth	6		Decimal	SINT
DevInfoAnswer.DateYear	2006		Decimal	INT
DevInfoAnswer.FinalAssemblyNumber	0		Decimal	DINT
DevInfoAnswer.Message	'DESCRIPTIVE DEV...	{...}		HARTMsg
DevInfoAnswer.PVCode	0		Decimal	SINT
DevInfoAnswer.SVCode	1		Decimal	SINT
DevInfoAnswer.TVCode	2		Decimal	SINT
DevInfoAnswer.FVCode	3		Decimal	SINT
DevInfoAnswer.PVUnits	8		Decimal	SINT
DevInfoAnswer.SVUnits	8		Decimal	SINT
DevInfoAnswer.TVUnits	8		Decimal	SINT
DevInfoAnswer.FVUnits	32		Decimal	SINT
DevInfoAnswer.TransferFunction	0		Decimal	SINT
DevInfoAnswer.RangeUnits	8		Decimal	SINT
DevInfoAnswer.pad6	0		Decimal	SINT
DevInfoAnswer.pad7	0		Decimal	SINT
DevInfoAnswer.PVLowerRange	0.0		Float	REAL
DevInfoAnswer.PVUpperRange	100.0		Float	REAL
DevInfoAnswer.DampingValue	2.0		Float	REAL
DevInfoAnswer.WriteProtectCode	0		Decimal	SINT
DevInfoAnswer.pad8	0		Decimal	SINT
DevInfoAnswer.pad9	0		Decimal	SINT
DevInfoAnswer.pad10	0		Decimal	SINT
DevInfoMsg	{...}	{...}		MESSAGE

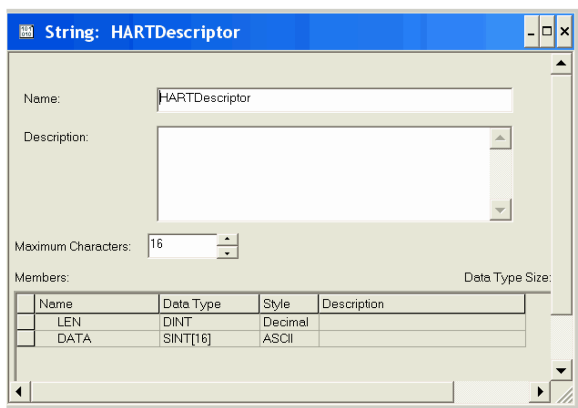
Monitor Tags / Edit Tags

The following figure shows string types for HARTTag, HARTDescriptor, and HARTMsg.

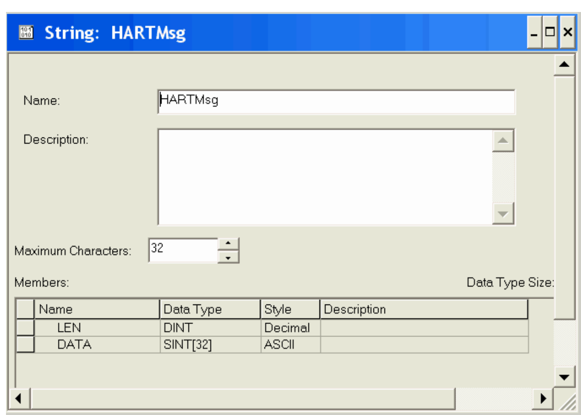
HARTTag



HARTDescriptor



HARTMsg



CIP Services to Pass-through a HART Message to the HART Field Device

The HART object supports these CIP messages for HART pass-through messaging: Pass-through Init, Pass-through Query, Flush Queue (rarely needed).

With these three CIP messages, your Logix controller can format the individual bytes of a HART command, send it to a HART field device, and retrieve the response in HART format.

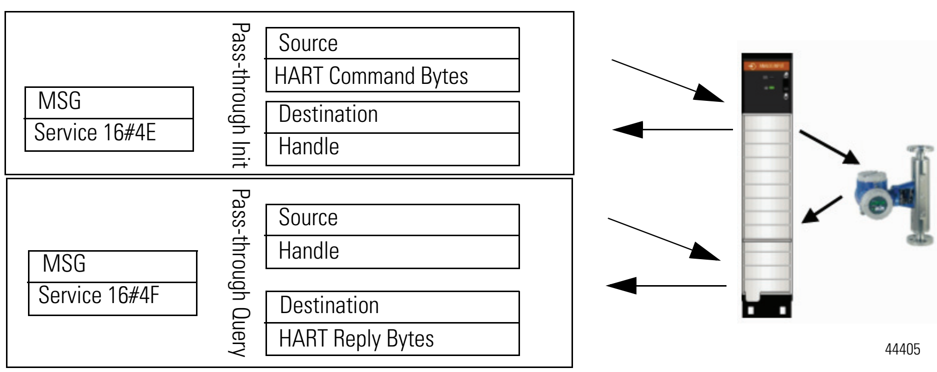
Note that native HART data is in a different format than used by Logix controllers. HART uses the Big Endian format and Logix uses Little Endian format. This means the order of the bytes in a number are in the opposite order so they must be reversed before use. Logix Little Endian means that the least significant byte of a number is stored at the lowest address (array index).

Logix also aligns data on boundaries that permit fast access and HART packs them into the smallest space. HART encodes text strings using 6 bits per letter into a format called Packed ASCII. When using pass-through messaging, your Logix program must be aware of these data layout issues.

The pass-through message CIP services supported by the HART object are somewhat simplified. The module provides the 5-byte address usually required by HART messages and the Checksum is calculated automatically for you.

Follow these steps to send a HART pass-through message.

1. Send a CIP message to tell the 1756-IF8H or 1756-OF8H module to send a message to a HART field device (Init).
2. Send a CIP message to retrieve the HART Reply from the 1756-IF8H or 1756-OF8H module (Query).



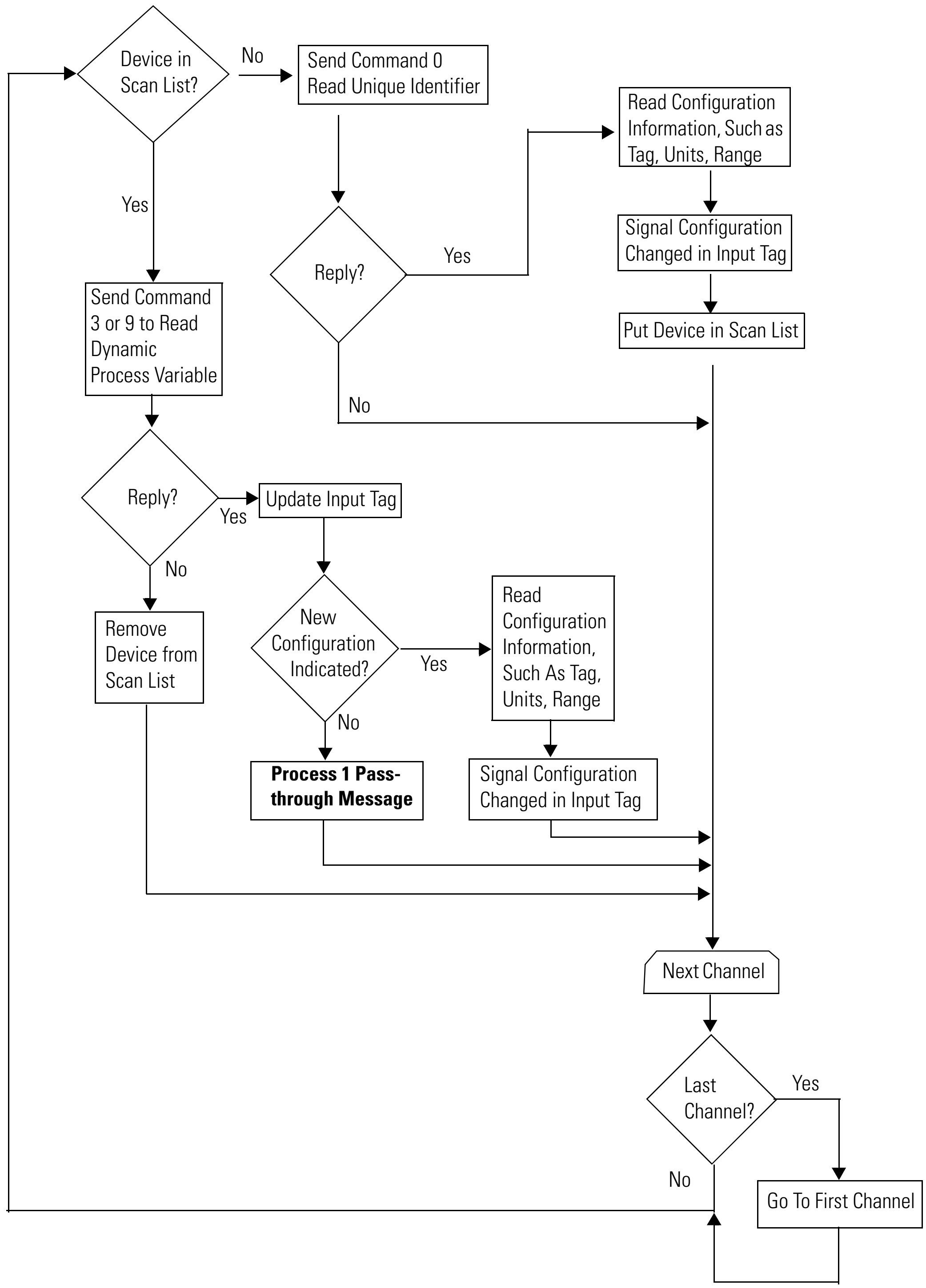
If your input tag includes the HART PV data, a status indicator HART.ChxDeviceStatus.MsgReady tells your program a HART reply is ready to retrieve with the Pass-through Query command.

The CIP reply from the Init service includes a number called the handle. This handle identifies the HART message that was placed in a queue for transmission to the field device. When the reply is received and MsgReady is set to 1, your Logix controller should send a Query containing that same handle to retrieve the HART reply. The reason these steps are necessary is that it can take a long time for the HART command to be transmitted and a reply received. If all eight channels are in use, the time for a reply would be about 10 seconds if there was no other pass-through traffic.

HART Module Scanning Diagram with Pass-through Messages

When HART pass-through messages are being sent, the normal data acquisition sequence is modified as shown in the diagram. In this case, the Pass-through is configured to send one pass-through message for each channel scanned.

It can be configured for lower priority on the Configuration tab of the Module Properties dialog box.



HART Pass-through CIP Message Layout Details

See the following tables for pass-through information.

Pass-through Init (Service Code= 16#4E)

These tables show the request and reply packet structures for the Pass-through Init service.

Table 40 - Request Packet

Offset	Field	Data Type	Definition
0	HART Command	USINT	HART Command Number(1) (2)
1	HART Data Size	USINT	Number of Data Bytes for Selected HART Command(1)(2)
2…256	HART Data bytes	As many bytes as in HART Data Size	HART Command Data(1)
Request Size = 2…257 bytes			

(1) See Appendix C on page 193 for more information.
(2) If this field is displayed as SINT in RSLogix 5000 software, values > 127 appear negative.

Table 41 - Reply Packet

Offset	Field	Data Type	Definition
0	Status	USINT	Command Status 32 = Busy - try again later 33 = Initiated - command started - send Query to get the reply 35 = Dead - Device not online
1	HART Command	USINT	Echo of HART Command(1)
2	Handle	USINT	Handle Used in Query Operation(1)
3	Queue Space Remaining	USINT	Number of Queues Still Available for This Channel(1) If status (bit 0) is 35, refer to Table 44 for the error code description.
Reply Size = 4 bytes			

(1) If this field is displayed as SINT in RSLogix 5000 software, values > 127 appear negative.

Pass-through Query (Service Code= 16#4F)

These tables show the request and reply packet structures for the Pass-through Query service.

Table 42 - Request Packet

Offset	Field	Data Type	Definition
0	Handle	USINT	Handle for Query (from Handle Field above)(1)
Request Size = 1 byte			

(1) If this field is displayed as SINT in RSLogix 5000 software, values > 127 appear negative.

Table 43 - Reply Packet

Offset	Offset	Data Type	Definition
0	Status	USINT	Query Status 00 = Success 34 = Running - try again later 35 = Dead (See MsgReady in Input Tag)
1	HART Command	USINT	Echo of HART Command(1)
2	HART CommStatus	USINT	HART Reply Status Byte #1 (response code)(1)
3	HART FieldDeviceStatus	USINT	HART Reply Status Byte #2(1) If status (bit 0) is 35, refer to Table 44 for the error code description.
4	Data Size	USINT	Number of Data Bytes in Reply for HART Command(1)
5…259	HART Reply Data …	USINT	Data Bytes Returned in Data Field of HART Reply to Requested Command(1)
Reply Size = 6…260 bytes			

(1) If this field is displayed as SINT in RSLogix 5000 software, values > 127 appear negative.

Pass-through Error Codes

The following table defines the error codes that are received when the pass-through status (bit 0) is Dead (35).

Table 44 - Pass-through Error Codes

Value	Definition	Notes
16#81	No response from HART device	
16#82	Invalid long frame address	Applies to only FULL-HART format
16#83	Invalid HART message checksum	Applies to only FULL-HART format
16#84	HART Command not allowed (blocked by module)	Applies to only Ladder Pass-through
16#85	Invalid channel selected	N/A for 1756-IF16H module
16#86	Channel is not HART Enabled	
16#87	Channel does not have a device connected	Module has not established HART communication on this channel
16#89	Size of CIP message too small to hold size of HART message	Module looks at HART data size field in request and validates that the incoming CIP message size is large enough to send all of the data
16#8A	Invalid handle	Applies to only Query message
16#8B	Invalid start delimiter	Applies to only FULL-HART format

TIP The 16# means this number is Hex display style.

Flush Queue (Service Code= 16#50)

These tables show the request and reply packet structures for the Flush Queue service.

Table 45 - Request Packet

Offset	Field	Data Type	Definition
			No request data
Request size = 0 bytes			

Table 46 - Reply Packet

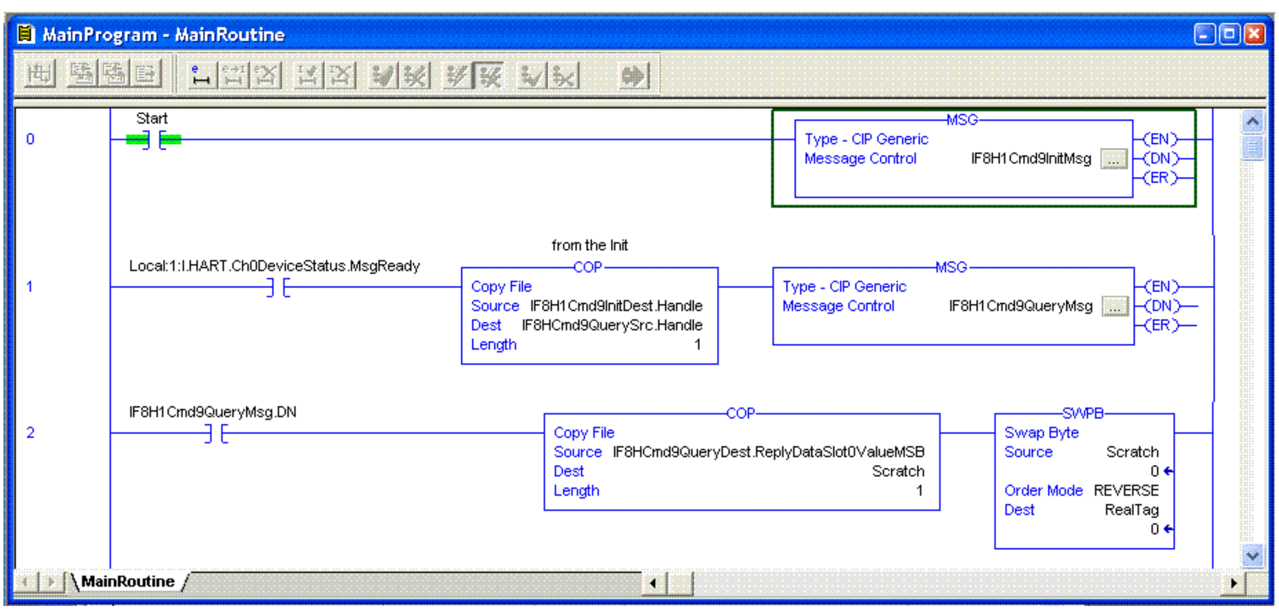
Offset	Field	Data Type	Definition

Note that Flush Queue can be sent to have the 1756-IF8H or 1756-OF8H module discard any pending HART replies awaiting a query command. These replies are automatically discarded after a period of time, which is configurable on the Configuration tab of the Module Properties dialog box. This value is usually 15 seconds. Unless you need to discard the replies faster than 15 seconds, you won't need to use this Flush Queue command.

HART Pass-through Message Ladder Logic Example

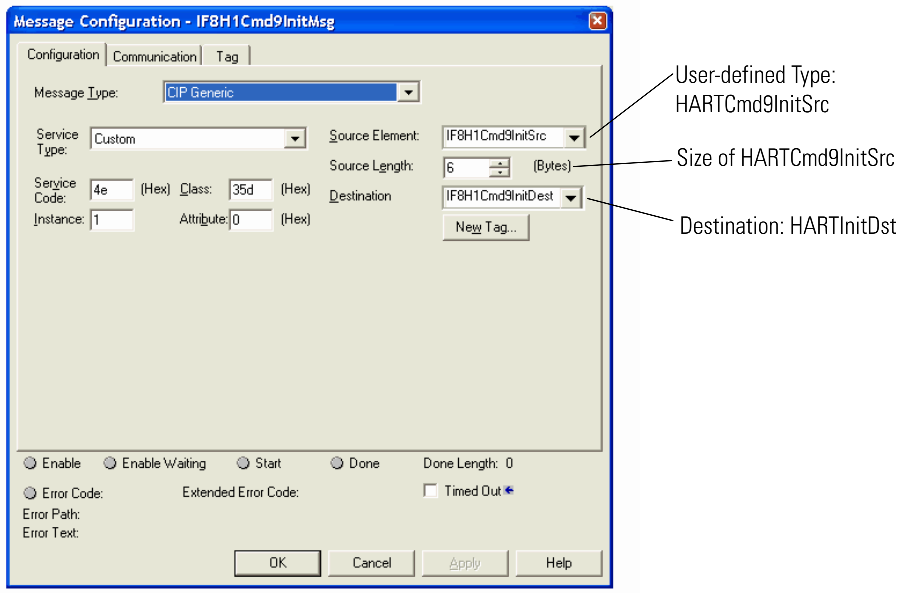
This is an example of sending HART command 9, which reads Device Variables from the HART field device. You send a list of the Device Variable codes you want, and the field device responds with its values, units, classification, and status.

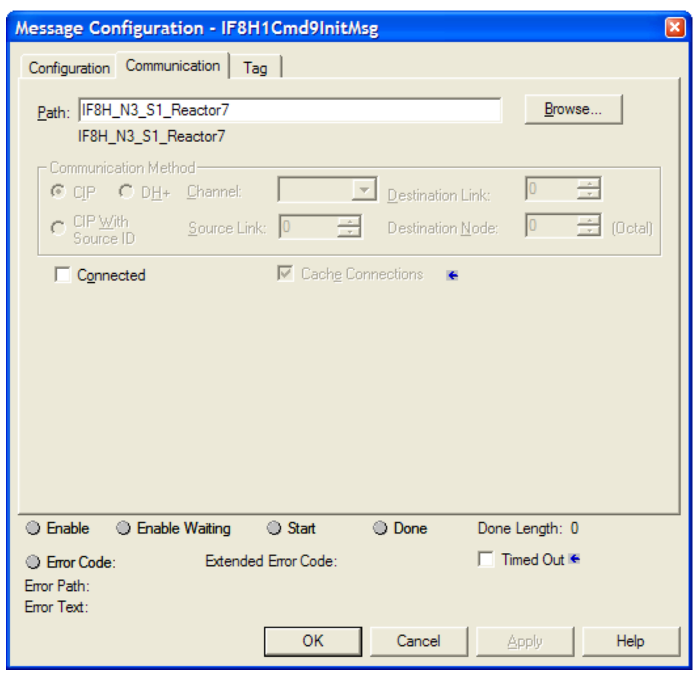
The information in HART command 9 can be obtained more easily by using service 4B, but this example gives you an idea of how to send any pass-through message command you want.



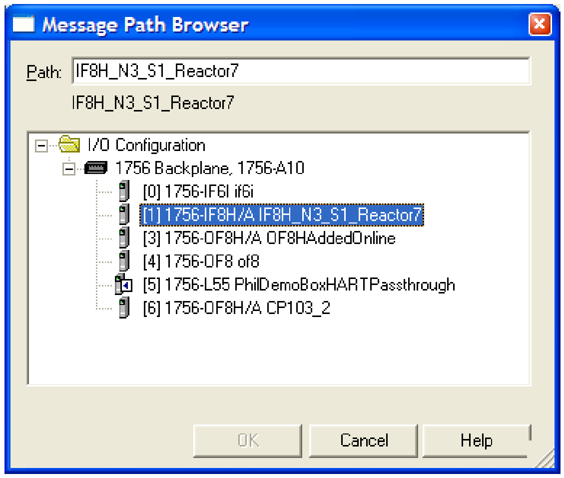
Note that SWPB reverses the order of bytes in the PV, SV, TV, FV floating-point numbers to be in the Logix REAL format.

The following dialog boxes are the Init Message Configuration and Communication tabs when Command 9 is sent to HART device on channel 0. Note instance 1 means Channel 0.

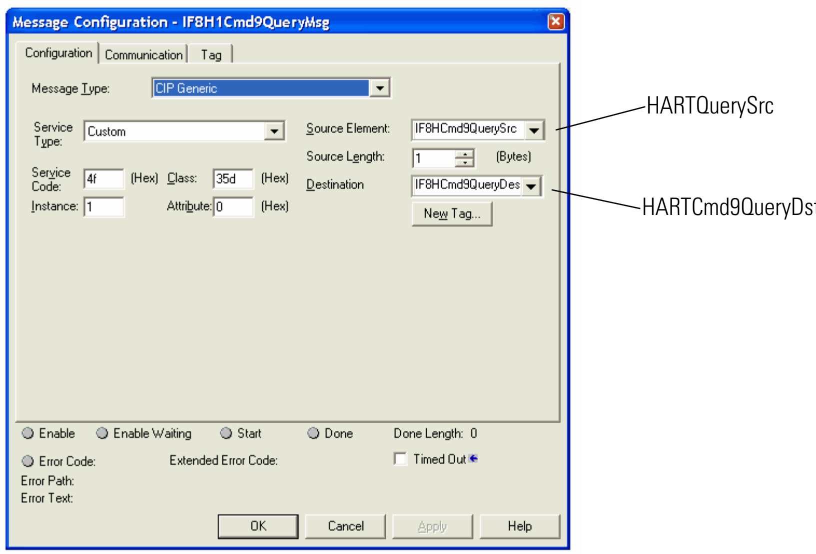




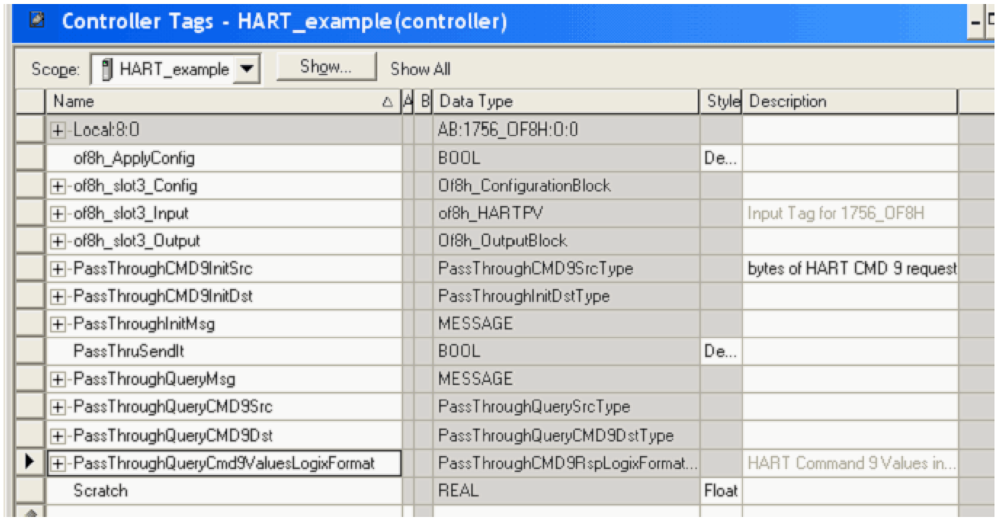
This is the Message Path Browser dialog box.



See the query-message configuration dialog box.



See the dialog box that shows tags. The data types are explained next.

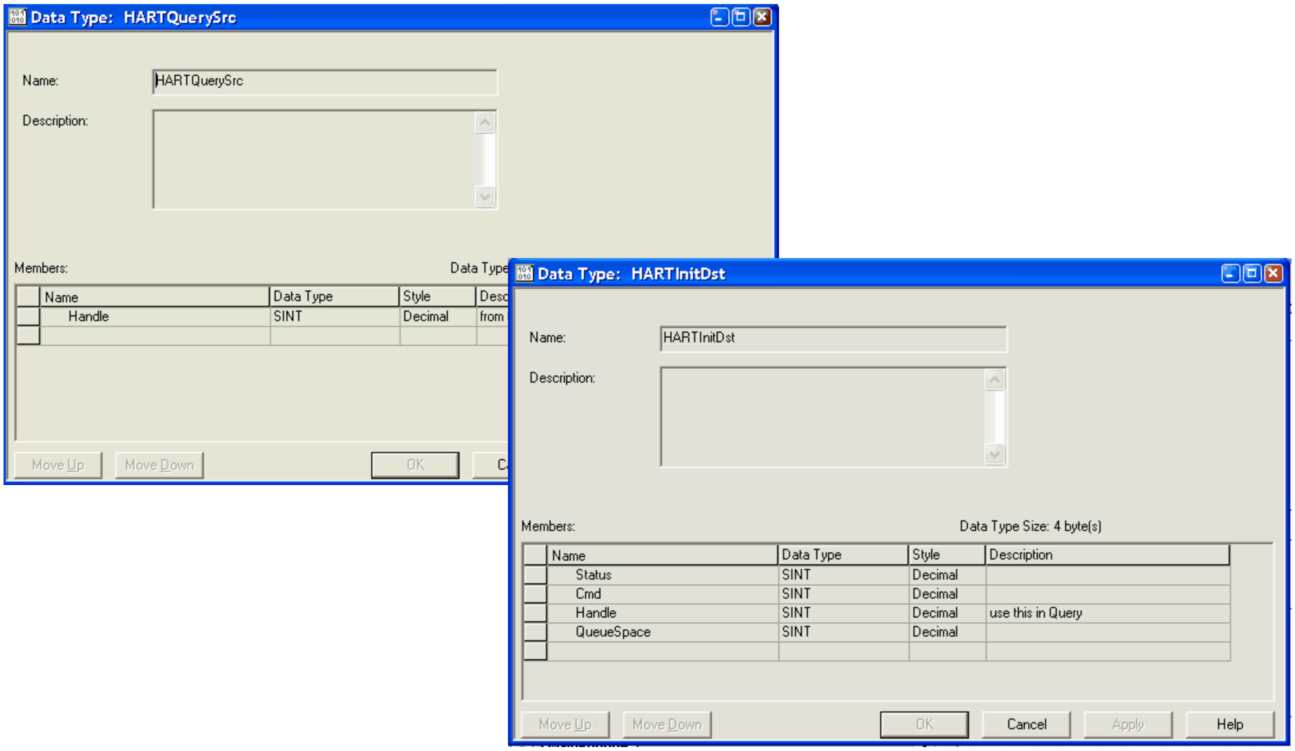


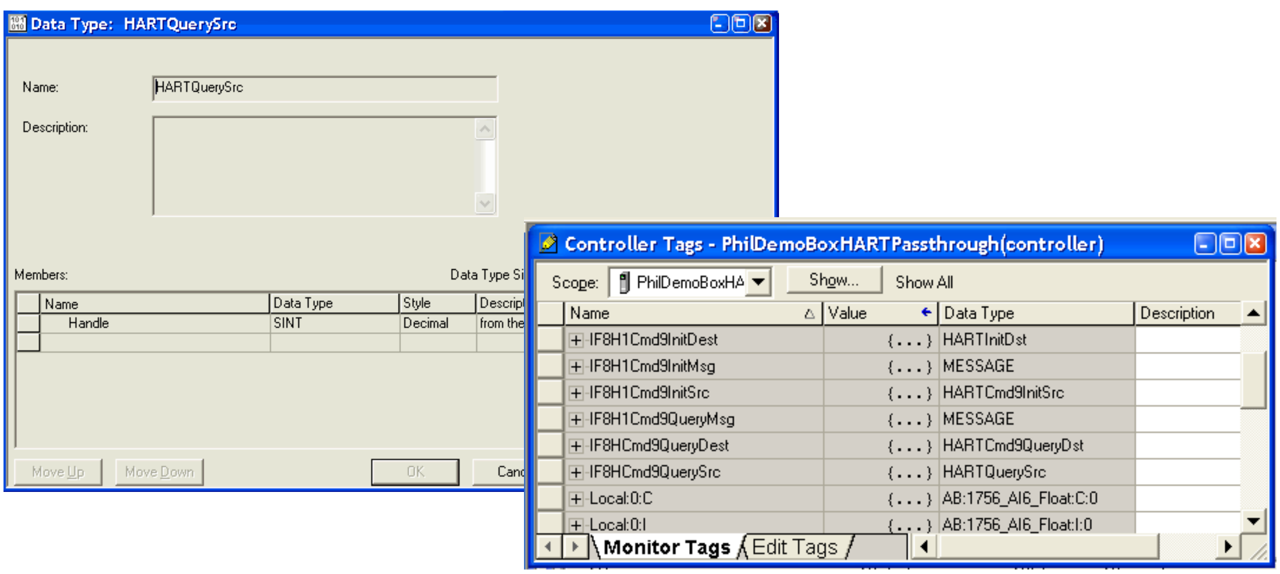
Name	Data Type	Style	Description
+-Local:8:0	AB:1756_OF8H:0:0		
of8h_ApplyConfig	BOOL	De...	
+-of8h_slot3_Config	Of8h_ConfigurationBlock		
+-of8h_slot3_Input	of8h_HARTPV		Input Tag for 1756_OF8H
+-of8h_slot3_Output	Of8h_OutputBlock		
+-PassThroughCMD9InitSrc	PassThroughCMD9SrcType		bytes of HART CMD 9 request
+-PassThroughCMD9InitDst	PassThroughInitDstType		
+-PassThroughInitMsg	MESSAGE		
PassThruSendIt	BOOL	De...	
+-PassThroughQueryMsg	MESSAGE		
+-PassThroughQueryCMD9Src	PassThroughQuerySrcType		
+-PassThroughQueryCMD9Dst	PassThroughQueryCMD9DstType		
+-PassThroughQueryCmd9ValuesLogixFormat	PassThroughCMD9RspLogixFormat...		HART Command 9 Values in...
Scratch	REAL	Float	

See the dialog boxes that show the data-type definition and structure examples used for the following:

- Init message
  - Source (User-defined Type: HARTCmd9InitSrc)
  - Destination (HARTInitDst Type)
- Query message
  - Source (HARTQuerySrc Type)
  - Destination (HARTCmd9QueryDst Type)

These are the HART command 9 example dialog boxes.





HART Modules Used with Asset Management Software

Introduction

This chapter describes important points about using the ControlLogix HART analog modules with asset management systems.

These topics are discussed in this chapter.

Considerations for Asset Management Systems

The following must be considered before using the I/O modules with asset management systems, such as FactoryTalk AssetCentre or Endress+Hauser FieldCare systems.

- HART must be enabled before any asset management system access is possible, including scanning for multiplexors, if supported by your asset management software. You do not need to include HART PV or HART by Channel data in your input tag, but you do need to check the Enable HART box on the Configuration tab of the Module Properties dialog box.
- The Logix controller must be connected to the I/O module. If the Logix controller is not connected, the module configuration was not sent to the HART module, and the channel is not yet configured for HART access.
- If using a handheld HART communicator and configuration tool, such as Rosemount 275 or Meriam, configure the tool as the secondary master. The Meriam handheld has a high-speed mode, which assumes it is the only master present. In this mode, the handheld may conflict with the I/O module. Usually, the Meriam handheld automatically detects the proper setting, but if not, set it manually.
- The ConfigurationChanged indication in the Field Device Status is automatically reset by the I/O module. Asset management systems might miss this indication if they are offline at the time of a change.
- A separate configuration-changed indication is in the field device status for the primary master (1756-IF8H or 1756-IF16H module) and secondary master (handheld, for example). The I/O modules do not reset the secondary master configuration changed status.

HART traffic from asset management pass-through messages or from secondary masters slows the update rate of HART data in the controller or other pass-through message clients. In the 1756-IF8H or 1756-OF8H modules, extra traffic on one channel also affects other channels.

Frequently Asked Questions

Read this section for answers to frequently asked questions.

How do you use ControlLogix HART analog I/O modules as part of an asset management system?

HART I/O modules let most asset management software packages communicate through the modules to HART field devices. Use RSLinx software to let the asset management software communicate through the NetLinx networks and 1756 backplane.

Which RSLinx software is needed to support asset management software?

You need RSLinx Classic software with a Professional, Gateway, or OEM activation.

What else do I need to use asset management software with a ControlLogix HART analog I/O module?

For Field Device Tool (FDT)/Device Type Manager (DTM) based asset management software such as E+H FieldCare, you use communication DTMs from Rockwell Automation. These same communication DTMs also work in the FactoryTalk AssetCentre software. For non FDT/DTM based asset management software, such Emerson AMS, use Connects software, available from Spectrum Controls http://www.spectrumcontrols.com/.

What is FDT/DTM?

FDT/DTM is a technology for managing intelligent devices.

E+H FieldCare asset management software is an FDT frame application. The frame application runs the DTM files. The DTM files are executable files provided by control and device vendors. There are communication DTMs and device DTMs.

We provide communication DTMs for components in the integrated architecture. Companies such as Endress+Hauser and Metso provide device DTMs for their instruments and valves. The device DTMs provide visualization of the parameters needed to configure, monitor, and maintain the devices.

See http://www.fdtgroup.org for more information on FDT/DTM technology and to search for registered DTMs.

What communication DTMs are used with the ControlLogix HART analog I/O modules?

Go to http://www.ab.com/io/downloads and click the HART DTM Files link to obtain the DTMs.

Can I get asset management software from Rockwell Automation?

Yes. Rockwell offers a software bundle (catalog number 9504-SPECHARTENE), which contains E+H FieldCare asset management software, RSLinx Classic Professional software, and a one-year TechConnect support contract. The FieldCare software supports 512 field device tags.

What version of Connects software by Spectrum Controls is needed for the ControlLogix HART analog I/O modules?

Use Spectrum Connects software, version 6.0 or later. This is needed only for asset management software that is not FDT/DTM-based.

What if a DTM is not available for my HART field device?

A generic DTM is available (included with FieldCare) that provides basic access to devices.

Notes:

Unlatch Alarms and Reconfigure Modules By Using Ladder Logic

Introduction

The information in this chapter applies only to the 1756-IF8H and 1756-OF8H modules. Alarms are not available in the 1756-IF16H module.

These topics are discussed in this chapter.

Using Message Instructions

In ladder logic, you can use message instructions to send occasional services to any ControlLogix I/O module. Message instructions send an explicit service to the module, causing specific behavior to occur, for example, unlatching a high alarm.

Message instructions maintain the following characteristics:

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

Processing Real-time Control and Module Services

Services sent via message instructions are not as time critical as the module behavior defined during configuration and maintained by a real-time connection. Therefore, the module processes messaging services only after the needs of the I/O connection are met.

For example, you want to unlatch all process alarms on the module, but real-time control of your process is still occurring using the input value from that same channel. Because the input value is critical to your application, the module prioritizes the sampling of inputs ahead of the unlatch service request.

This prioritization lets input channels be sampled at the same frequency and the process alarms be unlatched in the time between sampling and producing the real-time input data.

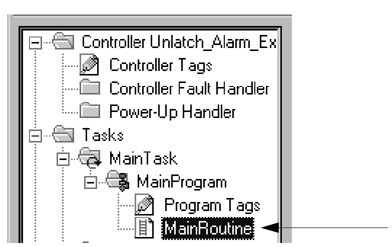
One Service Performed Per Instruction

Message instructions cause a module service to be performed once per execution. For example, if a message instruction sends a service to the module to unlatch the high high alarm on a particular channel, that channel's high high alarm unlatches, but can be set on a subsequent channel sample. The message instruction must then be re-executed to unlatch the alarm a second time.

Creating a New Tag

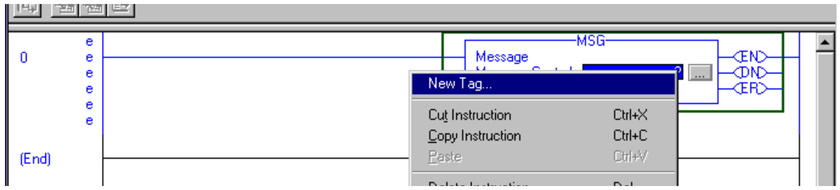
Do these steps to create a new tag by writing ladder logic in the Main Routine.

1. Double-click on MainRoutine (which might require expanding the MainProgram by clicking the '+' sign).

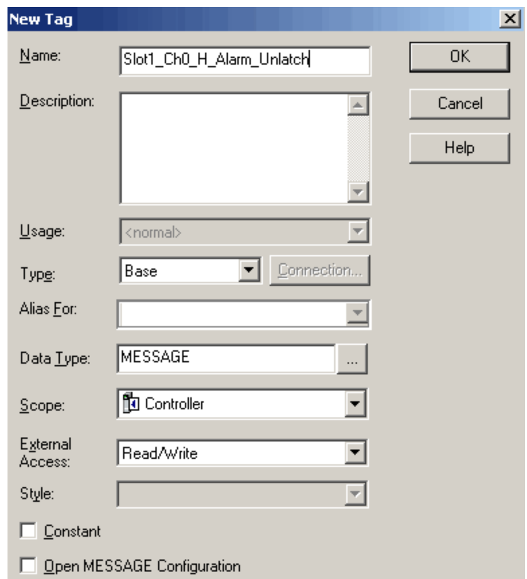


2. Add a message instruction to a rung by clicking the MSG button on the toolbar above the ladder project.

3. Create a tag for the message instruction that you are adding.
   a. Right-click the question mark (?).
   b. Choose New Tag.



The New Tag dialog box appears.



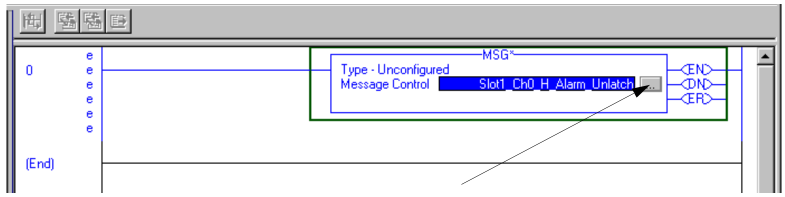
4. On the New Tag dialog box, complete these procedures:
   a. Name the tag.
   b. Click Base for tag type.
   c. Click Message data type.
   d. Click Controller scope, noting that to create message tags you must use Controller scope.

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

5. Click OK.

Enter Message Configuration

After creating a new tag, you must enter message configuration.



The small box with the ellipsis provides access to the Message Configuration dialog box.

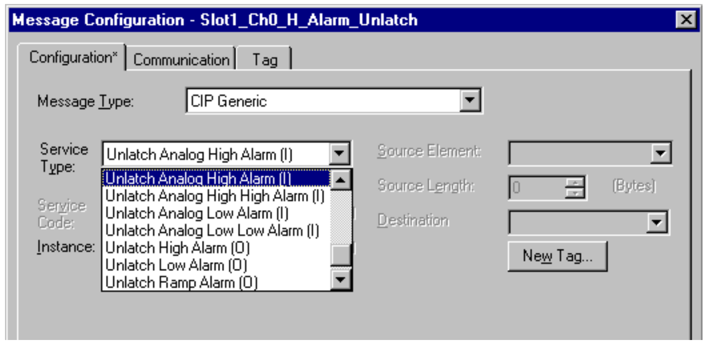
There are two dialog boxes on which you enter message configuration:

- Configuration
- Communication

A description of the purpose and setup of each dialog box is explained on the following pages.

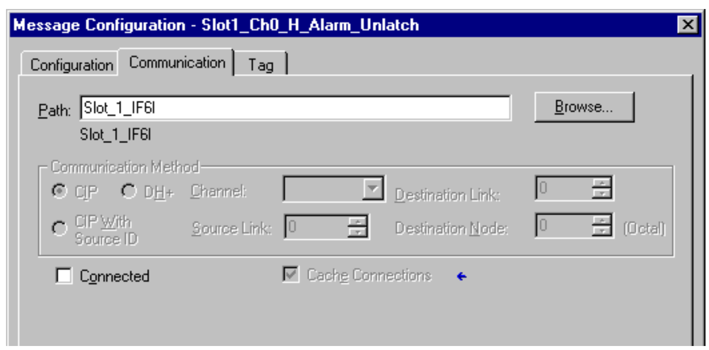
IMPORTANT	RSLogix 5000 software defaults information, such as the following, depending on the message type: • Service type • Service code • Class • Instance • Attribute • Source element • Source length • Destination You are required to choose a Service type and configure the Instance field. Instance represents the module channel on which the service is performed, if appropriate.

The Configuration tab provides information on what module service to perform and where to perform it. For example, you must use this dialog to unlatch high high alarms (module service) on channel 0 of a module (where to perform service).

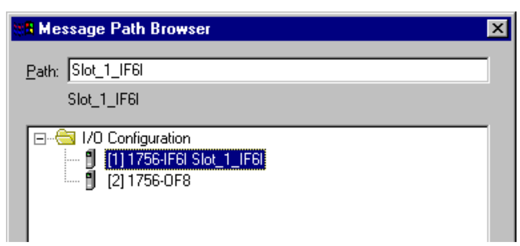


You select a service type by clicking the drop-down. A list of available services includes to unlatch high high, high, low low, low, low, ramp, and rate alarms.

The Communication tab provides information on the path of the message instruction. For example, the slot number of a 1756-IF6I module distinguishes exactly for which module a message is designated.



IMPORTANT Click Browse to see a list of the I/O modules in the system.



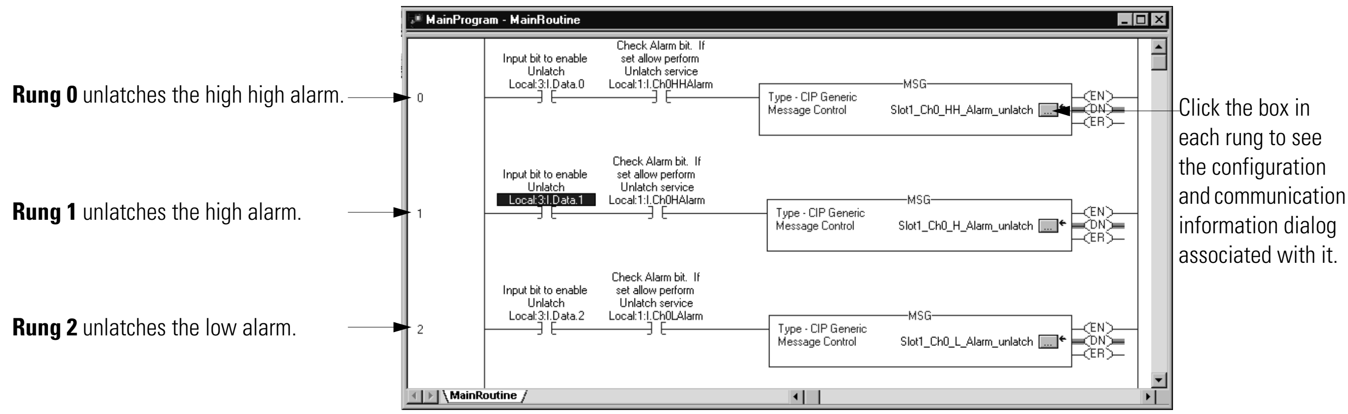
You choose a path when you choose a module from the list.

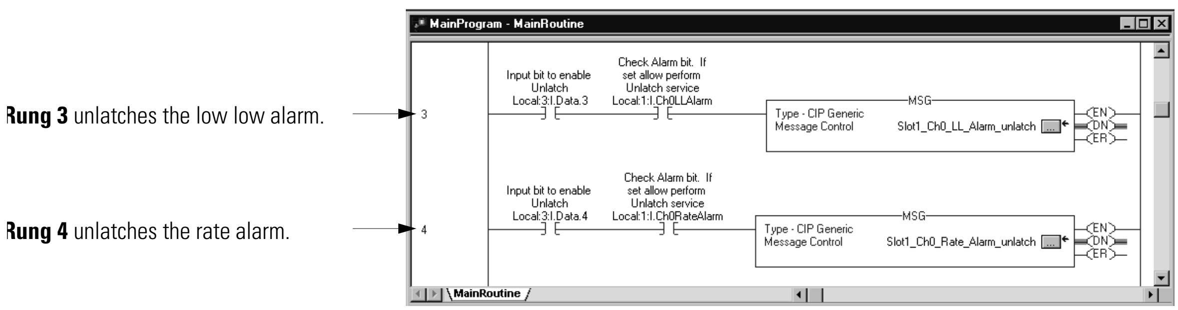
You must name an I/O module during initial module configuration to choose a path for your message instruction.

Unlatch Alarms in the 1756-IF8H Module

The example ladder logic rungs 0…4 show how to unlatch the following alarms:

- Channel 0 High high alarm - Rung 0
- Channel 0 High alarm - Rung 1
- Channel 0 Low alarm - Rung 2
- Channel 0 Low low alarm - Rung 3
- Channel 0 Rate alarm - Rung 4

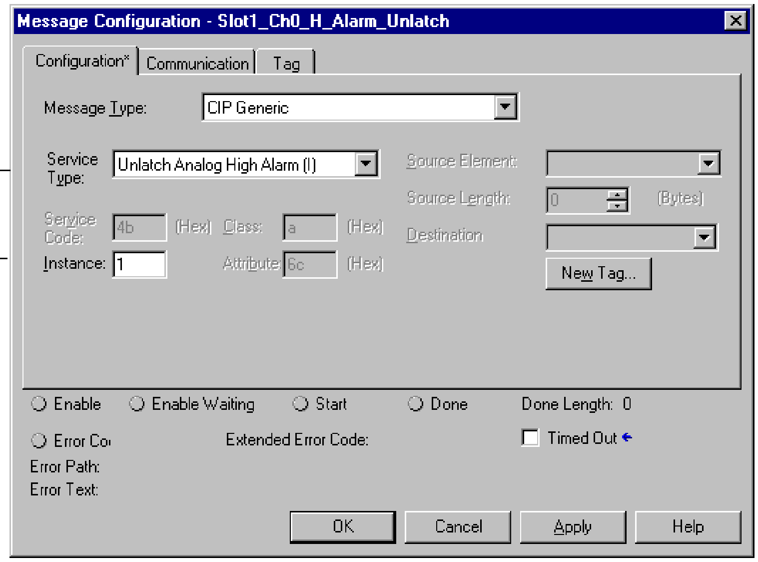




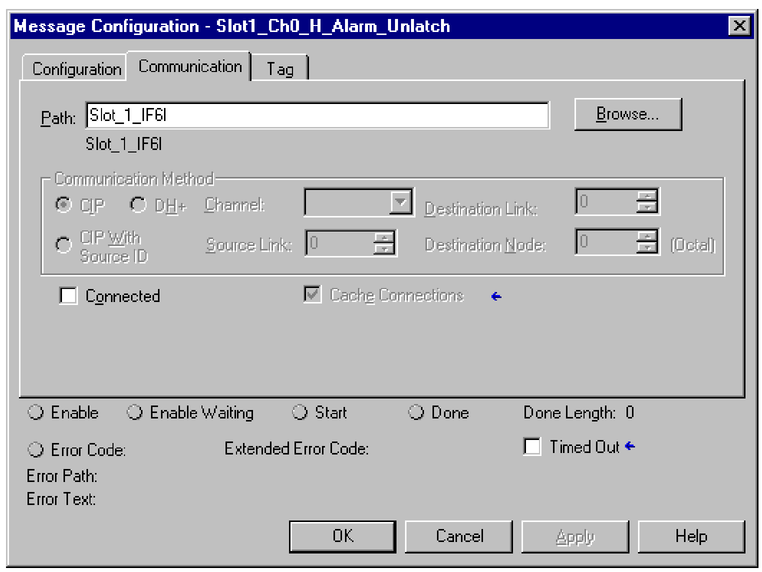
IMPORTANT	An I/O module must be configured to latch alarms, before you can perform unlatch services using ladder logic. If an unlatch service is received by a module not configured to latch alarms, the message instruction errors. All alarms for channel 0 can be unlatched simultaneously with a single message instruction by leaving the Attribute box blank.

Choose a service type and configure the instance.

Instance 1 is for channel 0.



The example shows the communication path for Rung 0



IMPORTANT	You must name an I/O module to set the message path under that module’s communication dialog.

Unlatch Alarms in the 1756-OF8H Module

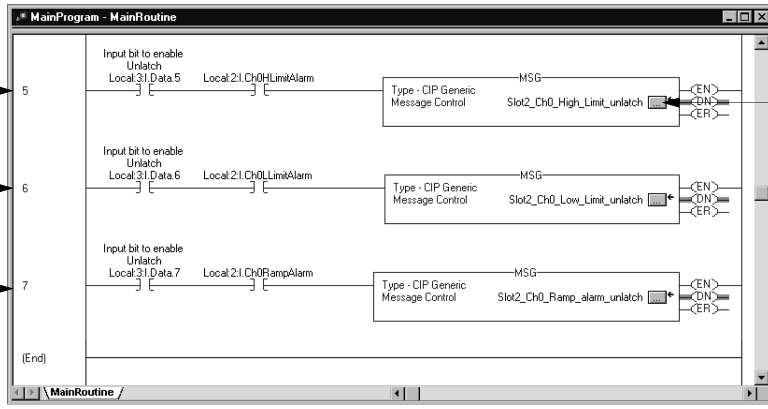
The example ladder logic rungs 5…7 show how to unlatch the following alarms.

- High limit alarm - Rung 5
- Low limit alarm - Rung 6
- Ramp alarm - Rung 7

Rung 5 unlatches the high limit alarm.

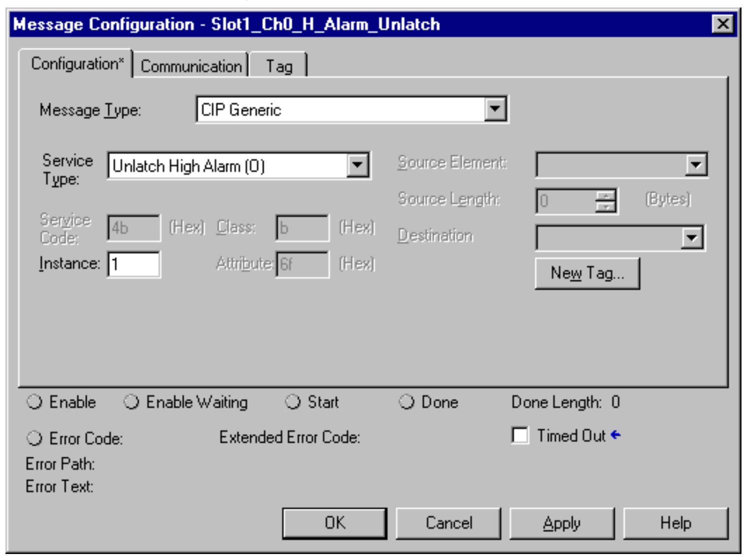
Rung 6 unlatches the low limit alarm.

Rung 7 unlatches the ramp alarm.

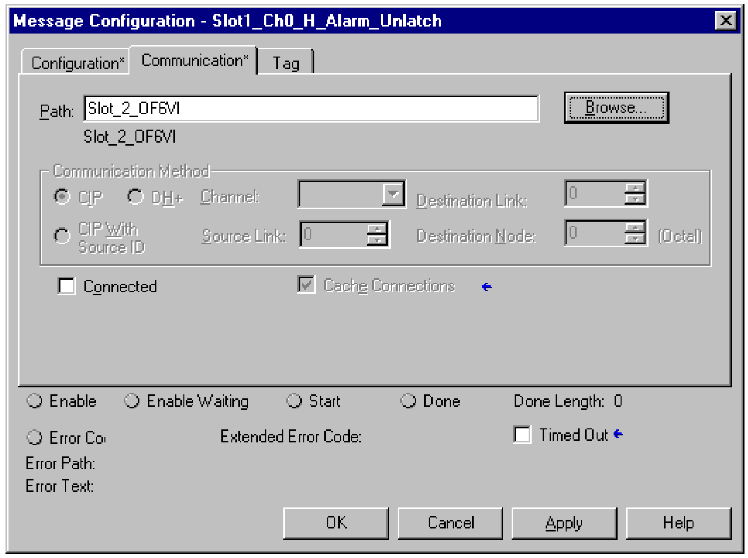


Click the box in each rung to see the configuration and communication information dialog associated with it.

The example shows the Configuration dialog box for Rung 5. You must choose a service type and configure the instance.



The example shows the communication path for Rung 5



IMPORTANT	You must name an I/O module to set the message path under that module's communication dialog.

Reconfigure a Module

It is sometimes advantageous to change the functional operation of a module in the ControlLogix system automatically via the user program rather than using RSLogix 5000 software to reconfigure a module. This way, changes in the process can dictate when the reconfiguration should take place rather than the user performing that function manually.

IMPORTANT	Reconfiguring analog modules via ladder should be limited to functions that involve **the changing of values only**. We do not recommend that enabling or disabling features be done via ladder. Use RSLogix 5000 software to enable or disable these features.

Use the steps in this example when reconfiguring a module via ladder logic.

1. Move new configuration parameters to the Configuration portion of the tag structure associated with the module.
2. Use a message instruction to send a Reconfigure Module service to the same module.

Before the new configuration parameters are sent to the module, you must make sure that their relationship to each other is in a format the module accepts (see Table 47 and Table 48).

The tables below list module parameters that you can change via ladder logic:

Table 47 - Analog Input Module Parameters

Feature	Restriction
High engineering value	Must not be equal to low engineering value
Low engineering value	Must not be equal to high engineering value
High-High alarm value	Must be greater than or equal to high alarm value
High alarm value	Must be greater than low alarm value
Low alarm value	Must be less than high alarm value
Low-Low alarm value	Must be less than or equal to low alarm value
Deadband	Must be less than half of high alarm minus low alarm

Table 48 - Analog Output Module Parameters

Feature	Restriction
High clamp value(1)	Must be greater than low clamp value
Low clamp value(1)	Must be less than high clamp value

(1) The values for user-defined state at Fault or Program (set during initial configuration) must fall within the range of the High and Low Clamp values.

Module Troubleshooting

Introduction

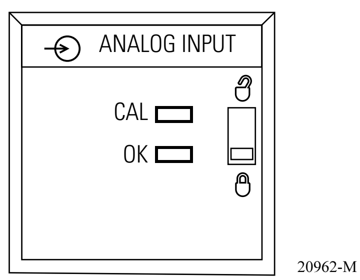
This chapter describes how to interpret status indicators and troubleshoot the modules.

These topics are discussed in this chapter.

Use Module Indicators

The analog I/O modules have indicators that provide indication of module status. ControlLogix modules use status indicators as shown in the table.

The illustration below shows the status indicators used with ControlLogix analog input HART modules.



The following tables provide a description of the colors that display in the status indicators.

Table 49 - ControlLogix Module Status Indicators

Indicator	Display	Means	Recommended Action
OK	Steady Green	The inputs are being multicast	None
OK	Flashing Green	The module has passed internal diagnostics, but is not currently performing connected communication	None
OK	Flashing Red	Previously established communication has timed out	Check controller
OK	Steady Red	It is likely the module should be replaced	See the blink codes(1)
CAL	Flashing Green	The module is in Calibration mode	None

(1) Under fault conditions the module communicates a particular error via the status indicator blink codes. Table 50 provides a description of the fault conditions and blink codes.

Table 50 - Status Indicator Blink Codes and Fault Status

If OK Is	And CAL Is	Fault Status	Recommended Action
Red	Flashing Green	Firmware Download in Process	Wait for download to complete.
Red	3 Blinks	Major Nonrecoverable	Boot code section has failed the CRC check. Send in module for repair.
Red	4 Blinks	Major Nonrecoverable	Serial Number not programmed. Send in module for repair.
Red	5 Blinks	Major Nonrecoverable	Boot code section has failed the CRC check. Send in module for repair.
Red	6 Blinks	Major Recoverable	Application code section has failed the CRC check. Try reprogramming the module firmware. If condition persists send module in for repair.
Red	9 Blinks	Major Nonrecoverable	Module has lost its calibration data. Send in module for repair.
Red	10 Blinks	Major Recoverable	Module firmware watchdog timer has timed out. Try resetting module. If condition persists send module in for repair.

To see fault status, click the Module Info tab on the Module Properties dialog box in RSLogix 5000 software. A channel fault, such as wire off, is displayed as a 'Recoverable' minor fault.

General Troubleshooting Tips

When troubleshooting, consider these typical problems:

- Check the Enable HART box if you want any HART communication access to the channel, including from asset management and Pass through messages.
- Choose the Input Tag Data Format that includes HART if you want to use the secondary process variables and device health information in your controller or display it in the FactoryTalk View software.
- On the 1756-IF8H module, put a jumper wire from IN0- to I-RTN-0 if using 4…20 mA devices.
- On the 1756-IF8H and 1756-IF16H modules, if you are mixing 2-wire and 4-wire HART devices on the same module, do not tie RTN-X together.
- Note that channel buttons apply to current dialogs only.

Channel buttons apply to the current dialog.

- From RSLinx software, if you click RSWho and see 1756-Module, install the EDS file from http://www.ab.com/networks.
- In some versions of RSLogix 5000 software, the profiles for the ControlLogix HART analog I/O modules are not available. Go to http://www.rockwellautomation.com/support/ and click the Add On Profiles link to download and install the profile.
- In RSLogix 5000 software, version 15 and later, with an error about ControlNet Attribute, use Scheduled Connections, or shutdown and restart the RSLogix 5000 software.
- If you can not find HART data, look in sub-field Local:7:I.HART at bottom of the tag or in chassis:7:I.Ch*xx*.PV for data grouped by channel.

When troubleshooting, consider these more obscure problems.

- The same device appears to be connected to every channel because a wiring problem causes signals to get connected across channels. In some cases, loose IRET wires cause the path to ground to flow through other channels.
- If Keep HART Replies for XX seconds is set small – less than 5 seconds - the module throws away replies before you get a chance to retrieve them. This affects both MSG pass-through messages and PC-based asset management, such as FieldCare software. We recommend 15 seconds for this parameter.
- Be sure you have a HART device. Foundation Fieldbus, Profibus PA, and plain 4…20 devices look the same on the outside and power up OK.
- Write protect jumper is not reported correctly. This gets refreshed only if the device reports it changed. E&H and Rosemount devices don't. Un-enable HART then re-enable HART to get it refreshed on the HART Device Info dialog.

For pass-through message troubleshooting issues, use these tips:

- Check module-specific online help.
- Copy the Handle to the Query.
- Check sizes of MSG and HART command.
- Check packing, alignment, and byte ordering.
- Use MsgReady.
- Name tags and UDTs similarly to group them together for convenience. For example, start the related tags with the same prefix.
- Check .ER and Status.

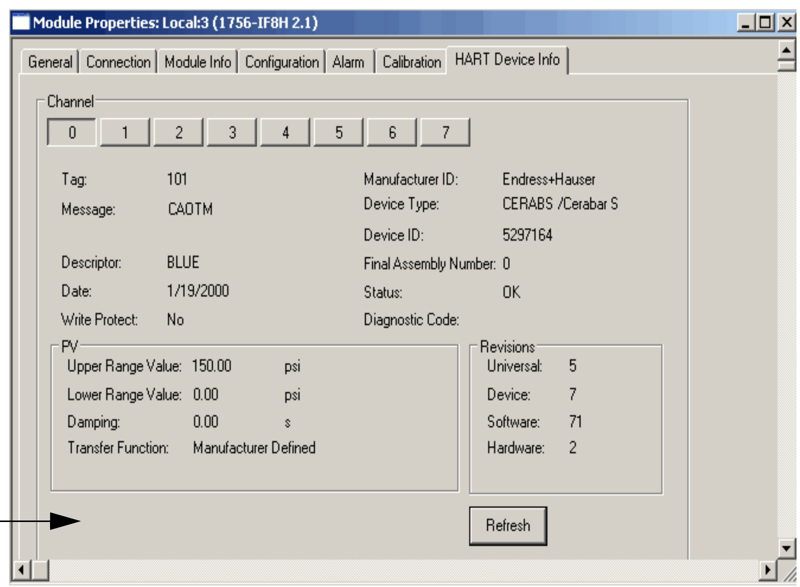
For input tag troubleshooting, use these tips:

- Local:7:I.Ch0Fault – if 1, suspect wiring/instrument problem.
- Local:7:I.Ch0HARTFault – if 1, check Local:7:C.HARTEn (Enable HART).
- Local:7:I.HART.Ch0DeviceStatus.Init – HART is enabled, but still trying to get a response from device.
- Local:7:I.HART.Ch0DeviceStatus.Fail – HART is disabled, or not responding.
- Local:7:I.HART.Ch0DeviceStatus.CurrentFault – the mA current measured doesn't match what is reported via HART. Could be caused by a recent change in value. This is intended to indicate a current leak, such as water in the conduit.
- Local:7:I.HART.Ch0DeviceStatus.ResponseCode – if negative, there is some communication problem. If positive, device is indicating some problem with the command. 16#40 means command not supported.
- Local:7:I.HART.Ch0DeviceStatus.FieldDeviceStatus – 0 is good; refer to Help or see the Table 73 on page 195 for more information.

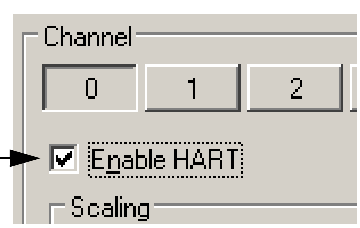
- Local:7:I.HART.Ch0PVStatus – 16#C0 is good. 0 is bad. This could be a communication problem or something wrong with device. For example, with SVStatus, this could mean the device does not support more than one measurement.

When working with the HART Device Info dialog for troubleshooting, use these tips:

- HART Initializing means that HART is enabled, but not communicating. If this persist for 10 seconds after you click Refresh several times, suspect a HART communication problem or no device.
- Be sure a channel is HART Enabled.
- Be sure values appear, meaning HART communication is okay.
- Check PV values Local:7:I:HART.Ch0PV or Local:12:I.Ch00.Data for changing numbers.
- Check analog values Local:7:I:Ch0Data or Local:12:I.Ch00.Data for changing numbers; for the 1756-OF8H module, check that is valid.
- Note that you must have a Logix connection for asset management, as this delivers the configuration to the module. From the Module Properties dialog, click HART Device Info to see if it shows information.



The words 'HART Initializing' appear here.

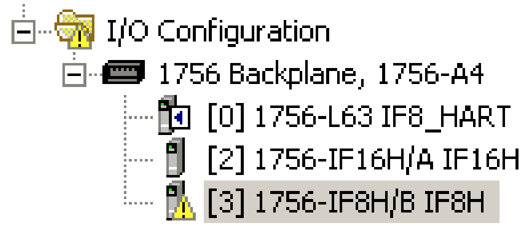


Be sure a channel is HART enabled.

Use RSLogix 5000 Software to Troubleshoot a Module

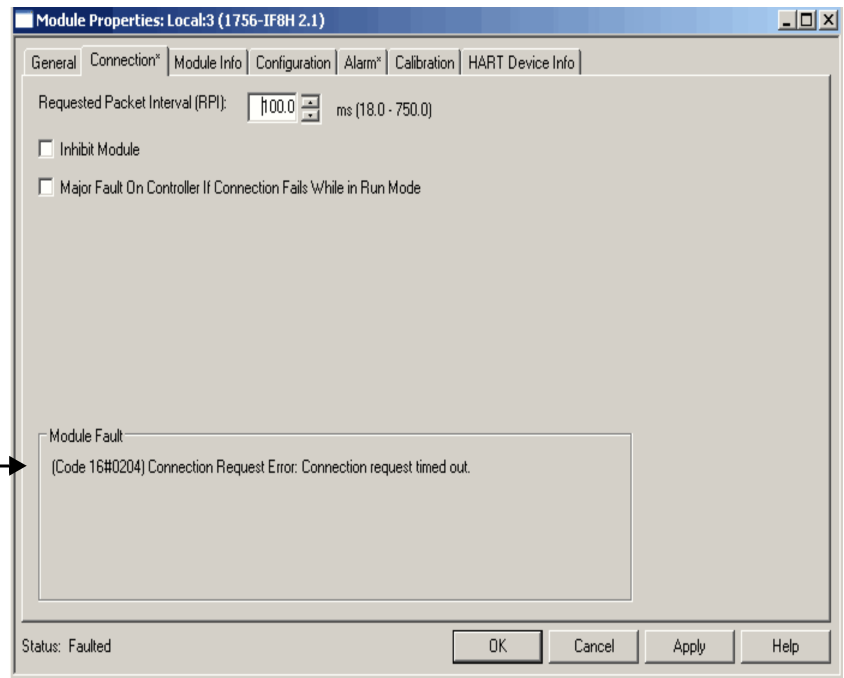
In addition to the status displayed on the module, RSLogix 5000 software alerts you to fault conditions. You are alerted in one of these ways.

- Warning signal in the I/O Configuration next to the module - This occurs when the connection to the module is broken



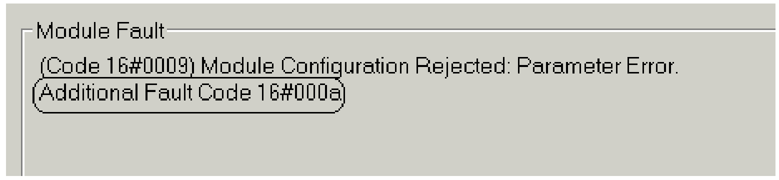
- Fault message in a status line
- Notification in the Tag Monitor
  - General module faults
  - Diagnostic faults
- Status on the Module Info Page

Fault Condition



Module Configuration Errors

The additional fault code value describes the configuration error if "(Code 16#0009) Module Configuration Rejected: Parameter Error" is displayed on the Connection Tab in RSLogix 5000 software.



Additional Fault Codes - Module Level

Table 51 shows error codes used by ControlLogix HART Analog modules for module level conditions (conditions that do not occur in a specific channel).

Table 51 - 1756-IF8H, 1756-IF16H, and 1756-OF8H Module Level Error Codes

Additional Fault Codes	Description
16#0001	Configuration revision number invalid Valid numbers are 0 or 1
16#0002	Filter value invalid
16#0003	RTS invalid
16#0004	Pass-through handle timeout
16#1001	Configuration does not match In a multiple owner setup, with the configuration revision number set to 1, the configurations must match

TIP The 16# means this number is Hex display style.

Additional Fault Codes - Channel Level

Each module has channel level error codes that are specific to the individual modules. These channel level error codes, which display in the Module Fault box on the Connection tab dialog box, are described in the following tables.

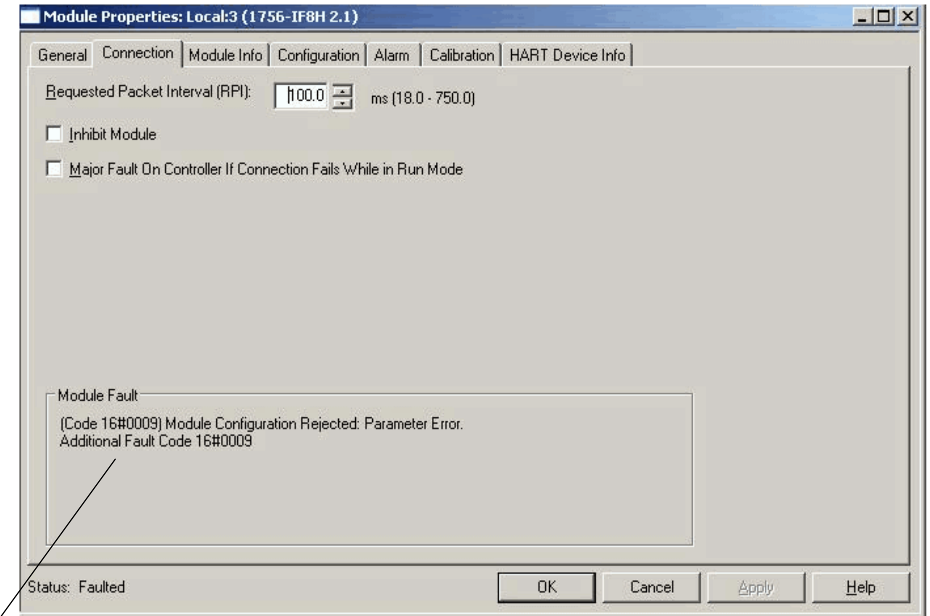


Table 52 - 1756-IF8H Channel Level Error Codes
Channel *x* Extended Status = Channel 0 Error Value + (*x* *16)

	Channel								Channel Status
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Additional Fault Codes	16#0005	16#0015	16#0025	16#0035	16#0045	16#0055	16#0065	16#0075	Process Alarm Latch Set and Disable All Alarms Set
	16#0006	16#0016	16#0026	16#0036	16#0046	16#0056	16#0066	16#0076	Rate Alarm Latch Set and Alarm Disable Set
	16#0007	16#0017	16#0027	16#0037	16#0047	16#0057	16#0067	16#0077	Invalid Input Range
	16#0008	16#0018	16#0028	16#0038	16#0048	16#0058	16#0068	16#0078	Invalid Digital Filter
	16#0009	16#0019	16#0029	16#0039	16#0049	16#0059	16#0069	16#0079	Invalid Rate Alarm
	16#000A	16#001A	16#002A	16#003A	16#004A	16#005A	16#006A	16#007A	High Signal and/or Low Signal outside of selected input range
	16#000B	16#001B	16#002B	16#003B	16#004B	16#005B	16#006B	16#007B	High Signal ≤Low Signal
	16#000C	16#001C	16#002C	16#003C	16#004C	16#005C	16#006C	16#007C	Sensor Offset set to NaN
	16#000D	16#001D	16#002D	16#003D	16#004D	16#005D	16#006D	16#007D	High Engineering = Low Engineering
	16#000E	16#001E	16#002E	16#003E	16#004E	16#005E	16#006E	16#007E	Invalid HART rate, HART rate fixed at 1:1
	16#000F	16#001F	16#002F	16#003F	16#004F	16#005F	16#006F	16#007F	High Alarm < Low Alarm
	16#0010	16#0020	16#0030	16#0040	16#0050	16#0060	16#0070	16#0080	Low Low Alarm > Low
	16#0011	16#0021	16#0031	16#0041	16#0051	16#0061	16#0071	16#0081	High High alarm < High Alarm
	16#0012	16#0022	16#0032	16#0042	16#0052	16#0062	16#0072	16#0082	Invalid Alarm Deadband

Table 53 - 1756-IF16H Channel Level Error Codes
Channel *x* Extended Status = Channel 0 Error Value + (*x* *16)

	Channel								Channel Status
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Extended Fault Codes	16#0007	16#0017	16#0027	16#0037	16#0047	16#0057	16#0067	16#0077	Invalid Input Range
	16#0008	16#0018	16#0028	16#0038	16#0048	16#0058	16#0068	16#0078	Invalid Digital Filter
	16#000A	16#001A	16#002A	16#003A	16#004A	16#005A	16#006A	16#007A	High Signal and/or Low Signal outside of selected input range
	16#000B	16#001B	16#002B	16#003B	16#004B	16#005B	16#006B	16#007B	High Signal ≤Low Signal
	16#000C	16#001C	16#002C	16#003C	16#004C	16#005C	16#006C	16#007C	Sensor Offset set to NaN.
	16#000D	16#001D	16#002D	16#003D	16#004D	16#005D	16#006D	16#007D	High Engineering = Low Engneering
	Channel (cont.)								
	8	**9**	**10**	**11**	**12**	**13**	**14**	**15**	
Extended Fault Codes	16#0087	16#0097	16#00A7	16#00B7	16#00C7	16#00D7	16#00E7	16#00F7	Invalid Input Range
	16#0088	16#0098	16#00A8	16#00B8	16#00C8	16#00D8	16#00E8	16#00F8	Invalid Digital Filter
	16#008A	16#009A	16#00AA	16#00BA	16#00CA	16#00DA	16#00EA	16#00FA	High Signal and/or Low Signal outside of selected input range
	16#008B	16#009B	16#00AB	16#00BB	16#00CB	16#00DB	16#00EB	16#00FB	High Signal ≤Low Signal
	16#008C	16#009C	16#00AC	16#00BC	16#00CC	16#00DC	16#00EC	16#00FC	Sensor Offset set to NaN.
	16#008D	16#009D	16#00AD	16#00BD	16#00CD	16#00DD	16#00ED	16#00FD	High Engineering = Low Engneering

Table 54 - 1756-OF8H Channel Level Error Codes
Channel *x* Extended Status = Channel 0 Error Value + (*x* *22)

	Channel								Channel Status
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Additional Fault Codes	16#0005	16#001B	16#0031	16#0047	16#005D	16#0073	16#0089	16#009F	Bad Ramp Latch
	16#0006	16#001C	16#0032	16#0048	16#005E	16#0074	16#008A	16#00A0	Bad Clamp Latch
	16#000A	16#0020	16#0036	16#004C	16#0062	16#0078	16#008E	16#00A4	Bad Ramp to Idle
	16#000B	16#0021	16#0037	16#004D	16#0063	16#0079	16#008F	16#00A5	Bad Ramp to Fault
	16#000C	16#0022	16#0038	16#004E	16#0064	16#007A	16#0090	16#00A6	Invalid Input Range
	16#000D	16#0023	16#0039	16#004F	16#0065	16#007B	16#0091	16#00A7	Bad Max Ramp
	16#000E	16#0024	16#003A	16#0050	16#0066	16#007C	16#0092	16#00A8	Bad Fault Value
	16#000F	16#0025	16#003B	16#0051	16#0067	16#007D	16#0093	16#00A9	Bad Idle Value
	16#0010	16#0026	16#003C	16#0052	16#0068	16#007E	16#0094	16#00AA	Signal Out of Range
	16#0011	16#0027	16#003D	16#0053	16#0069	16#007F	16#0095	16#00AB	Low Signal Greater or Equal to High Signal
	16#0012	16#0028	16#003E	16#0054	16#006A	16#0080	16#0096	16#00AC	Sensor Offset set to NaN
	16#0013	16#0029	16#003F	16#0055	16#006B	16#0081	16#0097	16#00AD	High Engineering Equal to Low Engineering
	16#0014	16#002A	16#0040	16#0056	16#006C	16#0082	16#0098	16#00AE	Invalid HART Rate
	16#0015	16#002B	16#0041	16#0057	16#006D	16#0083	16#0099	16#00AF	Bad Clamp

Tag Definitions

Communication Mode Member Names and Definitions

The set of tags associated with any module depends on the module type and the communication format. The tables below show input data choice, tag, and main module type.

IMPORTANT The Analog and HART PV input data type for the 1756-IF8H and 1756-OF8H modules has a :1 as the suffix instead of :0 in firmware revision 2.1.

Table 55 - 1756-IF8H Input Data Choice and Tags

Input Data Choice	Tag	Main Module Defined Type	Subtype Used by Main Type
Analog Only	Configuration	AB:1756_IF8H:C:0	AB:1756_IF8H_ChConfig_Struct:C:0
	Input	AB:1756_IF8H_Analog:I:0	None
Analog and HART PV	Configuration	AB:1756_IF8H:C:0	AB:1756_IF8H_ChConfig_Struct:C:0
	Input	AB:1756_IF8H_HARTPV:I:1	AB:1756_IF8H_HARTData:I:1 AB:1756_IF8H_HARTStatus_Struct:I:1
Analog and HART by Channel	Configuration	AB:1756_IF8H:C:0	AB:1756_IF8H_ChConfig_Struct:C:0
	Input	AB:1756_IF8H_AnalogHARTbyChannel:I:0	AB:1756_IF8H_HARTDataAll_Struct:I:0 AB:1756_IF8H_HARTStatusAll_Struct:I:0

Table 56 - 1756-IF16H Input Data Choice and Tags

Input Data Choice	Tag	Main Module Defined Type	Subtype Used by Main Type
Analog Only	Configuration	AB:1756_IF16H:C:0	AB:1756_IF16H_ChConfig_Struct:C:0
	Input	AB:1756_IF16H_Analog:I:0	None
Analog and HART PV	Configuration	AB:1756_IF16H:C:0	AB:1756_IF16H_ChConfig_Struct:C:0
	Input	AB:1756_IF16H_HARTPV:I:0	AB:1756_IF16H_HARTData:I:0 AB:1756_IF16H_HARTStatus_Struct:I:0
Analog and HART by Channel	Configuration	AB:1756_IF16H:C:0	AB:1756_IF16H_ChConfig_Struct:C:0
	Input	AB:1756_IF16H_AnalogHARTbyChannel:I:0	AB:1756_IF16H_HARTDataAll_Struct:I:0 AB:1756_IF16H_HARTStatusAll_Struct:I:0

Table 57 - 1756-OF8H Input Data Choice and Tags

Input Data Choice	Tag	Main Module Defined Type	Subtype Used by Main Type
Analog Only	Configuration	AB:1756_OF8H:C:0	AB:1756_OF8H_ChConfig_Struct:C:0
	Input	AB:1756_OF8H_Analog:I:0	None
	Output	AB:1756_OF8H:O:0	None

Table 57 - 1756-OF8H Input Data Choice and Tags

Input Data Choice	Tag	Main Module Defined Type	Subtype Used by Main Type
Analog and HART PV	Configuration	AB:1756_OF8H:C:0	AB:1756_OF8H_ChConfig_Struct:C:0
	Input	AB:1756_OF8H_HARTPV:I:1	AB:1756_OF8H_HARTData:I:1 AB:1756_OF8H_HARTStatus_Struct:I:1
	Output	AB:1756_OF8H:O:0	None
Analog and HART by Channel	Configuration	AB:1756_OF8H:C:0	AB:1756_OF8H_ChConfig_Struct:C:0
	Input	AB:1756_OF8H_AnalogHARTbyChannel:I:0	AB:1756_OF8H_HARTDataAll_Struct:I:0 AB:1756_OF8H_HARTStatusAll_Struct:I:0
	Output	AB:1756_OF8H:O:0	None

Module-defined Data Types, 1756-IF8H Module

These tables describe module-defined data types for the 1756-IF8H module and include information for configuration and input tags.

Configuration

This table describes the configuration tags available in the 1756-IF8H module.

Table 58 - Configuration (AB:1756_IF8H:C:0)

Member Name	Type	Style	Description
ModuleFilter (bits 0…7)	SINT	Decimal	See the Module Filter Values table on page 103.
RealTimeSample (bits 0…15)	INT	Decimal	Milliseconds between reading signal values. See Real Time Sample (RTS) on page 41 for more information.
Ch0Config	AB:1756_IF8H_ChConfig_Struct:C:0		
Config	SINT	Binary	
RateAlarmLatch	BOOL	Decimal	Ch0Config.Config.4, After a Rate Alarm is detected, keep I.Ch*x*RateAlarm set even after Rate returns to normal, until unlatched by CIP Service Message.
ProcessAlarmLatch	BOOL	Decimal	Ch0Config.Config.5, After a Process Alarm such as LL is detected, keep I.Ch*x*LLAlarm set even after measurement returns to normal, until unlatched by CIP Service Message.
AlarmDisable	BOOL	Decimal	Ch0Config.Config.6, Do not report Process or Rate Alarms.
HARTEn	BOOL	Decimal	Ch0Config.Config.7, Enable HART communication. Must be 1 for valid HART data in Input Tag and Asset Management access to HART Field Device.
RangeType	SINT	Decimal	0 = -10…+10 V. 1 = 0…5 V. 2 = 0…10 V. 3 = 0…20 mA. 4 = 4 …20 mA.
DigitalFilter	INT	Decimal	Time Constant of low pass filter in ms. See Digital Filter on page 71 for more information.
RateAlarmLimit	REAL	Float	Maximum Ramp Rate value to trigger a Rate Alarm when the Input Signal rate of change exceeds the setpoint. See Scaling to Engineering Units on page 98 for more information.
LowSignal	REAL	Float	Lower current value for scaling to engineering units. Default is 4 mA. Must be less than HighSignal and more than or equal to the minimum Input Range. See Scaling to Engineering Units on page 98 for more information.

Table 58 - Configuration (AB:1756_IF8H:C:0)

Member Name	Type	Style	Description
HighSignal	REAL	Float	Upper current value for scaling to engineering units. Default is 20 mA. Must be more than LowSignal and less than or equal to the maximum Input Range. See Scaling to Engineering Units on page 98 for more information.
LowEngineering	REAL	Float	Measured quantity in engineering units that results in a signal level equal to LowSignal. See Scaling to Engineering Units on page 98 for more information.
HighEngineering	REAL	Float	Measured quantity in engineering units that results in a signal level equal to HighSignal. See Scaling to Engineering Units on page 98 for more information.
LAlarmLimit	REAL	Float	User value sets low limit that causes the module to trigger a low alarm.
HAlarmLimit	REAL	Float	User value sets high limit that causes the module to trigger a high alarm.
LLAlarmLimit	REAL	Float	User value sets low low limit that causes the module to trigger a low low alarm.
HHAlarmLimit	REAL	Float	User value sets high high limit that causes the module to trigger a high high alarm.
AlarmDeadband	REAL	Float	User value sets the alarm deadband that stipulates the deadband range for the alarm trigger point. See Table 4 on page 58 for an illustration.
CalBias	REAL	Float	Sensor Offset in engineering units added to the measured signal before reporting Ch0.Data.
Ch1Config	AB:1756_IF8H_ChConfig_Struct:C:0		
Ch2Config	AB:1756_IF8H_ChConfig_Struct:C:0		
Ch3Config	AB:1756_IF8H_ChConfig_Struct:C:0		
Ch4Config	AB:1756_IF8H_ChConfig_Struct:C:0		
Ch5Config	AB:1756_IF8H_ChConfig_Struct:C:0		
Ch6Config	AB:1756_IF8H_ChConfig_Struct:C:0		
Ch7Config	AB:1756_IF8H_ChConfig_Struct:C:0		
PassthroughHandle Timeout	INT	Decimal	Seconds to keep a reply to a HART pass-through service request before discarding. 15 seconds recommended.
PassthroughCmdFreq_14	BOOL	Decimal	Selects the policy for sending HART pass-through messages. See Pass-through Setting, Ratio, and Priority on page 101
PassthroughCmdFreq_15	BOOL	Decimal	

Analog Only

This table describes the input tags available in the Analog Only data format.

Table 59 - Analog Only (AB:1756_IF8H_Analog:I:0)

Member Name	Type	Style	Description
ChannelFaults (bit0…15	INT	Binary	Indicates a problem with analog data on Channel x or broken communication between the Logix controller and the 1756-IF8H module. Example: Set if analog signal is larger than 20 mA.
ChxFault (Ch0…Ch7)	BOOL	Decimal	ChannelFaults.0…ChannelFaults.7
Ch*x*BrokenWire (Ch0…Ch7)	BOOL	Decimal	ChannelFaults.8…ChannelFaults.15 Indicates that current is not flowing through the module as expected. This might be caused by broken wiring, RTB removal, or a powered-off field device.

Table 59 - Analog Only (AB:1756_IF8H_Analog:I:0)

Member Name	Type	Style	Description
HARTFaults (Ch0…Ch7)	SINT	Binary	Indicates a problem with HART data from the Field Device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following Field Device Status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
Ch*x*HARTFault	BOOL	Decimal	HARTFaults.0…HARTFaults.7
ModuleFaults	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.1, 1756-IF8H Module Calibration Failed.
Calibrating	BOOL	Decimal	ModuleFaults.2, Calibration in progress.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
Ch0Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch0Fault for Overrange, Underrange and CalFault.
Ch0HHAlarm	BOOL		Ch0Status.0 Ch0Data > Ch0HHAlarmLimit. If Process Alarms are configured to Latch by setting Ch0Config.ProcessAlarmLatch this bit remains set even after the condition returns to normal, until reset via explicit CIP message. This message can be sent from the RSLogix 5000 Module Properties Alarm dialog box or from the Logix controller via MSG instruction.
Ch0LLAlarm	BOOL		Ch*x*Status.1 Ch0Data < Ch0LLAlarmLimit If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched
Ch0HAlarm	BOOL		Ch0Status.2 Ch0Data > Ch0HAlarmLimit If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched
Ch0LAlarm	BOOL		Ch0Status.3 Ch0Data < Ch0LAlarmLimit If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched
Ch0RateAlarm	BOOL		Ch0Status.4 Ch0Data changing faster than Ch0RateAlarmLimit. Both Positive and Negative changes can cause this alarm. If Ch0Config.RateAlarmLatch is set, this alarm remains set until it is unlatched
Ch0Overrange	BOOL		Ch0Status.5 Analog signal is greater than or equal to the maximum detectable signal. Because the signal cannot be measured, it may be significantly above the maximum value
Ch0Underrange	BOOL		Ch0Status.6 Analog signal is less than or equal to the minimum detectable signal. Because the signal cannot be measured, it may be significantly below the minimum value
Ch0CalFault	BOOL		Ch0Status.7 Set if an error occurs during calibration for Channel *x*, causing a bad calibration. Also sets CalFault
Ch1Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch1Fault.
Ch2Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch2Fault.
Ch3Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch3Fault.
Ch4Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch4Fault.
Ch5Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch5Fault.
Ch6Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch6Fault.
Ch7Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch7Fault.

Table 59 - Analog Only (AB:1756_IF8H_Analog:I:0)

Member Name	Type	Style	Description
Ch*x*Data (Ch0…Ch7)	REAL	Float	Value of analog signal on Channel *x* after conversion to engineering units.
CSTTimestamp	DINT[2]	Hex	Timestamp taken at the time the input data was sampled in terms of coordinated system time, which is a 64-bit value in microseconds coordinated across the modules in the 1756 backplane.
RollingTimestamp	INT	Decimal	Timestamp taken at the time the input data was sampled in millisecond resolution.

Analog and HART PV

This table describes the input tags available in the Analog and HART PV data format.

Table 60 - Analog and HART PV (AB:1756_IF8H_HARTPV:I:1)

Member Name	Type	Style	Description
ChannelFaults (bit0…15)	INT	Binary	Indicates a problem with analog data on Channel x or broken communication between the Logix controller and the 1756-IF8H module. Example: Set if analog signal is larger than 20 mA.
ChxFault (Ch0…Ch7)	BOOL	Decimal	ChannelFaults.0…ChannelFaults.7
Ch*x*BrokenWire (Ch0…Ch7)	BOOL	Decimal	ChannelFaults.8…ChannelFaults.15 Indicates that current is not flowing through the module as expected. This might be caused by broken wiring, RTB removal, or a powered-off field device.
HARTFaults (Ch0…Ch7)	SINT	Binary	Indicates a problem with HART data from the field device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following field device status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
Ch*x*HARTFault	BOOL	Decimal	HARTFaults.0…HARTFaults.7
ModuleFaults	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.1, 1756-IF8H Module Calibration Failed.
Calibrating	BOOL	Decimal	ModuleFaults.2, Calibration in progress.
UpdatedStatusReady	BOOL	Decimal	ModuleFaults.3, Module has collected updated Additional Device Status from HART command 48. This status can be retrieved by using the Read Additional Status service, 16#4C. For more information about this service, see Read Additional Status (Service Code = 16#4C) on page 125. Updated Cmd 48 status data available.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
Ch0Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch0Fault for Overrange, Underrange, and CalFault.
Ch0HHAlarm	BOOL		Ch0Status.0 Ch0Data > Ch0HHAlarmLimit. If process alarms are configured to latch by setting Ch0Config.ProcessAlarmLatch this bit remains set even after the condition returns to normal, until reset via explicit CIP message. This message can be sent from the RSLogix 5000 Module Properties Alarm dialog box or from the Logix controller via MSG instruction.
Ch0LLAlarm	BOOL		Ch*x*Status.1 Ch0Data < Ch0LLAlarmLimit If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched.

Table 60 - Analog and HART PV (AB:1756_IF8H_HARTPV:I:1)

Member Name	Type	Style	Description
Ch0HAlarm	BOOL		Ch0Status.2 Ch0Data > Ch0HAlarmLimit If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched
Ch0LAlarm	BOOL		Ch0Status.3 Ch0Data < Ch0LAlarmLimit If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched.
Ch0RateAlarm	BOOL		Ch0Status.4 Ch0Data changing faster than Ch0RateAlarmLimit. Both positive and negative changes can cause this alarm. If Ch0Config.RateAlarmLatch is set, this alarm remains set until it is unlatched.
Ch0Overrange	BOOL		Ch0Status.5 Analog signal is greater than or equal to the maximum detectable signal. Because the signal cannot be measured, it may be significantly above the maximum value.
Ch0Underrange	BOOL		Ch0Status.6 Analog signal is less than or equal to the minimum detectable signal. Because the signal cannot be measured, it may be significantly below the minimum value.
Ch0CalFault	BOOL		Ch0Status.7 Set if an error occurs during calibration for Channel *x*, causing a bad calibration. Also sets CalFault.
Ch1Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch1Fault.
Ch2Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch2Fault.
Ch3Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch3Fault.
Ch4Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch4Fault.
Ch5Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch5Fault.
Ch6Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch6Fault.
Ch7Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch7Fault.
Ch0Data	REAL	Float	Value of analog signal on Channel 0 after conversion to engineering units.
Ch1Data	REAL	Float	Value of analog signal on Channel 1 after conversion to engineering units.
Ch2Data	REAL	Float	Value of analog signal on Channel 2 after conversion to engineering units.
Ch3Data	REAL	Float	Value of analog signal on Channel 3 after conversion to engineering units.
Ch4Data	REAL	Float	Value of analog signal on Channel 4 after conversion to engineering units.
Ch5Data	REAL	Float	Value of analog signal on Channel 5 after conversion to engineering units.
Ch6Data	REAL	Float	Value of analog signal on Channel 6 after conversion to engineering units.
Ch7Data	REAL	Float	Value of analog signal on Channel 7 after conversion to engineering units.
CSTTimestamp	DINT[2]	Hex	Timestamp taken at the time the input data was sampled in terms of coordinated system time, which is a 64-bit value in microseconds coordinated across the modules in the 1756 backplane.
RollingTimestamp	INT	Decimal	Timestamp taken at the time the input data was sampled in millisecond resolution.
HART	AB:1756_IF8H_HARTData:I:1, Contains HART field device health and dynamic process variables.		
Ch0DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:1, Channel 0 HART Device status info.		
Init	BOOL		Searching for or Initializing HART device. If this is 0 and Fail is 1, then HART is not enabled on this channel. If both are 1, then 1756-IF8H is sending out HART messages attempting to establish communication with a HART device.
Fail	BOOL		HART communication failure or device not found or HART not enabled. If this bit is 1, none of the other data in the HART part of the input tag are valid. (HART.PVStatus will be set to 0 to also indicate this).
MsgReady	BOOL		Pass-through message reply is ready for query service.

Table 60 - Analog and HART PV (AB:1756_IF8H_HARTPV:I:1)

Member Name	Type	Style	Description
CurrentFault	BOOL		Analog current measurement does not match the current the field device reported over the HART network.
ConfigurationChanged	BOOL		The field device configuration has changed and new field device configuration information can be obtained from the 1756-IF8H module via CIP MSG GetDeviceInfo, which will clear this bit.
ResponseCode	SINT	Binary	HART communication status byte or Response code from a recent HART reply. See Response Code and Field Device Status on page 195 for more information.
FieldDeviceStatus	SINT	Binary	HART device status byte from a recent HART reply. Indicates the health of the HART field device. See Field Device Status Bit Mask Definitions on page 196 for more information.
PVOutOfLimits	BOOL	Decimal	The primary variable is beyond its operating limit.
VariableOutOfLimits	BOOL	Decimal	A device variable not mapped to the PV is beyond its operating limits.
CurrentSaturated	BOOL	Decimal	The loop current has reached its upper or lower endpoint limit and cannot increase or decrease any further.
CurrentFixed	BOOL	Decimal	The loop current is being held at a fixed value and is not responding to process variations.
MoreStatus	BOOL	Decimal	More status information is available via command 48, 'Read Additional Status' information.
ColdStart	BOOL	Decimal	A power failure or device reset occurred.
Changed	BOOL	Decimal	An operation was performed that changed the device's configuration.
Malfunction	BOOL	Decimal	The device detected a serious error or failure that compromises device operation.
ExtDeviceStatus	SINT	Binary	Extended device status byte.
Maintenance Required	BOOL	Decimal	Maintenance is needed.
DeviceVariableAlert	BOOL	Decimal	Device variable alert.
PowerLow	BOOL	Decimal	Low power.
Ch1DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:0, Channel 1 HART Device status information.		
Ch2DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:0, Channel 2 HART Device status information.		
Ch3DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:0, Channel 3 HART Device status information.		
Ch4DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:0, Channel 4 HART Device status information.		
Ch5DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:0, Channel 5 HART Device status information.		
Ch6DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:0, Channel 6 HART Device status information.		
Ch7DeviceStatus	AB:1756_IF8H_HARTStatus_Struct:I:0, Channel 7 HART Device status information.		
Ch*x*PV	REAL	Float	Channel *x* HART PV value.
Ch*x*SV	REAL	Float	Channel *x* HART SV value.
Ch*x*TV	REAL	Float	Channel *x* HART TV value.
Ch*x*FV	REAL	Float	Channel *x* HART FV value.
Ch*x*PVStatus	SINT	Hex	Channel *x* HART PV status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*x*SVStatus	SINT	Hex	Channel *x* HART SV status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*x*TVStatus	SINT	Hex	Channel *x* HART TV status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*x*FVStatus	SINT	Hex	Channel *x* HART FV status, see HART PV, SV, TV, and FV Status on page 202 for more information.

Analog and HART by Channel

Table 61 - Analog and HART by Channel (AB:1756-IF8H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
ChannelFaults (Ch0…Ch7)	INT	Binary	Indicates a problem with analog data on Channel *x* or broken communication between the Logix controller and the 1756-IF8H module. Example: Set if analog signal is larger than 20 mA.
Ch*x*Fault	BOOL		ChannelFaults.*x*
ModuleFaults	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.1, 1756-IF8H module calibration failed.
Calibrating	BOOL	Decimal	ModuleFaults.2, Calibration in progress.
UpdatedStatusReady	BOOL	Decimal	ModuleFaults.3, Module has collected updated Additional Device Status from HART command 48. This status can be retrieved by using the Read Additional Status service, 16#4C. For more information about this service, see Read Additional Status (Service Code = 16#4C) on page 125.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
Ch0	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 0 analog and HART data.		
Data	REAL	Float	Analog value in engineering units.
DeviceStatus	AB:1756_IF8H_HARTStatusAll_Struct:I:0, Channel 0 HART Device status info.		
HARTInit	BOOL	Decimal	Searching for or Initializing HART device. If this is 0 and Fail is 1, then HART is not Enabled on this channel. If both are 1, then 1756-IF8H is sending out HART messages attempting to establish communication with a HART device.
HARTCommFail	BOOL	Decimal	HART communication failure or device not found or HART not enabled. If this bit is 1, none of the other data in the HART part of the Input Tag are valid. (HART.PVStatus will be set to 0 to also indicate this)
MsgReady	BOOL	Decimal	Pass-through message reply is ready for query service.
CurrentFault	BOOL	Decimal	Analog current measurement does not match the current the Field Device reported over the HART network.
ConfigurationChanged	BOOL	Decimal	The field device configuration has changed and new field device configuration information can be obtained from the 1756-IF8H module via CIP MSG GetDeviceInfo, which will clear this bit.
BrokenWire	BOOL	Decimal	Indicates that current is not flowing through the module as expected. This might be caused by broken wiring, RTB removal, or a powered-off field device.
HARTFault	BOOL	Decimal	Indicates a problem with HART data from the field device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following Field Device Status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
ResponseCode	SINT	Binary	HART communication status byte or Response code from a recent HART reply. See Response Code and Field Device Status on page 195 for more information.
FieldDeviceStatus	SINT	Binary	HART device status byte from a recent HART reply. Indicates the health of the HART Field device. See Field Device Status Bit Mask Definitions on page 196 for more information.
PVOutOfLimits	BOOL	Decimal	The primary variable is beyond its operating limit.
VariableOutOfLimits	BOOL	Decimal	A device variable not mapped to the PV is beyond its operating limits.
CurrentSaturated	BOOL	Decimal	The loop current has reached its upper or lower endpoint limit and cannot increase or decrease any further.
CurrentFixed	BOOL	Decimal	The loop current is being held at a fixed value and is not responding to process variations.
MoreStatus	BOOL	Decimal	More status information is available via command 48, 'Read Additional Status' information.
ColdStart	BOOL	Decimal	A power failure or device reset occurred.

Table 61 - Analog and HART by Channel (AB:1756-IF8H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
Changed	BOOL	Decimal	An operation was performed that changed the device's configuration.
Malfunction	BOOL	Decimal	The device detected a serious error or failure that compromises device operation.
AlarmStatus	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch0Fault for Overrange, Underrange, and CalFault.
HHAlarm	BOOL	Decimal	AlarmStatus.0, If process alarms are configured to latch by setting Ch0Config.ProcessAlarmLatch this bit remains set even after the condition returns to normal, until reset via explicit CIP message. This message can be sent from the RSLogix 5000 Module Properties Alarm dialog box or from the Logix controller via MSG instruction.
LLAlarm	BOOL	Decimal	AlarmStatus.1, If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched.
HAlarm	BOOL	Decimal	AlarmStatus.2, If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched
LAlarm	BOOL	Decimal	AlarmStatus.3, If Ch0Config.ProcessAlarmLatch is set, this alarm remains set until it is unlatched.
RateAlarm	BOOL	Decimal	AlarmStatus.4, Ch0Data changing faster than Ch0RateAlarmLimit. Both positive and negative changes can cause this alarm. If Ch0Config.RateAlarmLatch is set, this alarm remains set until it is unlatched.
Overrange	BOOL	Decimal	AlarmStatus.5, Analog signal is greater than or equal to the maximum detectable signal. Because the signal cannot be measured, it may be significantly above the maximum value.
Underrange	BOOL	Decimal	AlarmStatus.6, Analog signal is less than or equal to the minimum detectable signal. Because the signal cannot be measured, it may be significantly below the minimum value.
CalFault	BOOL	Decimal	AlarmStatus.7, Set if an error occurs during calibration for Channel *x*, causing a bad calibration. Also sets CalFault.
ExtDeviceStatus	SINT	Binary	Extended device status byte.
Maintenance Required	BOOL	Decimal	Maintenance is needed.
DeviceVariableAlert	BOOL	Decimal	Device variable alert.
PowerLow	BOOL	Decimal	Low power.
PV	REAL	Float	Primary value. This is the same value as signaled on the analog channel and is the most important measurement made by this device.
SV	REAL	Float	Secondary value.
TV	REAL	Float	Third value.
FV	REAL	Float	Fourth value.
PVStatus	SINT	Hex	Primary status. 16#C0 = Connected. 16#00 = Not Connected.
SVStatus	SINT	Hex	Secondary status. 16#C0 = Connected. 16#00 = Not Connected.
TVStatus	SINT	Hex	Third status 16#C0 = Connected. 16#00 = Not Connected.
FVStatus	SINT	Hex	Fourth status. 16#C0 = Connected. 16#00 = Not Connected.
Ch01	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 01 analog and HART data.		
Ch02	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 02 analog and HART data.		
Ch03	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 03 analog and HART data.		
Ch04	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 04 analog and HART data.		

Table 61 - Analog and HART by Channel (AB:1756-IF8H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
Ch05	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 05 analog and HART data.		
Ch06	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 06 analog and HART data.		
Ch07	AB:1756_IF8H_HARTDataAll_Struct:I:0, Channel 07 analog and HART data.		
CSTTimestamp	DINT[2]	Hex	Timestamp taken at the time the input data was sampled in terms of coordinated system time, which is a 64-bit value in microseconds coordinated across the modules in the 1756 backplane.
RollingTimestamp	INT	Decimal	Timestamp taken at the time the input data was sampled in millisecond resolution.

Module-defined Data Types, 1756-IF16H Module

These tables describe module-defined data types for the 1756-IF16H module and include information for configuration and input tags.

Configuration

This table describes the configuration tags available in the 1756-IF16H module.

Table 62 - Configuration (AB:1756_IF16H:C:0)

Member Name	Type	Style	Description
ModuleFilter (bits 0…7)	SINT	Decimal	See the Module Filter Values table on page 103.
RealTimeSample (bits 0…15)	INT	Decimal	Milliseconds between reading signal values. See Real Time Sample (RTS) on page 41 for more information.
Ch00Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Config	SINT	Binary	
HARTEn	BOOL	Decimal	Ch00Config.Config.7, Enable HART communication. Must be 1 for valid HART data in input tag and asset management access to HART field device.
RangeType	SINT	Decimal	0 = 0…20 mA 1 = 4 …20 mA
DigitalFilter	INT	Decimal	Time constant of low pass filter in ms. See Digital Filter on page 71 for more information.
LowSignal	REAL	Float	Lower current value for scaling to engineering units. Default is 4 mA. Must be less than HighSignal and more than or equal to the minimum input range. See Scaling to Engineering Units on page 98 for more information.
HighSignal	REAL	Float	Upper current value for scaling to engineering units. Default is 20 mA. Must be more than LowSignal and less than or equal to the maximum input Range. See Scaling to Engineering Units on page 98 for more information.
LowEngineering	REAL	Float	Measured quantity in engineering units that results in a signal level equal to LowSignal. See Scaling to Engineering Units on page 98 for more information.
HighEngineering	REAL	Float	Measured quantity in engineering units that results in a signal level equal to HighSignal. See Scaling to Engineering Units on page 98 for more information.
CalBias	REAL	Float	Sensor Offset in engineering units added to the measured signal before reporting Ch00.Data.
Ch01Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch02Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch03Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch04Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch05Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch06Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch07Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch08Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch09Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch10Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch11Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch12Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch13Config	AB:1756_IF16H_ChConfig_Struct:C:0		

Table 62 - Configuration (AB:1756_IF16H:C:0)

Member Name	Type	Style	Description
Ch14Config	AB:1756_IF16H_ChConfig_Struct:C:0		
Ch15Config	AB:1756_IF16H_ChConfig_Struct:C:0		
PassthroughHandle Timeout	INT	Decimal	Seconds to keep a reply to a HART pass-through service request before discarding; 15 seconds is recommended.

Analog Only

This table describes the input tags available in the Analog Only data format.

Table 63 - Analog Only (AB:1756_IF16H_Analog:I:0)

Member Name	Type	Style	Description
ChannelFaults (bits 0…15)	INT	Binary	Indicates a problem with analog data on Channel x or broken communication between the Logix controller and the 1756-IF16H module. Example: Set if analog signal is larger than 20 mA.
Ch*xx*Fault (Ch00…Ch15)	BOOL	Decimal	ChannelFaults.0…ChannelFaults.15
Module Status	SINT	Binary	
Calibrating	BOOL		ModuleStatus.0, Calibration in progress
UpdatedStatusReady	BOOL		ModuleStatus.1, Module has collected updated Additional Device Status from HART command 48. This status can be retrieved by using the Read Additional Status service, 16#4C. For more information about this service, see Read Additional Status (Service Code = 16#4C) on page 125.
ModuleFaults (bits 0…5 not used)	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.6, 1756-IF16H Module Calibration Failed.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
BrokenWireFaults (bit 0…15)	INT	Binary	Indicates that current is not flowing through the module as expected. This might be caused by broken wiring, RTB removal, or a powered-off field device. If configured for 4…20 mA, a broken wire fault will set this bit.
Ch*xx*Broken Wire	BOOL	Decimal	BrokenWireFaults.0…BrokenWireFaults.15
HARTFaults (Ch0…Ch15)	INT	Binary	Indicates a problem with HART data from the Field Device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following Field Device Status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
Ch*xx*HARTFault	BOOL	Decimal	HARTFaults.0…HARTFaults.15
Ch00Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch00Fault.
Ch00Overrange	BOOL		Ch00Status.5 Analog signal is greater than or equal to the maximum detectable signal. Because the signal cannot be measured, it may be significantly above the maximum value
Ch00Underrange	BOOL		Ch00Status.6 Analog signal is less than or equal to the minimum detectable signal. Because the signal cannot be measured, it may be significantly below the minimum value
Ch00CalFault	BOOL		Ch00Status.7 Set if an error occurs during calibration for Ch00, causing a bad calibration. Also sets CalFault
Ch01Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch01Fault.

Table 63 - Analog Only (AB:1756_IF16H_Analog:I:0)

Member Name	Type	Style	Description
Ch02Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch02Fault.
Ch03Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch03Fault.
Ch04Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch04Fault.
Ch05Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch05Fault.
Ch06Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch06Fault.
Ch07Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch07Fault.
Ch08Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch08Fault.
Ch09Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch09Fault.
Ch10Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch10Fault.
Ch11Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch11Fault.
Ch12Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch12Fault.
Ch13Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch13Fault.
Ch14Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch14Fault.
Ch15Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch15Fault.
Ch*xx*Data (Ch00…Ch15)	REAL	Float	Value of analog signal on Channel *xx* after conversion to engineering units.
CSTTimestamp	DINT[2]	Hex	Timestamp taken at the time the input data was sampled in terms of Coordinated System Time, which is a 64-bit value in microseconds coordinated across the modules in the 1756 backplane.
RollingTimestamp	INT	Decimal	Timestamp taken at the time the input data was sampled in millisecond resolution.

Analog and HART PV

This table describes the input tags available in the Analog and HART PV data format.

Table 64 - Analog and HART PV (AB:1756_IF16H_HARTPV:I:0)

Member Name	Type	Style	Description
ChannelFaults (bit0…15)	INT	Binary	Indicates a problem with analog data on Channel x or broken communication between the Logix controller and the 1756-IF16H module. Example: Set if analog signal is larger than 20 mA.
Ch*xx*Fault (Ch0…Ch15)	BOOL	Decimal	ChannelFaults.0…ChannelFaults.15
Module Status	SINT	Binary	
Calibrating	BOOL		ModuleStatus.0, Calibration in progress
UpdatedStatusReady	BOOL		ModuleStatus.1, Module has collected updated Additional Device Status from HART command 48. This status can be retrieved by using the Read Additional Status service, 16#4C. For more information about this service, see Read Additional Status (Service Code = 16#4C) on page 125.
ModuleFaults (bits0…5 not used)	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.6, 1756-IF16H Module Calibration Failed.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).

Table 64 - Analog and HART PV (AB:1756_IF16H_HARTPV:I:0)

Member Name	Type	Style	Description
BrokenWireFaults (bit0…15)	INT	Binary	Indicates that current is not flowing through the module as expected. This might be caused by broken wiring, RTB removal, or a powered-off field device.
Ch*xx*Broken Wire	BOOL	Decimal	BrokenWireFaults.0…BrokenWireFaults.15
HARTFaults (Ch0…Ch15)	INT	Binary	Indicates a problem with HART data from the Field Device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following Field Device Status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
Ch*xx*HARTFault	BOOL	Decimal	HARTFaults.0…HARTFaults.15
Ch00Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch00Fault for Overrange, Underrange, and/or CalFault.
Ch00Overrange	BOOL		Ch00Status.05 Analog signal is greater than or equal to the maximum detectable signal. Because the signal cannot be measured, it may be significantly above the maximum value.
Ch00Underrange	BOOL		Ch00Status.06 Analog signal is less than or equal to the minimum detectable signal. Because the signal cannot be measured, it may be significantly below the minimum value.
Ch00CalFault	BOOL		Ch00Status.07 Set if an error occurs during calibration for Channel *x*, causing a bad calibration. Also sets CalFault.
Ch01Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch01Fault.
Ch02Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch02Fault.
Ch03Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch03Fault.
Ch04Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch04Fault.
Ch05Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch05Fault.
Ch06Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch06Fault.
Ch07Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch07Fault.
Ch08Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch08Fault.
Ch09Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch09Fault.
Ch10Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch10Fault.
Ch11Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch11Fault.
Ch12Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch12Fault.
Ch13Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch13Fault.
Ch14Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch14Fault.
Ch15Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch15Fault.
Ch00Data	REAL	Float	Value of analog signal on Channel 00 after conversion to engineering units.
Ch01Data	REAL	Float	Value of analog signal on Channel 01 after conversion to engineering units.
Ch02Data	REAL	Float	Value of analog signal on Channel 02 after conversion to engineering units.
Ch03Data	REAL	Float	Value of analog signal on Channel 03 after conversion to engineering units.
Ch04Data	REAL	Float	Value of analog signal on Channel 04 after conversion to engineering units.
Ch05Data	REAL	Float	Value of analog signal on Channel 05 after conversion to engineering units.
Ch06Data	REAL	Float	Value of analog signal on Channel 06 after conversion to engineering units.
Ch07Data	REAL	Float	Value of analog signal on Channel 07 after conversion to engineering units.
Ch08Data	REAL	Float	Value of analog signal on Channel 08 after conversion to engineering units.

Table 64 - Analog and HART PV (AB:1756_IF16H_HARTPV:I:0)

Member Name	Type	Style	Description
Ch09Data	REAL	Float	Value of analog signal on Channel 09 after conversion to engineering units.
Ch10Data	REAL	Float	Value of analog signal on Channel 10 after conversion to engineering units.
Ch11Data	REAL	Float	Value of analog signal on Channel 11 after conversion to engineering units.
Ch12Data	REAL	Float	Value of analog signal on Channel 12 after conversion to engineering units.
Ch13Data	REAL	Float	Value of analog signal on Channel 13 after conversion to engineering units.
Ch14Data	REAL	Float	Value of analog signal on Channel 14 after conversion to engineering units.
Ch15Data	REAL	Float	Value of analog signal on Channel 15 after conversion to engineering units.
CSTTimestamp	DINT[2]	Hex	Timestamp taken at the time the input data was sampled in terms of Coordinated System Time, which is a 64-bit value in microseconds coordinated across the modules in the 1756 backplane.
RollingTimestamp	INT	Decimal	Timestamp taken at the time the input data was sampled in millisecond resolution.
HART	AB:1756_IF16H_HARTData:I:0, Contains HART field device health and dynamic process variables.		
Ch00DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 0 HART Device status info.		
Init	BOOL		Searching for or Initializing HART device. If this is 0 and Fail is 1, then HART is not Enabled on this channel. If both are 1, then 1756-IF8H is sending out HART messages attempting to establish communication with a HART device.
Fail	BOOL		HART communication failure or device not found or HART not enabled. If this bit is 1, none of the other data in the HART part of the Input Tag are valid. (HART.PVStatus will be set to 0 to also indicate this)
MsgReady	BOOL		Pass-through message reply is ready for Query service.
CurrentFault	BOOL		Analog current measurement does not match the current the Field Device reported over HART network.
ConfigurationChanged	BOOL		The Field Device configuration has changed and new Field Device configuration information can be obtained from the 1756-IF8H module via CIP MSG GetDeviceInfo, which will clear this bit.
ResponseCode	SINT	Binary	HART communication status byte or Response code from a recent HART reply. See Response Code and Field Device Status on page 195 for more information.
FieldDeviceStatus	SINT	Binary	HART device status byte from a recent HART reply. Indicates the health of the HART Field device. See Field Device Status Bit Mask Definitions on page 196 for more information.
ExtDeviceStatus	SINT	Binary	Extended device status byte. Bit 0 is Maintenance Needed Bit 1 is Device Variable Alert Bit 2 is Low Power
Ch01DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 01 HART Device status info.		
Ch02DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel02 HART Device status info.		
Ch03DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 03 HART Device status info.		
Ch04DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 04 HART Device status info.		
Ch05DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 05 HART Device status info.		
Ch06DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 06 HART Device status info.		
Ch07DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 07 HART Device status info.		
Ch08DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 08 HART Device status info.		
Ch09DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 09 HART Device status info.		
Ch10DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 10 HART Device status info.		
Ch11DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 11 HART Device status info.		
Ch12DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 12 HART Device status info.		

Table 64 - Analog and HART PV (AB:1756_IF16H_HARTPV:I:0)

Member Name	Type	Style	Description
Ch13DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 13 HART Device status info.		
Ch14DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 14 HART Device status info.		
Ch15DeviceStatus	AB:1756_IF16H_HARTStatus_Struct:I:0, Channel 15 HART Device status info.		
Ch*xx*PV	REAL		Channel *xx* HART PV Value
Ch*xx*SV	REAL		Channel *xx* HART SV Value
Ch*xx*TV	REAL		Channel *xx* HART TV Value
Ch*xx*FV	REAL		Channel *xx* HART FV Value
Ch*xx*PVStatus	SINT		Channel *xx* HART PV Status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*xx*SVStatus	SINT		Channel *xx* HART SV Status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*xx*TVStatus	SINT		Channel *xx* HART TV Status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*xx*FVStatus	SINT		Channel *xx* HART FV Status, see HART PV, SV, TV, and FV Status on page 202 for more information.

Analog and HART by Channel

Table 65 - Analog and HART by Channel (AB:1756-IF16H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
ChannelFaults (Ch00…Ch15)	INT	Binary	Indicates a problem with analog data on Channel *xx* or broken communication between the Logix controller and the 1756-IF16H module. Example: Set if analog signal is larger than 20 mA.
Ch*xx*Fault	BOOL		ChannelFaults.*xx*
ModuleStatus	SINT	Binary	
Calibrating	BOOL	Decimal	ModuleStatus.0, Calibration in progress.
UpdatedStatusReady	BOOL	Decimal	ModuleStatus.1, Module has collected updated Additional Device Status from HART command 48. This status can be retrieved by using the Read Additional Status service, 16#4C. For more information about this service, see Read Additional Status (Service Code = 16#4C) on page 125.
ModuleFaults	SINT	Binary	
CalFault	BOOL		ModuleFaults.6, 1756-IF16H module calibration failed.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
Ch00	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 00 analog and HART data.		
Data	REAL	Float	Analog value in engineering units.
DeviceStatus	AB:1756_IF16H_HARTStatusAll_Struct:I:0, Channel 00 HART Device status info.		
HARTInit	BOOL	Decimal	Searching for or Initializing HART device. If this is 0 and Fail is 1, then HART is not Enabled on this channel. If both are 1, then 1756-IF16H is sending out HART messages attempting to establish communication with a HART device.
HARTCommFail	BOOL	Decimal	HART communication failure or device not found or HART not enabled. If this bit is 1, none of the other data in the HART part of the Input Tag are valid. (HART.PVStatus will be set to 0 to also indicate this)
MsgReady	BOOL	Decimal	Pass-through message reply is ready for query service.
CurrentFault	BOOL	Decimal	Analog current measurement does not match the current the Field Device reported over the HART network.

Table 65 - Analog and HART by Channel (AB:1756-IF16H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
ConfigurationChanged	BOOL	Decimal	The field device configuration has changed and new field device configuration information can be obtained from the 1756-IF16H module via CIP MSG GetDeviceInfo, which will clear this bit.
MaintenanceRequired	BOOL		Bit 0 of Extended Device Status (if using CMD 9, or from CMD 48 if supported).
BrokenWire	BOOL	Decimal	Indicates that current is not flowing through the module as expected. This might be caused by broken wiring, RTB removal, or a powered-off field device.
HARTFault	BOOL	Decimal	Indicates a problem with HART data from the field device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following Field Device Status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
ResponseCode	SINT	Binary	HART communication status byte or Response code from a recent HART reply. See Response Code and Field Device Status on page 195 for more information.
FieldDeviceStatus	SINT	Binary	HART device status byte from a recent HART reply. Indicates the health of the HART Field device. See Field Device Status Bit Mask Definitions on page 196 for more information.
AlarmStatus	SINT	Binary	Indicates various alarms on the analog signal.
DeviceVariableAlert	BOOL		AlarmStatus.4, Bit 1 of Extended Device Status. Device reports a problem with some measurement.
Overrange	BOOL		AlarmStatus.5, Signal value over range (over 20 MA).
Underrange	BOOL		AlarmStatus.6, Signal value under range. (less than 3.4 mA if configured for 4…20 mA).
CalFault	BOOL		AlarmStatus.7, Bad calibration.
PV	REAL	Float	Primary value. This is the same value as signaled on the analog channel and is the most important measurement made by this device.
SV	REAL	Float	Secondary value
TV	REAL	Float	Third value
FV	REAL	Float	Fourth value
PVStatus	SINT	Hex	Primary status 16#C0 = Connected 16#00 = Not Connected
SVStatus	SINT	Hex	Secondary status 16#C0 = Connected 16#00 = Not Connected
TVStatus	SINT	Hex	Third status 16#C0 = Connected 16#00 = Not Connected
FVStatus	SINT	Hex	Fourth status 16#C0 = Connected 16#00 = Not Connected
Ch01	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 01 analog and HART data.		
Ch02	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 02 analog and HART data.		
Ch03	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 03 analog and HART data.		
Ch04	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 04 analog and HART data.		
Ch05	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 05 analog and HART data.		
Ch06	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 06 analog and HART data.		
Ch07	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 07 analog and HART data.		
Ch08	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 08 analog and HART data.		
Ch09	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 09 analog and HART data.		

Table 65 - Analog and HART by Channel (AB:1756-IF16H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
Ch10	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 10 analog and HART data.		
Ch11	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 11 analog and HART data.		
Ch12	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 12 analog and HART data.		
Ch13	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 13 analog and HART data.		
Ch14	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 14 analog and HART data.		
Ch15	AB:1756_IF16H_HARTDataAll_Struct:I:0, Channel 15 analog and HART data.		
CSTTimestamp	DINT[2]	Hex	Timestamp taken at the time the input data was sampled in terms of coordinated system time, which is a 64-bit value in microseconds coordinated across the modules in the 1756 backplane.
RollingTimestamp	INT	Decimal	Timestamp taken at the time the input data was sampled in millisecond resolution.

Module-defined Data Types, 1756-OF8H Module

These tables describe module-defined data types for the 1756-OF8H module and include information for configuration, input, and output tags.

Configuration

This table describes the configuration tags available in the 1756-OF8H module.

Table 66 - Configuration (AB:1756_OF8H:C:0)

Member Name	Type	Style	Description
ProgToFaultEN	BOOL	Decimal	
Ch0Config	AB:1756_OF8H_ChConfig_Struct:C:0		
RampToFault	BOOL	Decimal	ConfigBits:9.
RampToProg	BOOL	Decimal	ConfigBits:8.
RampToRun	BOOL	Decimal	ConfigBits:7.
ProgMode	BOOL	Decimal	ConfigBits:6.
FaultMode	BOOL	Decimal	ConfigBits:5.
LimitAlarmLatch	BOOL	Decimal	ConfigBits:4.
RampAlarmLatch	BOOL	Decimal	ConfigBits:3.
AlarmDisable	BOOL	Decimal	ConfigBits:2.
HoldForInit	BOOL	Decimal	ConfigBits:1.
HARTEn	BOOL	Decimal	ConfigBits:0, HART enabled.
RangeType	INT	Decimal	0 = 0…20 mA 1 = 4…20 mA
MaxRampRate	REAL	Float	Time constant of low pass filter in ms. See Digital Filter on page 71 for more information.
FaultValue	REAL	Float	
ProgValue	REAL	Float	
LowSignal	REAL	Float	Lower current value for scaling to engineering units. Default is 4 mA. Must be less than HighSignal and more than minimum input range. See Scaling to Engineering Units on page 98 for more information.
HighSignal	REAL	Float	Upper current value for scaling to engineering units. Default is 10 mA. Must be more than LowSignal and less than maximum input range. See Scaling to Engineering Units on page 98 for more information.
LowEngineering	REAL	Float	Measured quantity in engineering units that results in a signal level equal to LowSignal. See Scaling to Engineering Units on page 98 for more information.
HighEngineering	REAL	Float	Measured quantity in engineering units that results in a signal level equal to HighSignal. See Scaling to Engineering Units on page 98 for more information.
LowLimit	REAL	Float	Output signal will be clamped at this value in engineering units even if Ch0Data is lower than this.
HighLimit	REAL	Float	Output signal will be clamped at this value in engineering units if Ch0Data is larger than this.
CalBias	REAL	Float	Sensor offset in engineering units added to the measured signal before reporting Ch0.Data.
Ch1Config	AB:1756_OF8H_ChConfig_Struct:C:0		
Ch2Config	AB:1756_OF8H_ChConfig_Struct:C:0		
Ch3Config	AB:1756_OF8H_ChConfig_Struct:C:0		
Ch4Config	AB:1756_OF8H_ChConfig_Struct:C:0		

Table 66 - Configuration (AB:1756_OF8H:C:0)

Member Name	Type	Style	Description
Ch5Config	AB:1756_OF8H_ChConfig_Struct:C:0		
Ch6Config	AB:1756_OF8H_ChConfig_Struct:C:0		
Ch7Config	AB:1756_OF8H_ChConfig_Struct:C:0		
PassthroughHandleTimeout	INT	Decimal	Seconds to keep a reply to a HART pass-through service request before discarding. 15 seconds recommended.
PassthroughFreq_14	BOOL	Decimal	Selects the policy for sending HART pass-through messages. See Pass-through Setting, Ratio, and Priority on page 101
PassthroughFreq_15	BOOL	Decimal	

Analog Only

This table describes the input tags available in the Analog Only data format.

Table 67 - Analog Only (AB:1756_OF8H_Analog:I:0)

Member Name	Type	Style	Description
ChannelFaults (bits 9…15 unused)	INT	Binary	
Ch*x*Fault	BOOL	Decimal	ChannelFaults.*x*, Indicates communication fault or fault condition from ChXStatus.
LoopOutputFault	BOOL	Decimal	ChannelFaults.8, This is a hardware fault where the module has detected that the power supply to the isolated (analog) side of the board has failed (no power). It does not roll into any other bits. The OK status indicator is set to solid red.
HARTFaults	SINT	Binary	
Ch*x*HARTFault	BOOL	Decimal	HARTFault.*x* Indicates a problem with HART data from the field device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following field device status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
ModuleFaults	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.1, 1756-IF8H module calibration failed.
Calibrating	BOOL	Decimal	ModuleStatus.2, Calibration in progress.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
Ch0Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch0Fault for Overrange, Underrange, and CalFault.
Ch0HLimitAlarm	BOOL	Decimal	Ch0Status:0 The analog output signal is being limited by the Ch0Config.HighLimit value.If Ch0Config.LimitAlarmLatch is 1, alarm is retained until explicitly reset.
Ch0LLimitAlarm	BOOL	Decimal	Ch0Status:1 The analog output signal is being limited by the Ch0Config.LowLimit value.If Ch0Config.LimitAlarmLatch is 1, alarm is retained until explicitly reset.
Ch0RampAlarm	BOOL	Decimal	Ch0Status:2 Rate of change in Ch0Data exceeds Ch0Config.MaxRampRate. Rate of change is determined by the change in Ch0Data divided by the RPI period. Thus if a step change in Ch0 cannot be reached via the configured MaxRampRate within one RPI, then Ch0RampAlarm is set to 1. If Ch0Config.RampAlarmLatch is 1, then Ch0RampAlarm remains set until explicitly reset using CIP message even if the condition returns to normal. The CIP message can be sent via MSG instruction in the Logix controller or from the the RSLogix 5000 Module Properties Limit dialog box.
Ch0InHold	BOOL	Decimal	Ch0Status:3 Channel holding its last output value, waiting for controller to match the value, indicating that bumpless initialization of the control loop is complete.
Ch0CalFault	BOOL	Decimal	Ch0Status:4 Fault during calibration of channel 0.

Table 67 - Analog Only (AB:1756_OF8H_Analog:I:0)

Member Name	Type	Style	Description
Ch0NotANumber	BOOL	Decimal	Ch0Status:5 Ch0Data is not a valid floating point number.
Ch0OpenWire	BOOL	Decimal	Ch0Status:7 Only valid in current mode (example 4…20 mA). 1 indicates no current is flowing, probably due to open circuit.
Ch1Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch1Fault.
Ch2Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch2Fault.
Ch3Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch3Fault.
Ch4Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch4Fault.
Ch5Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch5Fault.
Ch6Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch6Fault.
Ch7Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch7Fault.
Ch0Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch0Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
Ch1Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch1Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
Ch2Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch2Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
Ch3Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch3Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
Ch4Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch4Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
Ch5Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch5Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
Ch6Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch6Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
Ch7Data	REAL	Float	Analog value actually output in engineering units. This might be different than output tag Ch7Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode
CSTTimestamp	DINT[2]	Decimal	64-bit coordinated system time timestamp in microseconds of the last output update. Timebase synchronized with other modules in the rack
RollingTimestamp	INT	Decimal	16 bit timestamp in milliseconds. Timebase local to the 1756-OF8H module.

Analog and HART PV

This table describes the input tags available in the Analog and HART PV data format.

Table 68 - Analog Only (AB:1756_OF8H_HARTPV:I:1)

Member Name	Type	Style	Description
Channel Faults (bits 9...15 unused)	INT	Binary	
Ch*x*Fault	BOOL	Decimal	ChannelFaults.*x*, Indicates communication fault or fault condition from ChXStatus.
LoopOutputFault	BOOL	Decimal	ChannelFaults.8, This is a hardware fault where the module has detected that the power supply to the isolated(analog) side of the board has failed(no power). It does not roll into any other bits. The OK status indicator is set to solid red.
HARTFaults	SINT	Binary	
Ch*x*HARTFault	BOOL	Decimal	HARTFault.*x* Indicates a problem with HART data from the field device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following field device status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
ModuleFaults	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.1, 1756-IF8H module calibration failed.
Calibrating	BOOL	Decimal	ModuleFaults.2, Calibration in progress.
UpdatedStatusReady	BOOL	Decimal	ModuleFaults.3, Module has collected updated Additional Device Status from HART command 48. This status can be retrieved by using the Read Additional Status service, 16#4C. For more information about this service, see Read Additional Status (Service Code = 16#4C) on page 125.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
Ch0Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch0Fault for Overrange, Underrange, and CalFault.
Ch0HLimitAlarm	BOOL	Decimal	Ch0Status:0 The analog output signal is being limited by the Ch0Config.HighLimit value.If Ch0Config.LimitAlarmLatch is 1, alarm is retained until explicitly reset.
Ch0LLimitAlarm	BOOL	Decimal	Ch0Status:1 The analog output signal is being limited by the Ch0Config.LowLimit value.If Ch0Config.LimitAlarmLatch is 1, alarm is retained until explicitly reset.
Ch0RampAlarm	BOOL	Decimal	Ch0Status:2 Rate of change in Ch0Data exceeds Ch0Config.MaxRampRate. Rate of change is determined by the change in Ch0Data divided by the RPI period. Thus if a step change in Ch0 cannot be reached via the configured MaxRampRate within one RPI, then Ch0RampAlarm is set to 1. If Ch0Config.RampAlarmLatch is 1, then Ch0RampAlarm remains set until explicitly reset using CIP message even if the condition returns to normal. The CIP message can be sent via MSG instruction in the Logix controller or from the RSLogix 5000 Module Properties Limit dialog box.
Ch0InHold	BOOL	Decimal	Ch0Status:3 Channel holding its last output value, waiting for controller to match the value, indicating that bumpless initialization of the control loop is complete.
Ch0CalFault	BOOL	Decimal	Ch0Status:4 Fault during calibration of channel 0.
Ch0NotANumber	BOOL	Decimal	Ch0Status:5 Ch0Data is not a valid floating point number.
Ch0OpenWire	BOOL	Decimal	Ch0Status:7 Only valid in current mode (example 4…20 mA). 1 indicates no current is flowing, probably due to open circuit.
Ch1Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch1Fault.
Ch2Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch2Fault.
Ch3Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch3Fault.
Ch4Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch4Fault.

Table 68 - Analog Only (AB:1756_OF8H_HARTPV:I:1)

Member Name	Type	Style	Description
Ch5Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch5Fault.
Ch6Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch6Fault.
Ch7Status	SINT	Binary	Indicates various alarms on the analog signal. Also sets Ch7Fault.
Ch*x*Data	REAL	Float	Analog value actually output in engineering units. This might be different than Output Tag Ch*x*Data if the value exceeds the LowLimit or HighLimit, has a MaxRampRate applied, is being Held for initialization, or controller in Fault or Program mode.
CSTTimestamp	DINT[2]	Decimal	64-bit coordinated system time timestamp in microseconds of the last output update. Timebase synchronized with other modules in the rack.
RollingTimestamp	INT	Decimal	16 bit timestamp in milliseconds. Timebase local to the 1756-OF8H module.
HART	AB:1756_OF8H_HARTData:I:1, Contains HART field device health and dynamic process variables This applies to AB:1756_OF8H_HARTPV:I:1 only; for details on what appears in the variables, see the Module-defined Data Type: AB:1756_OF8H_HARTData:I:1 table		
Ch0DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:1, Channel 0 HART Device status info.		
Init	BOOL	Decimal	Searching for or Initializing HART device. If this is 0 and Fail is 1, then HART is not enabled on this channel. If both are 1, then 1756-OF8H is sending out HART messages attempting to establish communication with a HART device.
Fail	BOOL	Decimal	HART communication failure or device not found or HART not enabled. If this bit is 1, none of the other data in the HART part of the input tag is valid. (HART. PVStatus will be set to 0 to also indicate this).
MsgReady	BOOL	Decimal	Pass-through message reply is ready for query service.
CurrentFault	BOOL	Decimal	Analog current measurement does not match the current the field device reported over HART network.
ConfigurationChanged	BOOL	Decimal	The field device configuration has changed and new field device configuration information can be obtained from the 1756-OF8H module via CIP MSG GetDeviceInfo, which will clear this bit.
ResponseCode	SINT	Binary	HART communication status byte or Response code from a recent HART reply. See Response Code and Field Device Status on page 195 for more information.
FieldDeviceStatus	SINT	Binary	HART device status byte from a recent HART reply. Indicates the health of the HART field device. See Field Device Status Bit Mask Definitions on page 196 for more information.
PVOutOfLimits	BOOL	Decimal	The primary variable is beyond its operating limit.
VariableOutOfLimits	BOOL	Decimal	A device variable not mapped to the PV is beyond its operating limits.
CurrentSaturated	BOOL	Decimal	The loop current has reached its upper or lower endpoint limit and cannot increase or decrease any further.
CurrentFixed	BOOL	Decimal	The loop current is being held at a fixed value and is not responding to process variations.
MoreStatus	BOOL	Decimal	More status information is available via command 48, 'Read Additional Status' information.
ColdStart	BOOL	Decimal	A power failure or device reset occurred.
Changed	BOOL	Decimal	An operation was performed that changed the device's configuration.
Malfunction	BOOL	Decimal	The device detected a serious error or failure that compromises device operation.
ExtDeviceStatus	SINT	Binary	Extended device status byte.
Maintenance Required	BOOL	Decimal	Maintenance is needed.
DeviceVariableAlert	BOOL	Decimal	Device variable alert.
PowerLow	BOOL	Decimal	Low power.
Ch1DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:0, Channel 1 HART Device status information.		
Ch2DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:0, Channel 2 HART Device status information.		

Table 68 - Analog Only (AB:1756_OF8H_HARTPV:I:1)

Member Name	Type	Style	Description
Ch3DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:0, Channel 3 HART Device status information.		
Ch4DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:0, Channel 4 HART Device status information.		
Ch5DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:0, Channel 5 HART Device status information.		
Ch6DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:0, Channel 6 HART Device status information.		
Ch7DeviceStatus	AB:1756_OF8H_HARTStatus_Struct:I:0, Channel 7 HART Device status information.		
Ch*x*PV	REAL		Channel *x* HART PV value.
Ch*x*SV	REAL		Channel *x* HART SV value.
Ch*x*TV	REAL		Channel *x* HART TV value.
Ch*x*FV	REAL		Channel *x* HART FV value.
Ch*x*PVStatus	SINT		Channel *x* HART PV status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*x*SVStatus	SINT		Channel *x* HART SV status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*x*TVStatus	SINT		Channel *x* HART TV status, see HART PV, SV, TV, and FV Status on page 202 for more information.
Ch*x*FVStatus	SINT		Channel *x* HART FV status, see HART PV, SV, TV, and FV Status on page 202 for more information.

Analog and HART by Channel

Table 69 - Analog and HART by Channel (AB:1756-OF8H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
ChannelFaults (bits 9…15 unused)	INT	Binary	
Ch*x*Fault	BOOL		ChannelFaults.*x*
LoopOutputFault	BOOL	Decimal	ChannelFaults.8, This is a hardware fault where the module has detected that the power supply to the isolated(analog) side of the board has failed(no power). It does not roll into any other bits. The OK status indicator is set to solid red.
ModuleFaults	SINT	Binary	
CalFault	BOOL	Decimal	ModuleFaults.1, 1756-OF8H module calibration failed.
Calibrating	BOOL	Decimal	ModuleFaults.2, Calibration in progress.
UpdatedStatusReady	BOOL	Decimal	ModuleFaults.3, Module has collected updated Additional Device Status from HART command 48. This status can be retrieved by using the Read Additional Status service, 16#4C. For more information about this service, see Read Additional Status (Service Code = 16#4C) on page 125.
AnalogGroupFault	BOOL	Decimal	ModuleFaults.7, Indicates a fault has occurred on any channel (any of ChannelFaults).
Ch0	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 0 analog and HART data.		
Data	REAL	Float	Analog value in engineering units.
DeviceStatus	AB:1756_OF8H_HARTStatusAll_Struct:I:0, Channel 0 HART Device status info.		
HARTInit	BOOL	Decimal	Searching for or Initializing HART device. If this is 0 and Fail is 1, then HART is not enabled on this channel. If both are 1, then 1756-OF8H is sending out HART messages attempting to establish communication with a HART device.
HARTCommFail	BOOL	Decimal	HART communication failure or device not found or HART not enabled. If this bit is 1, none of the other data in the HART part of the input tag is valid. (HART.PVStatus will be set to 0 to also indicate this.)
MsgReady	BOOL	Decimal	Pass-through message reply is ready for query service.

Table 69 - Analog and HART by Channel (AB:1756-OF8H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
CurrentFault	BOOL	Decimal	Analog current measurement does not match the current the field device reported over the HART network.
ConfigurationChanged	BOOL	Decimal	The field device configuration has changed and new field device configuration information can be obtained from the 1756-OF8H module via CIP MSG GetDeviceInfo, which will clear this bit.
BrokenWire	BOOL	Decimal	Indicates that current is not flowing through the module as expected. This might be caused by broken wiring, RTB removal, or a powered-off field device.
HARTFault	BOOL	Decimal	Indicates a problem with HART data from the field device on Channel *x*. Examples are HART not enabled, HART device not connected, HART communication failure due to noise. The following field device status conditions also cause this to be set: Device Malfunction, PV Out of Limits, Loop Current Saturated, and Loop Current Fixed.
ResponseCode	SINT	Binary	HART communication status byte or Response code from a recent HART reply. See Response Code and Field Device Status on page 195 for more information.
FieldDeviceStatus	SINT	Binary	HART device status byte from a recent HART reply. Indicates the health of the HART field device. See Field Device Status Bit Mask Definitions on page 196 for more information.
PVOutOfLimits	BOOL	Decimal	The primary variable is beyond its operating limit.
VariableOutOfLimits	BOOL	Decimal	A device variable not mapped to the PV is beyond its operating limits.
CurrentSaturated	BOOL	Decimal	The loop current has reached its upper or lower endpoint limit and cannot increase or decrease any further.
CurrentFixed	BOOL	Decimal	The loop current is being held at a fixed value and is not responding to process variations.
MoreStatus	BOOL	Decimal	More status information is available via command 48, 'Read Additional Status' information.
ColdStart	BOOL	Decimal	A power failure or device reset occurred.
Changed	BOOL	Decimal	An operation was performed that changed the device's configuration.
Malfunction	BOOL	Decimal	The device detected a serious error or failure that compromises device operation.
ChStatus	SINT	Binary	Indicates various alarms on the analog signal. Also sets ChFault for Overrange, Underrange, and CalFault.
HLimitAlarm	BOOL	Decimal	Ch0.DeviceStatus.ChStatus:0 The analog output signal is being limited by the ChConfig.HighLimit value. If ChConfig.LimitAlarmLatch is 1, alarm is retained until explicitly reset.
LLimitAlarm	BOOL	Decimal	Ch0.DeviceStatus.ChStatus:1 The analog output signal is being limited by the ChConfig.LowLimit value. If ChConfig.LimitAlarmLatch is 1, alarm is retained until explicitly reset.
RampAlarm	BOOL	Decimal	ChStatus:2 Rate of change in Ch0.Data exceeds Ch0Config.MaxRampRate. Rate of change is determined by the change in Ch0.Data divided by the RPI period. Thus if a step change in Ch0.Data cannot be reached via the configured Ch0Config.MaxRampRate within one RPI, then Ch0.DeviceStatusRampAlarm is set to 1. If Ch0Config.RampAlarmLatch is 1, then Ch0.DeviceStatusRampAlarm remains set until explicitly reset by using CIP message even if the condition returns to normal. The CIP message can be sent via MSG instruction in the Logix controller or from the RSLogix 5000 Module Properties Limit dialog box.
InHold	BOOL	Decimal	ChStatus:3 Channel holding its last output value, waiting for controller to match the value, indicating that bumpless initialization of the control loop is complete.
CalFault	BOOL	Decimal	ChStatus:4 Fault during calibration of channel 0.
NotANumber	BOOL	Decimal	ChStatus:5 Ch0.Data is not a valid floating point number.
OpenWire	BOOL	Decimal	ChStatus:7 Only valid in current mode (example 4…20 mA). 1 indicates no current is flowing, probably due to open circuit.
ExtDeviceStatus	SINT	Binary	Extended device status byte.
Maintenance Required	BOOL	Decimal	Maintenance is needed.
DeviceVariableAlert	BOOL	Decimal	Device variable alert.

Table 69 - Analog and HART by Channel (AB:1756-OF8H_AnalogHARTbyChannel:I:0)

Member Name	Type	Style	Description
PowerLow	BOOL	Decimal	Low power.
PV	REAL	Float	Primary value. This is the same value as signaled on the analog channel and is the most important measurement made by this device.
SV	REAL	Float	Secondary value.
TV	REAL	Float	Third value.
FV	REAL	Float	Fourth value.
PVStatus	SINT	Hex	Primary status. 16#C0 = Connected. 16#00 = Not Connected.
SVStatus	SINT	Hex	Secondary status. 16#C0 = Connected. 16#00 = Not Connected.
TVStatus	SINT	Hex	Third status. 16#C0 = Connected. 16#00 = Not Connected.
FVStatus	SINT	Hex	Fourth status. 16#C0 = Connected. 16#00 = Not Connected.
Ch1	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 01 analog and HART data.		
Ch2	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 02 analog and HART data.		
Ch3	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 03 analog and HART data.		
Ch4	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 04 analog and HART data.		
Ch5	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 05 analog and HART data.		
Ch6	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 06 analog and HART data.		
Ch7	AB:1756_OF8H_HARTDataAll_Struct:I:0, Channel 07 analog and HART data.		
CSTTimestamp	DINT[2]	Hex	Coordinated system time.
RollingTimestamp	INT	Decimal	15-bit time from power on/reset in milliseconds.

Output

This table describes the output tags available in the 1756-OF8H module.

Table 70 - Output (AB:1756_OF8H:O:0)

Member Name	Type	Style	Description
Ch0Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 0.
Ch1Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 1.
Ch2Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 2.
Ch3Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 3.
Ch4Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 4.
Ch5Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 5.
Ch6Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 6.
Ch7Data	REAL	Float	Value in engineering units to output on the analog signal of Channel 7.

Notes:

Use 1492 Wiring Systems with Your Analog I/O Module

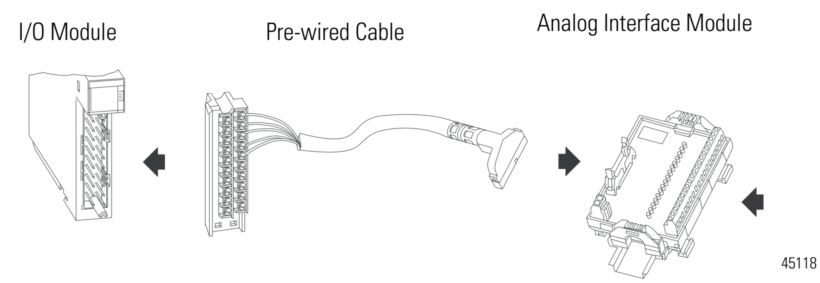
Wiring System Uses

As an alternative to buying removable terminal blocks and connecting the wires yourself, you can buy a wiring system with these items:

- Analog interface modules (AIFM) that mount on DIN rails and provide the output terminal blocks for the I/O module - Use the AIFMs with the pre-wired cables that match the I/O module to the interface module. For a list of the AIFMs available for use with ControlLogix analog I/O modules, see the table that provides the list.

- I/O module-ready pre-wired cables - One end of the cable assembly is a removable terminal base that plugs into the front of the I/O module. The other end has individually color-coded conductors that connect to a standard terminal block. For a list of the pre-wired cables available for use with ControlLogix analog I/O modules, see the table that provides the list.

Figure 21 - Analog Interface Modules



IMPORTANT	The ControlLogix system has been agency certified using the ControlLogix removable terminal bases (RTBs) only (for example, catalog numbers 1756-TBCH, 1756-TBNH, 1756-TBSH, 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.

The table lists the AIFMs and pre-wired cables that can be used with the 1756-IF8H, 1756-IF16H, and 1756-OF8H modules.

IMPORTANT	For the latest list, see the Digital/Analog Programmable Controller Wiring Systems Technical Data, publication 1492-TD008.

Table 71 - Analog Interface Module and Pre-wired Cables

I/O Cat. No.	Mode	AIFM Cat. No. (Fixed Terminal Block)	AIFM Cat. No. (RTB Socket Assembly)	AIFM Type	Description	Pre-wired Cable(2) (x=cable length)
1756-IF8H	Current	1492-AIFM8-3	1492-RAIFM8-3(1)	Feed-through	8-channel input or output with 3 terminals/channel	1492-ACABLExUD
		1492-AIFM8-F-5	N/A	Fused	8-channel input with 24V DC BF indicators and 5 terminals/channel	
	Voltage	1492-AIFM8-3	1492-RAIFM8-3(1)	Feed-through	8-channel input or output with 3 terminals/channel	1492-ACABLExUC
		1492-AIFM8-F-5	N/A	Fused	8-channel input with 24V DC BF indicators and 5 terminals/channel	
1756-IF16H	Single-ended Current	1492-AIFM16-F-3	N/A	Fused	16-channel input with 24V DC BF indicators and 3 terminals/channel	1492-ACABLExUB
1756-OF8H	Current	1492-AIFM8-3	1492-RAIFM-8-3(1)	Feed-through	8-channel input or output with 3 terminals/channel	1492-ACABLExWB
	Voltage					1492-ACABLExWA

(1) Compatible RTB plug; 1492-RTB8N (screw-style terminals) or 1492-RTB8P (push-in style terminals). Order plugs separately.

(2) Cables are available in lengths of 0.5 m, 1.0 m, 2.5 m, and 5.0 m. To order, insert the code for the desired cable length into the catalog number in place of the x: 005=0.5 m, 010=1.0 m, 025=2.5 m, 050=5 m. Example: 1492-ACABLE025TB is for a 2.5 m cable, and the letters TB.

Table 72 - I/O module-ready Pre-wired cables

Cat. No.(1)	Number of Conductors(2) (3)	Conductor Size	Nominal Outer Diameter	Removable Terminal Block at the I/O Module End
1492-ACABLExUB	20 conductors	22 AWG	8.4 mm (0.33 in.)	1756-TBCH
1492-ACABLExUC	9 twisted pairs		6.8 mm (0.27 in.)	
1492-ACABLExUD				
1492-ACABLExWA				1756-TBNH
1492-ACABLExWB				

(1) Cables are available in lengths of 0.5 m, 1.0 m, 2.5 m, and 5.0 m. To order, insert the code for the desired cable length into the catalog number in place of the x: 005=0.5 m, 010=1.0 m, 025=2.5 m, 050=5 m. Example: 1492-ACABLE025TB is for a 2.5 m cable, and the letters TB.

(2) Each cable for analog I/O has an overall shield with a ring lug on a 200 mm (8.87 in.) exposed drain wire at the I/O module end of the cable.

(3) Not every connection is always used.

Additional HART Protocol Information

Introduction

This appendix describes the HART protocol and provides references for additional information about the protocol. Consult the HART protocol specification and vendor-provided documentation for specifics on HART commands.

This appendix provides the following:
- HART protocol background information
- Common practice command sets
- Extended command sets
- References to additional information

HART Field Communication Protocol is widely accepted in the industry as the standard for digitally enhanced 4…20mA communication with smart field instruments. The HART Protocol message structure, command set, and status are discussed in this appendix.

The HART command set is organized into these groups and provides read and write access to a wide array of information available in smart field instruments:
- Universal commands provide access to information that is useful in normal plant operation such as the instrument manufacturer, model, tag, serial number, descriptor, range limits, and process variables. All HART devices must implement universal commands.
- Common practice commands provide access to functions that can be carried out by many devices.
- Device specific commands provide access to functions that can be unique to a particular device.

Message Structure

Read this section for a description of transaction procedure, character coding, and message structure of the HART protocol. These correspond to layer 2 (data-link layer) of the OSI protocol reference model.

Master-slave Operation

HART is a master-slave protocol. This means that each message transaction is originated by the master; the slave (field) device replies when it receives a command message addressed to it. The reply from the slave device acknowledges that the command was received and can contain data requested by the master.

Multiple Master Operation

The HART protocol provides for two active masters in a system: one primary and one secondary. The two masters have different addresses. Each can positively identify replies to its own command messages. The 1756-IF8H or 1756-OF8H module acts as primary master. A secondary master, such as a handheld configuration device, may also be connected.

Transaction Procedure

HART is a half-duplex protocol. After completion of each message, the FSK carrier signal must be switched off to let the other station transmit. The carrier control timing rules state that the carrier should be turned on not more than 5 bit times before the start of the message (that is, the preamble) and turned off not more than 5 bit times after the end of the last byte of the message (the checksum).

The master is responsible for controlling message transactions. If there is no reply to a command within the expected time, the master should retry the message. After a few retries, the master should abort the transaction, because presumably the slave device or the communication link has failed.

After each transaction is completed, the master should pause for a short time before sending another command, to provide an opportunity for the other master to break in if it wishes. This way, two masters (if they are present) take turns at communicating with the slave devices. Typical message lengths and delays allow two transactions per second.

Burst Mode

Burst mode is not supported by the ControlLogix HART analog modules.

Response Code and Field Device Status

Two bytes of status also called the response code and field device status are included in every reply message from a field or slave device. These two bytes convey communication errors, command response problems, and field device status. If an error is detected in the outgoing communication, the most significant bit (bit 7) of the first byte is set to 1 and the details of the error are reported in the rest of that byte. The second byte is then all zeros.

Communication errors are typically those that would be detected by a UART (parity overrun and framing errors). The field device also reports overflow of its receive buffer and any discrepancy between the message content and the checksum received.

In RSLogix 5000 software, if the leftmost bit of the ResponseCode is set, it displays a negative number. In this case, the ResponseCode represents a communication fault. Change the display format to hexadecimal to interpret communication status.

If the leftmost bit of the ResponseCode is 0 (value 0…127), then there was no communication error and the value is a ResponseCode from the HART field device. Response codes indicate if the device performed the command. 0 means no error. Other values are errors or warnings. To understand the ResponseCode, contact your HART field device manufacturer or the HART specification.

See Table 73 for descriptions of the response code and the field device status.

Table 73 - Response Codes and Field Device Status

Response Code		Description	
If Bit 7 is	**And Bits 6…0 are**		
1	16#40	Parity Error	Vertical parity error - The parity of one or more of the bytes received by the device was not odd
1	16#20	Overrun Error	Overrun error - At least one byte of data in the receive buffer of the UART was overwritten before it was read (for example, the slave did not process incoming byte fast enough)
1	16#10	Framing Error	Framing error - The Stop Bit of one or more bytes received by the device was not detected by the UART (for example, a mark or 1 was not detected when a Stop Bit should have occurred)
1	16#08	Checksum Error	Longitudinal parity error - The Longitudinal Parity calculated by the device did not match the Check Byte at the end of the message
1	16#04	(Reserved)	Reserved - Set to zero
1	16#02	RX Buffer Overflow	Buffer overflow - The message was too long for the receive buffer of the define
1	16#01	(undefined)	Reserved - Set to zero
0	0	No command specific error	
0	1	(undefined)	
0	3	Value too large	
0	4	Value too small	
0	5	Not enough bytes in command	
0	6	Transmitter-specific command error	
0	7	In Write-protect mode	

Table 73 - Response Codes and Field Device Status (Continued)

Response Code		Description
If Bit 7 is	And Bits 6…0 are	
0	8	Update Failed - Update In Progress - Set to Nearest Possible Value
0	9	Applied Process Too High - Lower Range Value Too High - Not In Fixed Current Mode
0	10	Applied Process Too Low - Lower Range Value Too Low - MultiDrop Not Supported
0	11	In MultiDrop Mode - Invalid Transmitter Variable Code - Upper Range Value Too High
0	12	Invalid Unit Code - Upper Range Value Too Low
0	13	Both Range Values Out of Limits
0	14	Pushed Upper Range Value Over Limit - Span Too Small
0	16	Access restricted
0	32	Device busy
0	64	Command not implemented

If no error was detected in the outgoing communication, the second byte contains status information pertaining to the operational state of the field or slave device.

Table 74 - Field Device Status Bit Mask Definitions

Bit	Bit Mask	Definition
7	16#80	Device malfunction - The device detected a serious error or failure that compromises device operation
6	16#40	Configuration changed - An operation was performed that changed the device's configuration
5	16#20	Cold start - A power failure or device reset occurred
4	16#10	More status available - More status information is available via command 48, Read Additional Status Information
3	16#08	Loop current fixed - The loop current is being held at a fixed value and is not responding to process variations
2	16#04	Loop current saturated - The loop current has reached its upper or lower endpoint limit and cannot increase or decrease any further
1	16#02	Non-primary variable out of limits - A device variable not mapped to the PV is beyond its operating limits
0	16#01	Primary variable out of limits - The PV is beyond its operating limit

IMPORTANT The 16# means this number is Hex display style.

Table 75 - HART Universal Commands

Command		Data in Command			Data in Reply			Contained in	
No.	**Function**	**Byte**	**Data**	**Type(1)**	**Byte**	**Data**	**Type(1)**	**Input Tag**	**CIP MSG**
0	Read Unique Identified		None		0 1 2 3 4 5 6 7 8 9…11	254 (expansion) Manufacturer identification code Manufacturer device type code Number of preambles required Universal command revision Device-specific command revision Software revision Hardware revision Device function flags(2) Device ID number	 (H) (B)		x x x x x x x x x x
1	Read primary variable				0 1…4	PV units code Primary variable	 (F)	 x	x x
2	Read current and percent of range		None		0…3 4…7	Current (mA) Primary variable %	(F) (F)	x x	x x
3	Read current and four (predefined) dynamic variables		None		0…3 4 5…8 9 10…13 14 15…18 19 20…23	Current (mA) PV units code Primary variable SV units code Secondary variable TV units code Third variable FV units code Fourth variable(3)		 x x x x	x x x x x x x x x
6	Write polling address	0	Polling address			As in command			
11	Read unique identifier associated with tag	0…5	Tag	(A)	0…11				
12	Read message		None		0…23	Message (32 characters)	(A)		x
13	Read tag, descriptor, date				0…5 6…17 18…20	Tag (8 characters) Descriptor (16 characters) Date	(A) (A) (D)		x x x
14	Read PV sensor information				0…2 3 4…7 8…11 12…15	Sensor serial number Units code for sensor limits and min span Upper sensor limit Lower sensor limit Min span	(B) (F) (F) (F)		
15	Read output information				0 1 2 3…6 7…10 11…14 15 16	Alarm select code Transfer function code PV/range units code Upper range value Lower range value Damping value (seconds) Write-protect code Private-label distributor code	 (F) (F) (F)		 x x x x x
16	Read final assembly number		None		0…2	Final assembly number	(B)		x

Table 75 - HART Universal Commands

Command		Data in Command			Data in Reply			Contained in	
No.	**Function**	**Byte**	**Data**	**Type[1]**	**Byte**	**Data**	**Type[1]**	**Input Tag**	**CIP MSG**
17	Write message	0…23	Message (32 characters)	(A)		As in command			
18	Write tag, descriptor, date	0…5 6…17 18…20	Tag (8 characters) Descriptor (16 characters) Date	(A) (A) (D)					
19	Write final assembly number	0…2	Final assembly number	(B)					
48	Read additional device status		Starting in HART version 7, the data in the command could be the same as in the reply.		0…5 6…7 8 9 10 11 12 13 14…24	Device-specific status Operational modes Standardized status 0 Standardized status 1 Analog channel saturated Standardized status 2 Standardized status 3 Analog channel fixed[4] Device-specific status	s[5]		x x x x x x x x x

(1) (A) = Packed ASCII, (B) = 3-byte integer, (D) = Date, (F) = Floating Point (HART format), (H) = HART flag
(2) Bit 6 = multisensor device. Bit 1 = EEPROM control required. Bit 2 = protocol bridge device.
(3) Truncated after last supported variable.
(4) 24 bits each LSB…MSB refers to A0 #1…24.
(5) Sint []

Table 76 - Common Practice Commands

Command		Data in Command			Data in Reply			Contained in	
No.	**Function**	**Byte**	**Data**	**Type[6]**	**Byte**	**Data**	**Type[6]**	**Input Tag**	**CIP MSG**
33	Read transmitter variables		None		0 1 2…5 6 7 8…11 12 13 14…17 18 19 20…23	Transmitter variable code for slot 0 Units code for slot 0 Variable for slot 0 Transmitter variable code for slot 1 Units code for slot 1 Variable for slot 1 Transmitter variable code for slot 2 Units code for slot 2 Variable for slot 2 Transmitter variable code for slot 3 Units code for slot 3 Variable for slot 3[7]	 (F) (F) (F)		
34	Write damping value	0…3	Damping value (seconds)	(F)		As in command	(F)		
35	Write range values	0 1…4 5…8	Range units code Upper-range value Lower-range value	 (F) (F)			(F) (F)		

Table 76 - Common Practice Commands

Command		Data in Command			Data in Reply			Contained in	
No.	**Function**	**Byte**	**Data**	**Type[6]**	**Byte**	**Data**	**Type[6]**	**Input Tag**	**CIP MSG**
36	Set upper-range value (= push SPAN button)		None			None			
37	Set lower-range value (= push ZERO button)								
38	Reset 'configuration changed' flag								
39	EEPROM control	0	EEPROM control code[3]			As in command			
40	Enter/exit Fixed Current mode	0…3[1]	Current (mA)	(F)		As in command			
41	Perform device self-test		None			None			
42	Perform master reset								
43	Set (trim) PV zero								
44	Write PV units	0	PV units code			As in command			
45	Trim DAC zero	0…3	Measured current (mA)						
46	Trim DAC gain	0…3		(F)					
47	Write transfer function	0	Transfer function code						
48	Read additional device status		Moved to Universal Commands in HART version 7.			See 48 in Universal Commands			
49	Write PV sensor serial number	0…2	Sensor serial number			As in command			
50	Read dynamic variable assignments		None	0 1 2 3		PV transmitter variable code SV transmitter variable code TV transmitter variable code FV transmitter variable code			x x x x
51	Write dynamic variable assignments	0 1 2 3	PV transmitter variable code SV transmitter variable code TV transmitter variable code FV transmitter variable code			As in command			
52	Set transmitter variable zero	0	Transmitter variable code						
53	Write transmitter variable units		Transmitter variable code						

Table 76 - Common Practice Commands

Command		Data in Command			Data in Reply			Contained in	
No.	**Function**	**Byte**	**Data**	**Type(6)**	**Byte**	**Data**	**Type(6)**	**Input Tag**	**CIP MSG**
54	Read transmitter variable information		Transmitter variable code		0 1…3 4 5…8 9…12 13…16	Transmitter variable code Transmitter variable sensor serial Transmitter variable limits units code Transmitter variable upper limit Transmitter variable lower limit Transmitter variable damping value (seconds)	 (F) (F) (F)		
55	Write transmitter variable damping value	0 1…4	Transmitter variable code Transmitter variable damping value (seconds)			As in command			
56	Write transmitter variable sensor serial number	0 1…3	Transmitter variable code Transmitter variable sensor			As in command			
57	Read unit tag, description, date		None		0…5 6…17 18…20		(A) (A) (D)		x x x x
58	Write unit tag, descriptor, date	0…5 6…17 18…2 0	Unit tag (8 characters) Unit descriptor (16 characters) Unit date	(A) (A) (D)					
59	Write number of response preambles	0	Number of response preambles						
60	Read analog output and percent of range	0	Analog output number code		0 1 2…5 6…9	Analog output number code Analog output units code Analog output level Analog output percent of range			
61	Read dynamic variables and PV analog output		None		0 1…4 5 6…9 10 11…14 15 16…19 20 21…24	PV analog output units code PV analog output level PV units code Primary variable SV units code Secondary variable TV units Tertiary variable FV units code Fourth variable	 (F) (F) (F) (F) (F)	 x x x x	 x x x x x x x x
62	Read analog outputs	 0 1 2 3(2)	 Analog output number; code for slot 0 Analog output number; code for slot 1 Analog output number; code for slot 2 Analog output number; code for slot 3(4)	0 1 2…5 6 7 8…11 12 13 14…17 18 19 20…23		Slot 0 analog output number code Slot 0 Slot 0 level Slot 1 Slot 1 Slot 1 level Slot 2 Slot 2 Slot 2 level Slot 3 Slot 3 Slot 3 level(8)	 (F) (F) (F) (F)		

Table 76 - Common Practice Commands

Command		Data in Command			Data in Reply			Contained in	
No.	**Function**	**Byte**	**Data**	**Type(6)**	**Byte**	**Data**	**Type(6)**	**Input Tag**	**CIP MSG**
63	Read analog output information	0	Analog output number code		0 1 2 3 4…7 8…11 12…15	Analog output number code Analog output alarm select code Analog output transfer function code Analog output range units code Analog output upper-range value Analog output lower-range value Analog output additional damping value (seconds)	 (F) (F) (F)		
64	Write analog output additional damping value	0 1…4	Analog output number code Analog output additional damping value (seconds)	 (F)		As in command			
65	Write analog output range value	0 1 2…5 6…9	Analog output number code Analog output range units code Analog output upper-range value Analog output lower-range value	 (F) (F)					
66	Enter/exit Fixed Analog Output mode	0 1 2…6	Analog output number code Analog output units code Analog output level(5)	 (F)					
67	Trim analog output zero	0 1 2…6	Analog output number code Analog output units code Externally measured analog output level	 (F)					
68	Trim analog output gain	0 1 2…6	Analog output number code Analog output units code Externally measured analog output level	 (F)					
69	Write analog output transfer function	0 1	Analog output number code Analog output transfer function code						
70	Read analog output endpoint values	0	Analog output number code		0 1 2…5 6…9	Analog output number code Analog output endpoint units code Analog output upper endpoint value Analog output lower endpoint value			
107	Write Burst mode transmitter variables (for command 33)	0 1 2 3	Transmitter variable code for slot 0 Transmitter variable code for slot 1 Transmitter variable code for slot 2 Transmitter variable code for slot 3			As in command			

Table 76 - Common Practice Commands

Command		Data in Command			Data in Reply			Contained in	
No.	**Function**	**Byte**	**Data**	**Type(6)**	**Byte**	**Data**	**Type(6)**	**Input Tag**	**CIP MSG**
108	Write Burst mode command number	0	Burst mode command number			As in command			
109	Burst mode control	0	Burst mode control code (0 = exit, 1 = enter)						
110	Read all dynamic variables		None		0 1…4 5 6…9 10 11…14 15 16…19	PV units code PV value SV units code SV value TV units code TV value FV units code FV value	 (F) (F) (F) (F)	 x x x x	x x x x x x x x

(1) 0 = exit Fixed Current mode.
(2) Truncated after last requested code.
(3) 0 = burn EEPROM, 1 = copy EEPROM to RAM.
(4) Truncated after last requested code.
(5) Not a number exits Fixed-output mode.
(6) (A) = Packed ASCII, (B) = 3-byte integer, (D) = Date, (F) = Floating Point (HART format), (H) = HART flag
(7) Truncated after last requested code. Truncated after last requested variable.
(8) Truncated after last requested level.

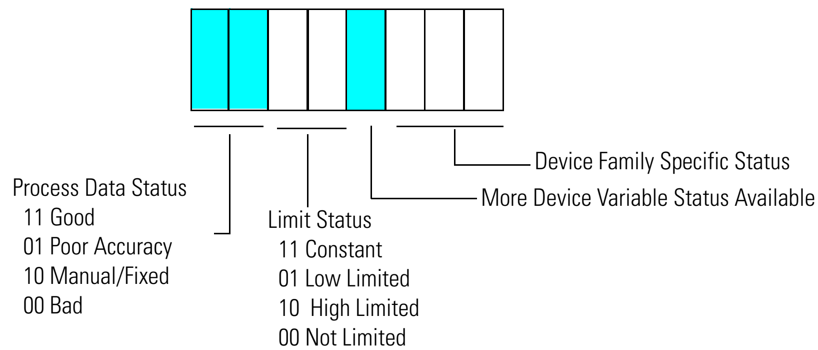
HART PV, SV, TV, and FV Status

HART PV, SV, TV, and FV are dynamic variables that contain the values of device variables, which are various direct or indirect process measurements performed by the HART field device.

Some devices let a set of their internal device variables be mapped to the PV, SV, TV, FV dynamic variables that are automatically collected in the 1756-IF8H Input Tag.

This mapping is part of the field device configuration, usually performed via a handheld configurator or asset management system, such as FactoryTalk AssetCentre or Endress+Hauser FieldCare system.

HART PVStatus, SVStatus, TVStatus, FVStatus are known as Device Variable Status values. These Status values are composed of groups of bits that indicate the quality of the associated device variable.



The Limit Status can be used to control windup in PID loops.

Table 77 - HART PV, SV, TV, and FV Status Values

HART PV, SV, TV FV Status Values			Quality		Limit		More Status Available?		Device Family Specific	
Decimal	**Hex**	**Binary**							**Binary**	**Decimal**
0	0	00000000	00	Bad	00	Not Limited	0	No	000	0
1	1	00000001	00	Bad	00	Not Limited	0	No	001	1
2	2	00000010	00	Bad	00	Not Limited	0	No	010	2
3	3	00000011	00	Bad	00	Not Limited	0	No	011	3
4	4	00000100	00	Bad	00	Not Limited	0	No	100	4
5	5	00000101	00	Bad	00	Not Limited	0	No	101	5
6	6	00000110	00	Bad	00	Not Limited	0	No	110	6
7	7	00000111	00	Bad	00	Not Limited	0	No	111	7
8	8	00001000	00	Bad	00	Not Limited	1	Yes	000	0
9	9	00001001	00	Bad	00	Not Limited	1	Yes	001	1
10	A	00001010	00	Bad	00	Not Limited	1	Yes	010	2
11	B	00001011	00	Bad	00	Not Limited	1	Yes	011	3
12	C	00001100	00	Bad	00	Not Limited	1	Yes	100	4
13	D	00001101	00	Bad	00	Not Limited	1	Yes	101	5
14	E	00001110	00	Bad	00	Not Limited	1	Yes	110	6
15	F	00001111	00	Bad	00	Not Limited	1	Yes	111	7
16	10	00010000	00	Bad	01	Low Limited	0	No	000	0
17	11	00010001	00	Bad	01	Low Limited	0	No	001	1
18	12	00010010	00	Bad	01	Low Limited	0	No	010	2
19	13	00010011	00	Bad	01	Low Limited	0	No	011	3
20	14	00010100	00	Bad	01	Low Limited	0	No	100	4
21	15	00010101	00	Bad	01	Low Limited	0	No	101	5
22	16	00010110	00	Bad	01	Low Limited	0	No	110	6

Table 77 - HART PV, SV, TV, and FV Status Values

23	17	00010111	00	Bad	01	Low Limited	0	No	111	7
24	18	00011000	00	Bad	01	Low Limited	1	Yes	000	0
25	19	00011001	00	Bad	01	Low Limited	1	Yes	001	1
26	1A	00011010	00	Bad	01	Low Limited	1	Yes	010	2
27	1B	00011011	00	Bad	01	Low Limited	1	Yes	011	3
28	1C	00011100	00	Bad	01	Low Limited	1	Yes	100	4
29	1D	00011101	00	Bad	01	Low Limited	1	Yes	101	5
30	1E	00011110	00	Bad	01	Low Limited	1	Yes	110	6
31	1F	00011111	00	Bad	01	Low Limited	1	Yes	111	7
32	20	00100000	00	Bad	10	High Limited	0	No	000	0
33	21	00100001	00	Bad	10	High Limited	0	No	001	1
34	22	00100010	00	Bad	10	High Limited	0	No	010	2
35	23	00100011	00	Bad	10	High Limited	0	No	011	3
36	24	00100100	00	Bad	10	High Limited	0	No	100	4
37	25	00100101	00	Bad	10	High Limited	0	No	101	5
38	26	00100110	00	Bad	10	High Limited	0	No	110	6
39	27	00100111	00	Bad	10	High Limited	0	No	111	7
40	28	00101000	00	Bad	10	High Limited	1	Yes	000	0
41	29	00101001	00	Bad	10	High Limited	1	Yes	001	1
42	2A	00101010	00	Bad	10	High Limited	1	Yes	010	2
43	2B	00101011	00	Bad	10	High Limited	1	Yes	011	3
44	2C	00101100	00	Bad	10	High Limited	1	Yes	100	4
45	2D	00101101	00	Bad	10	High Limited	1	Yes	101	5

Note that this Device Variable Status byte is a new HART feature in HART protocol revision 6 and many HART devices do not yet support it. For those devices, the module creates a status value based on the communication status of the device.

If the PV, SV, TV, FV are being collected without communication errors, the value is set to 16#C0, indicating Good, Not Limited. Otherwise, the value is set to 0, indicating Bad, Not Limited, no specific information available.

Manufacturer Identification Codes

Introduction

This appendix identifies the manufacturer with their assigned code.

Decimal	Hex	Company Name
1	01	Acromag
2	02	Allen-Bradley
3	03	Ametek
4	04	Analog Devices
5	05	ABB
6	06	Beckman
7	07	Bell Microsenser
8	08	Bourns
9	09	Bristol Babcock
10	0A	Brooks Instrument
11	0B	Chessell
12	0C	Combustion Engineering
13	0D	Daniel Industries
14	0E	Delta
15	0F	Dieterich Standard
16	10	Dohrmann
17	11	Endress+Hauser
18	12	ABB
19	13	Fisher Controls
20	14	Foxboro
21	15	Fuji
22	16	ABB
23	17	Honeywell
24	18	ITT Barton
25	19	Thermo MeasureTech
26	1A	ABB
27	1B	Leeds & Northup
28	1C	Leslie
29	1D	M-System Co.
30	1E	Measurex
31	1F	Micro Motion
32	20	Moore Industries

Decimal	Hex	Company Name
33	21	PRIME Measurement Products
34	22	Ohkura Electric
35	23	Paine
36	24	Rochester Instrument Systems
37	25	Ronan
38	26	Rosemount
39	27	Peek Measurement
40	28	Actaris Neptune
41	29	Sensall
42	2A	Siemens
43	2B	Weed
44	2C	Toshiba
45	2D	Transmation
46	2E	Rosemount Analytic
47	2F	Metso Automation
48	30	Flowserve
49	31	Varec
50	32	Viatran
51	33	Delta/Weed
52	34	Westinghouse
53	35	Xomox
54	36	Yamatake
55	37	Yokogawa
56	38	Nuovo Pignone
57	39	Promac
58	3A	Exac Corporation
59	3B	Mobrey
60	3C	Arcom Control System
61	3D	Princo
62	3E	Smar
63	3F	Foxboro Eckardt
64	40	Measurement Technology
65	41	Applied System Technologies
66	42	Samson
67	43	Sparling Instruments
68	44	Fireye
69	45	Krohne
70	46	Betz
71	47	Druck

Decimal	Hex	Company Name
72	48	SOR
73	49	Elcon Instruments
74	4A	EMCO
75	4B	Termiflex Corporation
76	4C	VAF Instruments
77	4D	Westlock Controls
78	4E	Drexelbrook
79	4F	Saab Tank Control
80	50	K-TEK
81	51	SENSIDYNE, INC
82	52	Draeger
83	53	Raytek
84	54	Siemens Milltronics PI
85	55	BTG
86	56	Magnetrol
87	58	Metso Automation
88	59	Siemens Milltronics PI
89	59	HELIOS
90	5A	Anderson Instrument Company
91	5B	INOR
92	5C	ROBERTSHAW
93	5D	PEPPERL+FUCHS
94	5E	ACCUTECH
95	5F	Flow Measurement
96	60	Courdon-Haenni
97	61	Knick
98	62	VEGA
99	63	MTS Systems Corp.
100	64	Oval
101	65	Masoneilan-Dresser
102	66	BESTA
103	67	Ohmart
104	68	Harold Beck and Sons
105	69	rittmeyer instrumentation
106	6A	Rossel Messtechnik
107	6B	WIKA
108	6C	Bopp & Reuther Heinrichs
109	6D	PR Electronics
110	6E	Jordan Controls

Decimal	Hex	Company Name
111	6F	Valcom s.r.l.
112	70	US ELECTRIC MOTORS
113	71	Apparatebau Hundsbach
114	72	Dynisco
115	73	Spriano
116	74	Direct Measurement
117	75	Klay Instruments
118	76	CiDRA CORP.
119	77	MMG AM DTR
120	78	Buerkert Fluid Control Systems
121	79	AALIANT Process Mgt
122	7A	PONDUS INSTRUMENTS
123	7B	ZAP S.A. Ostrow Wielkopolski
124	7C	GLI
125	7D	Fisher-Rosemount Performance Technologies
126	7E	Paper Machine Components
127	7F	LABOM
128	80	Danfoss
129	81	Turbo
130	82	TOKYO KEISO
131	83	SMC
132	84	Status Instruments
133	85	Huakong
134	86	Duon System
135	87	Vortek Instruments, LLC
136	88	AG Crosby
137	89	Action Instruments
138	8A	Keystone Controls
139	8B	Thermo Electronic Co.
140	8C	ISE Magtech
141	8D	Rueger
142	8E	Mettler Toledo
143	8F	Det-Tronics
144	90	Thermo MeasureTech
145	91	DeZURIK
146	92	Phase Dynamics
147	93	WELLTECH SHANGHAI
148	94	ENRAF
149	95	4tech ASA

Decimal	Hex	Company Name
150	96	Brandt Instruments
151	97	Nivelco
152	98	Camille Bauer
153	99	Metran
154	9A	Milton Roy Co.
155	9B	PMV
156	9C	Turck
157	9D	Panametrics
158	9E	R. Stahl
159	9F	Analytical Technologies Inc.
160	A0	FINT
161	A1	BERTHOLD
162	A2	InterCorr
163	A3	China BRICONTE Co Ltd
164	A4	Electron Machine
165	A5	Sierra Instruments
166	A6	Fluid Components Intl
167	A7	Solid AT
168	A8	Meriam Instrument
169	A9	Invensys
170	AA	S-Products
171	AB	Tyco Valves & Controls
172	AC	Micro Matic Instrument A/S
173	AD	J-Tec Associates
174	AE	TRACERCO
175	AF	AGAR
176	B0	Phoenix Contact
177	B1	Andean Instruments
178	B2	American Level Instrument
179	B3	Hawk
180	B4	YTC
181	B5	Pyromation Inc.
182	B6	Satron Instruments
183	B7	BIFFI
184	B8	SAIC
185	B9	BD Sensors
186	BA	Andean Instruments
187	BB	Kemotron
188	BC	APLISENS

Decimal	Hex	Company Name
189	BD	Badger Meter
190	BE	HIMA
191	BF	GP:50
192	C0	Kongsberg Maritime
193	C1	ASA S.p.A.
194	C2	Hengesbach
195	C3	Lanlian Instruments
196	C4	Spectrum Controls
197	C5	Kajaani Process Measurements
198	C6	FAFNIR
199	C7	SICK-MAIHAK
200	C8	JSP Nova Paka
201	C9	MESACON
202	CA	Spirax Sarco Italy
203	CB	L&J TECHNOLOGIES
204	CC	Tecfluid S.A.
205	CD	Sailsors Instruments
206	CE	Roost
207	CF	KOSO
208	D0	MJK
209	D1	GE Energy
210	D2	BW Technologies
211	D3	HEINRICHS
212	D4	SIC
213	D5	HACH LANGE
214	D6	Exalon Instruments
215	D7	FAURE HERMAN
216	D8	STI S.r.l.
217	D9	Manometr-Kharkiv
218	DA	Dalian-Instruments
219	DB	Spextrex
220	DC	SIPAI Instruments
221	DD	Advanced Flow
222	DE	Rexa. Koso America
223	DF	General Monitors, Inc.
224	E0	Manufacturer Expansion
249	F9	HART Communication Foundation
24576	6000	ExSaf
24577	6001	SEOJIN INSTECH

Decimal	Hex	Company Name
24578	6002	TASI FLOW
24579	6003	Daihan Control
24580	6004	APM
24581	6005	ORANGE INSTRUMENTS. UK
24582	6006	BARTEC
24583	6007	Detcon
24584	6008	MSA
24585	6009	METROVAL
24586	600A	Etalon Rus
24587	600B	JOGLER
24588	600C	KSB
24589	600D	Richter CT
24590	600E	NET SAFETY
24591	600F	SECanada
24592	6010	SUPCON
24593	6011	DKK - TOA
24594	6012	Dwyer Instruments
24595	6013	FineTek
24596	6014	Top Worx Inc.
24597	6015	Hoffer Flow Controls
24598	6016	Dust Networks
24599	6017	Forbes Marshall
24600	6018	All Measures, Ltd.
24601	6019	MACTek
24602	601A	CSI
24603	601B	TC Fluid Control
24604	601C	Rohrback Cosasco
24605	601D	AirSprite
24606	601E	Microcyber Inc.
24607	601F	TIG
24608	6020	ifm prover Gmbh
24609	6021	FLEXIM
24610	6022	TOKIMEC.INC
24611	6023	SBEM
24612	6023	SkoFlo Industries, Inc.
24613	6024	StoneL Corporation
24614	6026	EUREKA FLOW
24615	6027	BEKA associates
24616	6028	Capstar Automation

Decimal	Hex	Company Name
24617	6029	Pulsar
24618	602A	Elemer
24619	602B	Soft Tech Group

Engineering Unit Code Numbers

Code Number Details

This table maps engineering unit code numbers to their meaning and abbreviations. These codes are used in the process variable range display.

Unit Codes	Description from HART Specification	Abbreviated Units
1	inches of water at 20 °C (68 °F)	inH2O (20 °C or 68 °F)
2	inches of mercury at 0 °C (32 °F)	inHg (0 °C or 32 °F)
3	feet of water at 20 °C (68 °F)	ftH2O (20 °C or 68 °F)
4	millimeters of water at 20 °C (68 °F)	mmH2O (20 °C or 68 °F)
5	millimeters of mercury at 0 °C (32 °FC	mmHg (0 °C or 32 °F)
6	pounds per square inch	psi
7	bars	bar
8	millibars	mbar
9	grams per square centimeter	g/square cm
10	kilograms per square centimeter	kg/square cm
11	pascals	Pa
12	kilopascals	kPa
13	torr	torr
14	atmospheres	atm
15	cubic feet per minute	cubic ft/min
16	gallons per minute	usg/min
17	liters per minute	L/min
18	imperial gallons per minute	impgal/min
19	cubic meter per hour	cubic m/h
20	feet per second	ft/s
21	meters per second	m/s
22	gallons per second	usg/s
23	million gallons per day	million usg/d
24	liters per second	L/s
25	million liters per day	ML/day
26	cubic feet per second	cubic ft/s
27	cubic feet per day	cubic ft/d
28	cubic meters per second	cubic m/s
29	cubic meters per day	cubic m/d
30	imperial gallons per hour	impgal/h

Unit Codes	Description from HART Specification	Abbreviated Units
31	imperial gallons per day	impgal/d
32	Degrees Celsius	°C
33	Degrees Fahrenheit	°F
34	Degrees Rankine	°R
35	Kelvin	°K
36	millivolts	mV
37	ohms	ohm
38	hertz	hz
39	milliamperes	mA
40	gallons	usg
41	liters	L
42	imperial gallons	impgal
43	cubic meters	cubic m
44	feet	ft
45	meters	m
46	barrels	bbl
47	inches	in
48	centimeters	cm
49	millimeters	mm
50	minutes	min
51	seconds	s
52	hours	h
53	days	d
54	centistokes	centistokes
55	centipoise	cP
56	microsiemens	microsiemens
57	percent	%
58	volts	V
59	pH	pH
60	grams	g
61	kilograms	kg
62	metric tons	t
63	pounds	lb
64	short tons	short ton
65	long tons	long ton
66	milli siemens per centimeter	millisiemens/cm
67	micro siemens per centimeter	microsiemens/cm
68	newton	N
69	newton meter	N m

Unit Codes	Description from HART Specification	Abbreviated Units
70	grams per second	g/s
71	grams per minute	g/min
72	grams per hour	g/h
73	kilograms per second	kg/s
74	kilograms per minute	kg/min
75	kilograms per hour	kg/h
76	kilograms per day	kg/d
77	metric tons per minute	t/min
78	metric tons per hour	t/h
79	metric tons per day	t/d
80	pounds per second	lb/s
81	pounds per minute	lb/min
82	pounds per hour	lb/h
83	pounds per day	lb/d
84	short tons per minute	short ton/min
85	short tons per hour	short ton/h
86	short tons per day	short ton/d
87	long tons per hour	long ton/h
88	long tons per day	long ton/d
89	deka therm	Dth
90	specific gravity units	specific gravity units
91	grams per cubic centimeter	g/cubic cm
92	kilograms per cubic meter	kg/cubic m
93	pounds per gallon	lb/usg
94	pounds per cubic feet	lb/cubic ft
95	grams per milliliter	g/mL
96	kilograms per liter	kg/L
97	grams per liter	g/L
98	pounds per cubic inch	lb/cubic in
99	short tons per cubic yard	short ton/cubic yd
100	degrees twaddell	°Tw
101	degrees brix	°Bx
102	degrees baume heavy	BH
103	degrees baume light	BL
104	degrees API	°API
105	percent solids per weight	% solid/weight
106	percent solids per volume	% solid/volume
107	degrees balling	degrees balling
108	proof per volume	proof/volume

Unit Codes	Description from HART Specification	Abbreviated Units
109	proof per mass	proof/mass
110	bushels	bushel
111	cubic yards	cubic yd
112	cubic feet	cubic ft
113	cubic inches	cubic in
114	inches per second	in/s
115	inches per minute	in/min
116	feet per minute	ft/min
117	degrees per second	°/s
118	revolutions per second	rev/s
119	revolutions per minute	rpm
120	meters per hour	m/hr
121	normal cubic meter per hour	normal cubic m/h
122	normal liter per hour	normal L/h
123	standard cubic feet per minute	standard cubic ft/min
124	bbl liq	bbl liq
125	ounce	oz
126	foot pound force	ft lb force
127	kilo watt	kW
128	kilo watt hour	kW h
129	horsepower	hp
130	cubic feet per hour	cubic ft/h
131	cubic meters per minute	cubic m/min
132	barrels per second	bbl/s
133	barrels per minute	bbl/min
134	barrels per hour	bbl/h
135	barrels per day	bbl/d
136	gallons per hour	usg/h
137	imperial gallons per second	impgal/s
138	liters per hour	L/h
139	parts per million	ppm
140	mega calorie per hour	Mcal/h
141	mega joule per hour	MJ/h
142	british thermal unit per hour	BTU/h
143	degrees	degrees
144	radian	rad
145	inches of water at 15.6 °C (60 °F)	inH2O (15.6 °C or 60 °F)
146	micrograms per liter	micrograms/L
147	micrograms per cubic meter	micrograms/cubic m

Unit Codes	Description from HART Specification	Abbreviated Units
148	percent consistency	% consistency
149	volume percent	volume %
150	percent steam quality	% steam quality
151	feet in sixteenths	ft in sixteenths
152	cubic feet per pound	cubic ft/lb
153	picofarads	pF
154	mililiters per liter	mL/L
155	microliters per liter	microliters/L
156	percent plato	% plato
157	percent lower explosion level	% lower explosion level
158	mega calorie	Mcal
159	Kohms	kohm
160	mega joule	MJ
161	british thermal unit	BTU
162	normal cubic meter	normal cubic m
163	normal liter	normal L
164	standard cubic feet	normal cubic ft
165	parts per billion	parts/billion
235	gallons per day	usg/d
236	hectoliters	hL
237	megapascals	MPa
238	inches of water at 4 °C (39.2 °F)	inH2O (4 °C or 39.2 °F)
239	millimeters of water at 4 °C (39.2 °F)	mmH2O (4 °C or 39.2 °F)

Notes:

Glossary

The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication AG-7.1.

balanced circuit 1) A circuit whose two sides are electrically alike and symmetrical to a common reference point, usually ground. 2) Contrasted with **unbalanced circuit** (page 221).

broadcast Data transmissions to all addresses.

CIP Acronym for Common Industrial Protocol; a communication protocol, or language, between industrial devices. CIP provides seamless communication for devices on DeviceNet, ControlNet, and EtherNet/IP networks.

compatible match An Electronic Keying Protection mode that requires the physical module and the module configured in the software to match according to vendor, catalog number, and major revision. The minor revision of the module must be greater than or equal to that configured.

connection The continuous communication mechanism from the controller to an I/O module in the control system.

ControlBus The backplane used by the 1756 chassis.

coordinated system time (CST) Timer value, which is kept synchronized for all modules within a single ControlBus chassis. The CST is a 64-bit number with microsecond resolution.

differential 1) Pertaining to a method of signal transmission through two wires. The transmission always has opposite states. The signal data is the polarity difference between the wires; when one is high, the other is low. Neither wire is grounded. The circuit may be either a balanced circuit, a floating circuit, or a circuit with a high-impedance path to ground from either end. Usually used in reference to encoders, analog I/O circuits, and communication circuits. 2) Contrasted with **single-ended** (page 221).

direct connection An I/O connection, where the controller establishes an individual connection with I/O modules.

disable keying An 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. A connection is attempted to the module even if it is the wrong type.

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 physical module attributes are consistent with what was configured in software.

exact match An Electronic Keying Protection mode that requires the physical module and the module configured in the software to match identically, according to vendor, catalog number, major revision, and minor revision.

field side Interface between user field wiring and I/O module. In this glossary, see related entry for system side.

flash update The process of updating the firmware of the module.

fourth value (FV) Also abbreviated as QV for quaternary value, this dynamic variable contains the fourth value of Device Variables, which are direct or indirect process measurements by a HART field device.

frequency shift keying A method of using frequency modulation to send digital information used by HART field devices.

Hard Run mode Mode where keyswitch of controller is in Run position.

HART Acronym for highway addressable remote transducer.

inhibit A ControlLogix process that lets you configure an I/O module, but prevent it from communicating with the owner-controller. In this case, the controller does not establish a connection.

Input Data 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.

interface module (IFM) A pre-wired removable terminal block (RTB).

listen-only connection An I/O connection that lets a controller monitor I/O module data without owning the module, sending it a configuration, or controlling its outputs.

major revision A module revision that is updated any time there is a functional change to the module, resulting in an interface change with software.

minor revision A module revision that is updated any time there is a change to the module that does not affect its function or software user interface.

multicast Data transmissions which reach a specific group of one or more destinations.

multiple owners A configuration setup 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 can be configured over the range from 2…100 ms using RSNetWorx software.

owner-controller The controller that creates and stores the primary configuration and communication connection to a module.

primary value (PV) Dynamic variable that contains the primary value of Device Variables, which are direct or indirect process measurements by a HART field device. See page 113 for more information.

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 lets you 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. Outputs are actively controlled.

secondary value (SV) Dynamic variable that contains the secondary value of Device Variables, which are direct or indirect process measurements by a HART field device.

service A system feature that is performed on user demand.

single-ended 1) Unbalanced, as when one side is grounded. See **unbalanced circuit** (page 221) 2) Contrasted with **differential** (page 219).

system side Backplane side of the interface to the I/O module. In this glossary, see related entry for field side.

tag A named area of the controller's memory where data is stored like a variable.

third value (TV) Dynamic variable that contains the tertiary, or third, value of Device Variables, which are direct or indirect process measurements by a HART field device.

timestamping ControlLogix process that stamps a change in input, output, or diagnostic data with a time reference indicating when that change occurred.

unbalanced circuit 1) A circuit whose two sides are electrically dissimilar, as when one side is grounded. 2) Contrasted with **balanced circuit** (page 219).

Notes:

Numerics

A

B

C

D

E

Rockwell Automation Support

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

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

United States or Canada	1.440.646.3434
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