Reference Manual

Allen-Bradley

PlantPAx Process Automation System:

FOUNDATION Fieldbus Design Considerations

Catalog Numbers 1757-FFLD*x*, 1757-FFLDC*x*

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.

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

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

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

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
	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.

Chapter 3

Plan and Configure a Fieldbus System

Chapter 4

Visualize Fieldbus Instrument Data

Appendix A

Parameter Status

Appendix B

Third-party Device Information

Glossary

Index

Introduction

The purpose of this reference manual is to provide an overall framework of the concepts and design considerations for using your FOUNDATION™ Fieldbus network in a PlantPAx Process Automation System. The FOUNDATION Fieldbus protocol lets H1 process instruments communicate with Logix5000 controllers for plant-wide control via EtherNet/IP or ControlNet network linking devices.

Illustrations and examples will assist you in making system design choices.

Additional resources on page 12 are referenced in sections where procedural documentation may be helpful to complete tasks.

What is a FOUNDATION Fieldbus Network?

The FOUNDATION Fieldbus network is a digital, two-way communication protocol that uses function blocks and enables distribution of intelligent measurement and control devices. It serves as a network and bus-level control system that can be linked to the controller or HMI.

The terms FOUNDATION Fieldbus and Fieldbus Foundation are not to be used interchangeably. FOUNDATION Fieldbus is not a product but a communication network created by the Fieldbus Foundation. The Fieldbus Foundation organization developed the FOUNDATION Fieldbus protocol to create a fieldbus network based on the principles of the ISA and IEC standards (ISA S50.02 and IEC61158).

Today, this protocol is widely accepted as the standard for pure digital communication with 'smart' (microprocessor-based) field devices. Devices connected by a FOUNDATION Fieldbus network are used for sophisticated, highly-distributed process control.

The FOUNDATION Fieldbus protocol provides an open specification for both communication and the control application. FOUNDATION Fieldbus distributes to multiple devices both power and control functionality across a two-wire bus, making maximum use of cable to exchange information and reduce total system cost. Devices are required to be interoperable, providing you with tools to implement a control system with products from multiple manufacturers with a standard look and feel of function blocks for all configurations.

FOUNDATION Fieldbus technology has been integrated into the Rockwell Automation Integrated Architecture and PlantPAx Process Automation System through Fieldbus Foundation linking devices (catalog numbers 1757-FFLD and 1757-FFLDC).

A fieldbus linking device reduces equipment and maintenance costs with a single-layer network that bridges high-speed digital networks and H1 segments. This process provides connectivity for fieldbus devices and the PlantPAx control system.

Required Equipment

Before you begin to build your fieldbus system, make sure you have this equipment:

- FOUNDATION Fieldbus Power Supply
- FOUNDATION Fieldbus Power Conditioner
- 1757-FFLD or 1757-FFLDC Linking Device
- FOUNDATION Fieldbus Cable
- FOUNDATION Fieldbus Devices
- FOUNDATION Fieldbus Junction Box/Quick Connection Station
- FOUNDATION Fieldbus Terminators
- Software
- Host Computer

FOUNDATION Fieldbus Power Supply

Fieldbus uses 24V DC filtered power on the segment (bus). Bus-powered devices typically require 10…30 mA of current at 9…32V DC. FOUNDATION Fieldbus power supplies convert local electrical power to direct current.(1) The fieldbus power supplies provide a separate power to each H1 segment to prevent the nonisolated/nonfiltered power supply from absorbing digital noise from the communication signal because it would try to maintain a constant voltage level. The fieldbus power supply has an inductor between the power supply and the fieldbus wiring.

The current and H1 device signal travel on the same line. If the power is not conditioned, the H1 signal would be forced back to the standard power supply and distort the DC voltage. The fieldbus power supply also applies current to the H1 network, which derives its name from the H1 card interface installed on the host computer during initial configuration.

Some applications require intrinsically safe (IS) methods. There are several methods for limiting power for installations in IS classified areas. These methods include the following(2):

- High power trunk with current limiting device couplers (non-incendive)
- High power trunk with isolating device couplers (intrinsically safe)
- FNICO (Fieldbus Non-Incendive COncept) non-incendive bus limited power
- FISCO (Fieldbus Intrinsically Safe COncept) intrinsically safe bus limited power
- IS Entity Concept intrinsically safe bus limited power

(1) FOUNDATION Fieldbus System Engineering Guidelines (5.7 and 6.2.3).

(2) FOUNDATION Fieldbus System Engineering Guidelines (7.6).

FOUNDATION Fieldbus Power Conditioner

A power conditioner, which is required for fieldbus use, provides impedance matching between the fieldbus signal and a standard power supply. A power conditioner is a resistive/inductive network that is built into the fieldbus power supply.

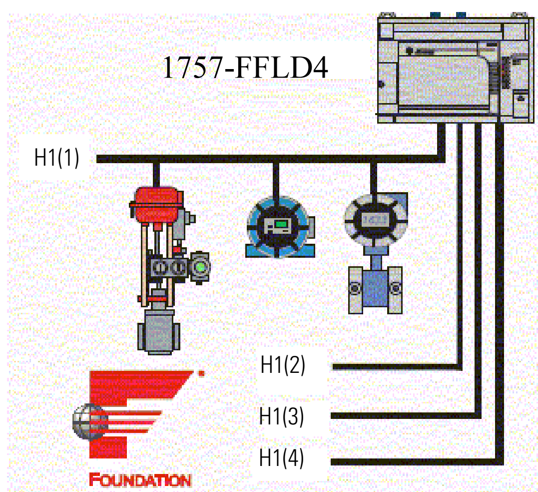
See page 22 for details.

1757-FFLD or 1757-FFLDC Linking Device

The choice of your Rockwell Automation linking device depends on your network requirements:

- The 1757-FFLD linking device bridges both FOUNDATION Fieldbus high-speed Ethernet and Ethernet/IP networks to FOUNDATION Fieldbus H1 device networks.
- The 1757-FFLDC linking device for ControlNet linking device allows systems with redundant ControlLogix controllers and redundant ControlNet media to communicate with FOUNDATION Fieldbus H1 process instrumentation.

The linking device supports two or four H1 segments, denoted by a 2 or 4 after the catalog number, for example, 1757-FFLD2, 1757-FFLD4. The greater the number of segments, the more connections for field devices you can use on the linking device.



FOUNDATION Fieldbus Cable

The preferred fieldbus cable is type 'A' fieldbus cable, a shielded, twisted pair. The voltage supplied to the fieldbus cable can be as high as 32V. The voltage at any device can be as low as 9V for the device to operate correctly. A typical fieldbus device takes about 20 mA of current from the cable.

IMPORTANT	You cannot use pigtails or wire nuts to splice the cable. The bus **must** be continuous; no splices are permitted.

Table 1 summarizes the typical cable characteristics as defined in the FOUNDATION Fieldbus Engineering Guidelines, Appendix 2.

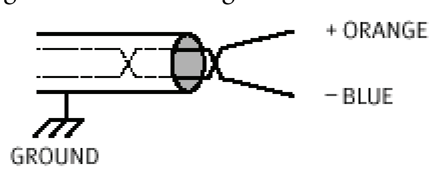
Table 1 - Fieldbus Cable Characteristics

Characteristics	Guidelines
Operating temperature	-30…90 °C (-22…194 °F)
Characteristic impedance	20 = 100 ±20 Ω
Attenuation	0 db/km at 39 kHz, max 3
Resistance	Copper, tin-coated wire at 23.5 Ω/k mA at 20 °C (68 °F) (18 AWG) per conductor
Shielding	Each twisted pair shall be individually shielded. A drain wire shall have resistance less than 52 Ω/km
Wire-to-shield capacitance unbalanced	No more than 4 pF/m with 30 m cable length
Wire twist per meter	10…22 twists per meter

The standard color code for wiring includes the following:

- Orange PVC jacket - general-purpose or Class 1, Division 2 applications
- Blue PVC jacket - intrinsically safe applications
- 18 AWG wires - orange for positive and blue for negative (see below)(1)

The fieldbus is configured so that one of the wires has a (+) voltage, the other wire has a (-) voltage, and the shield is grounded.



Other cables or existing plant wiring conventions may be different. Regardless of the color convention, keep the sense of fieldbus polarity consistent throughout the plant.(2)

(1) 'Efficient Foundation Fieldbus H1 Installations with Allen-Bradley ControlLogix and Pepperl+Fuchs FieldConnex Technology' White Paper by Michael I. McElroy, Account Manager for Rockwell Automation Encompass Partner Pepperl+Fuchs, Inc.

(2) RELCOM inc., Fieldbus Wiring Design and Installation Guide (2221 Yew Street, Forest Grove, OR 97116) p. 5. Reprinted by permission.

FOUNDATION Fieldbus Devices

FOUNDATION Fieldbus is the network that links smart field devices with an automation system. Devices may be powered either from the segment (type 113, bus powered) or locally (type 114, separate power). We recommend using bus-powered field devices, if available.

FOUNDATION Fieldbus Junction Box/Quick Connection Station

A junction box allows for quick installation of multiple field instruments via terminal connectors. A junction box is generically referred to as a connector block. This part of the FOUNDATION Fieldbus network allows solid connections between the network trunk and fieldbus devices and is useful for installations where devices may be periodically disconnected or moved.

FOUNDATION Fieldbus Terminators

A fieldbus segment consists of a trunk and a terminator at each end. These impedance-matching modules prevent distortion and signal loss. Some junction boxes have built-in terminators, but only one terminator should be active at each end of the line to prevent signal disturbance.

See page 14 for an illustration.

Software

RSFieldbus and RSLogix 5000 software, when using FOUNDATION Fieldbus with the Plant PAx Process Automation System, are required to set up the fieldbus linking devices with a Logix controller. Other software for the initialization and operation of a FOUNDATION Fieldbus network might also include: RSNetWorx for ControlNet, FactoryTalk View Site Edition (SE), and FactoryTalk AssetCentre.

Host Computer

RSFieldbus software resides on the host computer and is designated as the FOUNDATION Fieldbus server. The host computer/server also can store RSLogix 5000 configuration information for the Logix controller.

RSFieldbus software initiates configuration parameters that bridge H1 data to the PlantPAx system.

Additional Resources

These documents contain additional information concerning products from Rockwell Automation.

Resource	Description
FOUNDATION Fieldbus System User Manual, publication 1757-UM012	Provides information on using RSFieldbus software to configure a FOUNDATION Fieldbus network. This manual also contains RSLogix 5000 software configuration procedures for the 1757-FFLD and 1757-FFLDC linking devices.
FOUNDATION Fieldbus Linking Device Installation Instructions, publication 1757-IN021	Provides details on how to install the 1757-FFLD linking device.
ControlNet Foundation Fieldbus Linking Device Installation Instructions, publication 1757-IN022	Provides details on how to install the 1757-FFLDC linking device.
EtherNet/IP Modules in Logix5000 Control Systems, publication ENET-UM001	Provides details on how to configure a Logix5000 workstation on an EtherNet/IP network.
Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001	Provides information on Ethernet security and firewalls.
ControlNet Modules in Logix5000 Control Systems, publication CNET-UM001	Provides information on how a Logix5000 controller and field devices communicate on the ControlNet network.
FOUNDATION Fieldbus Linking Device Technical Data, publication 1757-TD003	Provides specifications for the 1757-FFLD linking device.
FOUNDATION Fieldbus Linking Device for ControlNet Technical Data, publication 1757-TD004	Provides specifications for the 1757-FFLDC linking device.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

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

These FOUNDATION Fieldbus documents contain information that you may find helpful as you read this manual.

Title	Number
System Engineering Guidelines	AG-181
Wiring and Installation 31.25 kbit/s, Voltage Mode, Wire Medium Application Guide	AG-140

For more information, go to http://www.fieldbus.org/.

Plan Your Network Architecture

Introduction

Fieldbus architecture design begins with deciding on the topology for your network application. Network topology refers to the shape and design of a fieldbus application. You must consider how many devices will be used, where they will be located, cable length, and power supply considerations. Attention to detail at this early stage can avoid late design changes and additional equipment costs.

This chapter provides information that will help you design your Piping and Instrumentation Drawings (P&IDs) to determine the location of instruments. It includes power grounding considerations and examples of various network connections with linking devices.

Fieldbus Network Topologies

There are three supported types of topologies for a fieldbus:

- Tree Topology
- Spur Topology
- Combination Topology

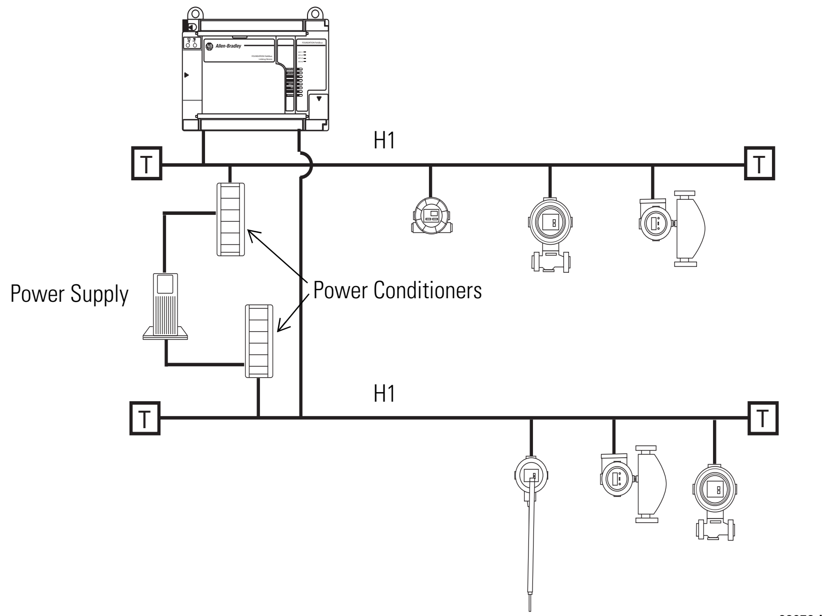
A daisy chain network, which consists of a cable segment that is routed from device to device, is not recommended. If a daisy chain is used, devices cannot be added or removed from the segment during operation without disrupting service to the other devices.

A point-to-point topology also is not suggested because the network consists of only two devices. Therefore, it's not an economical design.

See page 14 for an example of a simple fieldbus network to focus on workable topologies.

The illustration shows a network configuration of a 1757-FFLD linking device supporting two H1 segments. Notice that there are two terminators and one power conditioner per fieldbus segment. The terminators should be located at the farthest ends of the trunk.

Figure 1 - 1757-FFLD Device on an H1 Fieldbus Network



We recommend you do not exceed eight power conditioners per power supply.

IMPORTANT	There **must** be two terminators per segment; one at each end of the cable. The terminator allows the fieldbus signal to be viewed as a voltage while being offset on the DC segment voltage supply. This prevents distortion of the signal. Do not use terminators at a field device because the whole segment is affected if the device is removed.

Power conditioners must be used along with fieldbus power supplies. The conditioners prevent the power supply from shorting out the communications signal and shutting down a segment.

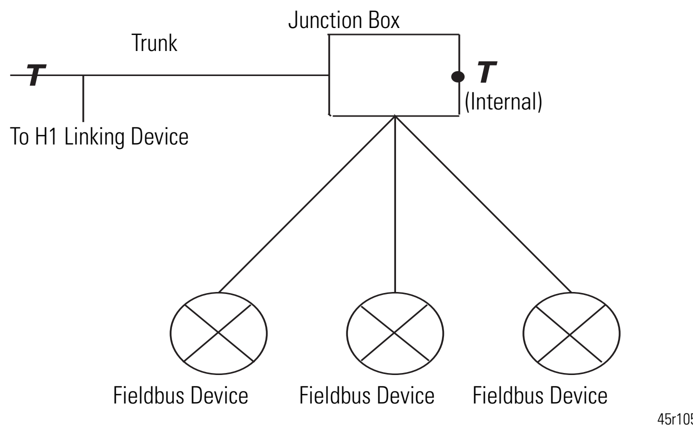
See Power and Grounding Considerations on page 21 for details.

Tree Topology

A tree topology, which is commonly referred to as a chicken foot, consists of a single fieldbus segment connected to a common junction box to form a network. A tree topology is practical if the devices on the same segment are well separated but in the general area of the junction box. It allows maximum flexibility when configuring and assigning devices to networks/segments, and it is the preferred topology for reuse of existing wiring. [1]

Figure 2 is an example of a junction box at the end of a trunk. A trunk is the longest cable path between any two devices on the network. Because it is at the end of the trunk, the terminator within the junction box is activated. The spurs that are shown on the bottom of the junction box must be taken into consideration using the maximum spur length table. (See Table 2 on page 16.)

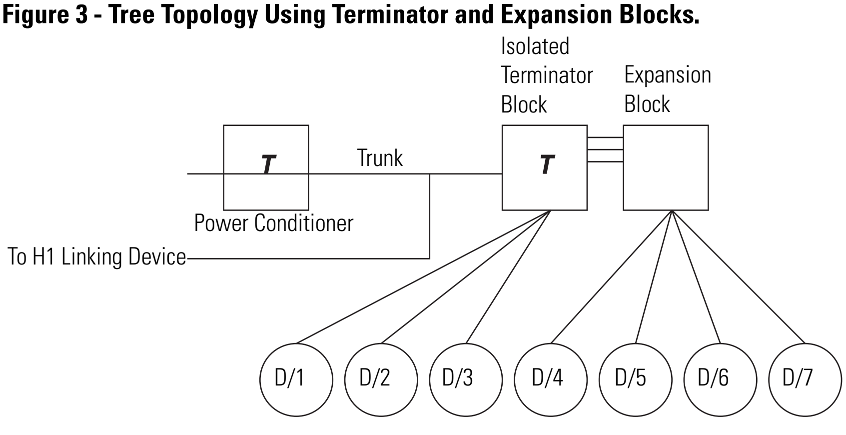
Figure 2 - Tree Topology



'T' is for terminator. Required power supply and power conditioner are not shown.

Figure 3 is an example of a tree topology using terminator and expansion blocks. Expansion blocks have additional terminals to add devices.

Figure 3 - Tree Topology Using Terminator and Expansion Blocks.



'T' is for terminator; 'D' is for field device.

(1) FOUNDATION Fieldbus System Engineering Guidelines (7.1.2).

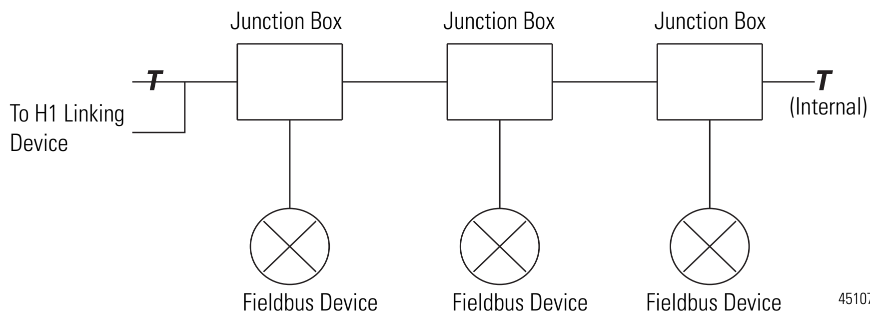
Spur Topology

This topology consists of fieldbus devices that are connected to the bus segment through a length of cable called a spur. Spur lengths can vary from 1 …120 m (3.28…394 ft) as shown in Table 2.

A spur topology is technically acceptable, but not generally a good economic choice when there is a high density of devices. It can be used for new installations that have a low density of devices in an area.

Figure 4 shows an example of a spur topology. Because it is at the end of the trunk, the junction box on the right has its internal terminator enabled.

Figure 4 - Spur Topology Using Junction Boxes



'T' is for terminator. Required power supply and power conditioner are not shown.

If you have a choice about spur length, the general rule is that the shorter the spur, the better. The maximum number of devices per segment is 12 as recommended by FOUNDATION Fieldbus guidelines.

Table 2 - Recommended Spur Lengths(1)

Total Devices	1 Device per Spur	2 Devices per Spur	3 Devices per Spur	4 Devices per Spur
1-12	120 m (394 ft)	90 m (295 ft)	60 m (197 ft)	30 m (98 ft)

(1) These lengths are recommended, not required.

The total cable length is the sum of trunk and spur lengths. If different cable preference types are used, apportion each type against its limit and be sure the total is less than one (1).

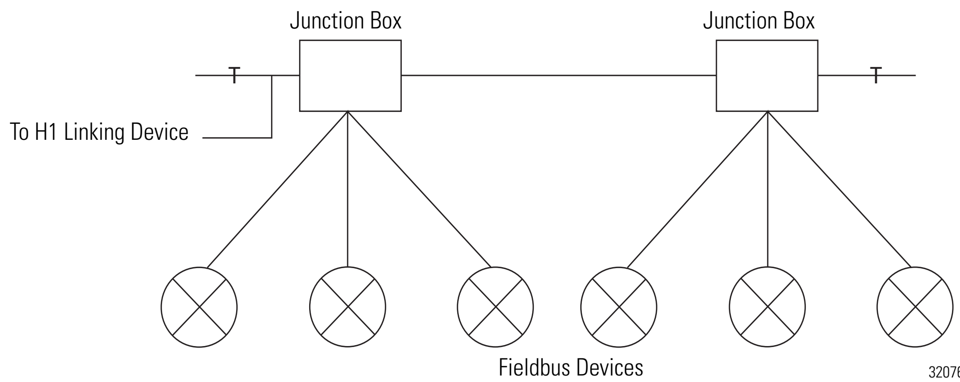
EXAMPLE	For example, if the 500 m (1640 ft) trunk cable is preferred type 1 cable and the spurs are 100 m (328 ft) preferred type 2 cable, the total cable resistance = 0.35 (500/1900 + 100/1200 = 0.35). 0.35 is less than 1.0, therefore segment resistance is good.

Spurs should be connected to current-limiting connections for short-circuit protection.

Combination Topology

You can design a combination tree and spur topology. However, you must follow the rules for maximum fieldbus network/segment length, including the length of the spurs in the total calculation.

Figure 5 - Combination Tree and Spur Topology



'T' is for terminator. Required power supply and power conditioner are not shown.

Shielding

Shielding is an important aspect of segment design. Various options (Class A…D) can be used, depending on local codes, standards and practices. Class A, single-point shielding, is recommended for most regions of the world. The instrument shield is terminated at the host (fieldbus power supply) end of the network and is not connected to ground at any other place.(1)

See Shielding Options on page 152 for illustrations and descriptions of shielding designs.

For optimal performance, fieldbus cables should be shielded to reduce electromagnetic and electrostatic signal interference. Common multi-conductor (multi-core) 'instrument' cable can be used. It has one or more twisted pairs, an overall metallized shield, and a shield wire.

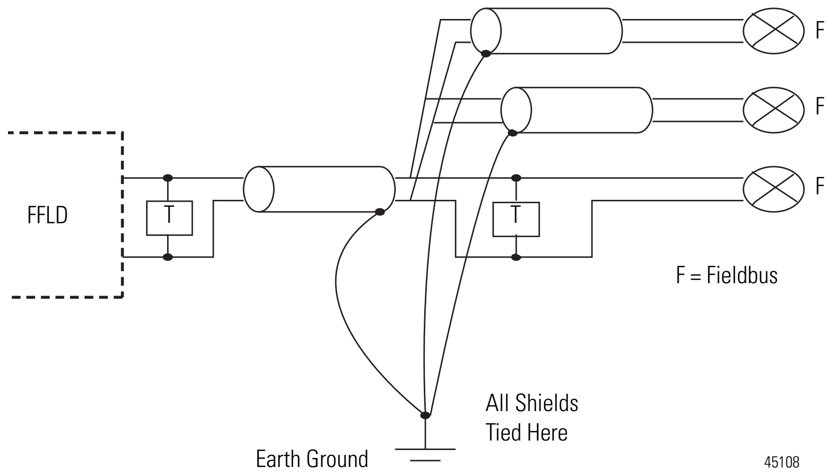
The instrument shield should be terminated at the host (power conditioner) end of the network in a marshalling cabinet and should not be connected to ground at any other place. If a multiple trunk cable goes to a fieldbus junction box, do not attach the cable shield wires from different networks together. This creates ground loops and noise on the network.

IMPORTANT	The most common anomalies with fieldbus networks are usually due to noise, which can occur if you have the wrong wiring, improper grounding, and/or bad connections.

(1) FOUNDATION Fieldbus System Engineering Guidelines (7.3.4).

A cable signal encountering a discontinuity, such as a wire open or short, produces a reflection. The reflection is a form of noise that distorts the original signal.

Figure 6 - Proper Shielding for a Tree Network



Partition a Network

The number of devices on an H1 segment depends on how much current each device requires and the resistance of the segment cable. A minimum of 9V must be delivered to the farthest end of the segment, taking into account voltage drops from the total current. The maximum devices used on an H1 segment is 8…10.

Besides the physical media, the limit optimizes the time required for devices to communicate and the extra bandwidth required for configuring the H1 network and to administer necessary housekeeping. Typically, it takes 100 ms for a fieldbus transmitter to make a new measurement of an input with all the associated calculations completed. That value can be read only every 40…50 ms because of the fieldbus data rate (31.25 Kbps, or 31 bits per ms) and the fieldbus protocol, which must allow time for each device to send non-scheduled messages in addition to publishing the process variables that are scheduled.

IMPORTANT	Intrinsic safety (IS) barriers can limit the maximum device numbers on the IS H1 segment to 4…6 devices, depending on the power consumption of the devices installed and the manufacturer's specification for both the barrier and the transmitter.

Intrinsically safe (IS) installations must follow the same guidelines as imposed by the technology for non-IS installations. The major differences are the power constraints imposed by the need to remain intrinsically safe and the requirement to use suitably certified power supplies, field instruments, and wiring components. IS wiring has a light blue outer jacket.[1]

(1) FOUNDATION Fieldbus System Engineering Guidelines (7.6.1).

Signal Considerations

When a fieldbus network's signal quality is poor, it can cause intermittent loss of communication to devices, unreasonably long downloads, and lost data. The following components are critical to achieving good signal quality:

- Shielded two-wire cable, preferably specifically designed for fieldbus. The type of cable will determine overall length of the trunks and drops.
- Terminators reduce noise on segments caused by signal reflections at the end of an open cable. One terminator on each end of the H1 trunk is needed for proper performance.
- Power conditioners are mandatory between a supply and the H1 trunk, which can deliver 9…32V DC consistently out of the conditioner when under the appropriate load from the cable resistance and while powering the devices. One power supply, or redundant power supplies designed for fieldbus, can be used.
- In areas vulnerable to lightning, lightning arresters should be installed.
- It's recommended that you use power supplies and power conditioners with built-in short-circuit protection.

With multiple devices sharing a cable, only one device should transmit at a time. This prevents signals from colliding at once and interfering with each other. The Link Active Scheduler (LAS) is a device that selects which device can transmit by sending a special frame to each one at a certain time. You might have one frame where a device is reporting an error, then a gap of silence; a device transmitting data, then another gap of silence; and so forth. The LAS directs this traffic.(1)

Cable Attenuation

Signals attenuate, or get smaller, as they travel through cables. Attenuation is measured in decibels (dB) based on the following formula.

$$dB = 20 \log (V1/V2)$$

Where:

V1 = amplitude of transmitted signal in volts

V2 = amplitude of received signal in volts

Cable have attenuation ratings for a given frequency; the frequency for fieldbus being 39 kHz. The preferred Type A cable for fieldbus has an attenuation of 3 dB/km.

(1) Relcom Inc., Fieldbus Wiring Guide (Chapter 3, page .)

A fieldbus device can transmit a signal as low as 0.75V peak-to-peak (Vpp) and detect a signal as small as 0.15 Vpp. This means that the cable can attenuate the signal by 14 dB (20 log (0.75/.015) = 14 dB).

When using the preferred Type A cable, a fieldbus can run can be up to 4.6 km (15091 ft), as determined by this formula.

14 dB / 3 dB/km = 4.6 km

A shorter cable will have proportionately less attenuation. For example, a preferred Type A cable that is 500 m (1640 ft) would have an attenuation of 1.5 dB.

Signal Distortion versus Capacitance

Other factors, such as varying characteristic impedance, spur connection reflections, and capacitive unbalance between the wires and shield can distort signals as they travel through the cable. This means that an ideal signal transmission within fieldbus specifications can arrive at the other end of the cable as a distorted signal.

In addition to cable attenuation, calculations for determining maximum fieldbus cable length must also use the these guidelines to calculate signal distortion due to spurs:

- Each spur is converted to an equivalent capacitance.
- All spurs are assumed to be at the extreme end of the trunk.
- Signal attenuation is calculated as 0.035 dB/nf.

For example, if the fieldbus topology includes five devices, with each on a 20 m (66 ft) spur, the total cable length is 100 m (328 ft), equivalent capacitance is 3 nf (100 m x 0.03 nf/m), and the spur distortion is 0.105 dB (3 nf x 0.035 dB/nf = 0.105 dB).

Another source of distortion is the fieldbus device's equivalent capacitance. Use the following guidelines to calculate the distortion due to device capacitance:

- Determine each device's input capacitance.
- Assume all devices are at the extreme end of the trunk.
- Use 0.035 dB/nf as the signal attenuation calculation.

For example, if the fieldbus topology includes five devices, each with a 3000 pF input capacitance, the equivalent capacitance is 15 nf (5 x 3000 pF) and the resulting attenuation is 0.525 dB (15 nF x 0.035 dB/nF).

There are a number of ways in which you can verify that the network you have set up will perform properly. See Startup and Maintenance on page 133 for details.

Power and Grounding Considerations

Fieldbus devices may be either powered from the segment (bus) or locally powered, depending on the design. If at all possible, field devices should be bus powered.

Bulk power supplies convert local electrical power to direct current. Segment supply voltage can range from 9…32V DC, according to FOUNDATION Fieldbus specifications. However, for most applications, trunk supply voltage at the power supply is 24 ±2V.[1]

It's important to calculate your power supply distribution to determine the number of devices that can be used on a fieldbus segment. Bus powered devices usually require 10…30 mA of current and between 9…32V.

The number of bus powered (two-wire) devices on a segment is limited by these factors:

- Output voltage of the fieldbus power supply.
- Current consumption of each device.
- Location of the device on the network/segment.
- Location of the fieldbus power supply.
- Resistance of each section of cable.
- Minimum operating voltage of each device.
- Additional current consumption due to one spur short-circuit fault (10 mA).

The length of a fieldbus wiring system and the number of devices on a network/segment are limited by the power distribution, attenuation, and signal distortion. Refer to ISA 50.02 for the limitations on cable length.

Power Supplies

Power supplies shall comply with IEC 61158-2 criteria and performance requirements, with preferential consideration given to the low-power signal option. We recommend using one power supply dedicated to the 1757-FFLD or FFLDC linking device and any additional supplies dedicated toward the field devices.

Rockwell Automation manufactures a DIN rail mountable 1794-PS3 supply that is Class 1, DIV2 compliant. It will supply 24V DC at 3 amps.

(1) FOUNDATION Fieldbus System Engineering Guidelines (6.2.1, 6.2.3).

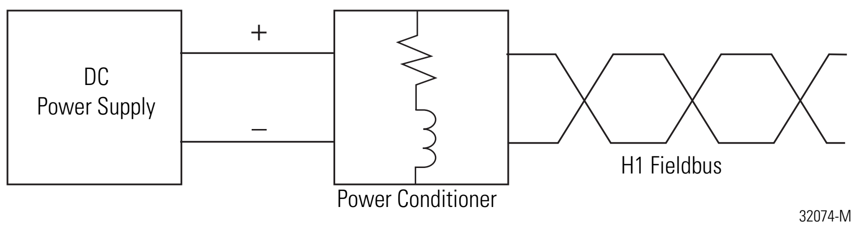
Power Conditioning

If an ordinary power supply were used to power the fieldbus, the power supply would absorb signals on the cable because it would try and maintain a constant voltage level. For this reason, an ordinary power supply must be 'conditioned' for fieldbus use.

Putting an inductor between the power supply and the fieldbus wiring is a way to isolate the fieldbus signal from the low impedance of the bulk supply. The inductor lets in the DC power on the wiring, but it prevents signals from going into the power supply.

One fieldbus power supply conditioner is required for each fieldbus network segment. We recommend using no more than eight power conditioners per power supply.

Figure 7 - Power Supply with One Power Conditioner



Power conditioners should be redundant units that provide flawless transfer from one unit to another. Primary and secondary sources should be physically separated, not sharing a common backplane or AC source.

See page 31 for more on redundancy.

Be aware that power conditioners have limits on how much current they can source. Power conditioners also can have an internal terminator, which should be considered when placing terminators on the network.

Signal Wire Polarity

The combination signal/power wires have a plus (+) and minus (-) polarity associated to the power conditioner outputs, which must be wired to the appropriate terminals on the devices. Some devices are polarity insensitive, meaning they still work if you connect the positive wire to the negative terminal, and vice-versa. But, some instruments are polarity sensitive and may not operate if incorrectly wired.

Grounding

Follow all international, national, and local codes for grounding and bonding equipment. Above all, follow the manufacturer's instructions and recommendations for each device installed in a plant.

IMPORTANT	Signal wiring of the fieldbus segment cannot be grounded. Grounding out one of the signal wires will shut down an entire fieldbus network.

To prevent ground loops, a fieldbus segment should be grounded at only one point. This is usually done by grounding the cable shield at the control room end of the segment.

Each process installation has a different requirement for grounding. Be sure that the shield is electrically isolated from the transmitter housing and other grounded fixtures.

EtherNet/IP Considerations

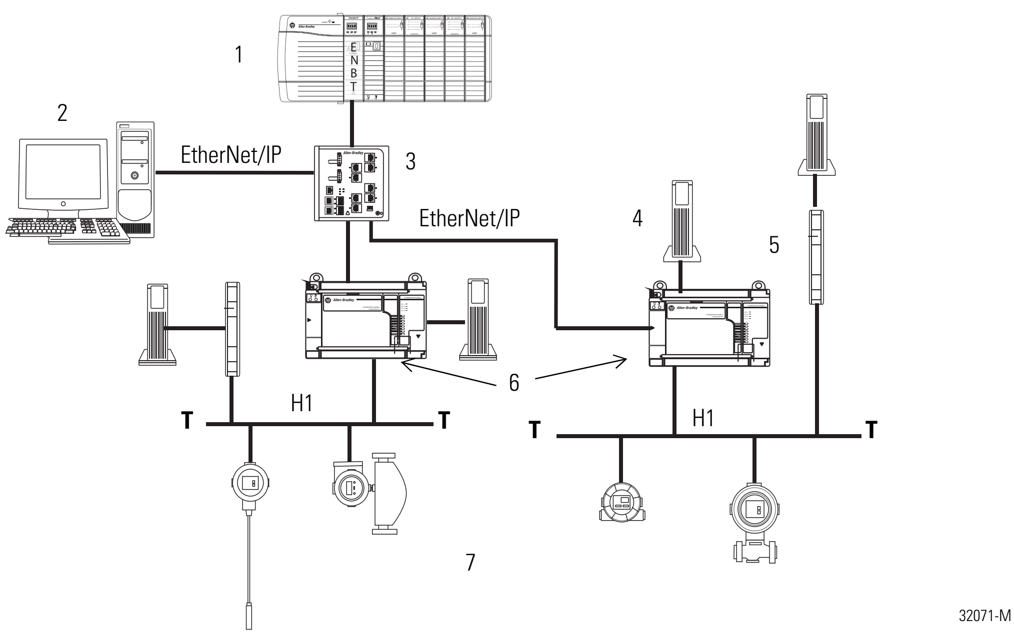
The number of connections and a managed switch are considerations for creating a fieldbus system on an Industrial Ethernet (EtherNet/IP) network. The EtherNet/IP network protocol uses the Common Industrial Protocol (CIP) via a switch to transmit messages along the High-speed Ethernet (HSE) cable.

The1757-FFLD linking device uniquely bridges both FOUNDATION Fieldbus HSE and EtherNet/IP networks to FOUNDATION Fieldbus H1 device networks. The linking device connects the FFLD Logix Blocks to a Logix controller via the CIP protocols. Logix Blocks connect the linking device to H1 field devices to complete the loop between hardware and signals to facilitate real-time communication. Transferred information includes device configuration (for example, set-up and diagnostic data) and plant floor process information (for example, temperature and data flow).

The numbers 2 and 4 at the end of the catalog number for the 1757-FFLD linking device indicate the number of available H1 segments. The greater the number of segments the more connections for field devices you can use on the network, keeping in mind the application requirements (see page 18).

Figure 8 shows an example of two 1757-FFLD linking devices transferring field device data on separate H1 segments back to the controller and host computer via a Stratix 8000 switch. See page 27 for details on switch requirements.

Figure 8 - EtherNet/IP and 1757-FFLD Linking Device Example



Item	Description	Item	Description
1	ControlLogix controller with 1756-ENBT module	5	Power conditioner
2	Host computer and OPC server	6	1757-FFLD linking device
3	Stratix 8000 switch	7	Field devices
4	24V DC power supply	T	Network terminator

Establishing Connections

Logix controllers produce (broadcast) and consume (receive) system-shared data that require connections. A communication bridge module, such as the 1756-ENBT, installed in the controller sends and receives this data via the EtherNet/IP network.

The OLE Process Control (OPC) server gathers and holds the data for retrieval on a host computer that is designated during RSFieldbus software initiation. The OPC data is encapsulated in the HSE packet.

The table describes the three types of traffic on an EtherNet/IP network.

Type	Description
Unicast	Peer-to-peer delivery of information.
Multicast	One to many; delivery of information simultaneously to a group of destinations.
Broadcast	Information recognized and delivered to every device.

Logix Blocks are created during RSFieldbus software configuration and programmed with a Logix controller by using RSLogix 5000 software. These blocks transmit multicast messages from H1 field devices to the host computer through the 1757-FFLD linking device.

A Logix5000 controller interprets each Logix block as a remote I/O module and the router switch must be multicast enabled. See page 27 for details.

Each Logix Block can send or receive eight analog and eight discrete signals in and out at one time to a Logix controller. You can use a maximum of 16 Logix Blocks within a single linking device, and each block requires one CIP connection.

For details on counting connections, see the FOUNDATION Fieldbus System User Manual, publication 1757-UM012.

To determine the number of connections and packets per second for your network plan, use the EtherNet/IP Capacity tool at http://www.ab.com/go/iatools.

Assigning IP Addresses and Subnet Masks

You must assign an IP address and subnet mask for each linking device on the network. The IP address specifically identifies the device from other devices on the network to receive multicast messages.

An IP address consists of 32 bits, often shown as 4 octets of numbers from 0…255 represented in decimal form instead of binary form.

> For example, the IP address 168.212.226.204 in binary form is 10101000.11010100.11100010.11001100.

It's easier to remember decimals as opposed to binary numbers, so we use decimals to represent the IP addresses when describing them. However, the binary number is important because it determines which class of network the IP address belongs to.

An IP address consists of two parts, one identifying the network and one identifying the node, or host. The class of the address determines which part belongs to the network address and which part belongs to the node address. All nodes on a given network share the same network prefix, but must have a unique host number.

The subnet mask defines a segmented group for better control and security. If the host computer and linking device are not on the same subnet, a switch is needed to connect the two.

The Dynamic Host Configuration Protocol (DHCP) is an Internet protocol for automating the configuration of computers that use TCP/IP. DHCP can be used to automatically assign IP addresses.

FFLD linking devices that have DHCP enabled or out-of-box, a BOOTP server must be used to assign IP addresses. If DHCP is disabled and a FFLD linking device has an existing IP address, you can use RSLinx software to change the address.

After IP addresses are assigned to each linking device, use the RSLogix 5000 software to program the 1757-FFLD linking device with a Logix controller.

Using a Managed Switch

A Layer-2 access switch is essential for the security and data dissemination on the EtherNet/IP network. You must enable IP multicasting to distribute I/O control data, which is consistent with the CIP produced/consumed model. Most switches retransmit multicast packets and broadcast packets to all ports.

A Layer-2 managed switch, however, provides Internet Group Multicast Protocol (IGMP) snooping, support for Virtual Local Area Networks (VLAN), and port mirroring.

You must **not** filter IGMP snooping or you risk shutting down the IP multicasting. IGMP snooping enables switches to forward multicast packets only to ports that are part of a particular multicast group.

VLAN segregates network traffic; creating multiple isolated networks so traffic from one network does not burden another network. Port mirroring lets you direct frames being transmitted on one port to another port for analysis by a traffic analyzer.

TIP We recommend all filtering removed on your VLAN.

Refer to these publications for more information:

- EtherNet/IP Modules in Logix5000 Control Systems, publication ENET-UM001
- Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001

ControlNet Considerations

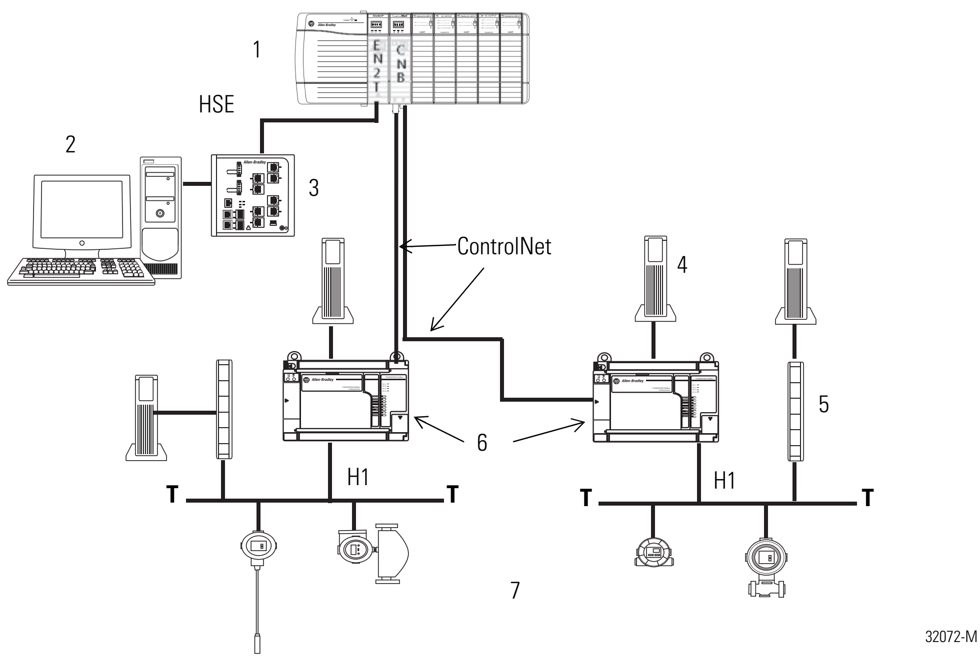
The number of connections and scheduled or unscheduled bandwidth are considerations when designing a fieldbus system on the ControlNet network. Unlike EtherNet/IP, the ControlNet network does not require a router switch because of a non-active physical layer (no power). The ControlNet network uses the Common Industrial Protocol (CIP) to combine the functionality of an I/O network and a peer-to-peer network.

The 1757-FFLDC linking device communicates with the controller through Logix Blocks. Each block, which can send or receive eight analog or eight discrete signals in and out at one time to a Logix controller, requires one CIP connection.

For details on counting connections, see the FOUNDATION Fieldbus System User Manual, publication 1757-UM012.

In addition, the ControlNet network requires each node to have its own address to communicate on this trunk/drop (bus) network. You cannot have more than 48 active devices and taps on a single coax segment. A repeater lets you extend the allowable cable distance for additional nodes (maximum of 99 on a ControlNet network).

Figure 9 - ControlNet and 1757-FFLDC Linking Device Example



Item	Description	Item	Description
1	ControlLogix controller with 1756-EN2T and 1756-CNB modules	5	Power conditioner
2	Host computer and OPC server	6	1757-FFLDC linking device
3	Stratix 8000 Switch (optional)	7	Field devices
4	24V DC power supply	T	Network terminator

Scheduling Data Communication

The network update time (NUT) lets you determine how much of the processor is to be used for communication. This control lets you schedule data communication between field devices at various rates, and guarantees that critical data is delivered in a predictable and repeatable manner. This type of data communication is referred to as 'scheduled' data.

At the same time, the ControlNet network allows devices to send data on an event basis when scheduled data is not being transmitted. This lower priority information is referred to as 'unscheduled' data.

Because a Logix Block module resides in the linking device, which acts like a remote chassis, the role of a requested packet interval (RPI) varies slightly with respect to getting data to the controller. The transmit interval depends on the type of connection (scheduled or unscheduled) that you are using to connect to the Logix Block module.

TIP We recommend that you set the value of your RPI to half of your macrocycle value.

To select a scheduled connection for communication to the Logic Blocks, you must run the RSNetWorx software to schedule the network for the connection to begin running.

For more connection details, see 'Connected Messaging Limits' in the ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001.

Using RSNetWorx Software and ControlNet Setup Tool

RSNetWorx software and the ControlNet Setup Tool must be configured on the host workstation. RSNetWorx software transfers configuration information for the 1757-FFLDC linking device, verifies and saves network update time (NUT), and establishes a schedule that is compliant with the RPIs and other connection options specified for each module.

RSNetWorx for ControlNet software also configures a 'keeper,' a designated module that stores programmed parameters for the network and configures the network with those parameters at startup.

The FFLDC ControlNet Setup Tool writes the CIP path of the 1757-FFLDC linking device to the IDShell HSE.ini file so the RSFieldbus software can communicate with various linking devices connected through ControlNet.

See page 100 for set-up procedures.

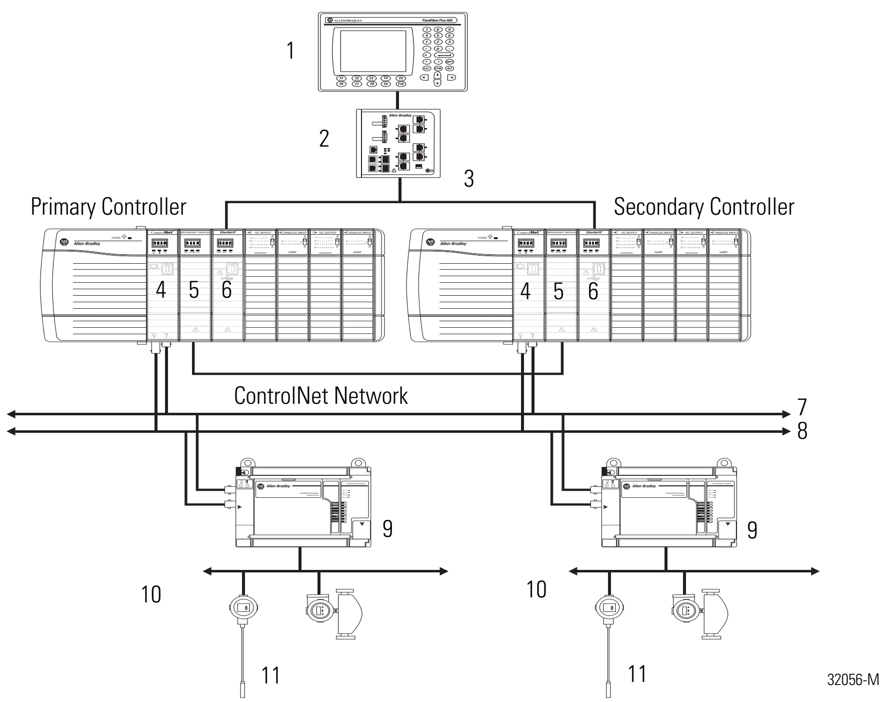
Redundancy Considerations

Redundancy on the ControlNet network provides for an increased level of protection by switching control to a secondary controller chassis if anything in the primary controller chassis fails. Media redundancy is achieved by installing devices with redundant ports and installing a second cabling system. In the event of a cable failure, the redundant network is used by the system.

The primary controller chassis automatically determines what data changes during its scan and sends that data to the secondary controller to keep it ready to immediately take over control without any change in the outputs. One of the basic considerations is the network update time (NUT) that specifies the switchover response time. A typical NUT used with a redundant system ranges from 5…10 ms.

For an EtherNet/IP network configuration, you should consider using IP address swapping between your partnered EtherNet/IP communication modules on the same subnet for a switchover. The partnered module must use the same values for the IP address, subnet mask, and gateway address.

Figure 10 - ControlNet Network Redundancy



Item	Description	Item	Description
1	HMI	7	Trunk cable A
2	Stratix 8000 switch	8	Trunk cable B
3	EtherNet/IP network	9	1757-FFLDC2 Linking device
4	1756-CN2R module	10	H1 segment
5	1756-Remote module	11	Field devices on separate linking device
6	1756-EN2T module		

As shown in Figure 10, the two trunk cables (A and B) should be routed that damage to one cable will not damage the other cable to reduce the chance of both cables being damaged at the same time. Also both cables' routing should be similar in distance and duplicate nodes for proper redundant cable operation.

When configured for redundant cabling on the ControlNet network, all nodes will simultaneously transmit and receive on both channel A and channel B. There is no distinction on the network between packets on channel A and channel B. Each node will independently decide which channel, A or B, it will listen to; this is based on historical counters that are internal to each node.

You can have as many as seven ControlNet communication modules in a redundant chassis. Each module must be in the **exact slot position** for the primary and secondary controllers. This duplicity provides seamless communication should there be a need to switchover to the other controller.

Equally important, redundant devices must be on separate 1757-FFLDC linking devices.

You can use the 1756-CN2R series B module for standalone or redundant control. For standalone control, only one module is required (as shown on page 28). For redundant control, a pair of 1756-CN2R modules are configured in the same slot position in both controllers (as shown on page 30).

An identical pair of 1756-EN2T modules link to the EtherNet/IP network and messages are controlled by a managed switch, such as a Stratix 8000 unit.

For more information referenced in this section, see the ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535.

Redundant Power Supplies and H1 Segments

Third-party devices are available to bolster redundant fieldbus operations with Rockwell Automation products. Back-up power supplies and power conditioners safeguard against a loss of power and provide alarms and diagnostics.

For example, Pepperl+Fuchs' Fieldbus Power Hub provides multiple redundant power supplies that can service up to four fieldbus segments.

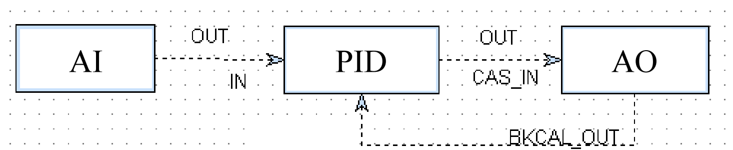
Notes:

Basic Usage of Function Blocks

Introduction

A function block is a named entity that has inputs, outputs, and parameters. It performs certain functions that command output parameters in accordance to instrument feedback, which are input parameters. These 'data building blocks' or 'encapsulated parameters' perform elementary control functions, such as analog input, analog output, discrete input, or discrete output. This enables a fieldbus device to transmit data between devices via algorithms contained in the function blocks.

You build a process control strategy by connecting the outputs of function blocks to the inputs of other function blocks. The blocks can be linked within a device or between devices. Data is then transferred via macrocycle schedules or event occurrences.



This section, as defined in the table, explains the basic usage of function blocks and the minimum configuration needed for basic control functionality.(1)

(1) Content within this section with permission from Fieldbus Foundation, http://www.fieldbus.org.

Basic Function Blocks

The three primary types of blocks are the following:

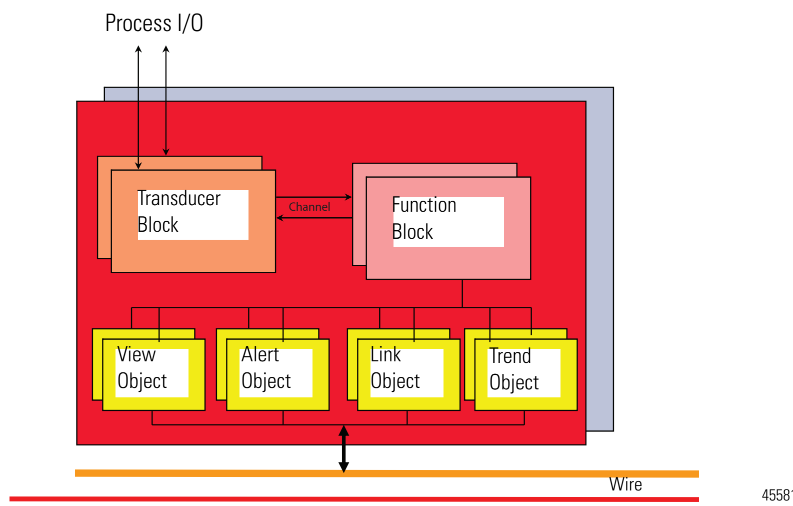
- Resource -defines the characteristics of the fieldbus device, such as the manufacturer name and serial number.
- Transducer - provides the interface between a manufacturer specific I/O and standard function blocks. It reads sensors and command outputs, and contains information, such as calibration date and sensor type.
- Function - defines the specific characteristics of the process control function. A single fieldbus device can include many function blocks to achieve the desired control functionality.

See page 35 for more information on the resource and transducer blocks.

Function blocks make it possible to build a control loop by using fieldbus devices that include the appropriate function block types. For example, a pressure transmitter that contains Analog Input (AI) and Proportional/Integral/ Derivative (PID) blocks can be used with a valve containing an Analog Output (AO) block to form a control loop.

Figure 11 illustrates how various objects are supported for monitoring and process control. Interoperation between function blocks is created by linking an output parameter of one function block to an input parameter of another. Function blocks can be linked together within and across field devices.

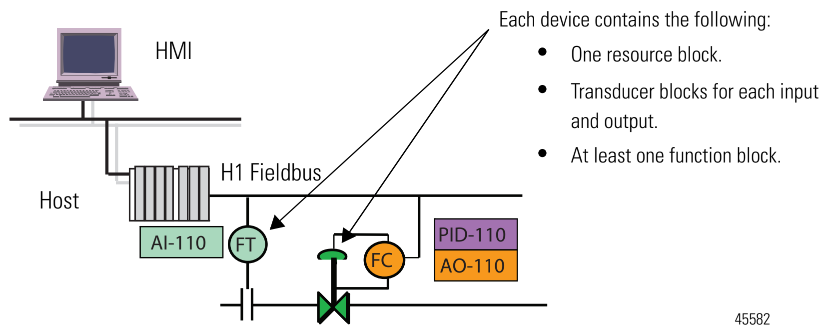
Figure 11 - Function Block Process



Fieldbus Foundation Function Blocks PowerPoint slides, Fieldbus Foundation, 9005 Mountain Ridge Drive, Bowie Building, Suite 200, Austin, TX., http://www.fieldbus.org.

The function blocks available in a device (see Figure 12) depend on the functionality provided by the device manufacturer.

Figure 12 - Function Blocks Connected for Deterministic Control



Fieldbus Foundation Function Blocks PowerPoint slides, Fieldbus Foundation,
9005 Mountain Ridge Drive, Bowie Building, Suite 200, Austin, TX., http://www.fieldbus.org.

Table 3 describes the blocks that are referenced in Figure 12.

Table 3 - Block Descriptions

Object	Description
Resource block (RES)	The resource block is the base block needed in all transmitters; only one is defined for each fieldbus device. It holds data specific to the device, such as the name, manufacturer, and serial number. A resource block contains an algorithm that is used to control and monitor the overall health and operational status of the device hardware. The algorithm may also generate events. You can change parameters but you cannot modify the block because its data is contained (no links to this block).
Transducer block (XDCR)	Field devices require at least one transducer block that allows the I/O blocks to access data on the wire and bring it into RSFieldbus software to be used for control loops. The transducer block also provides for running calibration and diagnostics for field devices. MODE_BLK and TERMINAL_NUMBER are parameters within the transducer block. Putting the MODE_BLK to AUTO allows the function block to be active upon download. TERMINAL_NUMBER reflects the physical wiring on a transmitter. Some transmitters have multiple inputs or outputs, so the parameter links the function block to the actual physical wires that have been placed on that terminal.
Function block	A function block represents the basic automation functions performed by the function block application. Each function block processes input parameters according to a specified algorithm and an internal set of control parameters. They produce output parameters that are available to use within the same function block application or by other function block applications.

In addition to the resource and transducer blocks, the list of required blocks include the following:

- Analog Input Block (AI)
- Analog Output Block (AO)
- Digital Input Block (DI)
- Digital Output Block (DO)

IMPORTANT	The majority of transmitters have the function blocks identified above, although some are not available in all field devices. There is seldom a need to have all the function blocks available in every field device. You should check the availability of function blocks with the instrument manufacturer and make sure the host system is compatible with the field device.

See page 40 for examples of these basic parameters.

Function Block Parameters

Parameters define the inputs, outputs, and control data for a block. Control parameters are also referred to as contained parameters because they may not be linked with parameters in other blocks.

Table 4 - Parameter Types

Type	Description
Contained	A contained parameter is a parameter whose value is configured, set by an operator, higher level device, or calculated. It may not be linked to another input or output block. Contained parameters are used to define the private data of a function block. Although visible over the network, they may not participate in function block links. The mode parameter is an example of a contained parameter common to all blocks.
Input	An input parameter obtains its value from a source external to the block. An input parameter may be linked to an output parameter of another function block. Its value may be used by the algorithm of the block. Input parameter values are accompanied by status. When an input parameter is linked to an output parameter, the status is provided as the status of the output parameter. When it is not linked to an output parameter, the status will indicate that the value was not provided by an output parameter. The difference between unlinked input parameters and contained parameters is that input parameters have the capability to support a link and contained parameters do not. Blocks whose purpose is to transform or operate on a single input will contain one parameter designed as the primary input parameter. Primary inputs are used for control or calculation purposes. These blocks may also contain secondary input parameters that support processing done on the primary input parameter.
Output	An output parameter is a parameter that may be linked to an input parameter of another function block. Output parameters contain status. The output status indicates the quality of the parameter value. The value of an output parameter may not be obtained from a source external to the block. It may be generated by the block algorithm. The values of certain output parameters are dependent on the value of the mode parameter (MODE_BLK) of the block. These output parameters may be referred to as mode-controlled output parameters. Blocks whose purpose is to generate a single output contain one parameter designed as the primary output parameter. Primary outputs are used by other blocks for control or calculation purposes. These blocks also contain secondary output parameters such as alarm and event parameters that play a supporting role to the primary output parameter.

Parameter Status

All input and output parameters are structures composed of status and value. Some contained parameters share that data type (for example, setpoint (SP) and primary value (PV).

Status has the following composition.

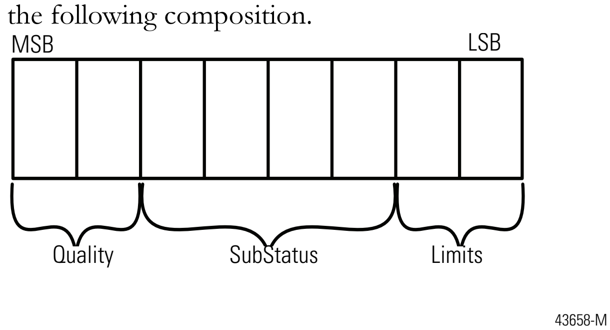


Table 5 - Composition of Status

Status	Description
Quality	Indicates the quality of the parameter value, based on the following: • Bad - The value is not useful. • Uncertain - The quality of the value is less than normal, but the value may still be useful. • Good Non-Cascade - The quality of the value is good, and the block doesn't support a cascade path. • Good Cascade - The quality of the value is good, and it may be part of a cascade structure.
Sub-status	Complements the quality status. Sub-Status data can be used to initialize or stop cascade control, to provide alarm information and to provide other more detailed information with respect to a particular data quality. There are different sets of sub-status for each quality.
Limits	Indicates if the associated value is limited or not, as well as the direction. The limits are classified as the following: • 0 = Not limited • 1 = Low limited • 2 = High limited • 3 = Constant

See Appendix A for a list of sub-status attributes.

MODE Block Parameter

The mode parameter (MODE_BLK) is defined in every function block. It's defined as having four elements that are described in Table 6.

Table 6 - MODE Block Descriptions

Element	Description
Target	This is the mode requested by the operator. Only one mode from those allowed by the permitted mode parameter may be requested. That check is done by the device.
Actual	This is the current mode of the block, which may differ from the target based on operating conditions and block configuration. Its value is always calculated as part of block execution, therefore, you cannot write in this attribute.
Permitted	These are the modes that are allowed for an instance of the block. The permitted modes are configured based on the application requirement. For example, if a PID block does not have a link for CAS_IN, then Cas mode can be configured as not permitted for that block.
Normal	This block should be set to this mode during normal operating conditions. The normal attribute is used as a reminder of the normal operating mode for the block. It does not affect the algorithm calculation.

Mode Types

Mode types determine how a mode operates. If it's not in the requested mode, the nearest mode is selected.

Table 7 - Modes of Operation

Mode Type	Description
Out of service (OOS)	The block is not executed. The output is maintained at last value or, in the case of output class function blocks, the output may be maintained at an assigned Fault State value - last value or configured Fault State value. Setpoint (SP) is maintained at last value.
Manual (MAN)	The block output is not being calculated, although it may be limited. The operator may set directly the outputs of the block.
Automatic (AUTO)	The normal algorithm calculates the block output. If the block has a setpoint, it is used as a local value that may be written by an operator through an interface device.

Putting Blocks in Auto

There are a few blocks that need some additional work to get them to go into AUTO. The Analog Output, Digital Output, Advanced PID, Splitter (multiple outputs from a single input), and Setpoint Generator all have an Initialization Manual (IMAN) status in the MODE_BLK parameter. This status is in response to the parameter BKCAL_ (OUT/IN) being used. It has to do with the handshaking between two blocks that need to be connected before the IMAN can be cleared. IMAN indicates a linking device is initializing or receiving a software download.

Mode Priority

The concept of priority is used when the block calculates the actual mode, and when determining if write access is allowed for a particular mode or other higher priority. The actual mode is derived when the block verifies there is no change to the mode with the next lowest priority.

Mode Calculation

The actual mode is calculated based on the following:

- Each mode type has some conditions that force the actual mode to be of higher priority than the target mode.
- Starting from the highest priority mode (OOS), the mode is analyzed by its corresponding conditions. If the conditions are present, then the actual mode will be this mode, otherwise it is necessary to check the conditions for the next lower priority mode (MAN, AUTO) until reaching the target mode. For example, if the target mode is AUTO, it is necessary to check the conditions for OOS and MAN, in this order. If all those conditions are false, the actual mode is the target mode.
- If the mode is OOS then the Resource block is in OOS or an enumerated parameter has an invalid value. If the actual mode is different from the target mode, check the resource block mode and all enumerated parameters.

Function Block Set Up

There are several things to keep in mind with regards to function block use. The sheer volume of individual transmitters available makes listing them all virtually impossible. The function blocks outlined in the remainder of this section let you put a device on the wire, access it through RSFieldbus software, and retrieve data.

Resource Block

Resource block data is not processed in the way that a function block processes data, so there is no function schematic.

Table 8 - Resource Block Parameters

Parameter	Valid Range	Default Value	Description
ST_REV	2 bytes	0	The revision level of the static data associated with the function block. The revision level will be incremented each time a static parameter value in the block is changed.
TAG_DESC	4 bytes	Blank	The user description of the intended application of the block.
STRATEGY	2 bytes	0	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	1 bytes, 1…255	0	The identification number of the plant unit. This information may be used in the host for sorting alarms, and so on.
MODE_BLK		OOS	Determines the block operating mode and available modes for a block instance.
BLOCK_ERR			This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
RS_STATE			State of the function block application state machine.
TEST_RW			Read/write test parameter - used only for conformance testing.
DD_RESOURCE		Blank	Not user configurable.
MANUFAC_ID		0x00014D	Manufacturer identification number - used by an interface device to locate the DD file for the resource block.
DEV_TYPE	Set by manufacturer		Manufacturer model number associated with the resource block - used by interface devices to locate the DD file for the resource block.
DEV_REV	Set by manufacturer		Manufacturer revision number associated with the resource block - used by an interface device to locate the DD file for the resource block.
DD_REV	Set by manufacturer		Revision of the DD associated with the resource block - used by an interface device to locate the DD file for the resource block.
GRANT_DENY		0	Not user configurable.

Table 8 - Resource Block Parameters

Parameter	Valid Range	Default Value	Description
HARD_TYPES	Set by manufacturer		Not user configurable.
RESTART	1: Run 2: Resource 3: Defaults 4: Processor 5: Factory	0	Allows a manual restart to be initiated. Several degrees of restart are possible.
FEATURES	Set by manufacturer		Used to show supported resource block options.
FEATURE_SEL		0	Used to select resource block options.
CYCLE_TYPE	Set by manufacturer		Identifies the event input types supported by the device, which invoke the execution of the device function blocks. • Scheduled - the blocks execute when a schedule event input is received from the LAS. • Block execution - the blocks execute when a block execution event input is received from another block that has just completed its execution. • Manufacturer specific - the blocks execute according to a manufacturer-specific schedule event input.
CYCLE_SEL		0	Used to select the block execution method for this resource block. This parameter is reserved for future use.
MIN_CYCLE_T	Set by manufacturer	0	Time duration for the shortest cycle interval of which the resource block is capable.
MEMORY_SIZE	Set by manufacturer		Available configuration memory in the empty resource. To be checked before attempting a download. This parameter is reserved for future use.
NV_CYCLE_T		0	Interval between writing copies of NV parameters to nonvolatile memory. Zero means never.
FREE_SPACE	0…100		Percent of memory available for further configuration. Zero in a preconfigured resource. This parameter is reserved for future use.
FREE_TIME	0…100		Percent of the block processing time that is free to process additional blocks. This parameter is reserved for future use.
SHED_RCAS		640000	Not user configurable.
SHED_ROUT		640000	Not user configurable.
FAULT_STATE	0: Uninitialized 1: Clear 2: Active	0	Condition set by loss of communication to an output block, failure promoted to an output block or a physical contact. When a fault state condition is set, then output function blocks will perform their configured actions.
SET_FSTATE	1: Off 2: Set	1	Allows the fault state condition to be manually initiated by selecting Set.

Table 8 - Resource Block Parameters

Parameter	Valid Range	Default Value	Description
CLR_FSTATE	1: Off 2: Set	1	Writing a Clear to this parameter will clear the device fault state if the field condition, if any, has cleared.
MAX_NOTIFY	Set by manufacturer	3	Not user configurable.
LIM_NOTIFY	0 to MAX_NOTIFY	MAX_NOTIFY	Not user configurable.
CONFIRM_TIME		640000	Not user configurable.
WRITE_LOCK	1: Not locked 2: Locked	1	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated.
UPDATE_EVT			This alert is generated by any change to the static data.
BLOCK_ALM			The block alarm is used for all configurations, hardware, connection failure or system anomalies in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
ALARM_SUM			The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
ACK-OPTION	0: Auto ACK Disable 1: Auto ACK Enable	0	Selection of whether alarms associated with the block will be automatically acknowledged.
WRITE_PRI	0…15	0	Priority of the alarm generated by clearing the write lock.
WRITE_ALM			Alert is generated if the write lock parameter is cleared.
ITK_VER			This parameter specifies to which ITK version the device is certified (only for certified devices).
ENP_VERSION			Version number of the electronic nameplate.
DEVICE_TAG			Device tag downloaded from the project to the device.
SERIAL_NUMBER			Manufacturer's serial number for the device.
ORDER_CODE			Manufacturer's order code for the device.
FIRMWARE_ REVISION			Revision number of the device firmware.
MS_RESOURCE_ DIRECTORY			Array describing the grouping of the enhanced parameters (not relevant to operation).

Block Errors

The BLOCK_ERR of the resource block indicates the following causes for the error:

- Device Fault State Set - When FAULT_STATE is active.
- Out of Service - When the block is in OSS mode.
- Block Configuration Out of Service - Incorrect parameter value or uninitialized value for a parameter that requires a value or selection for the block to operate.

Transducer Block

The transducer block has three main purposes:

- Contains parameters that identify the device and software
- Provides a standardized signal to an analog input block for use with measuring devices
- Processes a standardized signal provided by an analog output block for actuating devices

The CHANNEL parameter links the transducer and analog input blocks. If there are multiple devices, each process variable is assigned a different channel number. The device provides an equal number of input blocks for use in the control strategy.

Analog Input (AI) Block

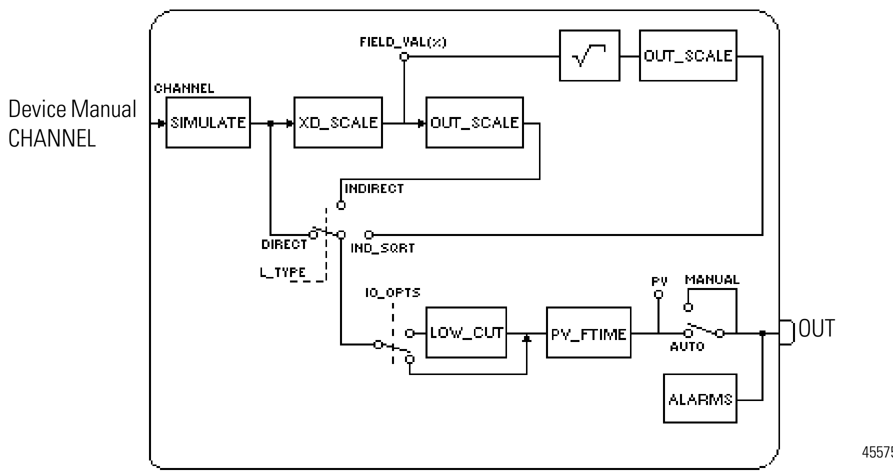
The Analog In (AI) function block takes the input data from a transducer block, such as scaling and square root, and calculates an output to be fed to other fieldbus function blocks.

An AI block must be created for each process value required in a control strategy.

Important parameters within the I/O blocks are the MODE_BLK and CHANNEL. Putting the MODE block to AUTO allows the function block to be active upon download.

CHANNEL is the I/O block equivalent of the transducer's TERMINAL_NUMBER. When the CHANNEL parameter is equal to the TERMINAL_NUMBER, data will flow from the physical transmitter wires to the I/O blocks and from the I/O blocks to the transmitter wires, eventually then to the device.

Figure 13 - AI Block Diagram Example

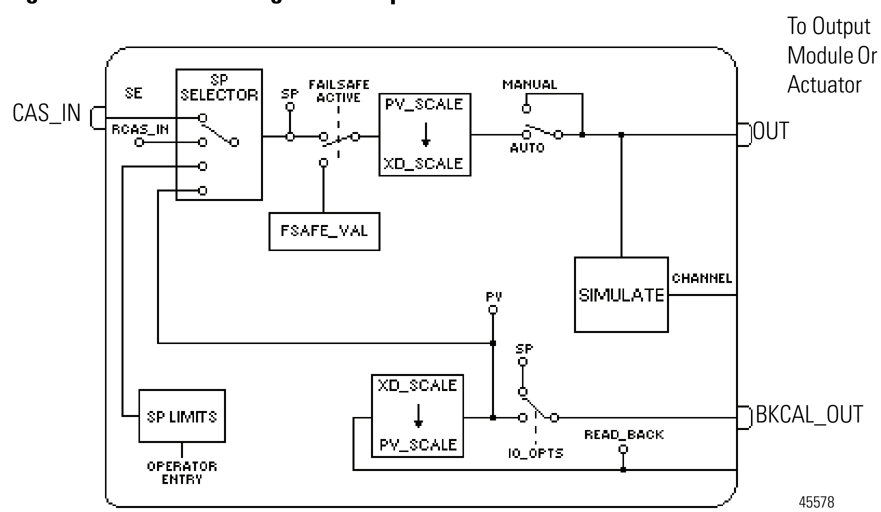


For descriptions of parameters that comprise the function blocks shown throughout this section, see Guideline FOUNDATION Fieldbus Function Blocks, Endress+Hauser, BA062S/04/en/07.09.

Analog Output (AO) Block

The Analog Out (AO) block receives and tracks the control value from a control block and outputs a signal. The current control value is sent back to the control block to determine the next control value. The control value from the controller becomes the setpoint (SP), or target value.

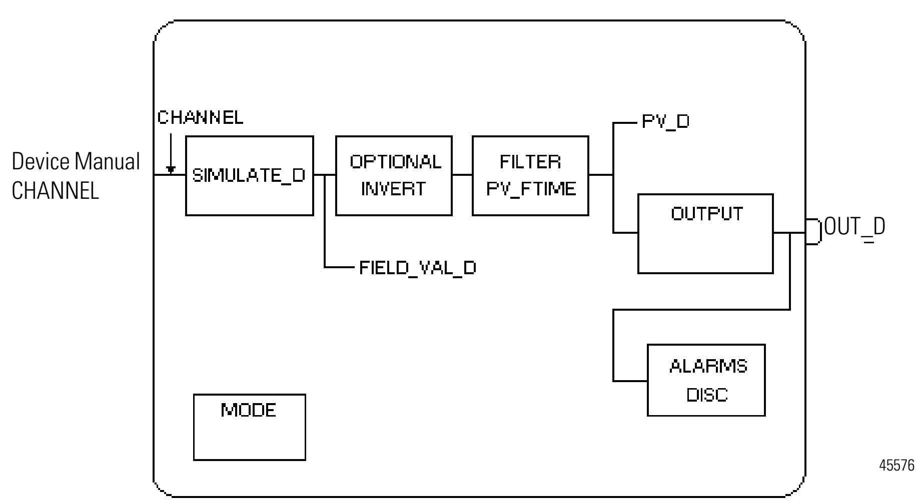
Figure 14 - AO Block Diagram Example



Discrete Input (DI) Block

The Discrete Input (DI) block takes a discrete signal and sends an output parameter.

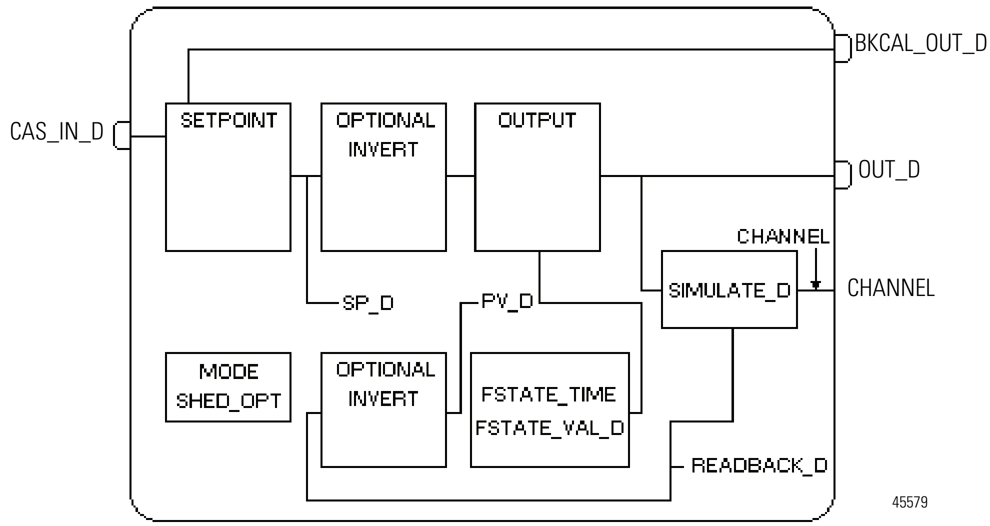
Figure 15 - DI Block Diagram Example



Discrete Output (DO) Block

The Discrete Output (DO) block converts the discrete setpoint value for the hardware being used and outputs a signal.

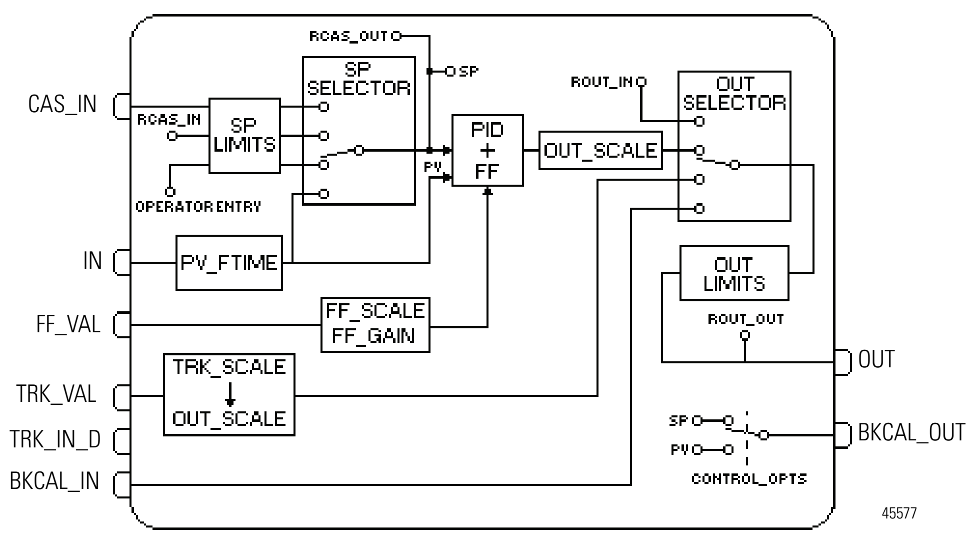
Figure 16 - DO Block Diagram Example



PID Control Block

The proportional, integral, derivative (PID) block attempts to correct a deviation between a measured process variable (PV) and setpoint (SP) by fixing the variable and sending a corrective action that adjusts the process.

Figure 17 - PID Block Diagram Example



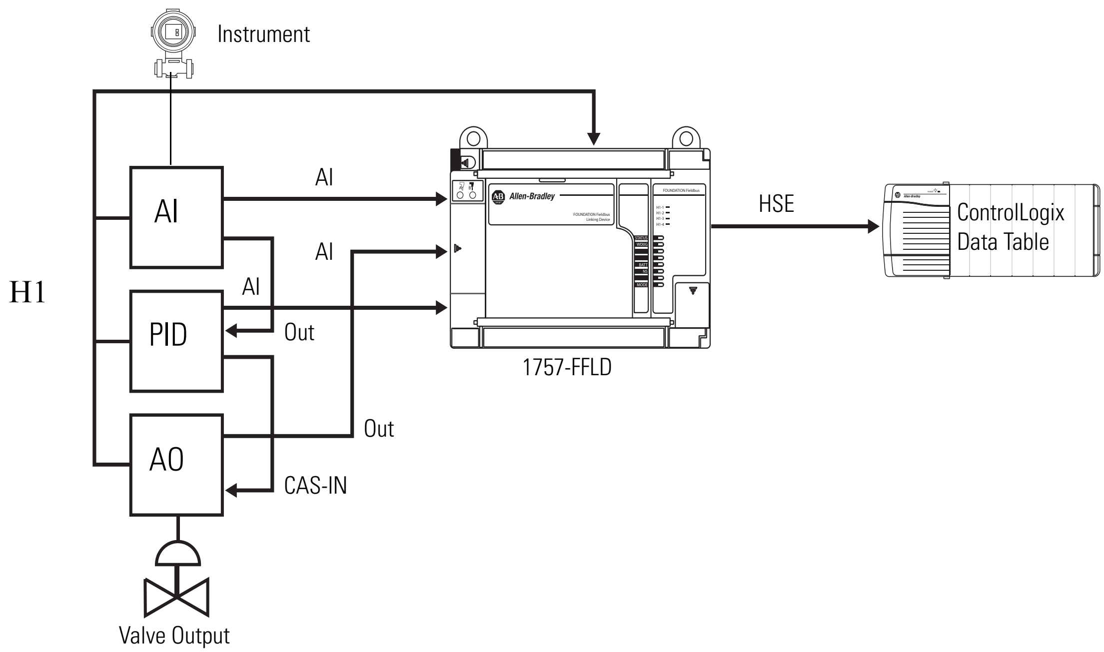
Refer to PID Guide on page 104 for more block examples.

Distributed Function Blocks

This process involves function blocks controlling different devices on the same H1 segment. One function block links to another function block that links to another function block, and so forth, to control the process.

Distributed function blocks do not depend on the linking device or the controller. The controller is a data collector only; used along with the linking device to set up the function block links.

Figure 18 - Distributed Function Blocks Example



Differences Between Configuration and Calibration

Configuration is the process of setting parameters in function blocks so that information processed from the I/O subsystem in the transducer block is made available to other function blocks.

Calibration is the process of adjusting certain device parameters so that the physical quantities measured meet an established standard for accuracy.

Calibration Parameters in the Transducer Block

Calibration parameters are located in the transducer function block because it's the interface between the physical measuring unit (I/O subsystem) and the other function blocks. Transducer blocks configure devices and decouple function blocks from the local input/output functions required to read sensors and command output hardware. They contain information such as calibration data and sensor type.

Figure 19 - Relationship of the Transducer Block to Other Input Function Blocks

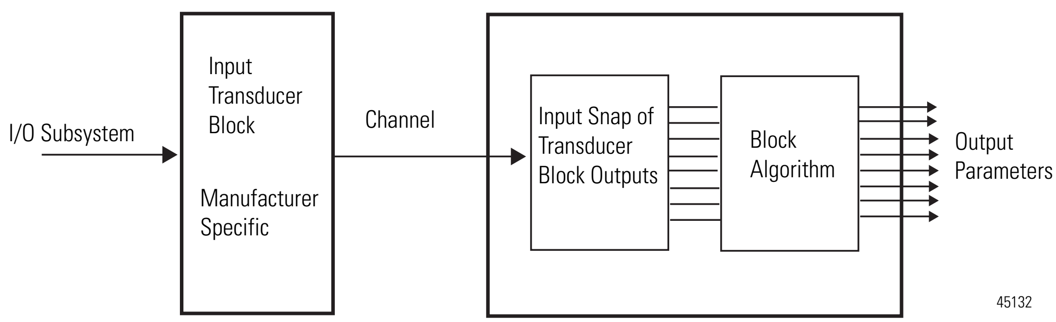
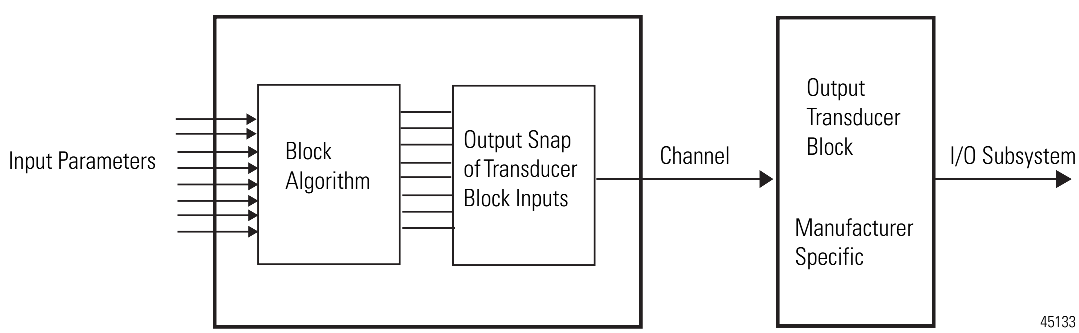


Figure 20 - Relationship of Output Function Blocks to the Transducer Block



Virtual Communication Relationships (VCRs)

Virtual Communication Relationships (VCRs) are communication links on an H1 network. A VCR transmits the algorithm that is contained in each function block. A total of 256 VCRS are possible for a linking device with up to four H1 segments or 128 VCRs for two H1 segments.

These VCRs are restricted to 64 per H1 channel. This is further restricted to 64 VCRs going to the Control Logix processor from H1 devices (publishers), and 64 VCRs coming from the Control Logix processor to H1 devices (subscribers).

These restrictions limit the number of inputs and outputs within an H1 line. However, there is no restriction on the type of signals. They can all be analog, all discrete, or a mixture of the two.

If the VCR limit is exceeded, a download still is permitted, although when the download reaches the 65th VCR, a 'download failure' occurs. The first 64 VCRs still are in place, but the 66th does not exist.

VCR Classes

The FOUNDATION Fieldbus specification Fieldbus Access Sublayer (FF-875-1.4) defines three classes of VCRs that are possible for communication with an H1 field device. These classes are the following:

- BNU: Buffered Network-Scheduled Unidirectional
- QUU: Queued User-triggered Unidirectional
- QUB: Queued User-triggered Bidirectional

	BNU	QUU	QUB
Permitted Roles	Publisher, Subscriber	Source, Sink	Client, Server, Peer
Conveyance Paths	1	1	2
Conveyance Policy	Buffered	Queued	Queued
Transmission Policy	Network Scheduled	User Triggered	User Triggered

The quantity of each class of VCR that is available for configuration and communication is device dependent. The quantities are specified in the DD files, which are provided with each device.

The table shows an example of the quantities defined in a DD file.

Table 9 - Example VCR DD File

//From VcrListCharacteristics		
MaxEntries	= 44	
NumPermanentEntries	= 44	
DynamicsSupportedFlag	= FALSE	//Rev 1.5
StatisticsSupported	= 0x0	//Rev 1.5
MaximumNumberOfClientVcrs	= 0	

Table 9 - Example VCR DD File

//From VcrListCharacteristics	
MaximumNumberOfServerVcrs	= 5
MaximumNumberOfSourceVcrs	= 8
MaximumNumberOfSinkVcrs	= 0
MaximumNumberOfPublisherVcrs	= 19
MaximumNumberOfSubscriberVcrs	= 12

As can be seen, the quantities are broken into sub-categories depending on usage. The above example states that the device can have more publisher BNU than subscriber BNU. Additionally, the device has no client QUB VCR, but it has the ability to serve 8 server QUB VCR. Currently, these limits manifest themselves in either download or communication errors when they are exceeded.

There is also a nuance to the quantities that need to be emphasized with regard to linking devices. Table 10 shows the 1757-FFLD *.cff file as an example.

Table 10 - Example 1757-FFLD *.cff File

//From VcrListCharacteristics		
MaxEntries	= 44	
NumPermanentEntries	= 44	
DynamicsSupportedFlag	= FALSE	//Rev 1.5
StatisticsSupported	= 0x0	//Rev 1.5
MaximumNumberOfClientVcrs	= 0	
MaximumNumberOfServerVcrs	= 5	
MaximumNumberOfSourceVcrs	= 8	
MaximumNumberOfSinkVcrs	= 0	
MaximumNumberOfPublisherVcrs	= 64	
MaximumNumberOfSubscriberVcrs	= 64	

You would be under the impression that there are 64 publishers and 64 subscribers available. This is both correct and incorrect at the same time. You can correctly use the total quantity, but it must be evenly distributed among the four H1 channels that the linking device uses. In other words, each channel owns 16 publishers and 16 subscribers. The 16 publishers and 16 subscribers are dedicated to each channel; they cannot be shared if not used by one particular channel.

BNU Class

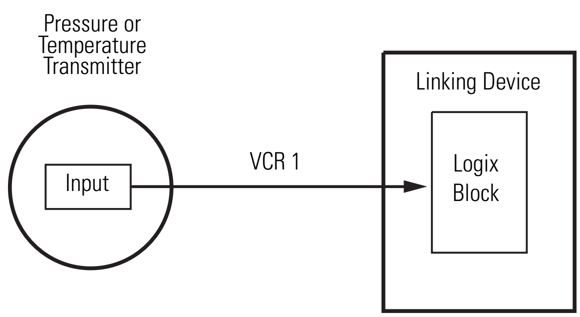
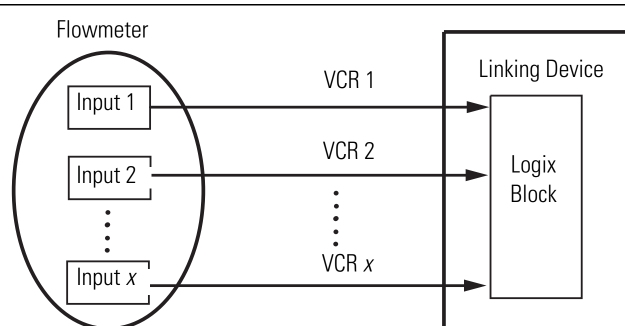
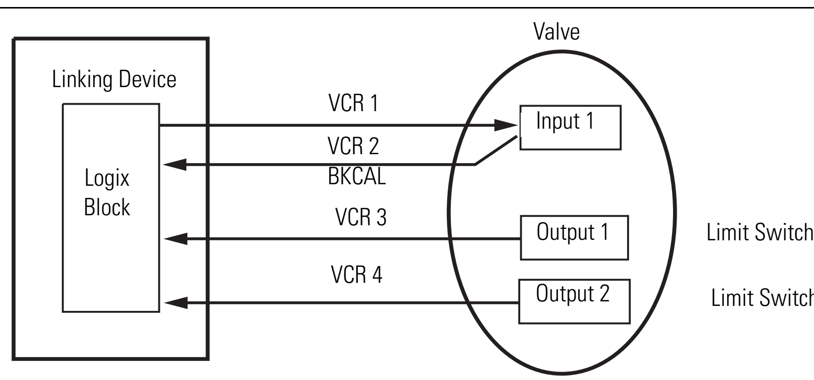
The VCR BNU class is defined as scheduled. It occurs on a synchronous basis within the macrocycle schedule. During the scheduled portion of FOUNDATION Fieldbus communication, when the devices receive the Compel Data token, this is the class of communication that occurs.

The BNU VCR is part of the function block strategy that transfers data from one function block to another.

This class can be further defined as the link between function blocks. More specifically, the BNU VCR is the unique link between function blocks in different devices. Links between function blocks within a device do not use a BNU VCR. Also, links that are used multiple times, or fanned out, between the same devices are not considered unique.

The connection of the link from one function block to another in a different device will be counted based on its point of origin. The originating device will consume a publisher VCR, whereas the receiving device will consume a subscriber VCR.

Figure 21 - VCR Examples

Example	Linking Device VCR Count	Diagram
Basic input device	1 input (PV) = 1 VCR (subscriber) total VCRs = 1 subscriber	
Complex input device	*x* inputs (PV) = *x* VCRs (subscribers) total VCRs = *x* subscribers	
Output device	1 output (PV) = 1 VCR (publisher) + 1 VCR (subscriber) from BKCAL 2 inputs (PV) from Limit Switch = 2 VCRs (subscribers) total VCRs = 1 publisher 3 subscribers	

QUU and QUB VCR Classes

The QUU and QUB VCR classes are defined as user triggered. During the unscheduled portion of FOUNDATION Fieldbus communication, these are the class of communication that occur when the available time is sensed by the devices. QUU and QUB communication takes place when the Link Active Scheduler passes the token to the devices, allowing them to communicate.

The QUU class can be defined as the reporting link with function blocks. Specifically, the QUU VCR is used to report contained parameter values in function blocks, such as alarms and change of state. HMI information such as alarm conditions and device calibration data uses this type of configuration with an existing strategy.

The QUB class can be defined as the command link with function blocks. More specifically, the QUB VCR is used to change contained parameter values in function blocks, such as Mode or setpoint. HMI interaction via a faceplate or a configuration tool uses this type of communication with an existing strategy.

Because the QUU and QUB VCR use the asynchronous portion of the macrocycle, enough time must be made available. The focus during configuration is to make the macrocycle as small as possible to allow function block execution to occur quickly. Minimizing the asynchronous portion of the macrocycle will adversely affect QUU and QUB VCR from taking place, because that time must also be used for housekeeping activities such as probe nodes.

If there is an expectation of increased communication with devices, either from a control or HMI monitoring standpoint, then the macrocycle should be increased. This is to be done with the understanding that the function block cycle time will be increased as a consequence. Therefore, judicious choice of macrocycle times must be exercised to allow effective QUU and QUB communication.

Plan and Configure a Fieldbus System

Introduction

Fieldbus Foundation linking devices and RSFieldbus configuration software extend the distributed process control capability of Rockwell Automation's integrated architecture. With the 1757-FFLD for EtherNet/IP, or the 1757-FFLDC for ControlNet network applications, you have the flexibility to do process control with any Logix5000 controller while using the advanced capabilities of network-based process instrumentation.

So how many fieldbus devices can be added to each H1 segment? How does that number affect software licenses?

This chapter examines how to efficiently construct a plan that defines segment requirements. Once you've decided your process control strategy, configuration instructions are provided to establish the fieldbus system by using RSFieldbus and RSLogix 5000 programming software.

The table lists the main topics included for quick reference.

Layout Sizing

In general, 8…10 field devices can be placed on a segment loop to accommodate the length of cycle times and housekeeping on the network bandwidth.

You can configure multiple projects with one RSFieldbus installation license. Each single project can have several 1757-FFLD or FFLDC linking devices. But, if your project requires multiple site installations, multiple licenses must be purchased.

IMPORTANT	Rockwell Automation does not support multiple HSE servers on the same network. Therefore, do not open multiple RSFieldbus projects because more than one instance of the HSE server will open.

One Logix5000 controller can operate multiple fieldbus linking devices.

With this in mind, let's say a project consists of three Process Areas. Area 1 has 100 devices, Area 2, 100 devices, and Area 3, 250 devices.

If we apply either a 1757-FFLD or 1757-FFLDC linking device with four H1 segments, and assume an average of eight fieldbus devices per H1 segment, Area 1 and 2 will each require 13 H1 segments (100/8=13). That's equivalent to four, 1757-FFLD4 or seven, 1757-FFLD2 linking devices. The numbers 2 and 4 at the end of the linking device's catalog number represent the number of available H1 segments.

Area 3 will require 250/8=32 H1 segments that correspond to eight, 1757-FFLD4 linking devices. If a decision is made to have up to three, 1757-FFLD4 linking devices per RSFieldbus project, it corresponds to 12 H1 segments or approximately 96 fieldbus devices (using our average of 8 devices per H1 segment).

Each RSFieldbus license is based on the maximum number of function blocks per project. There are three levels of function blocks—64, 256, 1024. Assuming a minimum of 3 function blocks per device, and using our example above of 96 devices, you would need 288 (96 x 3) function blocks. Therefore, you could purchase an RSFieldbus license with 1024 function blocks.

The number of linking devices will depend on the geographical location of field devices. But, the formulas used in these examples can aid in estimating the number of instruments and function blocks for your system.

Network Basics

In addition to the hardware and software, there are two networks to be considered when configuring an application:

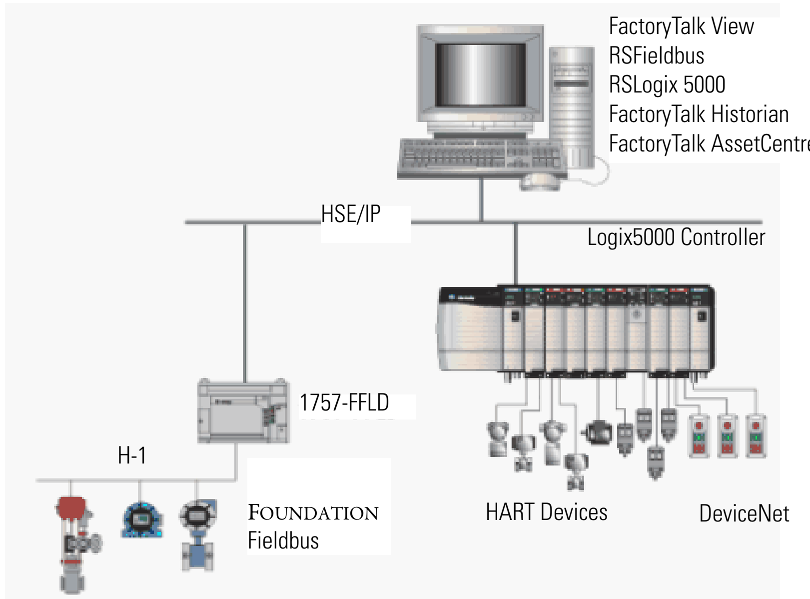
- HSE
- H1

High-speed Ethernet (HSE) is the Fieldbus Foundation's backbone network that can run on standard Ethernet physical media. An HSE field device is a fieldbus device connected directly to a High-speed Ethernet (HSE) fieldbus. Typical HSE field devices include HSE linking devices, HSE field devices running function blocks, and the host computers.

H1 Fieldbus is a digital, serial, multidrop data bus for communication with industrial devices or systems. A bus segment consists of at least a fieldbus power supply, devices, and a trunk cable with a terminator at each end to eliminate reflections (noise) along the line.

The H1 Physical Layer provides for transparent transmission of data between Data Link Layer entities across physical connections. See Figure 22 on page 55 for an example.

Figure 22 - Fieldbus System Example



The 1757-FFLD linking device bridges both the FOUNDATION Fieldbus HSE and Ethernet/IP networks to FOUNDATION Fieldbus H1 device networks. Connecting these networks facilitates information flow between the control layers. Transferred information can include device configuration (for example, operational and diagnostic data) and plant floor process information (for example, temperature and pressure data).

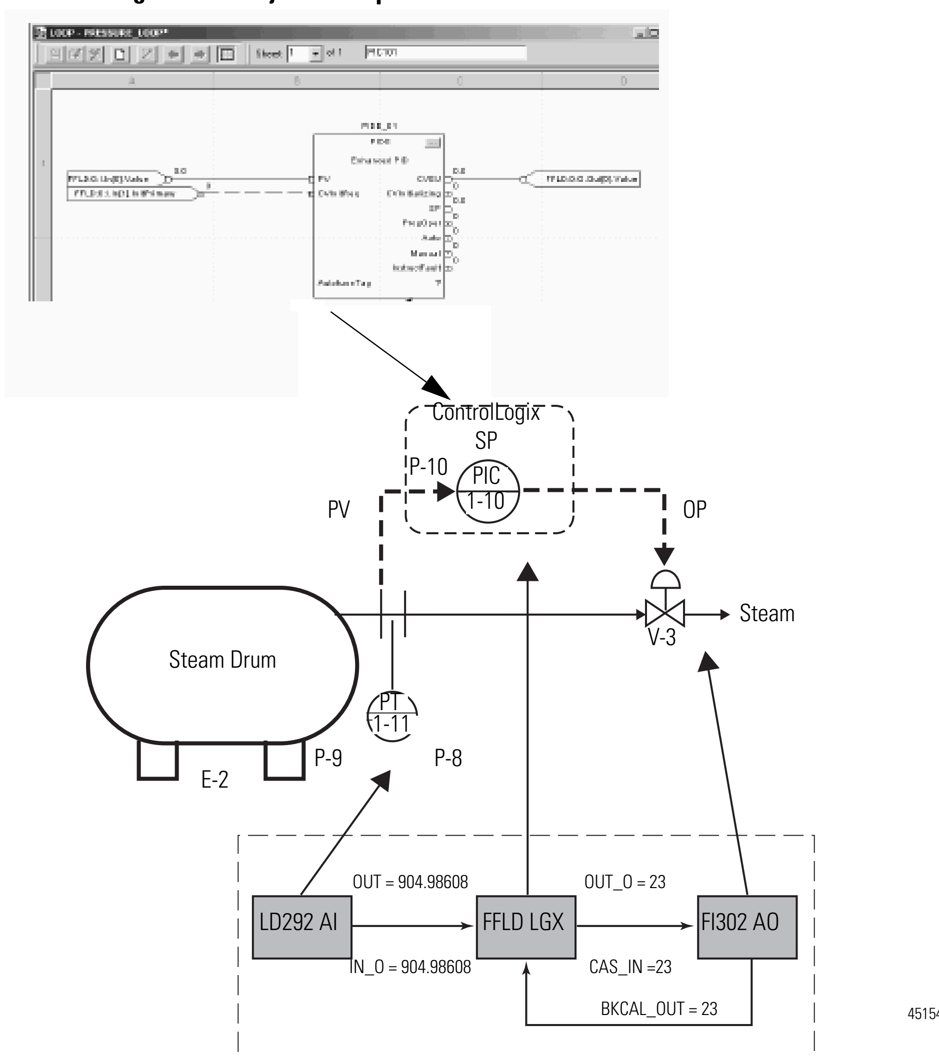
The majority of fieldbus projects involve loop control of process, in which the input from a transmitter is compared with a desired setpoint and the controller is then adjusted to meet the desired state. The standard Proportional, Integral and Derivative (PID) function block is precisely designed to achieve this type of process control.

The strategy shown in Figure 23 on page 56 uses the fieldbus devices as I/O modules and the ControlLogix controller as the PID controller.

The example shows the 1757-FFLD linking device communicating with a Smar FI 302 temperature transmitter and a Smar LD 292 pressure transmitter to send and receive data from the Logix controller.

Therefore, RSFieldbus software and RSLogix 5000 programming software must be installed on your host computer to initiate and maintain FOUNDATION Fieldbus projects. Figure 23 shows an example of a function block in RSLogix 5000 software followed by a control strategy in RSFieldbus software.

Figure 23 - Project Example



SP stands for setpoint; the target value for the AI function block. See page 44.

The procedures on the following pages describe how to initiate a process control system. This is only an example; your application likely will include different instrumentation but the procedures are similar.

Create an Application

This section is divided into three parts for a better understanding of how to initiate a fieldbus system:

- Create a New RSFieldbus Project
- Initiate a ControlLogix Control Strategy
- Set Up FactoryTalk View Software

You should have your plans and drawings for the fieldbus segments and hardware requirements (including the number of devices) completed before starting configurations. RSFieldbus and RSLogix 5000 software also should be installed on your host computer.

Here are additional considerations before setting up a system:

- For greater reliability, one Link Master capable device should be installed on each H1 network as a back-up LAS. Please design for this if you are doing 'control on the wire'. If control is on the host system, all devices should be set to Basic. See page 65.
- Redundant transmitters should be installed in separate H1 networks, preferably in separate linking devices.
- Each H1 segment should have a separate fieldbus power supply. As a recommendation, a maximum of eight power conditioners can be used with one bulk power supply.
- Each linking device should have a separate power supply.
- Factory Acceptance Tests (FATs) can be completed on a fieldbus system to verify graphics, database, power, communication, and other system integration features and functions. For more information on FATs, see the System Engineering Guidelines, publication AG-181.

Create a New RSFieldbus Project

Do these steps to initiate an RSFieldbus project.

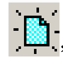
1. To open RSFieldbus software, click Start>Programs>Rockwell Software>RSFieldbus>RSFieldbus.

   There is a choice for a demo license that lets you create a limited number of function blocks. In the non-demo mode, you must activate a license. The Licensing System Information window shows how many blocks are licensed on your system.

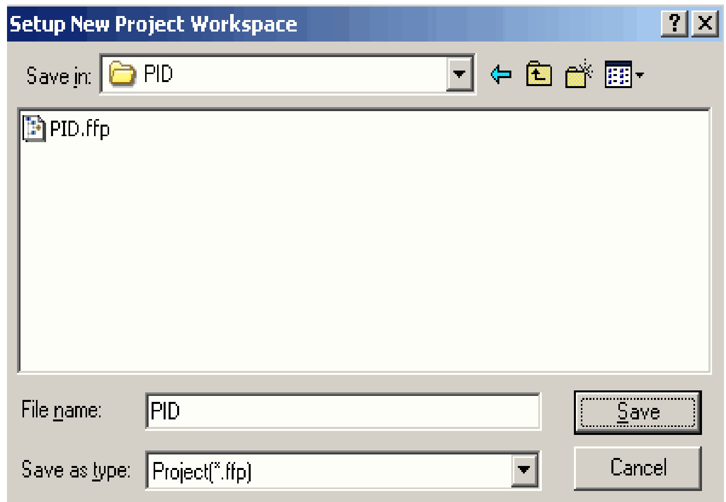
IMPORTANT	When choosing an RSFieldbus license, keep in mind that a typical device requires a minimum of three blocks (Resource, Transducer, and process control) with an average of five blocks used. For example, a 64-block RSFieldbus license will support approximately 21 devices. Any device that requires more than three blocks will reduce the number of supported devices.

2. Click OK.

   The RSFieldbus window appears.

3. Click New icon , and choose Project.

   The Setup New Project Workspace dialog box appears.



4. Type a project name for the File name.

   Our example shows PID.

5. Click Save.

   The Setup New Project Workspace dialog box displays the File name, with an '.ffp' extension for FOUNDATION Fieldbus project.

Define the Server

Do these steps to define the OLE Process Control (OPC) server that stores field device data.

1. In the Setup New Project Workspace dialog box, double-click the file name with the .ffp extension.

   In our example, it would be PID.ffp.

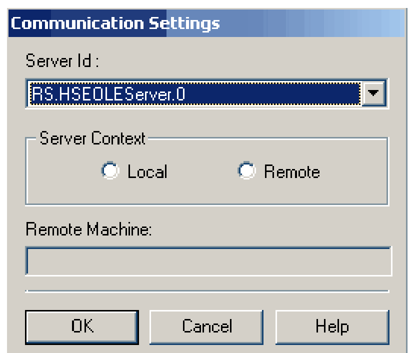
   A Project window appears to define your computer as the HSE Host and the bridge from RSFieldbus software to your HSE fieldbus devices. The HSE Host has also been designated as the Link Master.

IMPORTANT	You cannot have two workstations running RSFieldbus software with the HSE host defined locally and connected on the same network.

- Area 1 contains the process cell that contains the function block logic. This is where the logical component of the project is created.
- Fieldbus Networks is where the physical bridges and devices are found. This is where the physical component of the project is created.

2. In the Project window, right-click Fieldbus Networks and choose Communication Settings.

   The Communication Settings window appears.



3. Verify the settings are the same as the window shows, and click OK.

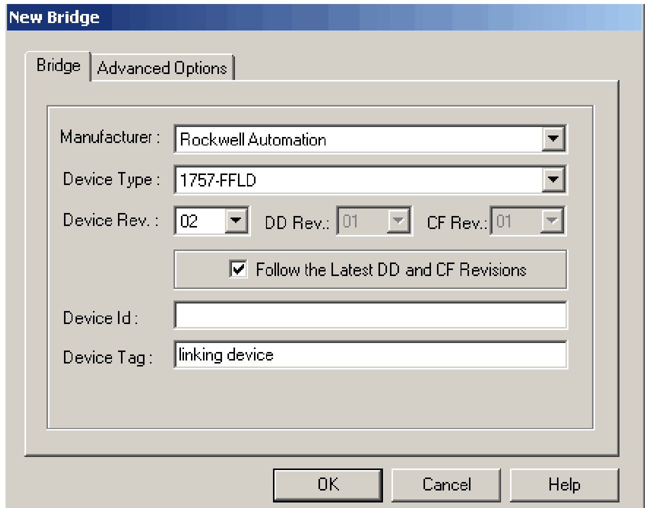
Create a New Bridge (Linking Device)

This section defines the linking device as the bridge from HSE to your H1 field devices. You can add a bridge in either the Project window or the HSE window, this example shows the former.

Do these steps to create a new bridge.

1. In the Project window, right-click HSE Network 1 and choose New>Bridge.

The New Bridge dialog box appears.



2. Select the settings for the linking device you are using (as shown in the above example).

IMPORTANT	Be sure that the Device Rev and DD Rev match the version of linking device and revision of firmware that you are using.

3. In the Device Tag box, type a tag name for the bridge.

   If you do not enter a tag, the default tag is Bridge_#.

   You must give each device a tag name to differentiate between devices on the same H1 segment. Tags cannot include a '.' (period). If a separator is necessary, we suggest using an '_' (underscore). Spaces are allowed, but not recommended.

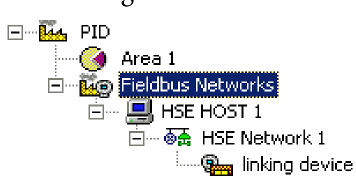
   Observe the 'Follow the Latest DD and CF Revisions 'box is checked. You need the device support files to configure a device. A device description (DD) file contains parameters for each device type. A capabilities file (CF) contains the resources available for creating function block applications.

4. Click the Advanced Options tab.

   Keep the default of 'Creation based on Default Template.' For more information on templates, see the FOUNDATION Fieldbus User Manual, publication 1757-UM012.

5. Click OK.

   The linking device is added to the HSE Host.

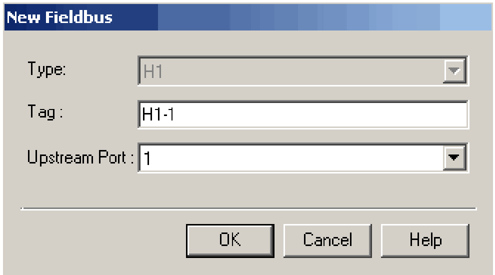


Create a New Fieldbus (H1)

Do these steps to associate the fieldbus with the H1 segment.

1. In the Project window, right-click the linking device and choose New Fieldbus.

The New Fieldbus dialog box appears.



2. In the Tag box, type a tag for the H1.

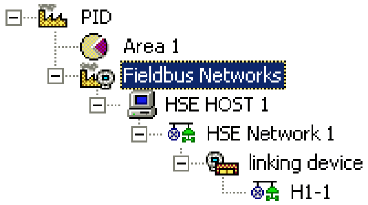
   If you do not enter a tag, the default tag is Fieldbus #.

   The linking device has 2 or 4 H1 ports. We recommend that you name them according to their port number. For example, H1-1 indicates that this is Upstream Port 1.

3. Select the Upstream Port (H1 port) on the linking device to which the H1 segment is connected.

4. Click OK.

   The Fieldbus (H1) is added to the Project.



Set the Macrocycle

A macrocyle is the automatically calculated time by RSFieldbus software for a fieldbus device to send and receive data. In many cases, you will have to increase the macrocycle time because the calculated time may be too short. Increasing the macrocycle time gives you more time for background traffic, such as downloading, monitoring, assigning tags, and other commissioning tasks.

IMPORTANT If the macrocycle time is too short, you will receive a failure when you attempt to download and you may not be able to add devices to the network.

To facilitate commissioning activities, the macrocycle can be set to 1000… 2000 ms. After all the devices are commissioned and operating and the strategy is downloaded, the macrocycle can be reduced.

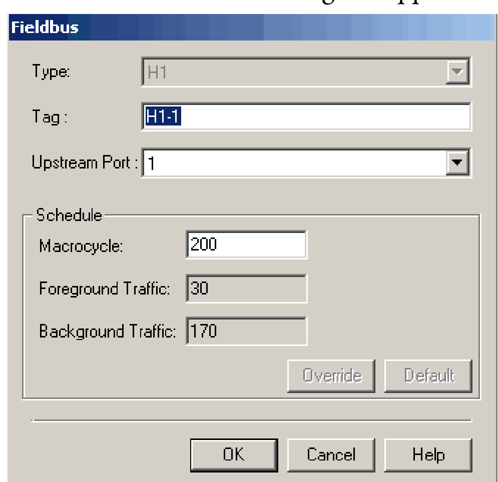
If more unscheduled time is needed, increase the macrocycle. The unused scheduled time will be used for the unscheduled activities.

1. In the Project window, double-click H1-1 (or what you named the tag).

   The H1 dialog box appears.

2. Right-click H1-1 and choose Attributes.

   The Fieldbus attributes dialog box appears.



3. Type a macrocycle time (in milliseconds) and click OK.

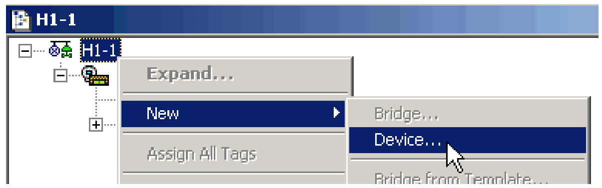
TIP The new macrocycle time will not take effect until the H1 segment is downloaded.

To determine a stale count, see the FOUNDATION Fieldbus System User Manual, publication 1757-UM012.

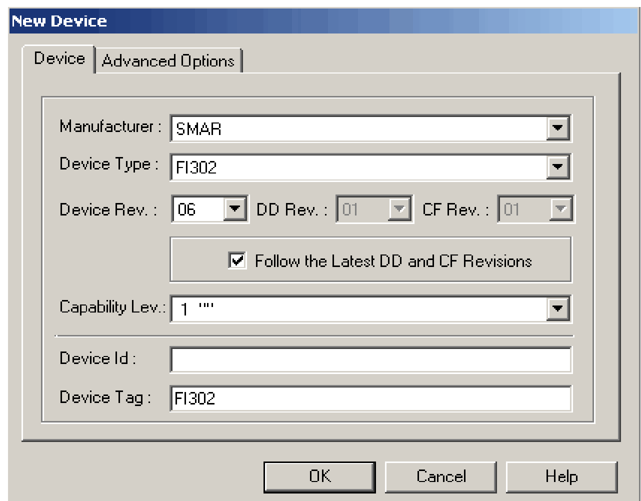
Add Devices

Do these steps to add devices to the H1 network.

1. In the Fieldbus (H1) window, right-click the H1 icon, and choose New>Device.



The New Device dialog box appears.



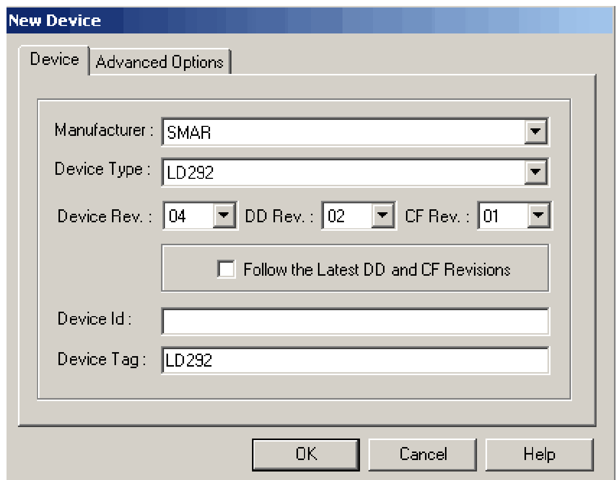
2. Configure the device by entering information in the New Device dialog box.

Field	Description
Manufacturer	Choose a manufacturer from the pull-down menu.
Device Type	Choose a device type from the pull-down menu.
Device Rev	Choose the device revision. **Note:** The DD and CF values default to the latest revisions in the device support files if the 'Follow the Latest DD and CF Revisions' box is checked. If the DD and CF revisions do not match your device firmware, clear the box and choose the correct revisions.
Capability Level	Defaults to the capability of the instrument.
Device Tag	Type a Device Tag. If you do not enter a tag, the default tag is Device_#.

IMPORTANT	If the correct revisions are not listed, the correct DDs need to be imported. Refer to Device Support in the FOUNDATION Fieldbus System User Manual, publication 1757-UM012. If you do not match the correct revisions with your device firmware, you receive a warning on download. Incorrect DD files will cause download failures, which results in the project configuration not functioning for that device.

3. Repeat step 1 and step 2 for additional devices.

   For our example, we typed LD 292for the Device Type and LD292 for the Device Tag.

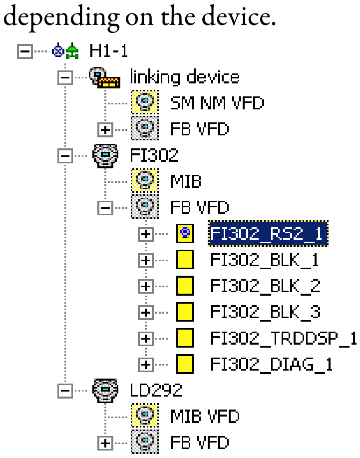


4. Click the Advanced Options tab.

   Keep the default of 'Creation based on Default Template.' For more information on templates, see the FOUNDATION Fieldbus System User Manual, publication 1757-UM012.

5. Click OK.

   Devices are added to the H1 and a set of function blocks are added as well. This set includes a Transducer and Resource block, and may include others depending on the device.



Change Device Class to Back-up LAS

Set up devices to Basic if you are controlling output devices by using the PlantPAx controllers. Otherwise, a back-up LAS should be used.

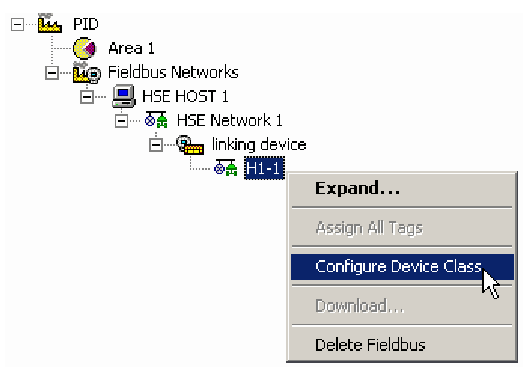
This procedure enables you to configure the device class of all the devices in the project at the same time. You must be online for this task.

ATTENTION: During this procedure, control of the associated devices and anything linked to them will be lost.

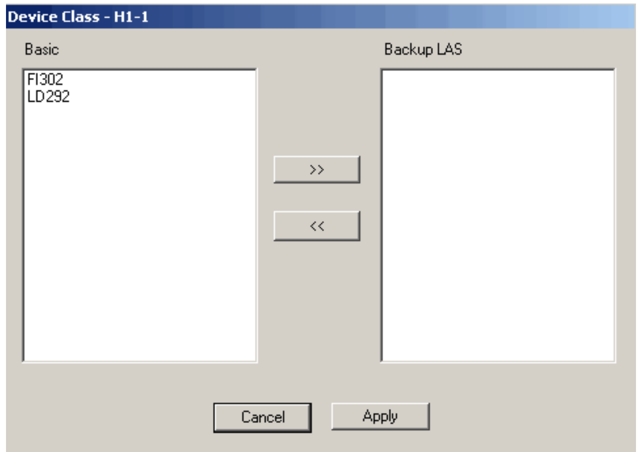
Do these steps to configure the device class to back-up LAS.

IMPORTANT	We recommend that you open the Live List to verify the current device class of the devices on the network. If a device is added to the project that is already configured as a Link Master, you **must** complete this procedure to keep that configuration. If you do not add the device to the Back-up LAS list it will be returned to Basic when you complete the device configuration for other devices. Also, if you do not complete this procedure for preconfigured Link Masters, there will be a mismatch error during download and the project will not be downloaded.

1. Right-click the H1 icon and choose Configure Device Class.



The Device Class dialog box appears.



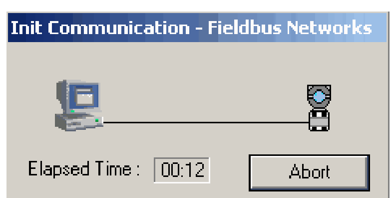
2. Select the device that you want to change to a back-up LAS and click the right arrow .
3. Repeat for any other devices that you want to change to a back-up LAS.
4. Click Apply.

Initialize Communication and Associate the Linking Device

Before continuing, click Window and choose Tile to make all windows visible at the same time.

1. Click the RSFieldbus online icon .

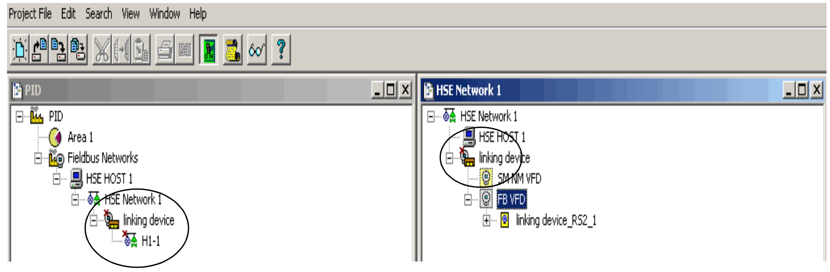
   The Initialize Communication animation begins.



   During this time, all devices are located on the network.

   TIP This window may appear for up to 20 seconds while RSFieldbus software is waiting for the HSE Server to respond.

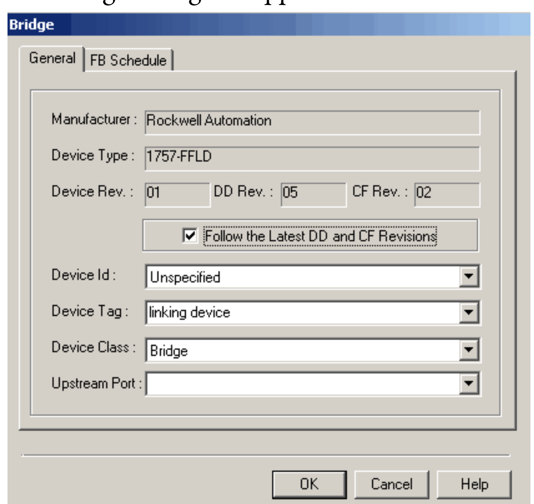
A red 'x' appears next to the H1, linking device, and device icons. This indicates that they need to be associated with the actual hardware.



There is an order of precedence in associating devices. The bridges on the HSE network need to be associated prior to the devices on the H1 network, because the linking device is the link between the H1 and the host computer.

2. Right-click the device and choose Attributes.

   The Bridge dialog box appears.



3. From the Device Id pull-down menu, choose the corresponding Device ID.
4. Click OK.

   Note that the red 'x' in the HSE window has disappeared once the association is made. This indicates that communication with the linking device is established.

   The next step requires opening the Live List to verify that you are connected to the proper devices.

5. Right-click H1-1 network and choose Live List.

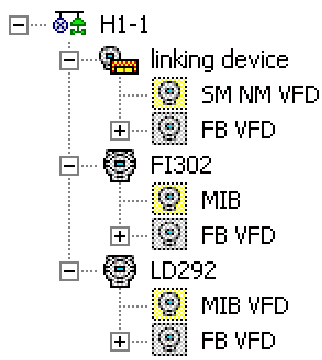
   The H1-1 Live List appears and shows all of the devices connected through your linking device. Devices that are ghosted in the H1-1 Live List have not yet established a connection to RSFieldbus software through the HSE Server and linking device. Prior to continuation, the device must not be in a ghosted state in the live list.

Associate Devices

If this is the first time you have initialized communication, you must assign the Device Ids.

1. Right-click the device and choose Attributes.
2. From the Device Id pull-down menu, choose the corresponding Device ID.
3. Click OK.
4. Complete step 1 through step 3 for each device.

   Note that the red 'x' next to each device in the HSE window has disappeared once the association is made. This indicates that communication with the linking device is established.



Assign Tags

ATTENTION: During this procedure, control of the associated devices and anything linked to them will be lost.

This section describes how to assign unique tags to each device to differentiate between similar devices on the network.

IMPORTANT	If this step is not completed, the device tag in the project and the online device tag will not match and the project can not be downloaded.

1. In the H1 window, right-click the linking device and choose Attributes.

   The Bridge attributes dialog box appears.

TIP	The next step is an example of naming a device. Develop a naming scheme that lets you distinguish between your devices.

2. Enter #### at the end of the Device Tag, where #### is the last four digits of the linking device's Device Id.

   ATTENTION: Be sure the tags used in your RSFieldbus projects on the same HSE Server are unique or your project may not function properly.

   Tags cannot include a '.' (period). If a separator is needed, use an '_' (underscore). Spaces are allowed, but not recommended.

3. Click OK.
4. Right-click the linking device icon and choose Assign Tags.
5. Click OK when you are asked if you want to assign a new tag.

   The Assign Tag dialog box appears and the tag is sent to the device.

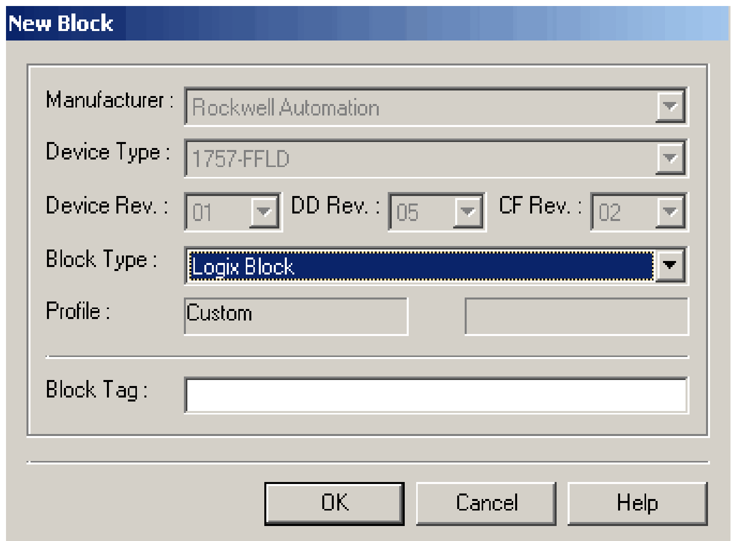
6. Repeat step 1 through step 5 in the H1 window with all other devices, using the last four digits of their Device Ids.

Add Function Blocks

Do these steps to add function blocks to a device.

1. In the Fieldbus (H1) window, if the device is not already expanded, expand it by clicking the .
2. Right-click the FB VFD icon and click New Block.

   The New Block dialog box appears.



3. From the Block Type pull-down menu, choose a block tag.

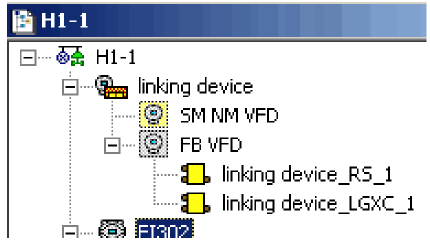
> **ATTENTION:** Be sure the tags used in your RSFieldbus projects on the same HSE Server are unique or your project may not function properly.
>
> Tags cannot include a '.' (period). If a separator is needed, use an '_' (underscore). Spaces are allowed, but not recommended.

TIP Block tags must be unique throughout each project. Develop a naming scheme that lets you identify the block and the device in which it is contained. (for example, FI302-AI).

If you do not enter a tag, a tag is generated according to the settings in the Preference dialog box on the Project File menu.

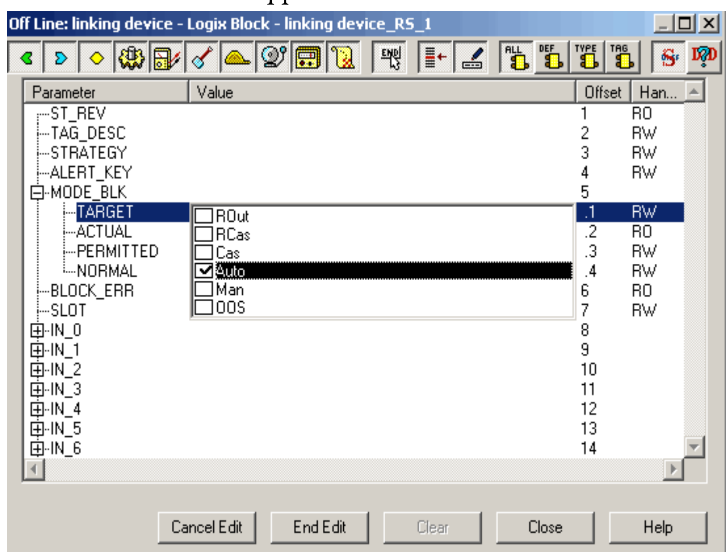
4. Click OK.

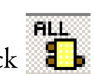
The block is added to the device.



5. Right-click what you named the block (example, linking device_RS-1) and choose Off Line Characterization.

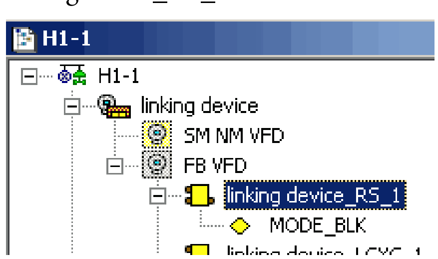
The Off Line window appears.



To view all of the parameters, click  and maximize the Characterization window.

6. Expand the MODE_BLK parameter.
7. Select TARGET, then click in the Value column and select Auto.
8. Click Enter to complete the edit.
9. Click Close.

The MODE_BLK parameter icon is shown under the linking device_RS_1 icon.

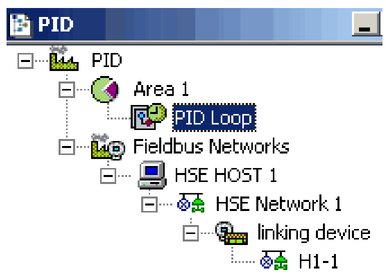


Create a Fieldbus Control Strategy

Each control module has its own Strategy window. Changes in the Strategy window are updated in the H1 and Process Cell windows. The following steps can also be used to open an existing strategy.

1. In the Project window, right-click the Area 1 icon and choose New Process Cell.
2. Type PID Loop (as an example) for the tag.
3. Click OK.

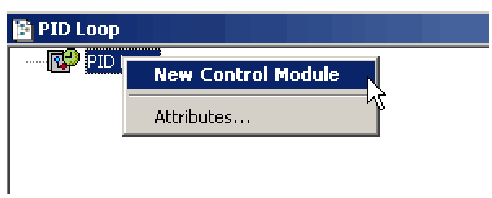
   The Process Cell is added to the Project.



4. Right-click the Process Cell icon and click Expand.

   The Process Cell window appears.

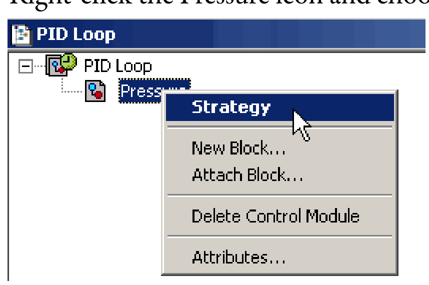
5. Right-click the Process Cell icon and choose New Control Module.



6. Type Pressure for the tag and click OK.

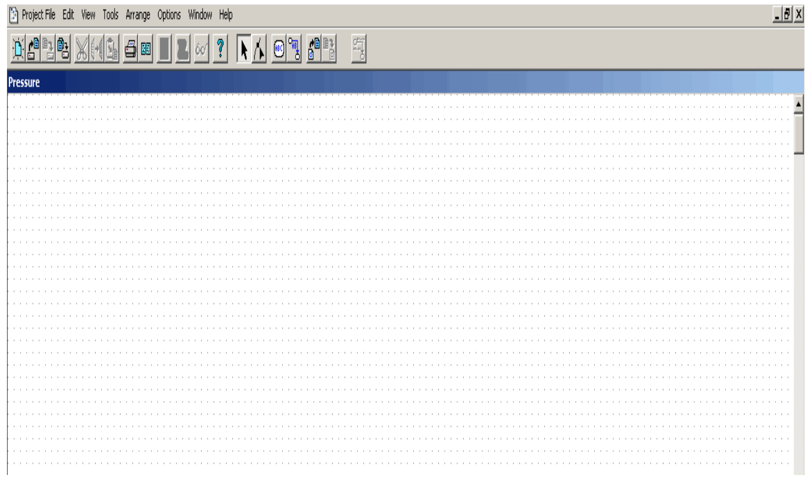
   The Pressure Control Module is added to the Project.

7. Right-click the Pressure icon and choose Strategy.



The Strategy window appears. Maximize the window. to view the toolbar.

TIP If this window does not appear, click Tool Boxes on the Tools pull-down menu. Strategy should be checked. If it is not, check it.



8. On the Strategy toolbar, click Function Block Icons on the Options pull-down menu.
9. Click Rectangle.

   Once blocks are added to the Strategy you can not change them to a different shape.

10. With the Strategy window selected, click the function block template icon .
11. Click in the strategy drawing area.

    The New Block dialog box appears.

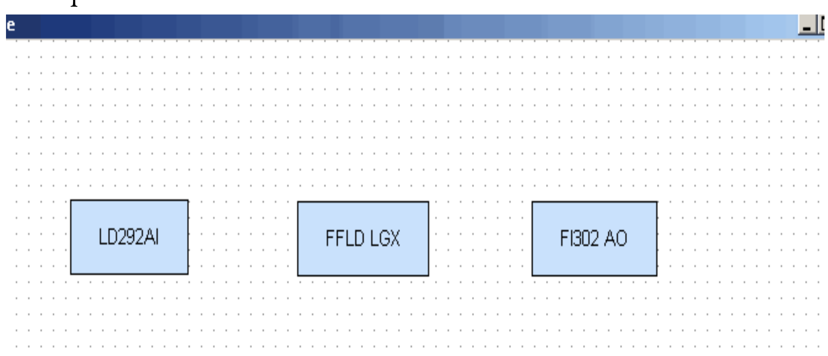
12. Choose the correct Manufacturer, Device Type, Device Rev, DD Rev, CF Rev and Block type for your device.

IMPORTANT	The Device Rev, DD Rev and CF Rev values in this dialog box default to the latest version in the device support files. If your device firmware does not match these values, change them accordingly. If the correct revisions are not listed, contact the device vendor for the DD files that match the device's firmware. If you do not match the correct revisions with your device firmware, you receive a warning on download

13. Type a tag for the function block and click OK.

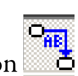
    If you do not enter a tag, a tag is generated according to the settings in the Preference dialog box on the Project File menu.

14. The function block is added to the strategy.
15. Repeat step 10 through step 13 for your H1-1 devices, as shown in the example.

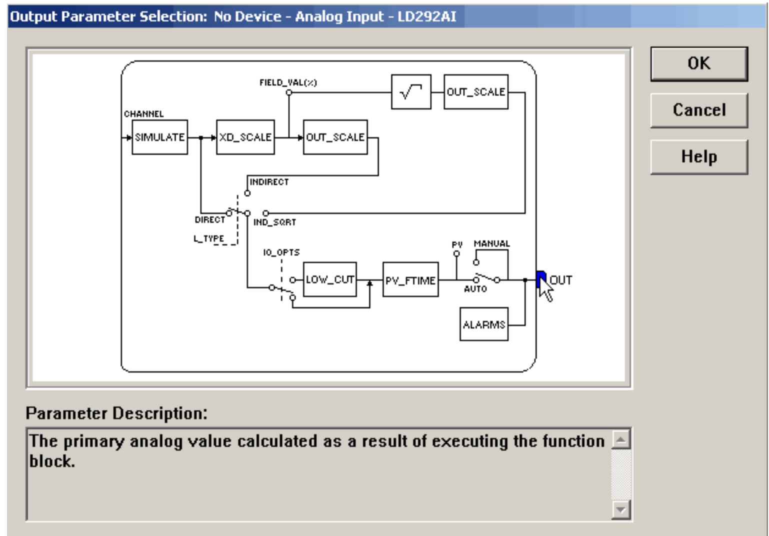


Link Blocks

Blocks can be linked only in the Strategy window. Do these steps.

1. In the Strategy window, click the Link icon  .
2. Click the AI Block.

The Output Parameter Selection window appears.



3. Select the OUT pin (as shown in the example).

   The pin fills to show that it is selected.

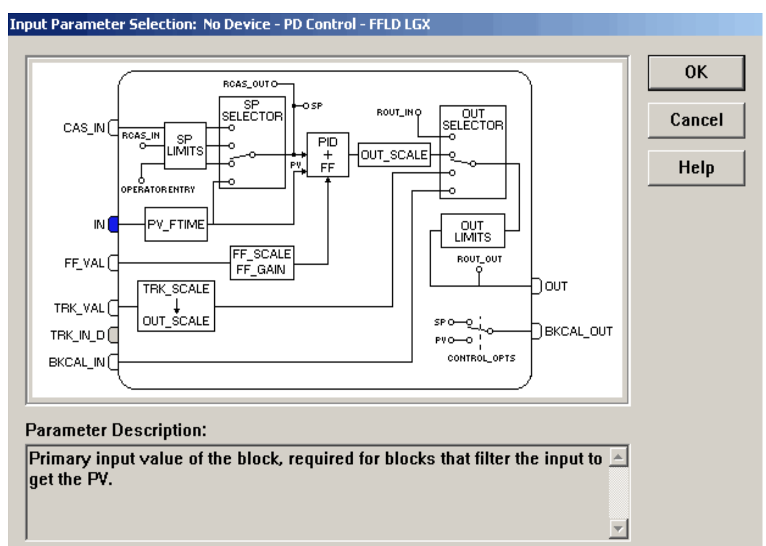
4. Click OK.

   A blue line is added to the AI block to represent the incomplete link.

5. Click the LGX Block to complete the link.

TIP	Press and hold Shift to draw lines at 45° and 135°. Press and hold Control to draw lines at 0° and 90°.

The Input Parameter Selection window appears.



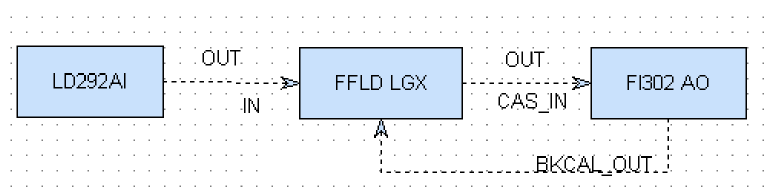
6. Select the IN pin and click OK.

   A link is drawn from the AI block to the LGX block.
7. Click the LGX block again.
8. Select the OUT pin and click OK.
9. Click the AO block to complete the Link.
10. Select the CAS_IN pin and click OK.

   A link is drawn from the PID block to the AO block.
11. Click the Link button and select the AO block again.
12. Select the BKCAL_OUT pin and click OK.
13. Click below the block, move the cursor under the Logix block, and click again.

   A segmented line is drawn.
14. Click the LGX block to complete the Link.
15. Select the BKCAL_IN pin and click OK.

   Your Strategy window should look like the example.



Download the Configuration

Before Downloading you must complete the Export Tags function. This lets you view function block parameters in the On Line mode.

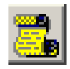
Export Tags

1. In the Project window, right-click the Project name (in this case, PID) and choose Export Tags.

   The Export Tags window opens.
2. Click OK to acknowledge that the Tags were exported successfully.

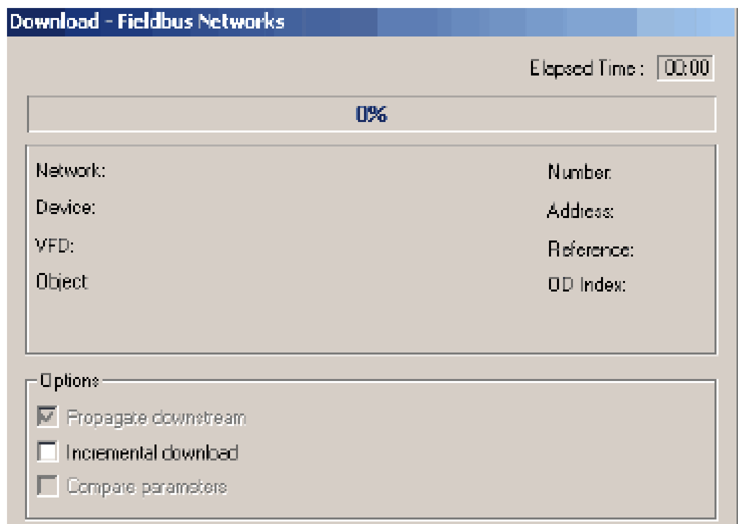
Download

Before downloading, you should clear the error log so new errors will be easier to detect.

1. Click the Error Log icon .
2. Right-click within the Communication window and choose Clear Log.

   The window clears.
3. In the HSE Fieldbus window, right-click the HSE icon and choose Download.

   The Download dialog box appears.



IMPORTANT	The Propagate downstream check box is selected and grayed out be default. This means that after the HSE is downloaded, all H1 segments in the project are then downloaded.

4. Click Start.

   The Download dialog box shows the progress while the configuration downloads.

   After a download, it may take up to two minutes for OPC data to be available from the OPC server.

Initiate a ControlLogix Control Strategy

You should have a basic understanding of the ControlLogix system before configuring a 1757-FFLD or 1757-FFLDC linking device. Every module must be owned by a Logix5000 controller. This owner-controller stores configuration data for every I/O module that it owns.

Adding a linking device to the I/O configuration tree of the RSLogix 5000 programming software creates configuration and I/O data structures and tags for the module. Controllers interpret a linking device as a remote I/O chassis with a virtual blackplane with up to 16 slots.

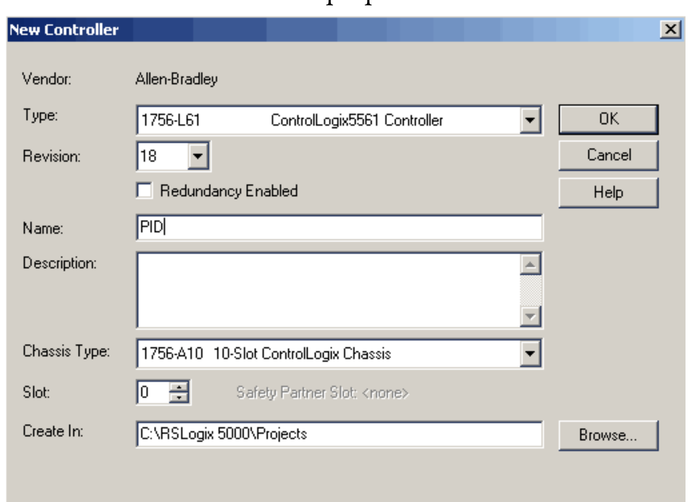
To communicate with the controller, you add a bridge (local communication module), the linking device, and then the Logix Blocks; each requiring a unique slot number in the I/O configuration. Logix Blocks facilitate communication between the controller and the linking device to transfer field device data in a controlled process.

IMPORTANT	The rate at which information is multicast to the controller depends on the network that is being used. However, we recommend that you set the RPI value to half of your macrocycle value. See page 62 for more macrocycle information.

Do these steps to initiate a ControlLogix control strategy.

1. Start the RSLogix 5000 programming software, and click the New icon .

   The New Controller dialog box appears. The sample illustration shows information for instructional purposes.



2. Complete the New Controller dialog box to configure the controller.

Field	Description
Vendor	Field defaults to Allen-Bradley.
Type	Choose type of controller from the pull-down menu.
Revision	Choose the software version.
Redundancy Enabled	Leave this field blank if you are not using redundancy.
Name	Type a name for the controller, for example PID.
Description	Type an optional description for the controller.
Chassis Type	Choose a chassis type from the pull-down menu.
Slot	Choose the slot number for the controller in your chassis.
Create in	Use the default project folder or click the Browse button to select another database location.

3. Click OK.

   The RSLogix 5000 software window redisplays with the controller project name in the Controller Organizer on the left side.

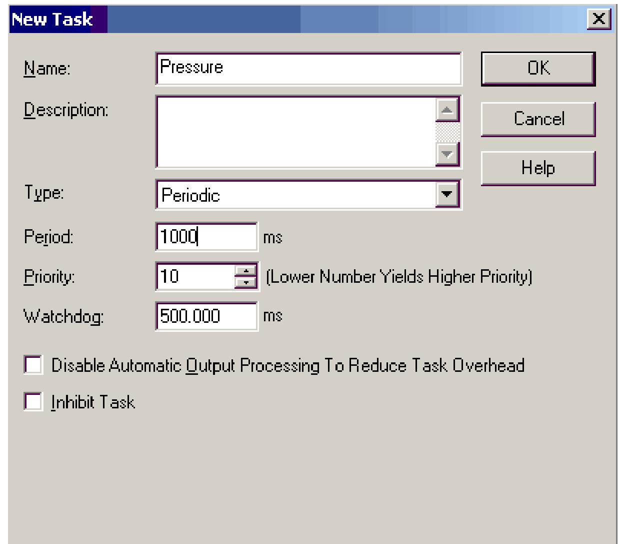
Create and Configure a New Periodic Task

The ContolLogix PID function block uses an algorithm that needs a defined time period of operation, so a Periodic Task needs to be created.

Do these steps.

1. On the Controller Organizer, right-click Task and choose New Task.

The New Task dialog box appears.



2. Complete the New Task dialog box to configure the task.

Field	Description
Name	Type the name of the task.
Description	Type an optional description for the task.
Type	Use the default of periodic task.
Period	Type 1000 (ms) for the period. PID loops generally do not require fast executions.
Priority	Use the default of 10.
Watchdog	Use the default of 500 (ms).
Disable Automatic Output Processing To Reduce Task Overhead	Leave blank.
Inhibit Task	Leave blank.

3. Click OK.

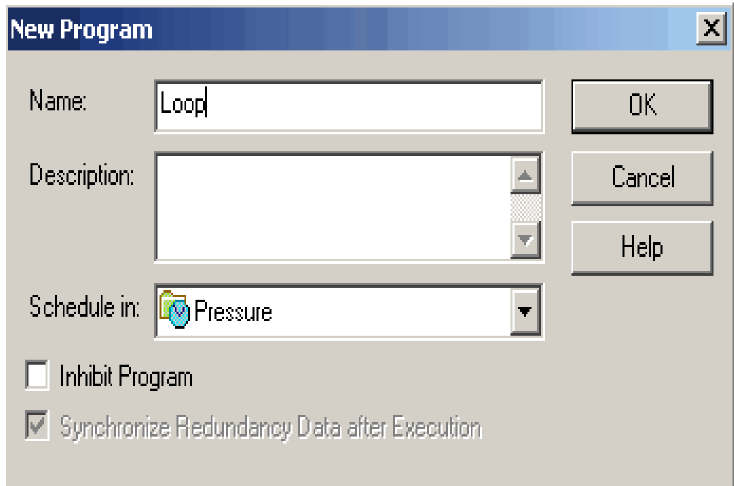
Pressure is listed under Tasks on the Controller Organizer.

Create a Program

Do these steps to create a program to run in your task.

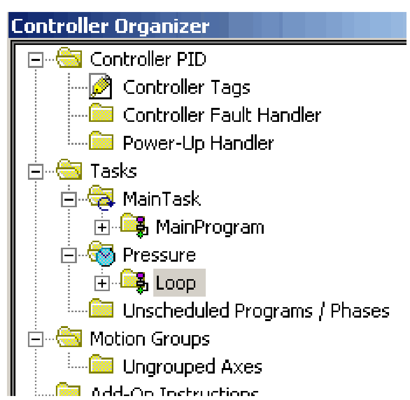
1. Right-click Pressure and choose New Program.

   The New Program dialog box appears.



2. Type Loop for the Name and click OK.

   Loop is added under Pressure in the Tasks folder of the Controller Organizer.

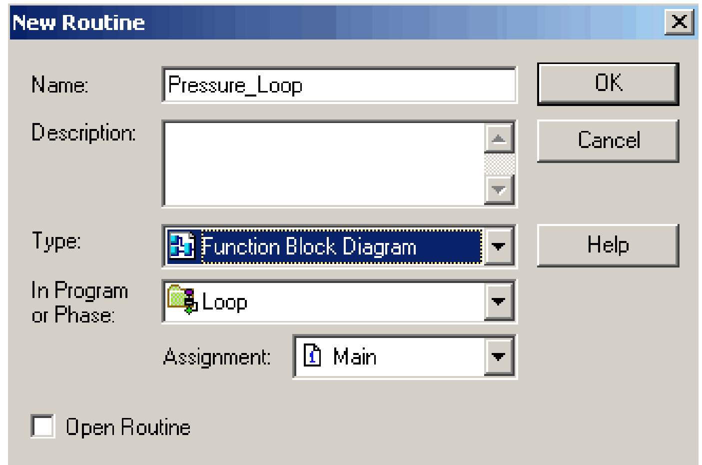


Create and Schedule a Routine

Do these steps to program Pressure Loop as the Main Routine.

1. Right-click Loop and choose New Routine.

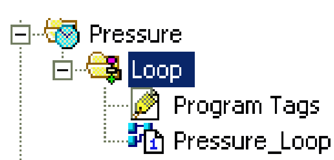
   The New Routine dialog box appears.



2. Type Pressure Loop for the name of the routine.
3. From the Type pull-down menu, choose Function Block Diagram.
4. Click OK.

   Pressure Loop is added to the program on the Controller Organizer.
5. Right-click Loop and choose Properties.
6. On the Configuration tab of the Program Properties dialog box, choose Pressure Loop for the Main Routine.
7. Click OK.

   Pressure Loop is designated as the Main Routine.

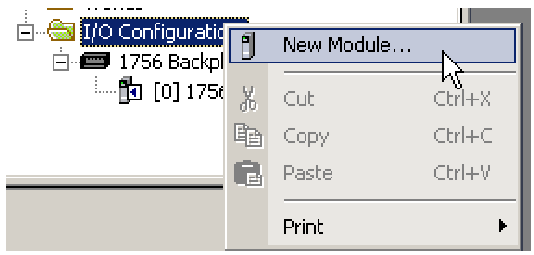


Add the Bridge Module

A bridge module allows the linking device to communication on the network via CIP protocols with the ControlLogix controller. Do these steps to create a new module.

IMPORTANT	The 1757-FFLD linking device connects both the HSE and EtherNet/IP networks. If your fieldbus system is using the ControlNet network, you require the 1757-FFLDC linking device with the CN2R/B bridge module.

1. Right-click I/O Configuration and choose New Module.

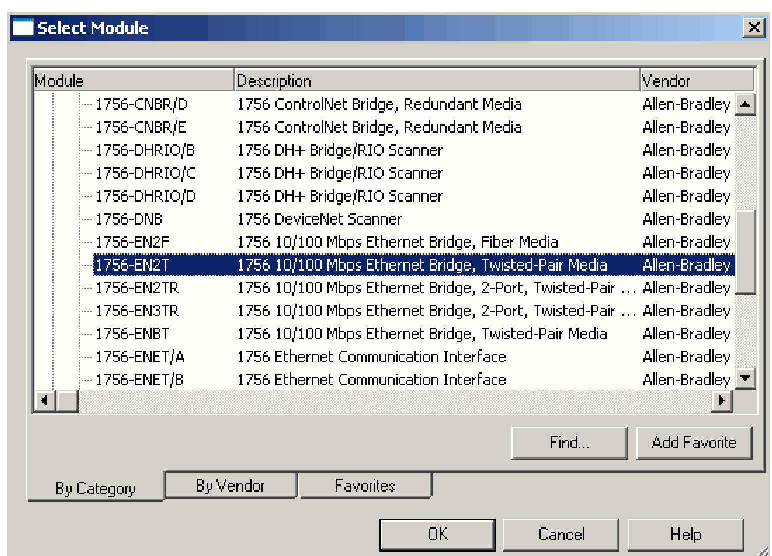


   The Select Module dialog box appears with a list of module types.

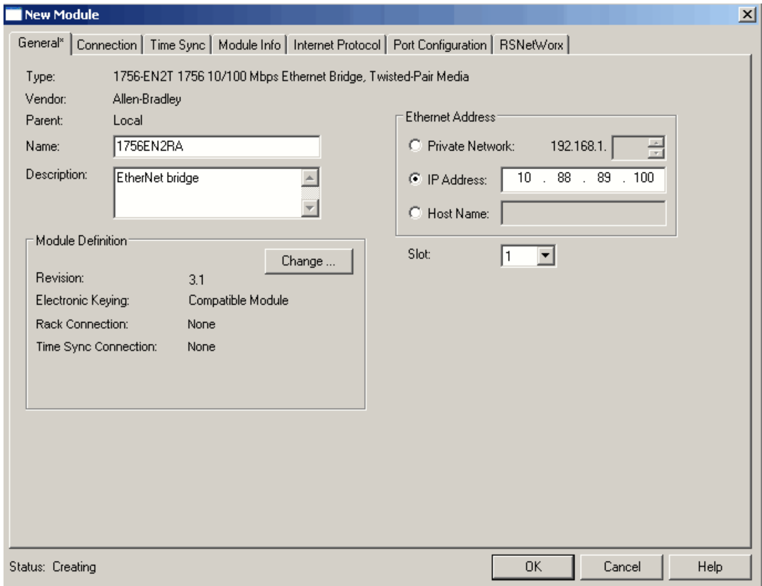
2. Click the '+' sign in front of Communications.

   A list of communication modules appears.

3. Select the appropriate bridge module, such as 1756-EN2T for the 1757-FFLD linking device, and click OK.

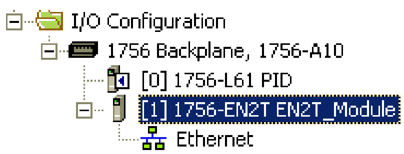


The New Module dialog box appears.



4. Type a name and EtherNet/IP address .
5. Enter a slot number in the chassis.
6. Click OK.

A network icon appears under the bridge module on the Controller Organizer.



Add the Linking Device

Do these steps to add a linking device to your I/O configuration.

1. On the Controller Organizer, right-click Ethernet and choose New Module.

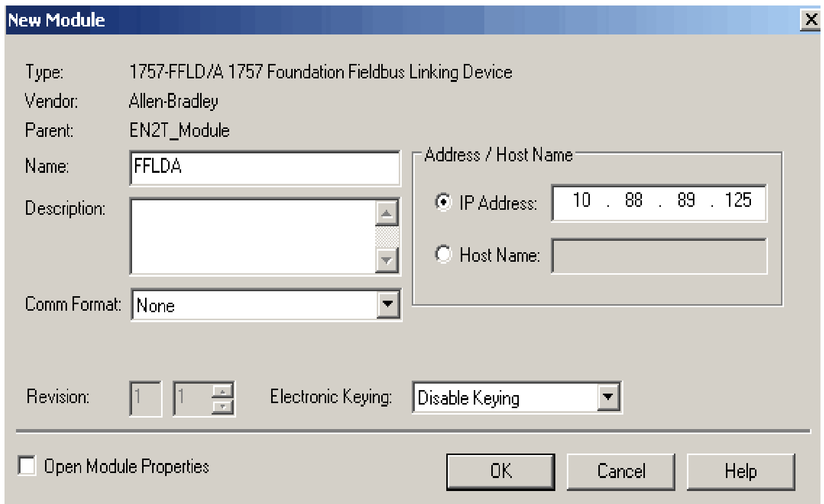
   The Select Module dialog box appears.

2. Click the '+' sign in front of Communications.

   A list of communication modules appears.

3. Select the 1757-FFLD/A linking device and click OK.

   The New Module dialog box appears.



4. Type a module name and EtherNet/IP address.
5. From the Electronic Keying pull-down menu, choose Disable Keying.
6. Click OK.

   For details on Electronic Keying, see the FOUNDATION Fieldbus System User Manual, publication 1757-UM012.

Add the Logix Blocks

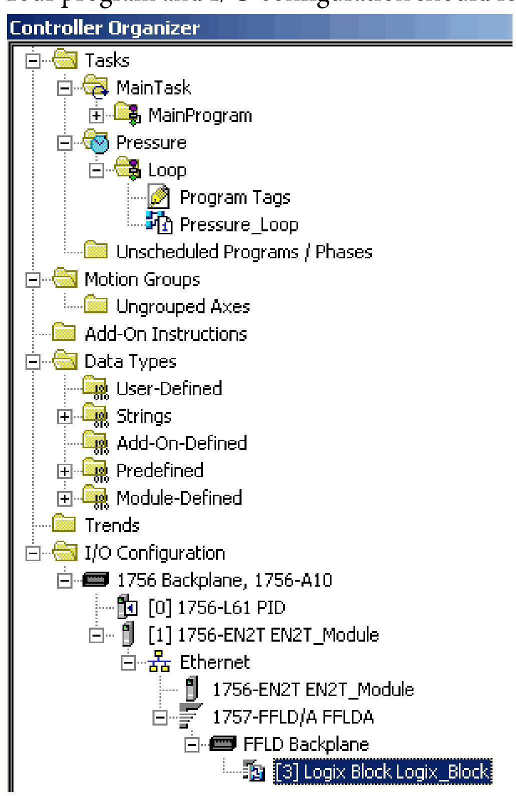
Logix Blocks facilitate linking control between the controller and H1 field devices. A controller interprets each Logix Block as a remote module. You can program up to 16 Logix Blocks within a single linking device.

Do these steps to add a Logix Block module to the linking device.

1. On the Controller Organizer, right-click FFLD module and choose New Module.
2. Click OK as the Logix Block is the only choice in the analog folder on the Select Module Screen.
3. In the Name box, type FFLD Logix.
4. From the Electronic Keying pull-down menu, choose Disable Keying.

   The Slot value must match the value that you have set up for the FFLD_LGX function block.
5. Click OK.

   Your program and I/O configuration should look like the example.



RSLogix 5000 Control Data Types

Module-defined data types and tags are created when a linking device is initiated. However, you cannot view the linking device's controller tags in RSLogix 5000 software **until at least one** Logix Block is initiated in your I/O hierarchy.

The example shows controller tags in RSLogix 5000 software.

Name	Alias For	Base Tag	Data Type	Description	External Access	Constant	Style
FFLDC:0:I.In4Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In5Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In6Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In7Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D0Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D1Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D2Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D3Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D4Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D5Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D6Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In_D7Fault			BOOL		Read/Write		Decimal
FFLDC:0:I.In			AB:FF_REAL_ST...		Read/Write		
FFLDC:0:I.In[0]			AB:FF_REAL_ST...		Read/Write		
FFLDC:0:I.In[0].Value			REAL		Read/Write		Float
FFLDC:0:I.In[0].Quality			SINT		Read/Write		Decimal
FFLDC:0:I.In[0].SubStatus			SINT		Read/Write		Decimal
FFLDC:0:I.In[0].WindupL			BOOL		Read/Write		Decimal
FFLDC:0:I.In[0].WindupH			BOOL		Read/Write		Decimal
FFLDC:0:I.In[0].InitPrimary			BOOL		Read/Write		Decimal
FFLDC:0:I.In[0].Initializing			BOOL		Read/Write		Decimal
FFLDC:0:I.In[0].InitiateFaultState			BOOL		Read/Write		Decimal
FFLDC:0:I.In[1]			AB:FF_REAL_ST...		Read/Write		
FFLDC:0:I.In[2]			AB:FF_REAL_ST...		Read/Write		

Edit the PID Regulatory Routine

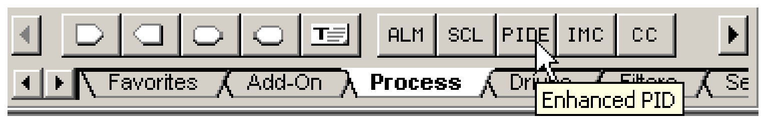
Do these steps to define parameters for the PID routine.

1. On the Controller Organizer, double-click Pressure Loop.

   A blank sheet appears.

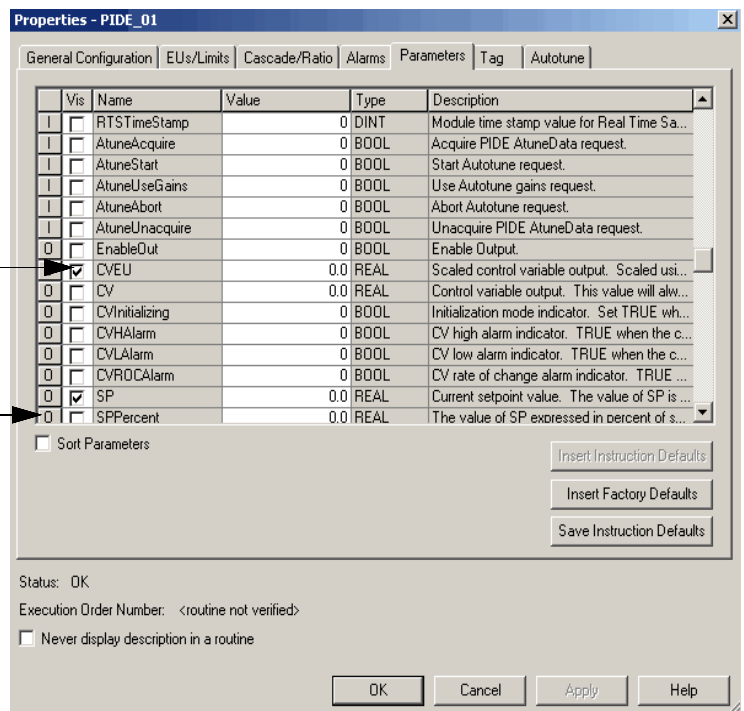
2. Type a name in the box. For example, PIC101.

3. On the Process Tab (near the top of the RSLogix 5000 software window), click PIDE.



   The block is added to the sheet.

4. Click the Block Properties button .



Check mark in Vis column denotes parameter is selected and visible on the block.

First column distinguishes between Input (I) and Output (O) parameters.

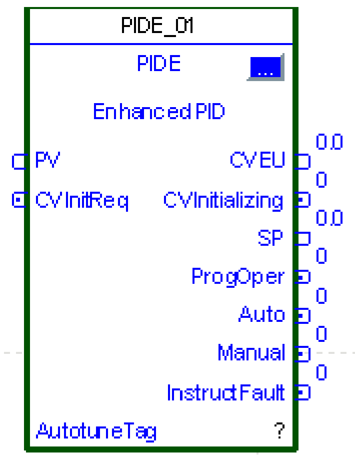
5. On the Parameters tab, select and deselect the Vis parameters so that the listed parameters only are selected.

   This exposes the desired pins on the PIDE block.

Input Parameters	**Output Parameters**
PV	CVEU
CVInitReq	CVInitializing
	SP
	ProgOper
	Auto
	Manual
	InstructFault

6. Click OK.

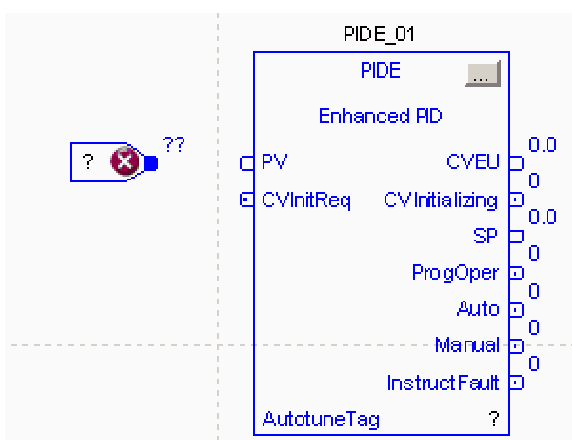
   The block is updated with your selections.



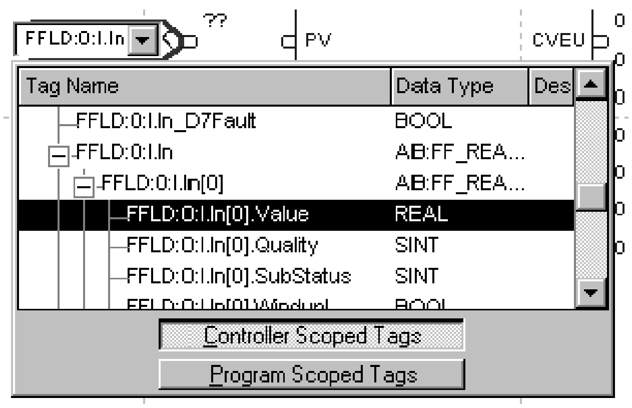
7. Click the Input Reference button .

   The Input Reference is added to your sheet.

8. Drag and drop the Input Reference to the left of the PIDE block.

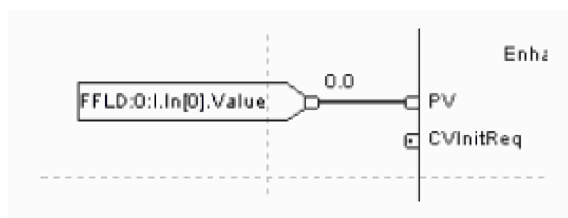


9. Double-click the single ? on the Input Reference and select the Controller Scoped tag, FFLD:0:1.In[0].Value.



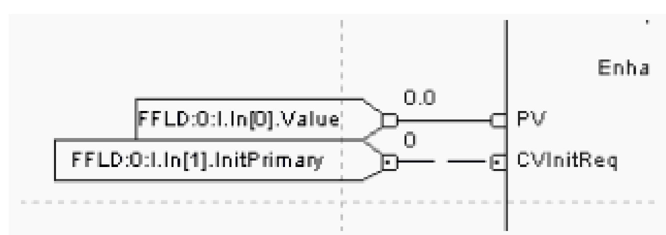
10. Press Enter.

11. Click the FFLD:0:I.In[0].Value pin, then the Source A pin to connect them.



12. Repeat step 7 through step 11 to connect the FFLD:0:I.In[1].InitPrimary tag to the CVInitReq parameter.

    This tag is the IN_1 pin from the RSFieldbus Logix Block and the FI 302 BKCAL_OUT.

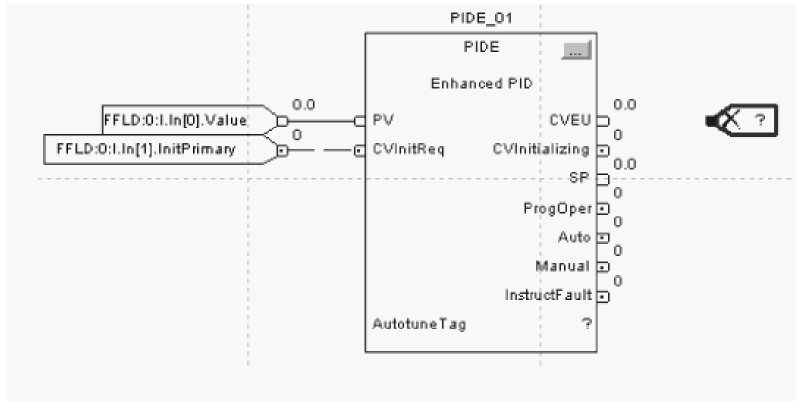


    This input stops the PIDE function block from generating an output in the AO.

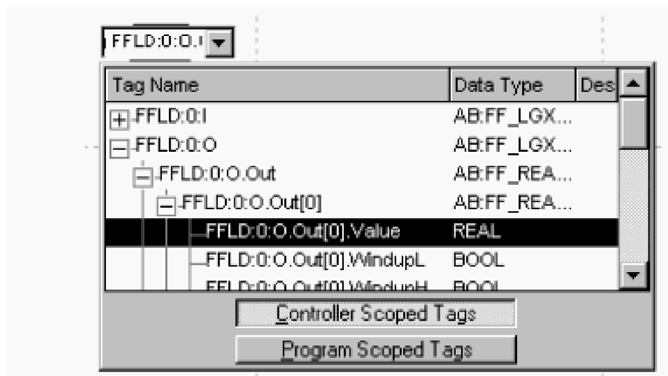
13. Click the Output Reference button .

    The Output Reference is added to your sheet.

14. Drag and drop the Output Reference to the right of the PIDE block.



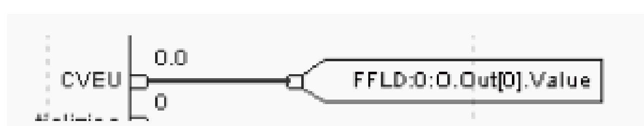
15. Double-click the single ? on the Output Reference and select the Controller Scoped tag, FFLD:0:O.Out[0].Value.



This tag is the OUT_0 pin from the RSFieldbus Logix Block and the FI 302 AO input.

16. Press Enter.

17. Click the FFLD:0:O.Out[0].Value pin, then the CVEU pin to connect them.



18. Right-click Pressure_Loop and choose Verify to verify the routine.

Add Handshaking Logic

When configuring an output device, you **must** initialize the CAS-IN parameter because the linking device Logix Block operates as a pass through to the ControlLogix platform. The normal handshaking that takes place between cascaded function blocks is not available. You must provide this handshaking in the ladder program of the controller.

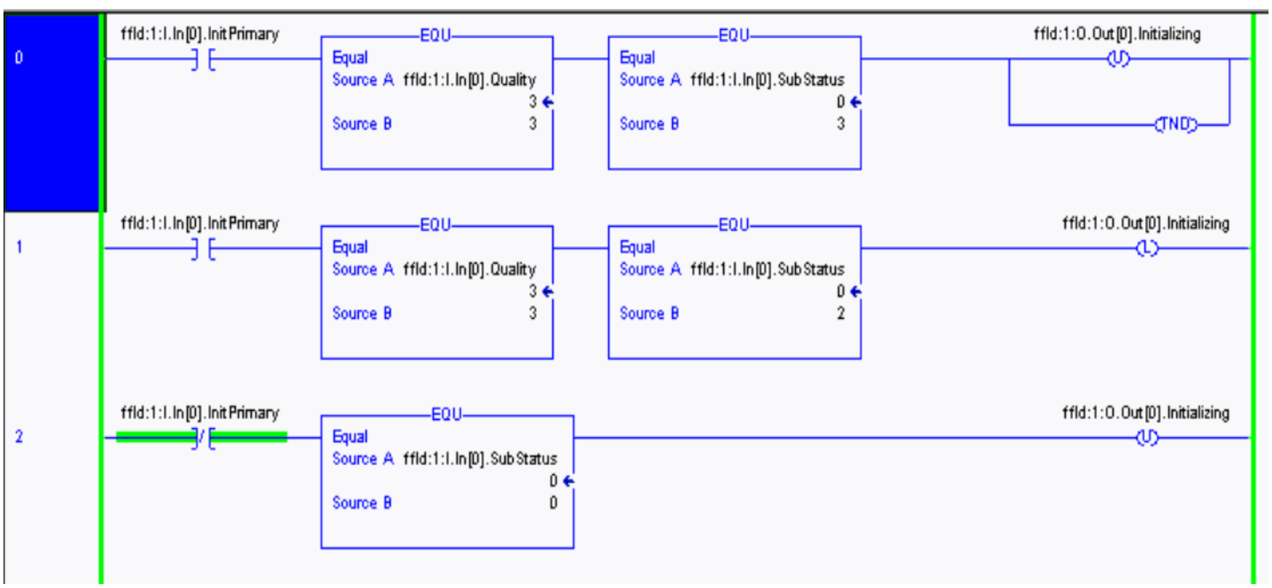
This sample initialization of the CAS-IN parameter is based on a strategy with these links.

From	To	Logix Tag Name
AO_FB.BKCAL_OUT	AB_FFLD_LOGIX.IN_0	ffld:1:I.In[0]
AB_FFLD_LOGIX.OUT_0	AO_FB,CAS_IN	ffld:1:O.Out[0]

The initialization process must account for at least two conditions:

- The Not Invited status that results after a download or mode change in the processor.
- The Initialize Request that results from a mode change in the function block.

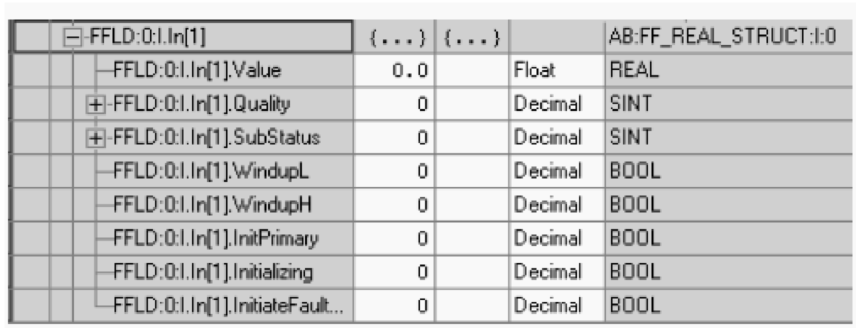
TIP This sample code is an example only; your ladder code may be different.



The ladder instruction does the following:

- Assumes the InitPrimary bit is set in the ffld:1:I.In[0] tag.
- Uses Rung 0 to test for the unique condition Not Invited status in the ffld:1:I.In[0] tag: Quality=3, Sub Status=3. If True, then clear (unlatch) the Initializing bit in the ffld:1.Out[0] tag. Do not execute any other elements until the Not Invited condition is cleared (TND).

Every Fieldbus value has quality and status associated with it. These indications are separated by the ControlLogix Logix block, as shown below.



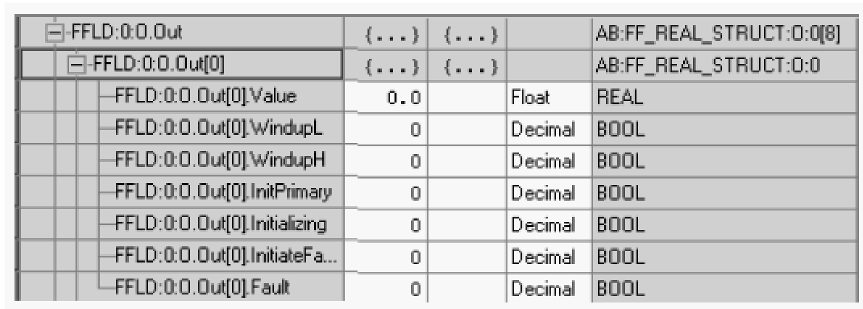
FFLD:0:I.In[1]	{...}	{...}	AB:FF_REAL_STRUCT:I:0
FFLD:0:I.In[1].Value	0.0	Float	REAL
FFLD:0:I.In[1].Quality	0	Decimal	SINT
FFLD:0:I.In[1].SubStatus	0	Decimal	SINT
FFLD:0:I.In[1].WindupL	0	Decimal	BOOL
FFLD:0:I.In[1].WindupH	0	Decimal	BOOL
FFLD:0:I.In[1].InitPrimary	0	Decimal	BOOL
FFLD:0:I.In[1].Initializing	0	Decimal	BOOL
FFLD:0:I.In[1].InitiateFault...	0	Decimal	BOOL

Table 7 shows the SubStatus value on Initialization Request. Logic needs to be built so that the value of 2 for the BKCAL_OUT from the AO block is being monitored.

Table 11 - Initialization Request SubStatus Values

Quality		Substatus	
0	BAD - the value is not useful.	X	Any
1	Uncertain - the quality of the value is less than normal, but may still be useful.	X	Any
2	Good NC.	X	Any
3	Good Cascade - value may not be useful for control. SubStatus carries Back Initialization handshake.	0	NonSpecific
		1	Initialization Acknowledge
		2	Initialization Request
		3	Not Invited
		4	Not Selected
		5	Reserved
		6	Local Override
		7	Fault State Active
		8	Initiate Fault State

Once the Initialization Request is received by the ControlLogix routine, a signal must be generated and sent back to the RSFieldbus AO stating that initialization has been acknowledged. The Logix Block has an Initializing parameter associated with each output to accommodate this acknowledgement. This value must be toggled from off to on, then off again. As with the input values, this initializing value is part of the substatus of the output value.



FFLD:0:0.Out	{...}	{...}		AB:FF_REAL_STRUCT:0:0[8]
FFLD:0:0.Out[0]	{...}	{...}		AB:FF_REAL_STRUCT:0:0
FFLD:0:0.Out[0].Value	0.0		Float	REAL
FFLD:0:0.Out[0].WindupL	0		Decimal	BOOL
FFLD:0:0.Out[0].WindupH	0		Decimal	BOOL
FFLD:0:0.Out[0].InitPrimary	0		Decimal	BOOL
FFLD:0:0.Out[0].Initializing	0		Decimal	BOOL
FFLD:0:0.Out[0].InitiateFa...	0		Decimal	BOOL
FFLD:0:0.Out[0].Fault	0		Decimal	BOOL

Do these steps to add handshaking logic.

1. From the Compare tab, click the Equal button  and move the Equal block below the PIDE block.

2. Click the Block Properties button .

   The Equal Properties window appears.

3. Type 2 for the SourceB value and click OK.

4. Click the Input Reference button .

   The Input Reference is added to your sheet.

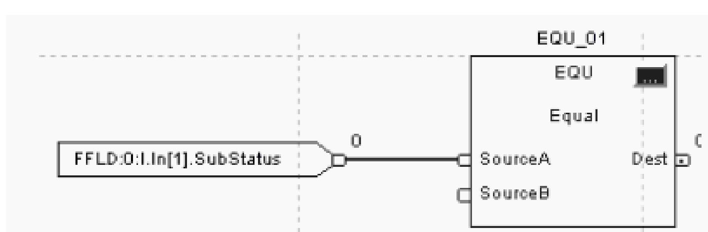
5. Drag and drop the Input Reference to the left of the Equal block.

6. Double-click the single ? on the Input Reference and select the Controller Scoped tag, FFLD:0:I.In[1].SubStatus.

   This function block will monitor the SubStatus of the AO BKCAL_OUT for the Initialization Request.

7. Press Enter.

8. Click the FFLD:0:I.In[1].SubStatus pin, then the SourceA pin to connect them.



9. From the Move/Logical tab, click the Band button  and move the Band block to the right of the Equal block.

10. Click the Output Reference button .

    The Output Reference is added to your sheet.

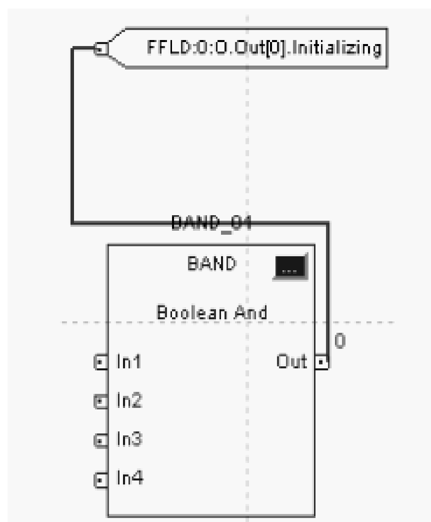
11. Drag and drop the Output Reference above the Band block.

12. Double-click the single ? on the Output Reference and select the Controller Scoped tag, FFLD:0:O.Out[0].Initializing.

    This function block will send the Initializing Acknowledge status to the AO CAS_IN based on the status of the PIDE and the Initialization Request.

13. Press Enter.

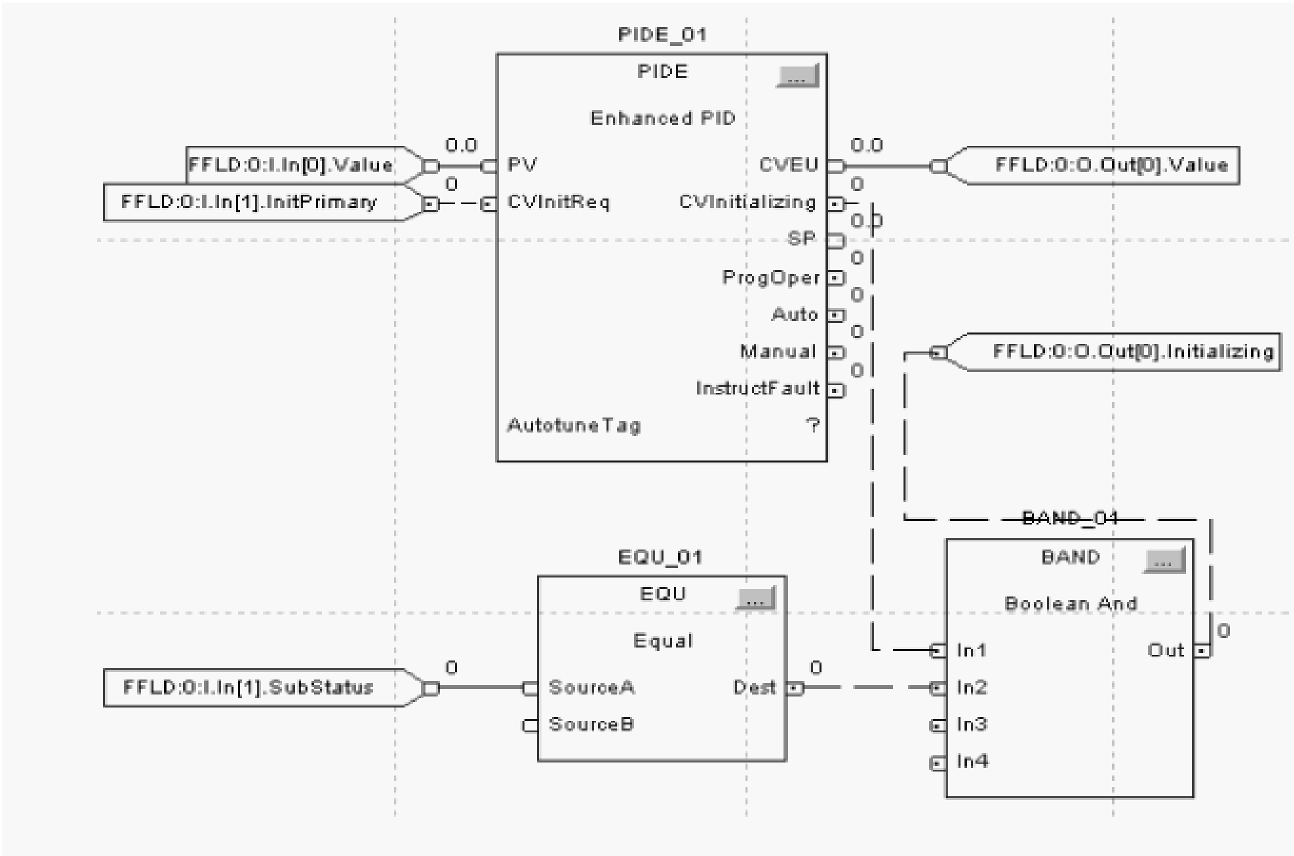
14. Click the FFLD:0:O.Out[0[.Initializing pin, then the OUT pin to connect them.



15. Connect the Equal Dest pin to the Band In2 pin.

16. Connect the PIDE CVInitializing pin to the Band In1 pin.

Your sheet should look similar to the example.



17. Right-click Pressure_Loop and choose Verify to verify the routine.

Determining Bad Quality or Loss of Input

To add robustness into the strategy, add logic to handle bad quality inputs or loss of input. You must force the PID into manual when the input is determined to be faulty so that you are not attempting to control with questionable field data as a reference.

1. Select the PID block properties button and edit it to expose the PVFault and ManualAfterInit input pins.

   The PVFault pin will force the PID function block into manual when the input is true and the ManualAfterInit pin will force the PID function block into manual when the CVInitReq is true.

2. Wire the existing FFLD:0:I.In[1].InitPrimary input reference to the ManualAfterInit input pin.

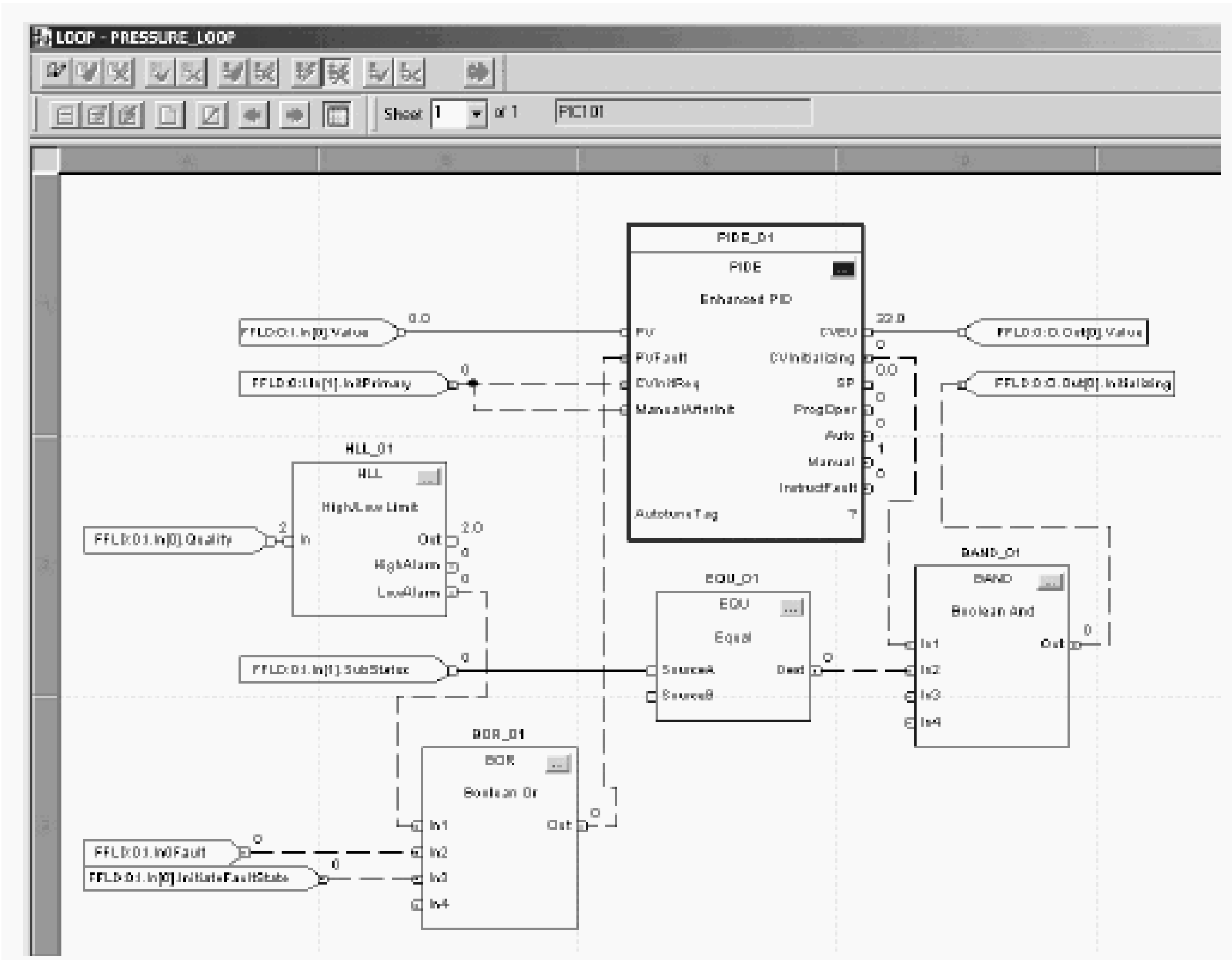
   This signal will force the PIDE function block into manual when the initialization signal is received.

3. From the Move/Logical category of function blocks, select the BOR function block.
4. Wire the "Out" output of the BOR function to the PVFault of the PIDE function block.
5. Wire FFLD:0:I.In0Fault using an input reference connector to the In2 input pin of the BOR function block.
6. Finally, wire FFLD:0:I.In[0].InitiateFaultState using an input reference connector to the In3 input pin of the BOR function block.

   These inputs will cause a PVFault condition based on input quality of condition.
7. From the Select/Limit category of function blocks, select the HLL function block.
8. Wire the "LowAlarm" output of the HLL function to the In1 of the BOR function block.
9. Wire "FFLD:0:I.In[0].Quality" using an input reference connector to the In input parameter of the HLL function block.
10. Edit the HLL function block so that the HighLimit is 4.

    This function block will evaluate the quality signal of the fieldbus data and send a true signal if the quality association is BAD; 0.

11. The wired function block and the entire strategy should look similar to the example.



12. From the Communication menu in the Menu Bar, choose Who Active.

13. Navigate to your controller and click Set Project Path.

14. Click Close.

15. Click the Mode button  and choose Go Online.

16. On the Connected to Go Online window, click Download.

17. Click Download to acknowledge the warning.

    The Downloading window shows the download progress.

18. Click Yes to change the controller to Remote Run mode.

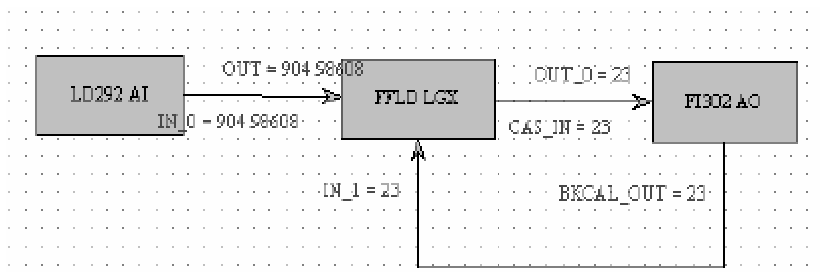
    The I/O OK is Solid Green.

    If the I/O OK light is blinking green, the IP address may be wrong, or the Slot number does not match the Slot number in RSFieldbus software.

Test the PID Loop

Do these steps to confirm the loop works properly.

1. Click the Mode button and choose Program Mode.
2. Click the PIDE Block Properties button .
3. Edit the PIDE, which is currently in manual mode, to output a value by changing the CVOoper value, and click OK.
4. In RSFieldbus software, go online to view the changes caused by the previous change.



5. Exercise the loop and verify the operations.
6. Edit the PIDE instruction for automatic operations with appropriate tuning parameters.
7. Exercise the loop by changing either the Set Point or the AI value.

Set Up FactoryTalk View Software

You must install the FactoryTalk View Site Edition software on your computer to create graphical designs and link objects to a controller.

Rockwell Automation provides objects that you apply values to before connecting these parameters to a Logix5000 controller. We suggest that you add the objects to your library so the coded faceplates can be reused in other projects.

IMPORTANT	You must have a Rockwell Automation TechConnect contract with Process to access FOUNDATION Fieldbus faceplates.

The P_Aln_FF Add-On Instruction contains a standard operator interface that you can copy into your RSLogix 5000 project.

For more information, see the following:

- Chapter 4 in this manual
- FactoryTalk View Site Edition User's Guide, publication VIEWSE-UM006

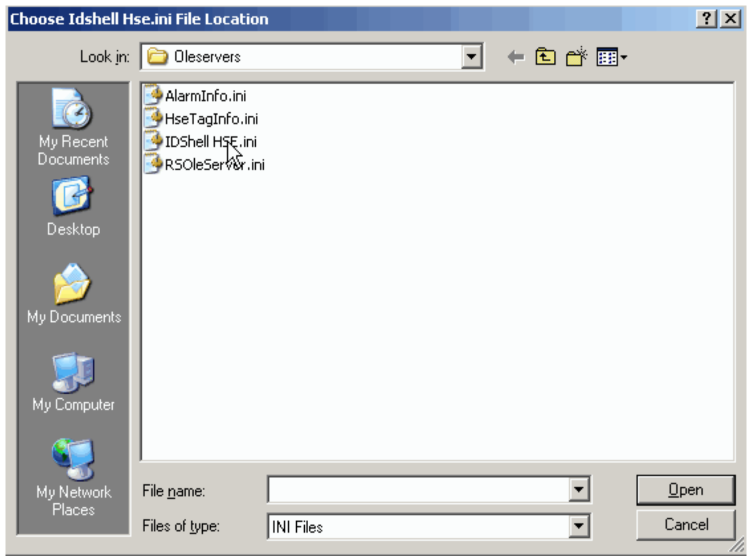
Add Device to the FFLDC ControlNet Setup Tool

Do these steps to define the CIP path of the 1757-FFLDC linking device so the RSFieldbus software can communicate with various linking devices connected through the ControlNet network.

IMPORTANT	• RSLinx Classic software must be installed to use the FFLDC ControlNet Setup Tool. • The linking device's EDS file must be installed to use the FFLDC ControlNet Setup Tool.

1. Configure the proper RSLinx Classic drivers to navigate to the ControlNet network where your 1757-FFLDC linking device resides.
2. From the Start menu, choose Programs>Rockwell Software>RSFieldbus>FFLDC ControlNet Setup.

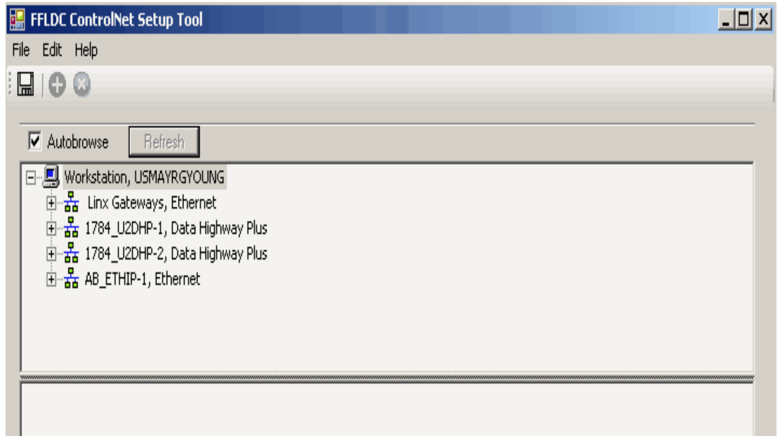
   The Open dialog box appears to the default installation folder.

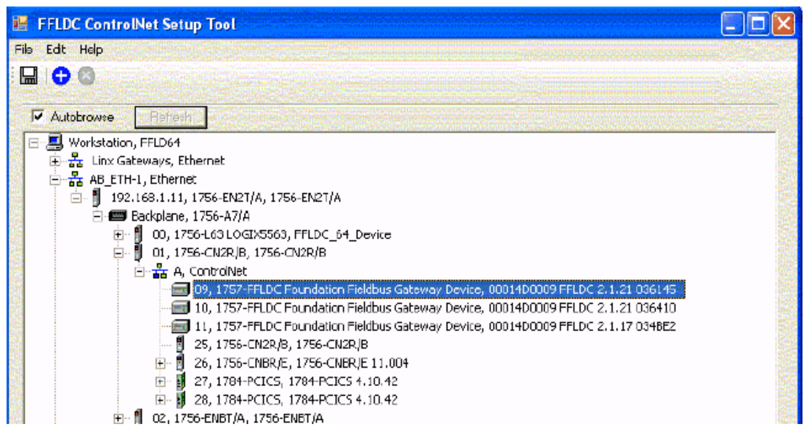
   If RSFieldbus software was not installed to the default folder, you must browse to the folder where it was installed.

3. Double-click the IDShell HSE.ini file.

The FFLDC ControlNet Setup tool appears.

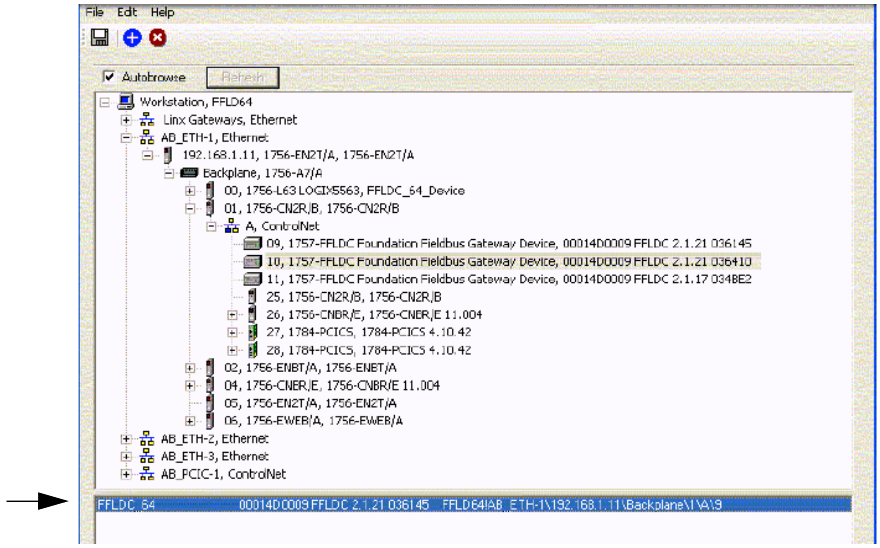


4. Browse the network and select the 1757-FFLDC linking device that you plan to use in your RSFieldbus projects.

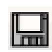


5. Click the Add Item icon. 

The FFLDC path is added to the lower window.



6. Complete step 4 and step 5 with all other 1757-FFLDC linking devices you plan to use in RSFieldbus projects.

7. Click the Save to INI file button. 

   The CIP path is saved to the IDShell HSE.ini file.

8. Close the FFLDC ControlNet Setup tool.

Naming Conventions

When discussing naming conventions, the standard for the facility takes precedence. However, when naming devices on your H1 segment, one should try to incorporate either the device type (temperature transmitter, pressure transmitter) or the serial number of the device within the name.

When a device first comes up on the Live List and makes the connection to RSFieldbus software, the ID field contains Device Description (DD file) information. The Live List is a list of devices on a linking device's H1 segments.

The specific serial number that is sought is in the last four numbers of the string. These numbers are the unique serial number for that device. It is this number that we recommend that you incorporate with the tag name somewhere.

Device Tag	ID
FFLDC_09	00014D0009 FFLDC 2.2.5 03614F
FI302 1420	0003020005:SMAR-FI302:006801420
IF302 4494	0003020003:SMAR-IF302:004804494
LD302 5477	0003020001:SMAR-LD302:000805477
TT302 4739	0003020002:SMAR-TT302:004804739
TT302 4650	0003020002:SMAR-TT302:004804650
TT302 4624	0003020002:SMAR-TT302:004804624
TT302 4279	0003020002:SMAR-TT302:004804279
TT302 4656	0003020002:SMAR-TT302:004804656

Device Addressing

The network address is the current address that the fieldbus is using for the device. When installing instruments for the first time, it is recommended that each instrument be installed one at a time and that you address the instruments in succession (one after the other).

Because like instruments have the same H1 fieldbus address from the factory, you will be able to see only one device. This condition will disable the installer from knowing which device they are actually programming in the plant.

Also, the installer must decide which address to start with for each H1 node. Currently, the linking device (address 16) is set to default at 24. Other Rockwell Interfaces, like the 1756-CN2 module (address 16), starts numbering at 17. The 1757-FIM module starts numbering at address 18.

The Fieldbus Foundation uses node addresses in the range of 0…255. If you need to reset, use the table in accordance with the following ranges.

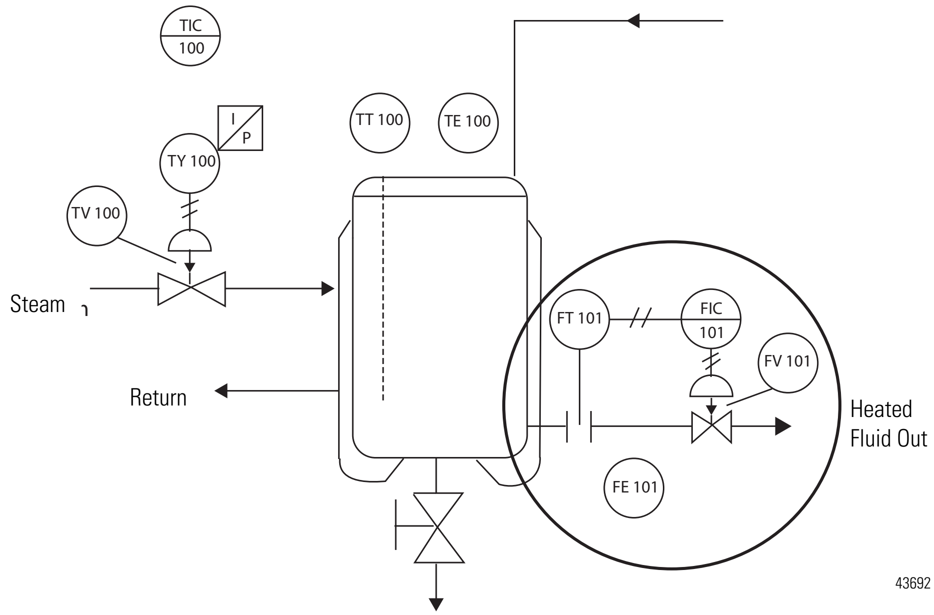
Address Range	Description
0…15	Reserved for overhead and Host interfaces.
16…247	Available for permanent devices. Some Host systems may further subdivide this range. This range is typically shortened for efficiency.
248…251	Available for devices with no permanent address, such as new devices or decommissioned devices.
252…255	Available for temporary use, such as handheld devices.

IMPORTANT High node addresses require more network time than lower ones.

PID Guide

This section includes several diagrams of PID formations, as well as tables listing components.

Simple PID



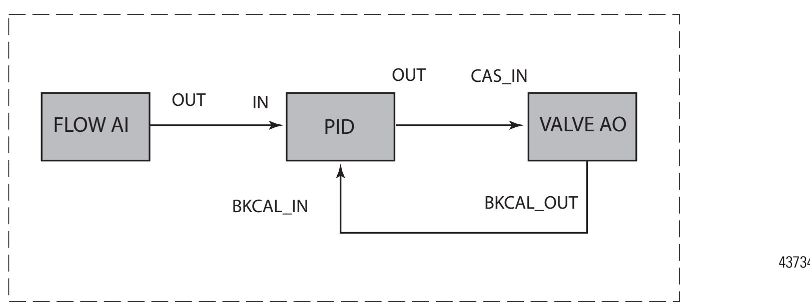


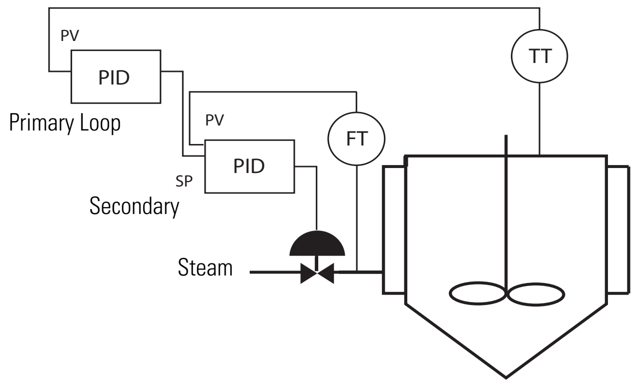
Table 12 - Simple PID Logic

Block	Block Type	Parameter	Element	Value
FLOW	Analog Input	MODE_BLK	TARGET	Auto
		XD_SCALE (these values must match the PRIMARY_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct

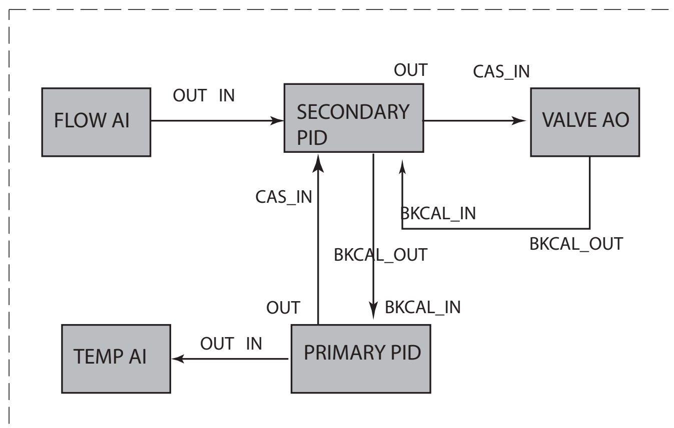
Table 12 - Simple PID Logic

Block	Block Type	Parameter	Element	Value
PID	PID	MODE_BLK	TARGET	Auto
		GAIN		Loop Dependent
		RESET		
		RATE		
		PV_SCALE (these values must match in Analog Input range)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
VALVE	Analog Output	MODE_BLK	TARGET	CAS
		XD_SCALE (these values must match the FINAL_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct

Cascade PID



43702-M



43735

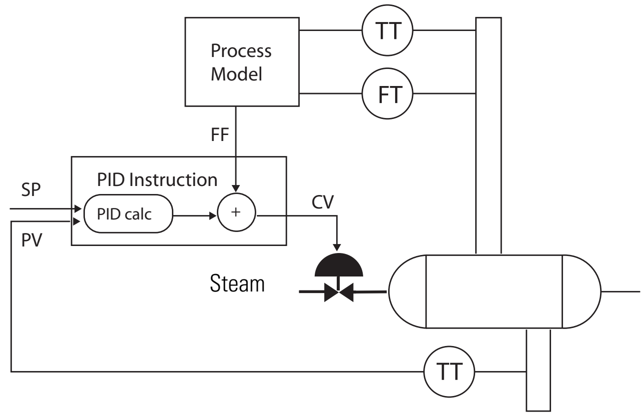
Table 13 - Cascade PID Logic

Block	Block Type	Parameter	Element	Value
FLOW	Analog Input	MODE_BLK	TARGET	Auto
		XD_SCALE (these values must match the PRIMARY_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct
Secondary PID	PID	MODE_BLK	TARGET	CAS
		GAIN		Loop Dependent
		RESET		
		RATE		
		PV_SCALE (these values must match in Analog Input range)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	

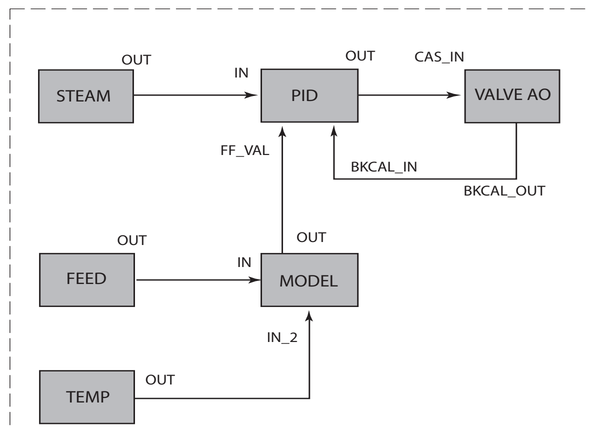
Table 13 - Cascade PID Logic

Block	Block Type	Parameter	Element	Value
TEMP	Analog Output	MODE_BLK	TARGET	Auto
		XD_SCALE (these values must match the FINAL_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct
Primary PID	PID	MODE_BLK	TARGET	Auto
		GAIN		Loop Dependent
		RESET		
		RATE		
		PV_SCALE (these values must match in Analog Input range)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
VALVE	Analog Output	MODE_BLK	TARGET	CAS
		XD_SCALE (these values must match the FINAL_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct

Feed Forward PID



43704



43737

Table 14 - Feed Forward PID Logic

Block	Block Type	Parameter	Element	Value
STEAM	Analog Input	MODE_BLK	TARGET	Auto
		XD_SCALE (these values must match the PRIMARY_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct
PID	PID	MODE_BLK	TARGET	CAS
		FF_GAIN		1.0
		GAIN		Loop Dependent
		RESET		
		RATE		
		PV_SCALE (these values must match in Analog Input range)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	

Table 14 - Feed Forward PID Logic

Block	Block Type	Parameter	Element	Value
FEED	Analog Output	MODE_BLK	TARGET	Auto
		XD_SCALE (these values must match the PRIMARY_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct
TEMP	Analog Input	MODE_BLK	TARGET	Auto
		XD_SCALE (these values must match the PRIMARY_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL	STATUS	1
		L_TYPE		Direct
MODEL	Arithmetic	MODE_BLK	TARGET	Auto
		ARITH_TYPE(1)		Average
		GAIN		4.0
		IN-1(1)	VALUE	Negative of expected temp
		IN-1(1)	STATUS	GNC
		IN-3(1)	VALUE	Negative of expected temp
		IN-3(1)	STATUS	GNC
VALVE	Analog Output	MODE_BLK	TARGET	CAS
		XD_SCALE (these values must match the PRIMARY_VALUE_ RANGE of the transducer block)	EU_100	
			EU_0	
			UNITS_DECIMAL	
			DECIMAL	
		CHANNEL		1
		L_TYPE		Direct

(1) User-defined values. These represent the suggested use for this application.

Notes:

Visualize Fieldbus Instrument Data

Introduction

This chapter describes how to use RSLogix 5000 Add-On Instructions with pre-designed, instrument-specific faceplates for a visual representation of field device data.

The generic configuration shown in this section can be applied to a wide range of instruments and applications. The example does not limit the multitude of faceplates that can be designed for your fieldbus application. It does, however, provide a common set of features that can be used in the majority of applications.

IMPORTANT Add-On Instruction functionality is available for RSLogix 5000 software, versions 16 or later; therefore, earlier versions cannot be used. Import/Export features in RSLogix 5000 software, version 19 and later, make it easier to import an entire routine with logic, Add-On Instructions, user-defined data types (UDT) ,and new tags into existing projects.

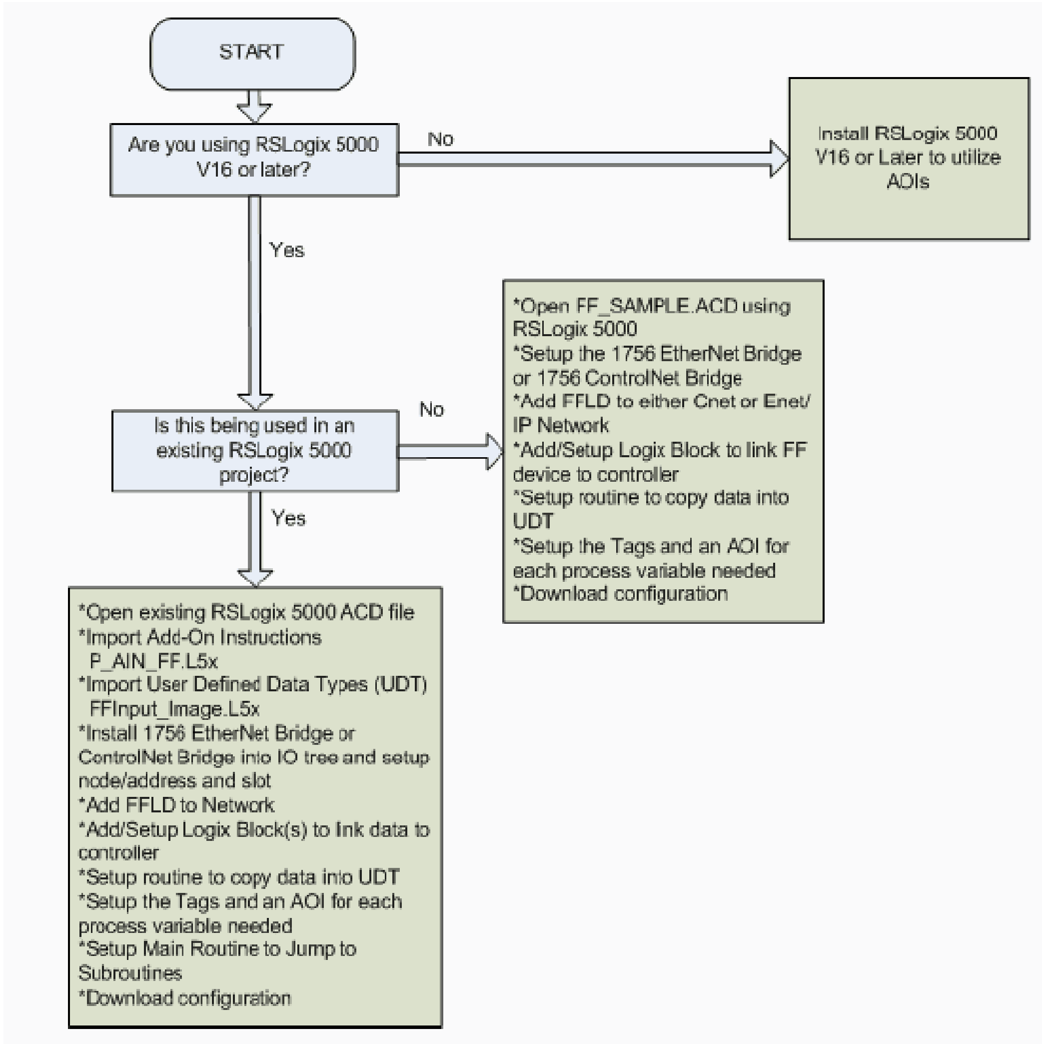
Add-On Instructions contain code that is encapsulated into pre-validated modules that can be easily reused without modification. This lets you create standardized libraries that can reduce project development time and provide consistency to reduce equipment start-up and support costs.

In a fieldbus application, Add-On Instructions provide a two-way exchange of data between the faceplates and the ControlLogix controller. Add-On Instruction data is populated in faceplates via global objects, which are created in the FactoryTalk View Site Edition software.

The table explains the topics discussed in this chapter.

The diagram helps you choose what files are needed to set up an RSLogix 5000 project.

Figure 24 - Installation Diagram for RSLogix 5000 project



Add-On Instruction Set Up

You must connect a Fieldbus H1 network to a linking device to use the RSLogix 5000 Add-On Instruction and FactoryTalk View Site Edition (SE) software faceplates. First, the 1757-FFLD or 1757-FFLDC linking device and instruments must be communicating with the controller after being configured with RSLogix 5000 and RSFieldbus software.

The following pages provide a basic outline for designing a faceplate to view RSLogix 5000 data.

For specific configuration procedures, see the following:

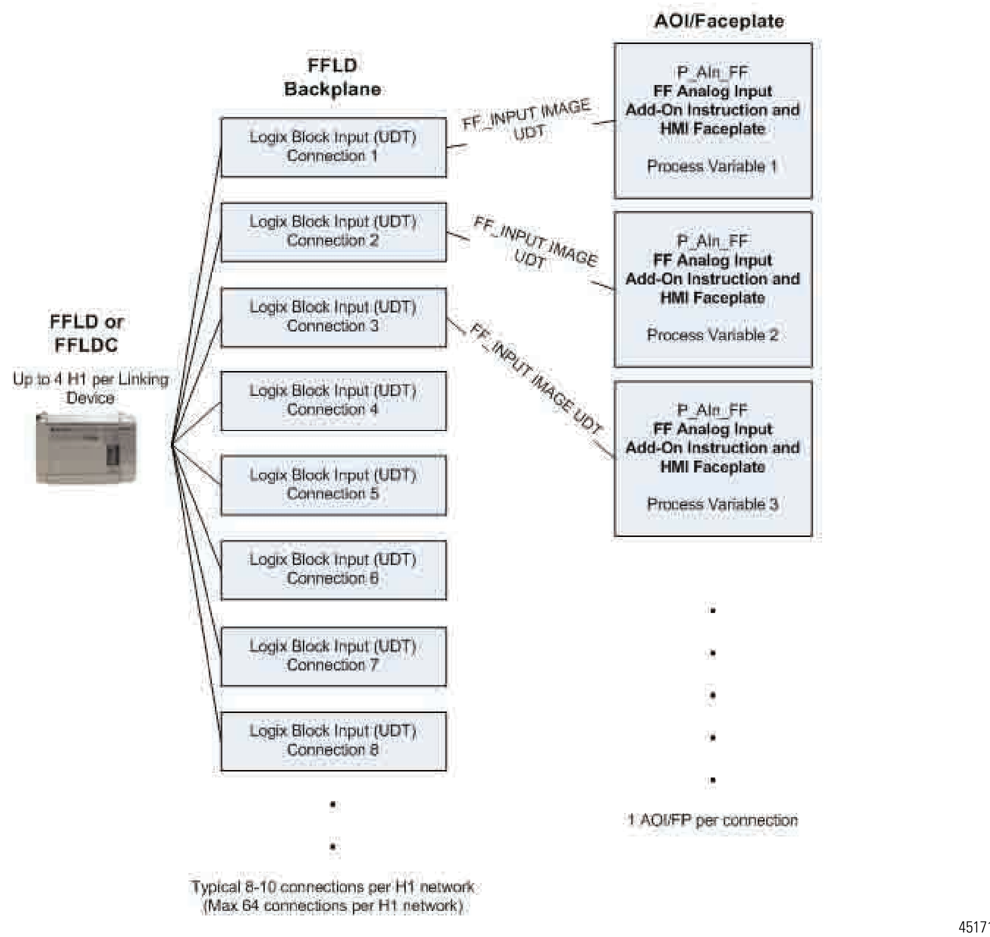
- FOUNDATION Fieldbus System User Manual, publication 1757-UM012
- Endress+Hauser instrument specific integration document at http://www.rockwellautomation.com/solutions/process/integrationdocs.html

Configuring RSLogix 5000 with an Add-On Instruction

The P_AIn_FF Add-On Instruction is required to present the relevant data for the purposes of maximizing flexibility of use and to provide a standard operator interface that can be customized to suit your plant's need. This Add-On Instruction is used to take the structured data from each input by using a user-defined data type (UDT) and to provide the data to the FOUNDATION Fieldbus generic faceplate.

By using a combination of the P_AIn_FF Add-On Instruction and the faceplate, you can display the process variables available from each instrument.

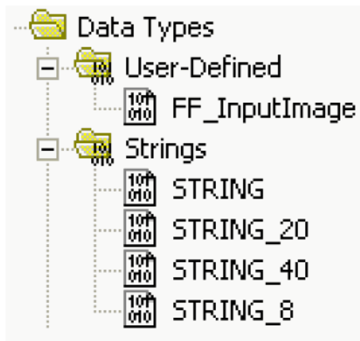
Figure 25 - Process Variable Configuration

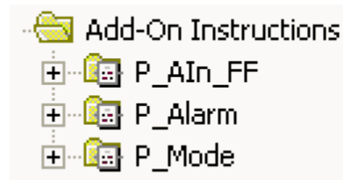


IMPORTANT	Before beginning configuration, you should download the FF_SAMPLE.ACD file for an example of how the user-defined data types and Add-On Instructions should be set up for a single instrument with a single FFLD connected to a controller. This file is available at the Rockwell Automation Sample Code website (http://www.samplecode.rockwellautomation.com).

Data Types and Add-On Instructions

Whether you are using a new project or adding to an existing project, the examples show the data types and Add-On Instructions that must exist in the Controller Organizer for the RSLogix 5000 project that is being set up for use with a faceplate.





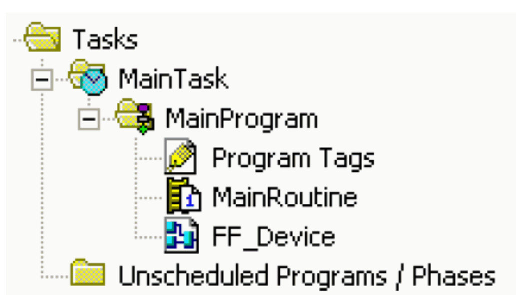
Add-On Instructions have their own user-defined data structure for each instance being used.

For more information, see the RSLogix 5000 Controllers Add-On Instructions Programming Manual, 1756-PM010.

Programs and Routines

Once the data types and Add-On Instructions are installed in the project, the Add-On Instructions must be inserted into the logic. The example shows how the routines are structured under the MainProgram of the RSLogix 5000 project, and what logic is inserted into which routine. This is the same setup included in the FF_SAMPLE.ACD code.

The key routines added for this example are the MainRoutine, which is a ladder diagram routine, and FF_Device, which is a function block routine. One of the benefits of RSLogix 5000 software is that an Add-On Instruction developed in one language can be used in any of the four RSLogix 5000 configuration languages.

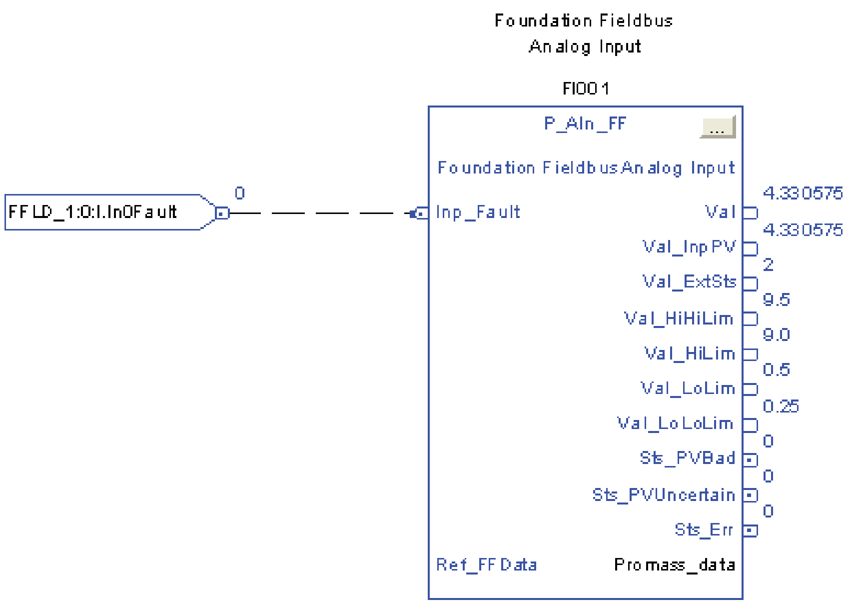


FF_Device Routine

The logic set up for the FF_Device routine consists of a function block sheet that is wired together with the P_AIn_FF Add-On Instruction that pulls data from each Analog Input UDT. P_AIn_FF is named via a tag (example, FI001) and the instrument's UDT is mapped into the Ref_FFData (example, Promass_data).

The Inp_Fault on the P_AIn_FF must be connected to the corresponding Input Fault parameter (example, FFLD_1:0:1.In0Fault) on the FFLD as shown in Figure 26.

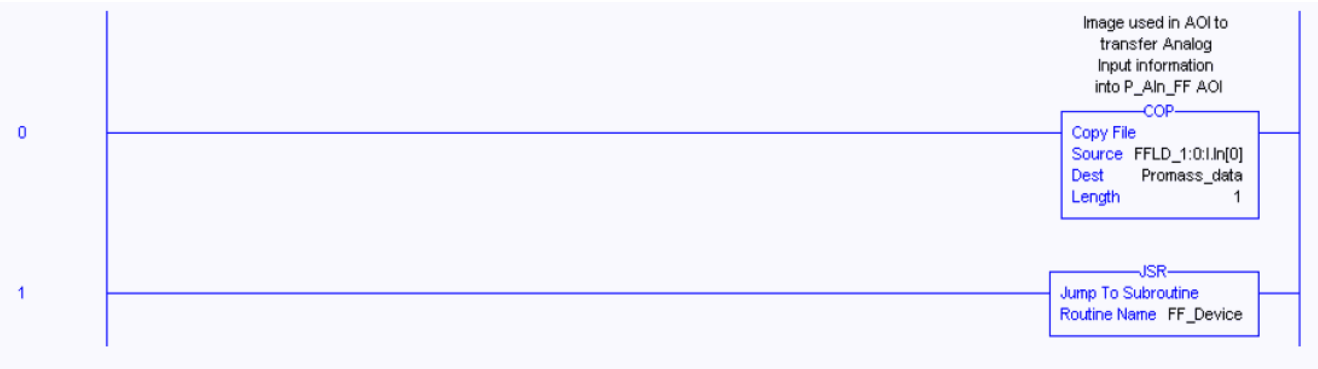
Figure 26 - P_AIn_FF Function Block



MainRoutine

The module data from the Logix Block must be moved into the UDT. This is completed by adding rung 0 in the MainRoutine.

Additionally, the new sub-routine (example, FF_Device) must be forced to execute by adding a jump sub-routine to rung 1.



IMPORTANT	This ladder logic is included in the FF_SAMPLE.ACD file. Refer to the Rockwell Automation Sample Code website (http://samplecode.rockwellautomation.com).

You are now ready to design the faceplate. You must have FactoryTalk View SE software installed on your computer.

See page 119 for important installation instructions.

Pre-designed FactoryTalk View SE Faceplates

The FOUNDATION Fieldbus faceplates can be used with the P_AIN_FF Add-On Instruction. This Add-On Instruction should be used for FOUNDATION Fieldbus instruments that can display the linked process variable and the actual link status.

The P_AIN_FF Add-On Instruction stores the tag name, description, and engineering units that are configured by the user in the controller. This Add-On Instruction also can be set up to display controller based alarms in the faceplate and HMI Alarm Summary within FactoryTalk View SE software.

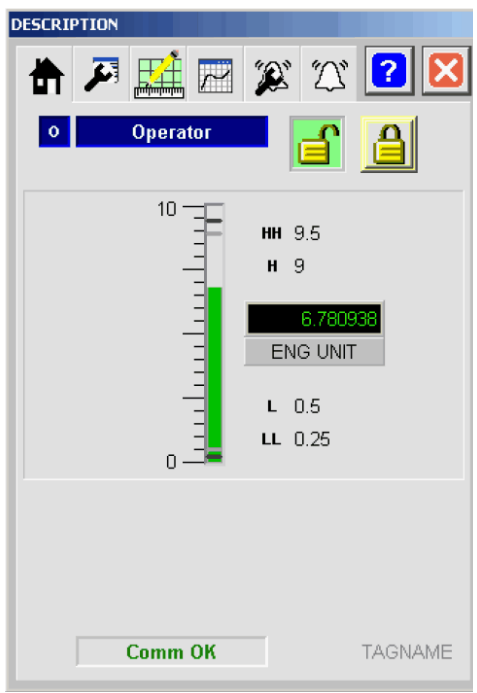
IMPORTANT	You must have a Rockwell Automation TechConnect contract for Process to access FOUNDATION Fieldbus faceplates.

Navigation icons at the top of the faceplate change the information displayed. Status displays show information using a bar graph, numeric values, and a trend display. Additional displays show specific alarms, warnings, and are used to create alarms.

See faceplate tabs on page 125.

The faceplate, as shown in Figure 27, provides a help display , and also lets you set manual values on the output process variable.

Figure 27 - FactoryTalk View SE Faceplate Example



Install Files into FactoryTalk View Studio Software

When configuring FactoryTalk View SE software, you can add the pre-designed faceplates, example displays, and global objects into a current project. Copy all the Display (.gfx), Image (.bmp), and Global Object (.ggfx) files into a separate accessible directory, and then open an existing FactoryTalk View Studio project.

FactoryTalk View Studio software contains editors for creating complete applications, and contains software for testing the applications you create. Use the editors to create applications that are as simple or as complex as you need.

Do these steps to copy files within an existing FactoryTalk View Studio project.

1. In the Graphics folder, right-click either Displays, Global Objects, or Images and choose Add Component Into Application.
2. Select all the files in each folder.
3. Click Open to copy the .gfx, .bmp, or .ggfx files, respectively.

   Refer to the FactoryTalk View Site Edition User's Manual, publication VIEWSE-UM006, for details.

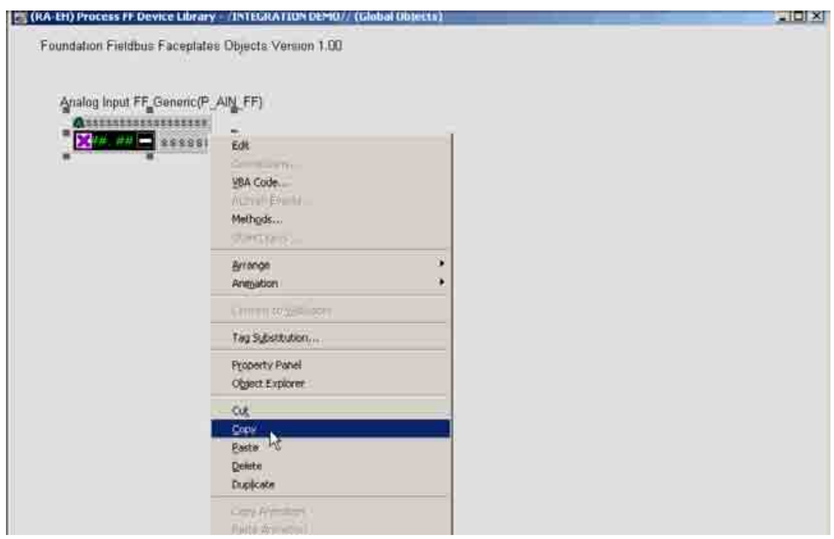
Insert Global Object to Link Data

The faceplate uses one FactoryTalk View licensed screen only while showing the six displays. The navigation tabs operate in conjunction with Visual Basic for Application code to display different grouped objects that are layered on top of each other.

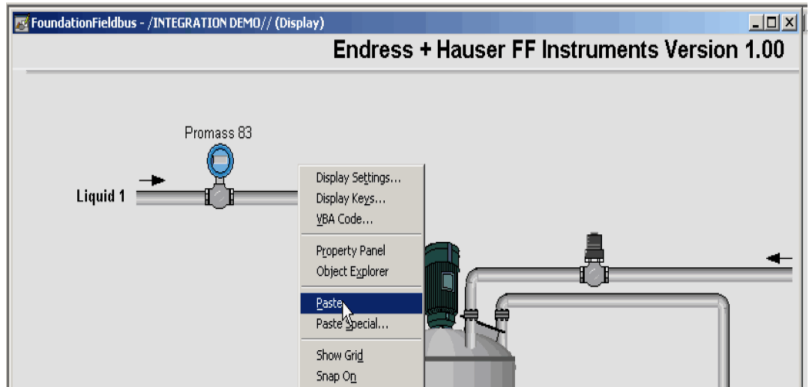
To display the faceplate for a specific instrument, the faceplate is linked by the tag used in the P_AIN_FF instruction that ultimately displays the process variable needed by the operator.

A global object is inserted for the process variable that is needed for each instrument. The following examples show a generic global object (P_AIN_FF) for an Endress+Hauser instrument being inserted into a FactoryTalk View SE display screen.

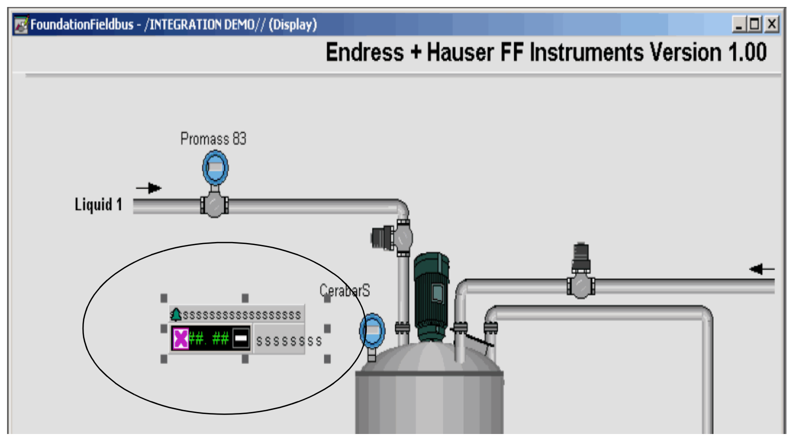
1. Right-click the global object and choose Copy.



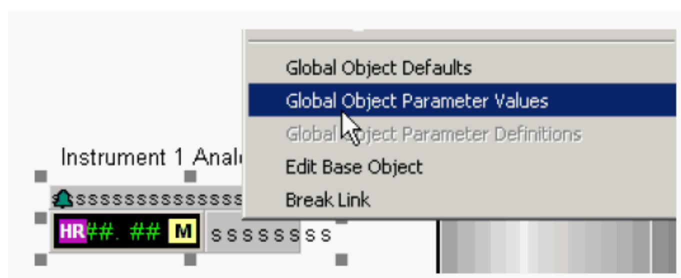
2. Right-click into each graphic, as needed, and choose Paste.



The global object appears on the display after it is copied into a graphic.

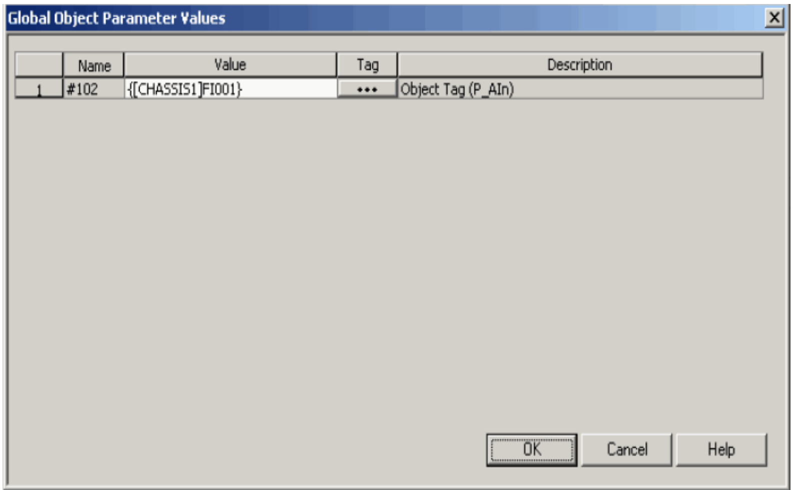


3. Right-click the global object and choose Global Object Parameter Values.



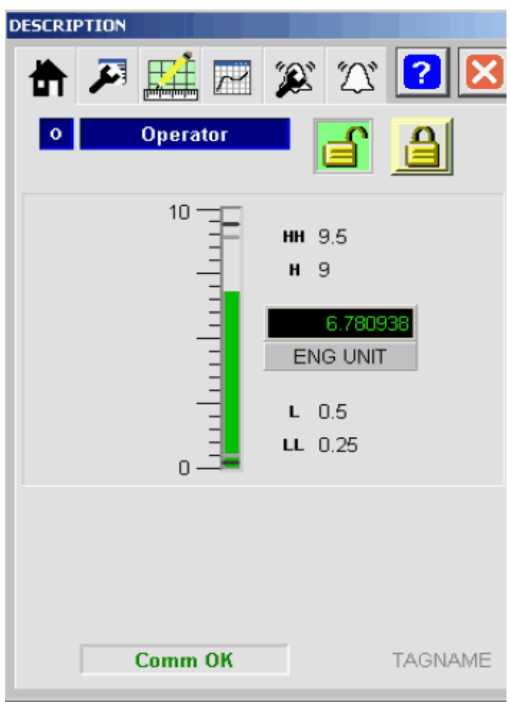
4. In the Value field, type the name of your tag that is relevant to your instrument's tag.

   This is the specific unique Add-On Instruction tags in RSLogix 5000.

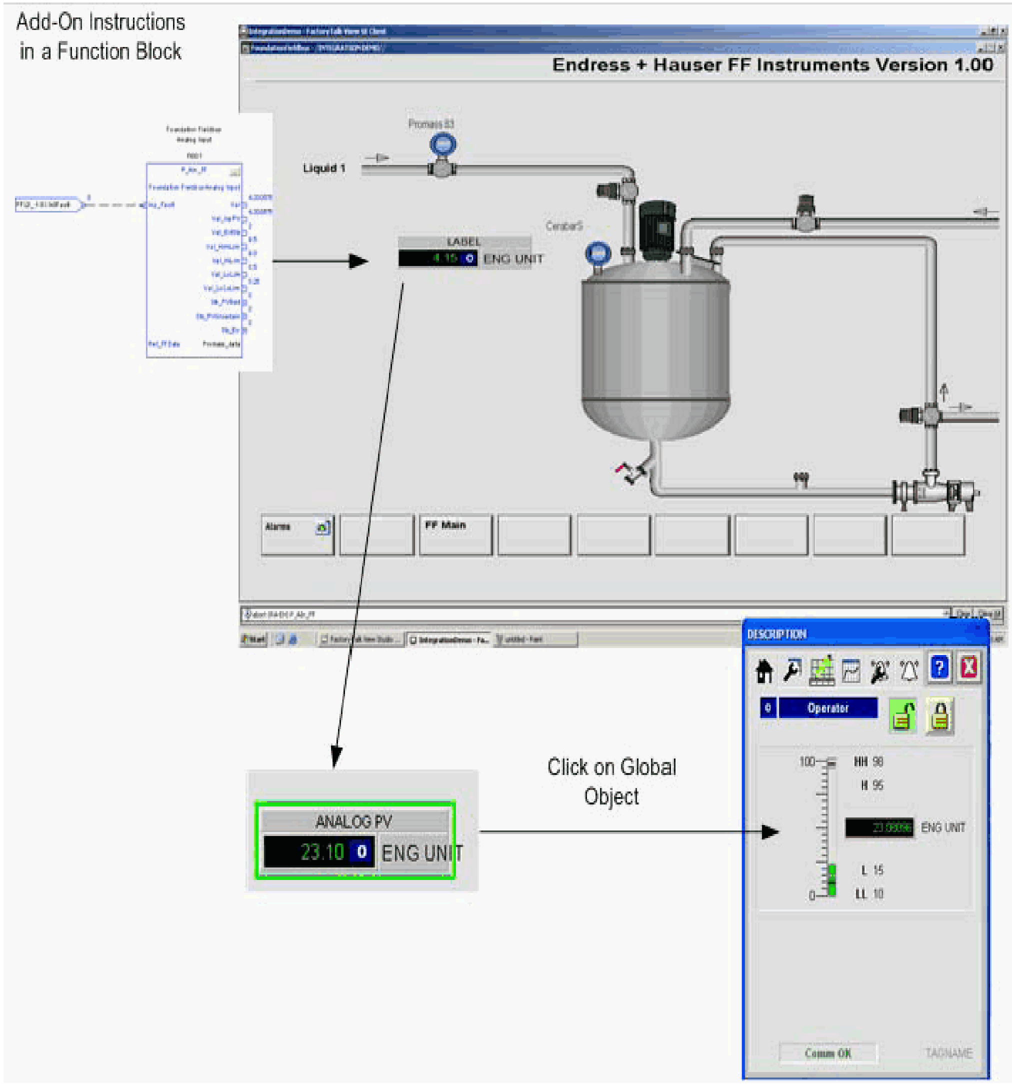


5. Repeat step 4 for each instance of the variables displayed.
6. Open the graphical display where the global oject was inserted and click the global object button on the display.

   The faceplate appears with the FOUNDATION Fieldbus information.



The main setup is nearly finished. The Add-On Instruction is linked to the faceplate through the global object.

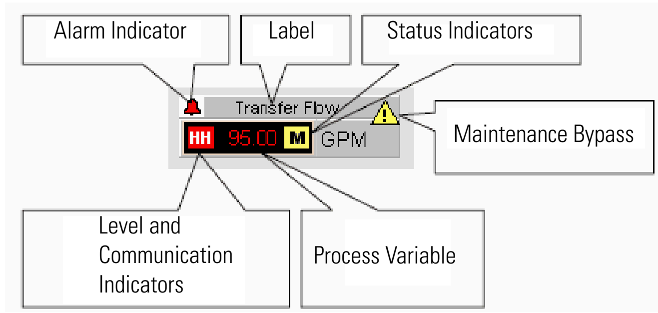


7. To complete the process, you must enter the tagname, description, label, PV scaling, engineering units, and alarming with the FactoryTalk View client server.

   The information is saved to the online controller. To archive changes, the online controller **must** be saved to the offline project by using the RSLogix 5000 software.

Global Objects Attributes

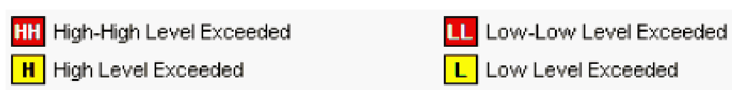
Analog input global objects have common attributes on graphic displays. This section explains the codes and colors for operational use and maintenance.



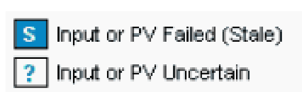
The process variable changes color if there is an error. The table explains the state of the object based on the color.

Color	State
Green	Value within limits.
Yellow	Above the High or below the Low limits.
Red	Above the High-High or below the Low-Low limits.
Magenta	Above or below the failure limits, or a communication failure.

These icons are level indicators.

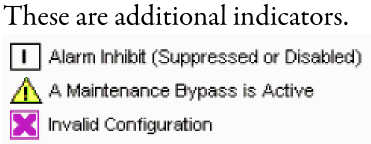


These icons are communication indicators.



These icons are status indicators.

These are additional indicators.

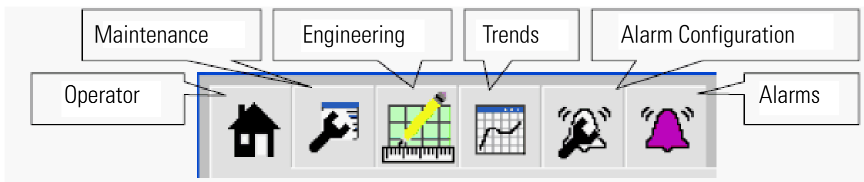


An alarm indicator changes color based on the alarm's severity, and blinks if an acknowledgement is required. This icon is visible only if the object has active or unacknowledged alarms. The table shows the color and alarm severity.

Color	Alarm Severity
White	Out of Alarm, Acknowledgement Required
Light Blue	Information Alarm
Yellow	Warning
Red	Exception
Magenta	Fault

Faceplate Tabs

The FOUNDATION Fieldbus analog input faceplate has six tabs as shown in the illustration. You also can access Help by clicking the  icon.



The Alarm icon on the Alarms page changes color based on the current active alarm. A blinking alarm icon indicates that one or more alarms must be acknowledged and/or the device must be reset.

Operator Tab

This tab appears when you click a value in the global object on a graphical display. The data includes the current mode and process value.

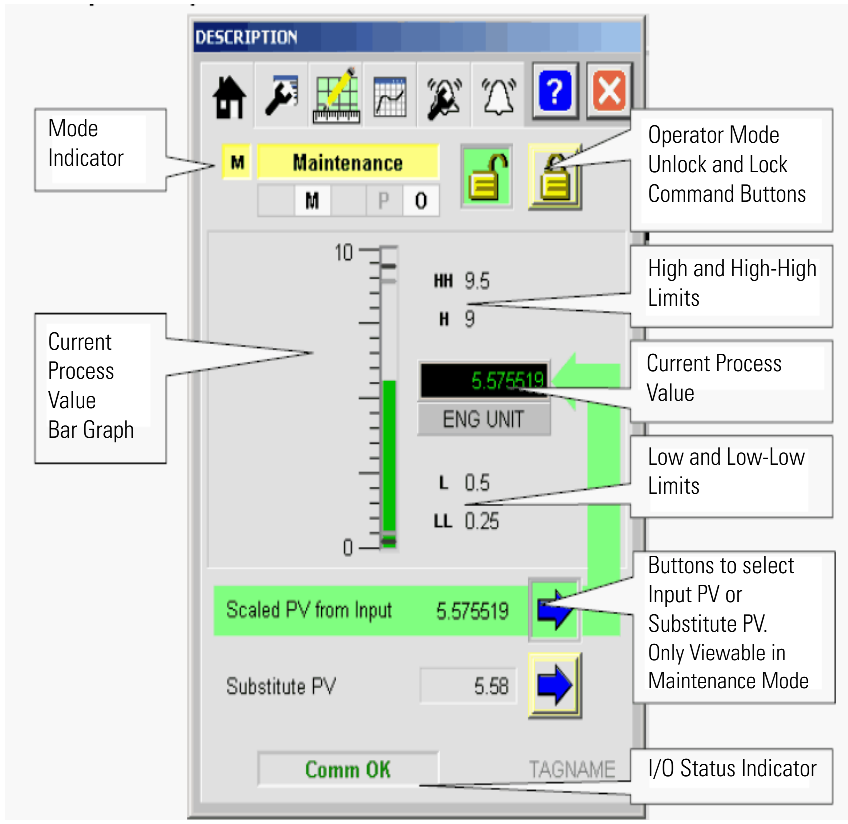


Table 15 - Operator Tab Definitions

Item	Description
Current Mode	Program (P), Operator (O), Override (OV), Maintenance (M), Hand.
Requested Mode Indicator	Appears only if the Operator or Program mode has been superseded by another mode.
Current Process Value	Numerical value appears.
Current Process Value Bar Graph	Visual of numerical process value. The bar graph changes color (magenta, fault; red, exception; yellow, warning) depending on the state of the process value.
Scaled High Range and Low Range Values	Top and bottom labels on the bar graph as determined by the scaled range values on the Engineering tab.
High-High (HH) and Low-Low (LL) Limits	Limits are displayed with a label background that turns red when exceeded. These limits are visible if the threshold (entered on the Maintenance tab) falls within the limits of the graph.

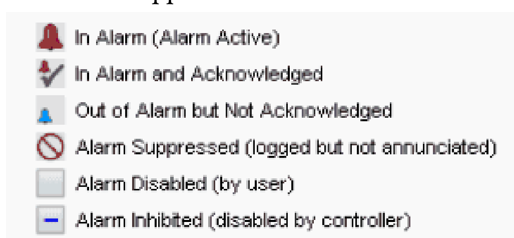
Table 15 - Operator Tab Definitions

Item	Description
High (H) and Low (L) Limits	Limits are displayed with a label background that turns yellow when exceeded. These limits are visible if the threshold (entered on the Maintenance tab) falls within the limits of the graph.
Communication Status	Status shows 'OK' or 'Fault'.
Maintenance Mode or Substitute Process Value is Selected	Input Process Value, Substitute Value, and buttons for selecting either one display, along with a colored arrow indicating which is in use.

These alarm states appear on the Operator tab:

- Fail (left of the Communication Status)
- High-High (left of the High-High label)
- High (left of the High label)
- Low (left of the Low label)
- Low-Low (left of the Low-Low label)

These icons appear for alarm states.



These functions require security codes on the Operator tab:

- Release Operator Lock - security code 'A'
- Lock in Operator Mode - security code 'A'
- Use Input Process Value - security Code 'C'
- Use Substitute Process Value - security code 'C'

There also is an entry field for Substitute Process Value. This field is available only if the Substitute Process Value is in use unless the Bumpless Program/Operator Transition checkbox is not enabled on the Maintenance tab. You must have a security code 'C' to modify this value

When the device is in Simulation mode, then the PV Used in Simulation entry field appears. You must have security code 'A' to modify this value.

Maintenance Tab

The Maintenance tab shows the level alarm thresholds and deadbands, and lets you release command buttons.

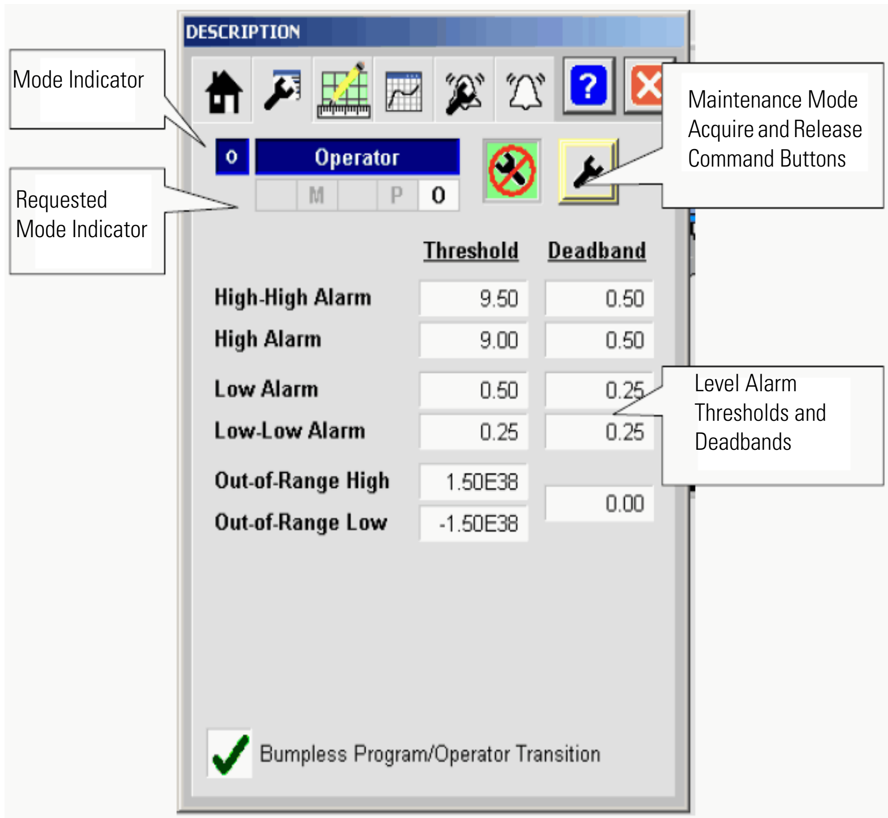
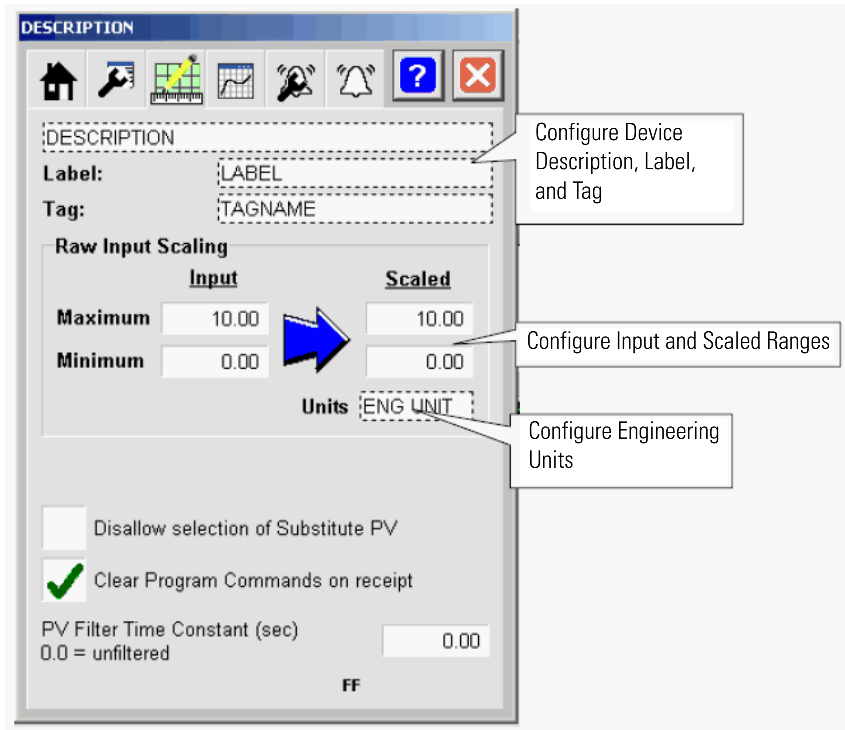


Table 16 - Maintenance Tab Definitions

Item	Description
Current Mode	Program (P), Operator (O), Maintenance (M).
Requested Mode Indicator	Display highlights all of the modes that have been requested. The leftmost highlighted mode is the active mode.
Acquire and Release Maintenance Mode	You must have security code ‘C’ to use these icons to acquire and release maintenance modes.
Threshold and Deadband Values	You must have security code ‘H’ to modify these values.
Bumpless Program/Operator Transition	You must have security code ‘C’ to modify this checkbox.

Engineering Tab

This tab provides entry of the device's text configuration items, such as description, label, tag, and process value units.

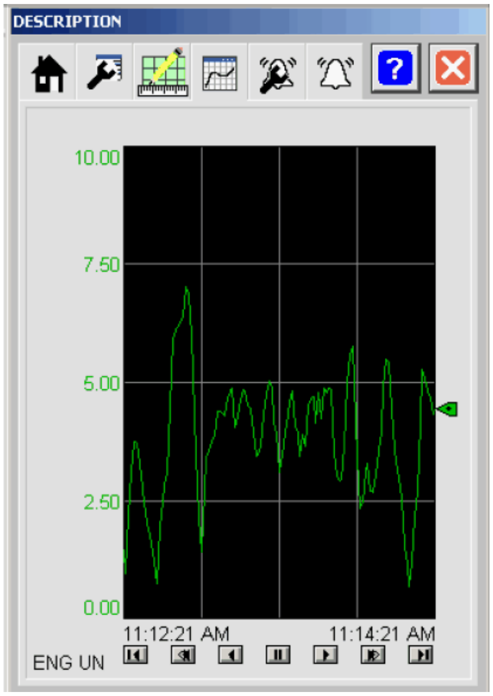


You must have security code 'E' to perform these tasks:

- Modify the maximum and minimum scaled values.
- Modify the checkboxes.
- Modify the process variable filter time constant.

Trend Tab

The Trend tab contains a trend of the process variable. The scaling and engineering units for the trend are changed by using the Engineering tab.



Alarm Configuration Tab

This tab lets you configure attributes for the alarms for a device.

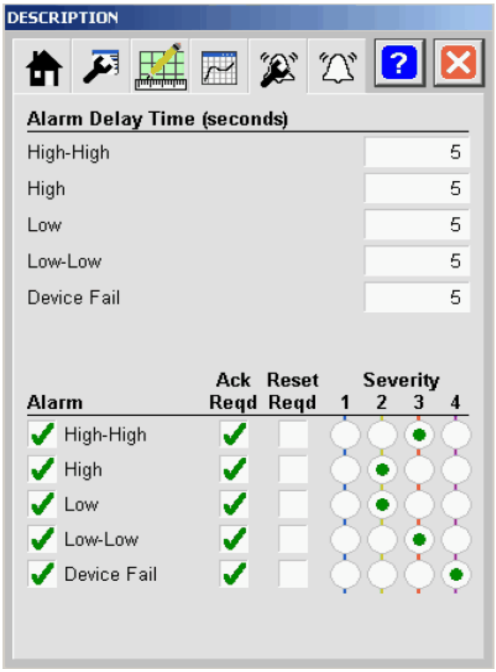


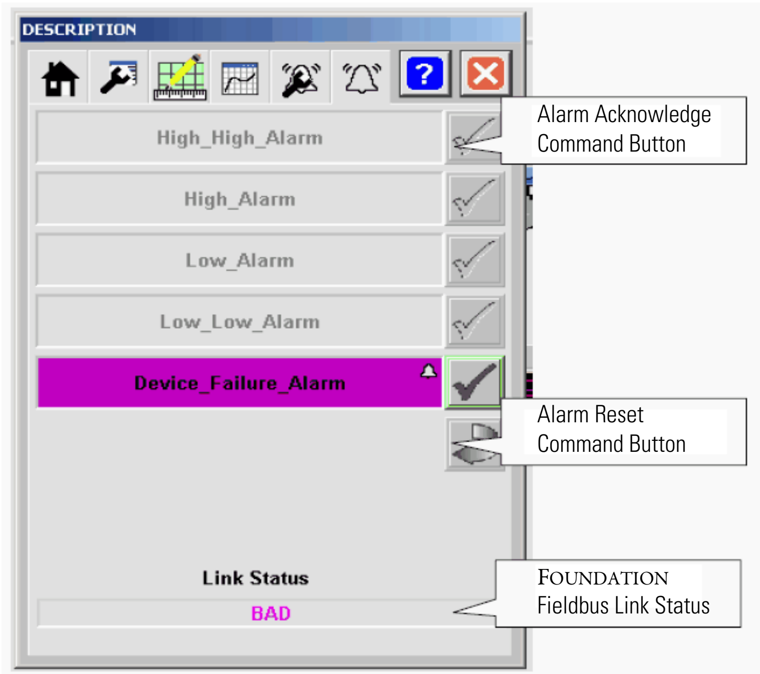
Table 17 - Alarm Configuration Tab Definitions(1)

Item	Description
Alarm Delay Time	This is the minimum time in the alarm condition before the alarm is raised. You must have security code 'D' to modify these fields.
Alarm	These checkboxes relate to alarms for the device. If a box is not checked, the controller does not process the alarm and all configurations and displays for this alarm are hidden on the faceplate.
Acknowledgement Required	An acknowledgement is required to clear an alarm. If you are using alarms in the FactoryTalk View SE software, the corresponding acknowledgement box must be checked in the FactoryTalk View Alarm and Events configuration.
Reset Required	Reset is required to clear an alarm. If you are using FactoryTalkView Alarm and Events, do not check the Latch checkbox because the controller handles the alarm reset within the Add-On Instruction.
Severity	The radio box configures the severity level of an alarm.

(1) Except where noted, you must have security code 'E' to modify any of the Alarm Configuration parameters.

Alarms Tab

This tab displays each alarm state for a device. If an alarm is active, the panel behind the alarm changes color to match the severity (Magenta, fault; Red, exception; Yellow, warning). The panel blinks if the alarm needs an acknowledgement. The checkmark is enabled if the corresponding alarm needs achnowledgement.



The alarm reset icon is enabled if any of the alarms requires a reset. You must have security code 'F' to acknowledge and reset alarms.

The link status provides information on the status of the FOUNDATION Fieldbus instrument or the FOUNDATION Fieldbus function blocks. The link state displays 'Good,' 'Uncertain', and 'Bad' depending on the situation.

FactoryTalk AssetCentre Software Multi-vendor Options

FactoryTalk AssetCentre software is a server-based, centralized tool that provides flexibility and the latest technology to extend your fieldbus system. Acting as a host system, AssetCentre software lets you work with process instrumentation from multiple vendors in one common platform.

Using Field Device Tool (FDT) technology to access device parameters, FactoryTalk AssetCentre software aids in configuring, operating, and reading diagnostic information in process devices. This means you can implement an asset management solution for your installed asset base that consists of multiple vendors' products or for new installations from vendors supporting FDT technology.

The FDT interface standardizes the communication interface between field devices and systems. This allows any device to be accessed from FactoryTalk AssetCentre software through any protocol.

Along with our Encompass Partners, such as Endress+Hauser and Metso Automation, we develop a Device Type Manager (DTM) for each device or group of devices. The DTM encapsulates all the device-specific data and functionality.

FactoryTalk AssetCentre software contains the communication component to interface the FactoryTalk AssetCentre Client with the specific fieldbus communication, such as FOUNDATION Fieldbus communication. FactoryTalk AssetCentre software initiates the DTM and enables the devices to interoperate with the operating environment.

The FDT interface allows FactoryTalk AssetCentre software to integrate many different kinds of devices, including handheld diagnostic tools.

A DTM can be launched from a button in FactoryTalk View SE software. This option provides additional capabilities provided by each device vendor.

Startup and Maintenance

Introduction

This chapter describes techniques and tools that can be used to set up and maintain fieldbus devices and segments. Third-party tools that are discussed are suggestions and do not include all the diagnostic equipment that is available to keep your system running optimally.

The table explains the topics discussed in this chapter.

Recommended Tools

At a minimum, you will need the following tools to capture fieldbus data:

- Relcom's Fieldbus Network Monitor FBT-3 or FBT-6
- Pepperl+Fuchs mobile diagnostic module and fieldbus analyzer

Relcom's FBT-3 can be used to examine the operation of a live fieldbus network, without interfering with its operation.[1]

The FBT-3 will verify the DC voltage on the network and check how much noise is on the network. It also can be used to measure peak noise levels, framing errors, the number of transmitters on the wire, and what the signal level of the weakest field transmitter is. In addition, with the FBT-3 you can see the total number of devices up and running, and what devices are left on the network. The FBT-3 can be purchased from Relcom (http://www.relcominc.com).

A protocol analyzer is a tool that lets you test for the content of the message sent, what the messages mean, and what sequence the fieldbus devices talk to each other. It should be noted, however, that a protocol analyzer is an advanced tool with a complex range of functions.

See page 143 for more details on advanced diagnostic modules.

(1) FBT-3 Manual.

If a monitor or analyzer are not available, a digital oscilloscope is necessary. We recommend a hand-held battery-operated unit because of its small size and ease of use. The Fluke 199-3 ScopeMeter is one such scope.

Fluke 199-3
200 MHz ScopeMeter

45280

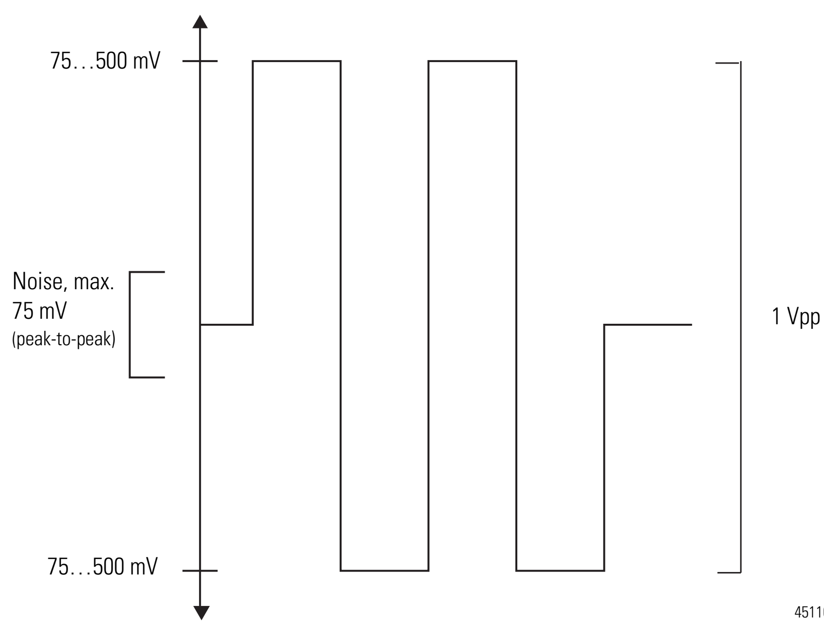
Other scopes that can be used include the TPI-E1505, the Extech-381275 (http://www.professionalequipment.com), and the Techtronix THS700 Series (http://www.tek.com).

Signal Analysis

Oscilloscopes, whether portable or stationary, from 50 MHz…1 GHz, can be used to capture and examine the waveform. The power supply waveform should be a ± 0.75V DC …± 1.00V DC square wave riding on the 9… 32V DC steady power supply with <0.10V DC ripple. The sharper the rising and falling edges of the waveform, the better the data transfer. The physical media of a system determines what shape the waveform takes.

Figure 28 shows a signal that is a current modulated ±10 mA signal on a 50 test load. This generates a 1.0 Vpp signal. A valid signal can range from 150 mVpp up to 1.0 Vpp and noise must not exceed 75 mVpp.

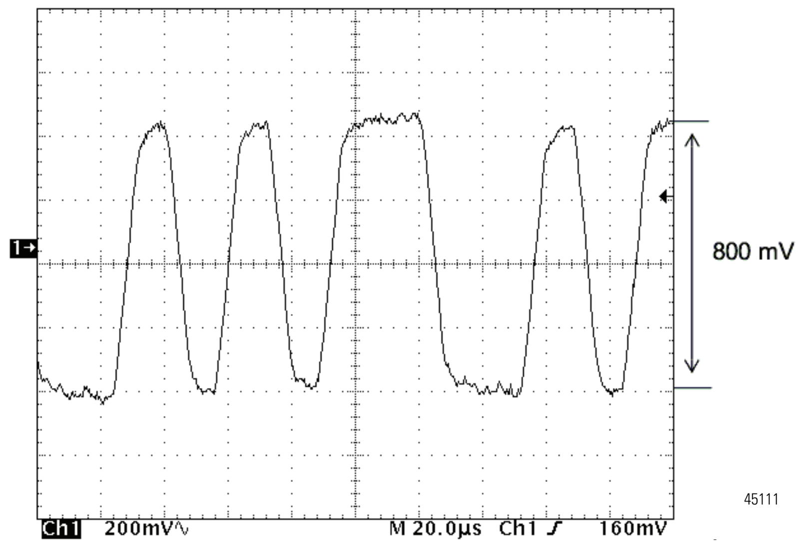
Figure 28 - Ideal Fieldbus Communication Signal



Good Network Scope Display

In order to analyze a fieldbus network signal, you must know what constitutes a good signal versus a bad one. Figure 29 represents a normal signal consisting of two terminators and 1000 ft of cable. Its peak-to-peak voltage is 850 mV, which is close to the ideal value of 1 Vpp.

Figure 29 - Good Network Signal(1)

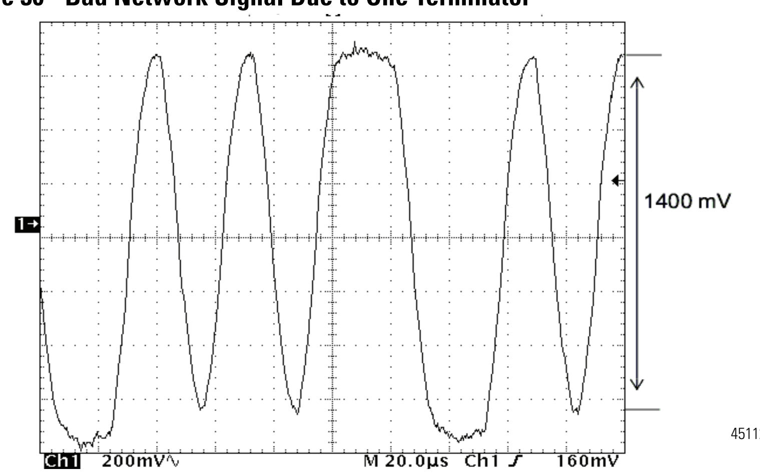


Bad Network Scope Display

Bad network signals can inhibit the performance of your network. A common reason for bad signals is the addition of one or more unnecessary terminators in a network.

IMPORTANT	Remember, there can be only **two** terminators per bus segment.

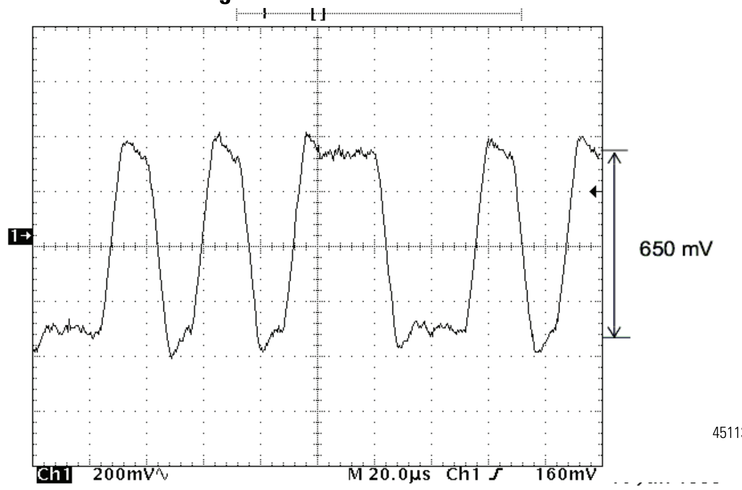
Figure 30 - Bad Network Signal Due to One Terminator(2)



(1) FOUNDATION Fieldbus System Engineering Guidelines (Appendix 5.1).

(2) FOUNDATION Fieldbus System Engineering Guidelines (Appendix 5.2).

Figure 31 - Bad Network Signal Due to Three Terminators(1)



In both examples of a bad signal, the Vpp is far from the ideal of 1 Vpp that a good signal would display.

Device Recovery

These tools can be used to reset a device:

- Rosemont 375 or 475.
- Endress + Hauser Field Expert, handheld model

Device Replacement

RSFieldbus software, version 2.0 and later, supports device replacement. However, when a device is exchanged, you will receive a warning message if the parameters list does not match. The parameters in the device running must be related to the common parameters in the function blocks.

Also, because FOUNDATION Fieldbus is a communication protocol with manufacturer specific function blocks, there is no guarantee that one manufacturer's function blocks will operate in a similar manner as another's. Therefore, reuse of one manufacturer's function block in another manufacturer's device is to be avoided.

Interoperability

If a device is to be replaced with another manufacturer's device, or a device from the same manufacturer but from a different model series, this replacement falls under the category of interoperability.

Interoperability will require a complete recreation of the control strategy function blocks in the failed unit. The existing blocks in the failed unit need to be deleted and then replaced by appropriate function blocks in the existing strategy. The resulting strategy will then require a complete download of the entire network.

(1) FOUNDATION Fieldbus System Engineering Guidelines (Appendix 5.3).

Interchangeability

Interchangeability is the ability to replace one failed device with a good device, provided that the devices are from the same manufacturer and class. In this case, replacement can be accomplished by moving blocks from the failed device to the replacement device. The replacement device can then be downloaded without any need to edit the strategy or download the entire network.

Alarms

Rockwell Automation's 1757-FFLD and 1757-FFLDC linking devices do not support alarms. There are no alarm function blocks for these linking devices.

Alarm data in a FOUNDATION Fieldbus device, however, may be accessed from an HMI by using Ole Process Control (OPC). You are solely responsible for the implementation of this application. Alarm data also is accessed by using CIP messaging from the Logix5000 controller.

Set and Reset

There are web pages available to show you the status of your linking device, VCRs, and the communication (or lack thereof) between H1 devices, linking devices, and the host computer. The H1 Live List captures information for the traffic between the linking device and field devices. HSE captures contain data transferred between the computer and the linking device.

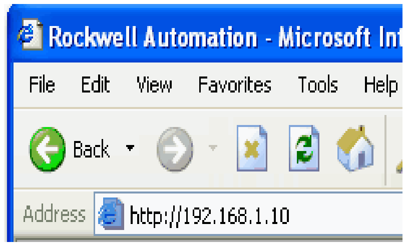
IMPORTANT	HSE captures require an additional driver to be installed in the host computer. Refer to Knowledgebase Tech Note ID G128737547 at http://www.rockwellautomation.com/knowledgebase/ for more information.

You must set up a password and user name to access the web diagnostic pages and hidden pages, which are viewable only to your administrator account.

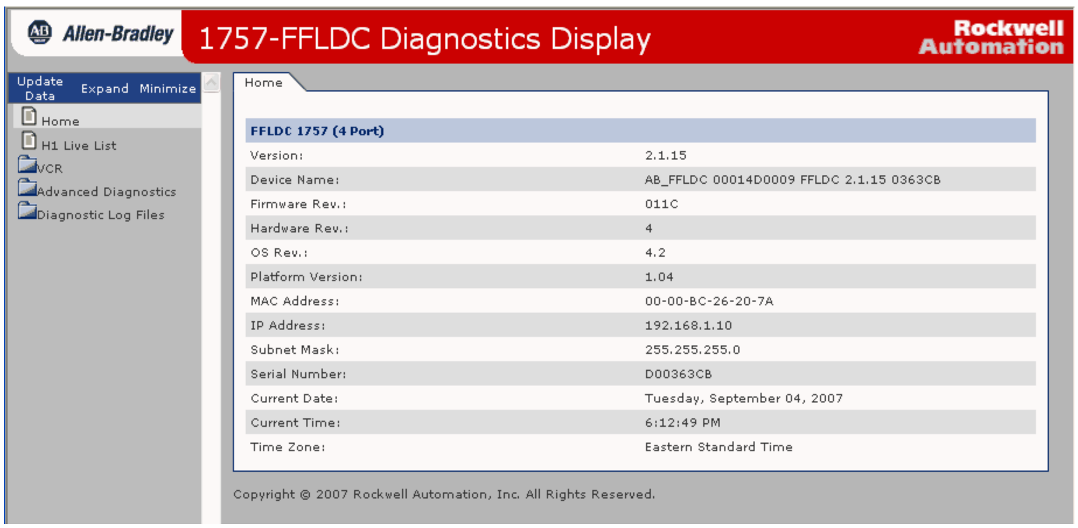
Before setting up a user name/password, you must assign an IP address through the BOOTP server so the Ethernet port of the linking device can access module data. The Ethernet port is set to Dynamic Host Configuration Protocol (DHCP). Devices communicate on the Ethernet by their unique address.

1. In your Web browser, enter the IP address of the linking device and press Enter.

The IP address shown is an example.



The Home page appears.

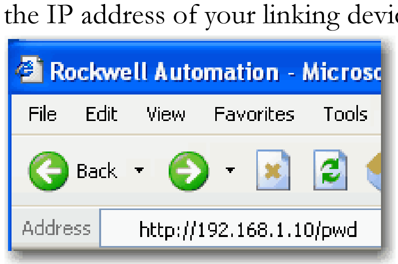


You navigate the web pages by using the navigation panel on the left side of the Home page. Some pages also include tabs that access additional pages in each folder. Hidden pages, which access the linking device's Reset, Date and Time Zone pages, require an administrator account.

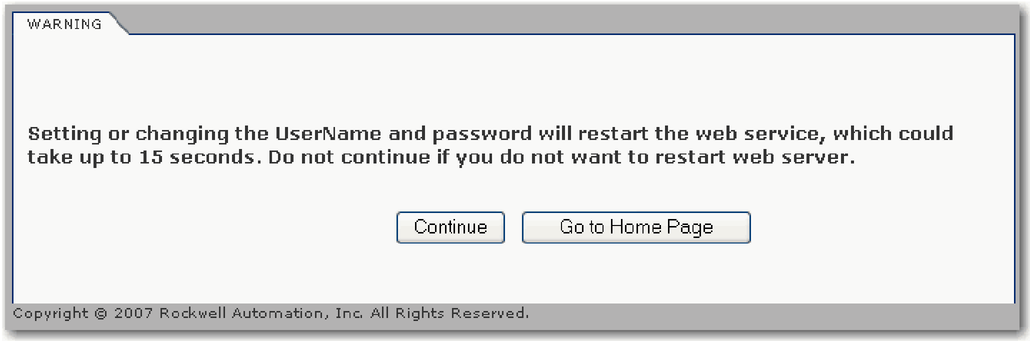
Maintain the User Name and Password

Do these steps to set or reset the user name and password to manage an administrator account.

1. In a web browser window, enter an IP address (where the IP address is the IP address of your linking device).

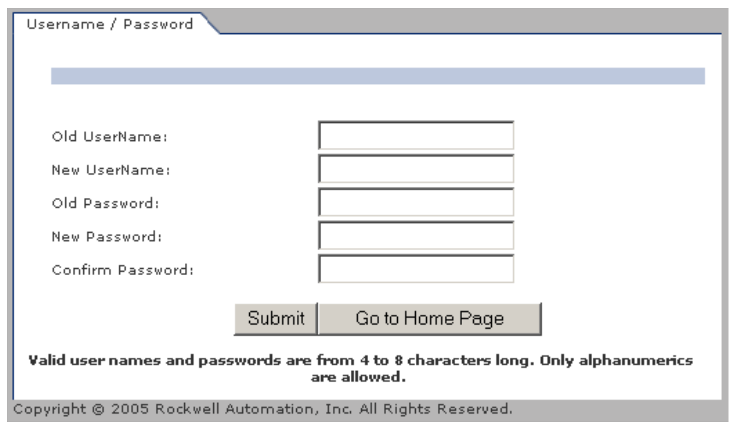


The Password Warning appears.



2. Click Continue if the Web service can be safely restarted.

   The Username/Password page appears.



3. Enter the following information:
   - Old UserName (default)
   - Old Password (password)
   - New Password (4…8 alphanumeric characters)
   - Confirm the New Password

4. Click Submit or press Enter to submit the password information.

   The following message is displayed:

   UserName and Password has been changed.

Reset the User Name and Password

If you forget your user name or password, you can reset the default values by resetting the linking device to its factory defaults.

Shaded cells in Table 16 indicate these types of resets:

- Reset jumper (locally)
- Reset button (locally)
- Reset Web page (remotely)

IMPORTANT	When you reset the linking device, it no longer communicates with the fieldbus devices. Make sure your process is shut down or under manual control before you reset the linking device.

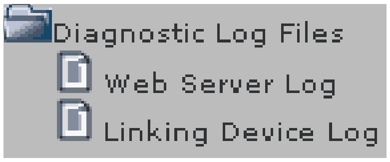
For details on resetting a linking device to default or factory-default settings, see the RSFieldbus System User Manual, publication 1757-UM012.

IMPORTANT	After you complete any type of reset, verify that the time and time zone are still correct.

Logout

Once confirmed, you do not have to re-enter a user name or password when accessing subsequent web pages. You must close your browser to logout.

Linking Device Logs



The Diagnostic Log Files consist of the Web Server Log and the Linking Device Log.

Web Server Log

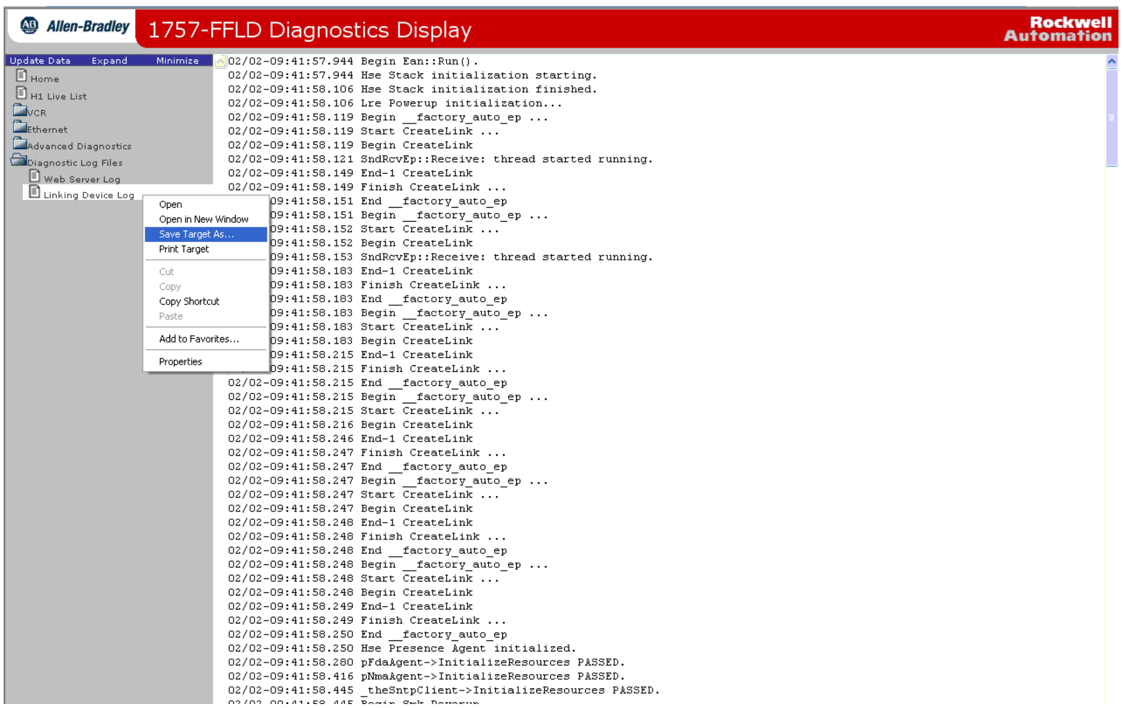
The Web Server Log provides a log of recent requests to the web pages. It lists when the request was made, from which IP address the request came, and a description of what was requested.

Time Stamp	IP Address	Message
Tue, 04 Sep 2007 22:56:00	None	The web server is starting up.
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET / 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /css/radevice.css 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /Web 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /Web 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /images/spacer.gif 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /Web 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /images/ablogo.gif 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /images/ralogo.gif 200
Tue, 04 Sep 2007 23:12:39	192.168.1.111	GET /css/navtree.css 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/menustarton.gif 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/menuendon.gif 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/border.gif 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/menubgon.gif 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/menuendbg.gif 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/folderselect.gif 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/folder.gif 200
Tue, 04 Sep 2007 23:12:40	192.168.1.111	GET /images/paper.gif 200
Tue, 04 Sep 2007 23:12:48	192.168.1.111	GET /css/radevice.css 304
Tue, 04 Sep 2007 23:12:48	192.168.1.111	GET /images/menuendon.gif 304
Tue, 04 Sep 2007 23:12:48	192.168.1.111	GET /images/menustarton.gif 304
Tue, 04 Sep 2007 23:12:48	192.168.1.111	GET /images/border.gif 304
Tue, 04 Sep 2007 23:12:48	192.168.1.111	GET /Web 200

Linking Device Log

The Linking Device Log provides a log of recent activities in the linking device. This information is useful to our Technical Support representatives to diagnose anomalies in your linking device. It lists when the activity occurred and a description of the activity.

To download the Linking Device Log, right-click the Linking Device Log document on the navigation panel and choose Save Target As.



IMPORTANT	To be sure that your data is current, you must change your temporary Internet files settings in Internet Explorer.

Follow these steps to change your temporary Internet files settings in Internet Explorer.

1. From the Tools menu, choose Internet Options.
2. On the General tab, under Temporary Internet Files, click Settings.
3. Under Checkfornewerversionsofstoredpages, click Every visit to the page.
4. Click OK.

Advanced Diagnostics Module

The Pepperl+Fuchs Advanced Diagnostic Module is a tool that analyzes a fieldbus network. The module lets you troubleshoot for ground faults, faulty or noisy field devices, and other potential anomalies to help prevent network downtime.

The ADM module can check segments during a Factory Acceptance Test (F.A.T.) or during startup.

Other equipment, such as a value positioner from Westlock Controls, provide precise and repeatable feedback for predictive maintenance.

Diagnostic Blocks

There also are field devices that have diagnostic function blocks that can show the status of the transmitters. Fieldbus standards define the type and format of the diagnostic data, however, how this information is processed by a controller is vendor-specific. Check the manufacturers' support documentation to gauge whether the diagnostic function blocks can be used.

Network Checklist

A segment testing form, per FOUNDATION Fieldbus guidelines, must be completed for checking out and commissioning a segment. The installation of wiring shall be carried out according to the procedure below and requires the completion of the field wiring (trunk and spurs) before the trunk wiring is connected to the FOUNDATION Fieldbus power supply.

These steps must be followed with the testing checklist, which is shown in Table 18 on page 145.

1. Install trunk cables, making sure that cable tags are installed.
2. Check wiring for the proper color code.
3. Tag and terminate the trunk cable in the field junction box.
4. Tag and terminate the trunk (segment) wiring at the fieldbus power supply plug, but **do not plug into the fieldbus power supply at this time**.

   The segment will be powered up after step 1 in Table 18 on page 145 is complete.

   The trunk cables should not be connected to the fieldbus power supplies until all devices on the segment have been properly terminated.

5. Perform the resistance tests for each segment according to step 1 in Table 18 on page 145.

IMPORTANT	Table 18 on page 145 is applicable to nonisolated couplers. If isolated couplers are being used, a separate procedure is necessary to test the associated FOUNDATION Fieldbus segments. See step 10 below for instruction.

6. Power up the segment by plugging the segment into the fieldbus power supply, see step 2 in Table 18 on page 145.
7. Log the shield to ground bus bar resistance.

   Be careful that no signal conductor becomes grounded because the system is now powered.
8. Capture the segment diagnostic files with clip-on segment test tools (for example, a Pepperl+Fuchs tester, FBT-6, and so forth) per step 3 in Table 18 on page 145.
9. Save the diagnostic files and combine them into a master document as a deliverable record.
10. For segments with isolated couplers, repeat step 6 and step 8 for each spur before proceeding with these instructions.
11. Capture segment trace files with clip-on segment test tools (optional per project) per step 4 in Table 18 on page 145.
12. Save the segment trace files and combine them into a master document as a deliverable record.

Table 18 - Fieldbus Segment Commissioning Form[1]

Company	____________________	
Location	____________________	
Unit	____________________	
Segment No.	____________________	
Date	____________________	
Step 1: This testing is performed before the segment is plugged into the power conditioner.		
(+) to (-)	Expected > 50K ohm	Actual =
(+) to shield	Expected > 20M ohm	Actual =
(-) to shield	Expected > 20M ohm	Actual =
(+) to ground	Expected > 20M ohm	Actual =
(-) to ground	Expected > 20M ohm	Actual =
shield to ground	Expected > 20M ohm	Actual =
Step 2: Plug the segment into the power conditioner.		
Shield to ground	Expected < 1 ohm	Actual =
Step 3: Clip a FBT-6 or P&F tester onto the segment and capture the segment diagnostics file.		
Segment Diagnostic File	____________________	
Date	____________________	
Technician	____________________	
Step 4: Optionally capture a segment trace file with an oscilloscope.[2]		
Segment Trace File	____________________	
Date	____________________	
Technician	____________________	

(1) This form is for nonisolated couplers or trunks only on segments with isolated couplers (for spurs on segments wirh isolated couplers repeat the test for each spur).

(2) Segment trace files are retained for historical reference to aid in troubleshooting. They are not intended for segment acceptance. Segment acceptance is primarily based on conformance to the measurement requirements.

Notes:

Troubleshooting

Introduction

This chapter offers troubleshooting tips.

The table explains the topics discussed in this chapter.

Manufacturer's Documentation

Most manufacturers of fieldbus devices and components offer product-specific support documentation in some form, whether it be online or in print. When experiencing difficulties with these elements, it is recommended that you use the specific documentation provided by individual manufacturers.

Common Anomalies

Table 19 describes a number of known fixes to anomalies that can occur while using RSFieldbus software. Before you call Technical Support, please check to see if your symptoms match any of these anomalies.

Table 19 - Troubleshooting Tips

Symptom	Possible Anomaly	Solution
Cannot communicate with the linking device and the Status indicator is blinking green.	The linking device's IP address is not established.	Configure the linking device's IP address per the FOUNDATION Fieldbus Linking Device Installation Instructions, publication 1757-IN021.
Cannot communicate with the linking device and the Status indicator is solid green.	The linking device's IP address is configured but unknown.	Use RSLinx software (Ethernet_IP driver) to browse the local subnet.
The IP address does not appear in RSLinx or the RSFieldbus Live List and it is needed.	Your computer's subnet mask is not compatible to the linking devices' subnet mask.	1. Go online in the RSFieldbus software to launch the RSHSE OLE Server. 2. Click the RSHSE OLE Server button in your Windows toolbar. This opens a list of linking devices that are broadcasting their IP addresses. If the linking device in question does not appear in the list, refer to Assigning an IP Address in the . 3. Change the IP settings for your computer so that the subnet mask is compatible to the linking devices' subnet mask. 4. Once the subnet masks are compatible, refer to Assigning an IP Address in the FOUNDATION Fieldbus Linking Device Installation Instructions, publication 1757-IN021.

Table 19 - Troubleshooting Tips

Symptom	Possible Anomaly	Solution
H1,2,3,4 status indicators are off.	An ethernet connection is not established between the Host computer and the linking device.	• Configure the linking device IP address per the FOUNDATION Fieldbus Linking Device Installation Instructions, publication 1757-IN021. • Or, cycle power on the linking device.
	Another Link Master is active on the network and it is not sending a probe node to the linking device.	Powercycle or reset the other device so that the linking device can take over as LAS.
	IP address is is not configured or the DHCP server is not found.	Refer to Assigning an IP Address in the FOUNDATION Fieldbus Linking Device Installation Instructions, publication 1757-IN021.
H1,2,3,4 status indicators are blinking, more off than on.	Another device on the network is the LAS.	• If everything is working properly, this can be ignored. • Or, configure the other device to be Basic and/ or remove its Primary Link Master setting. • Or for a temporary fix, power cycle the other device so that the linking device can take over as the LAS.
A Red X is on the linking device in the HSE/H1 window.	The Device Id may not be associated in the linking device's attributes.	Refer to Initialize Communication and Associate the Linking Device on page 66.
A Red X is on a fieldbus device in the H1 window.	The Device Id may not be associated in the Device's attributes.	Refer to Initialize Communication and Associate the Linking Device on page 66.
Online characterization doesn't show any real-time values.	Strategy is not downloaded.	Download the devices associated with the strategy. Refer to Download the Configuration on page 76.
	Tags are not exported.	Refer to Export Tags on page 76 .
Online CM monitor parameter tags are gray and have no values.	Tags are not exported.	Refer to Export Tags on page 76 .
Unable to download after adding new device to an existing strategy.	Macrocycle value on H1 network may be too low.	Increase the macrocycle time on the H1 network. Refer to the macrocycle section of the FOUNDATION Fieldbus System User Manual, publication 1757-UM012.
Red Links on the Strategy after a successful download.	Links are not properly established.	Update the H1 device and re-download the device. To update a device, right-click it and choose Update.
Download error.	Communication error.	Update the H1 device associated with the error message and redownload the device. Update the H1 device and re-download the device. To update a device, right-click it and choose Update.
Schedule download failure.	Communication error.	Right-click the H1 and choose Download Schedule.
Logix block inputs and outputs are red.	CLX is not in Run mode.	Put the CLX in Run mode.
Yellow triangles on Logix blocks in the I/O tree in RSLogix 5000 software.	Mismatched slot number.	Match the slot number in the Logix block with configuration in CLX. Refer to Add the Logix Block on page 86.
NS status indicator is blinking green.	Communication not configured on RSLogix 5000 or RSFieldbus software packages.	Refer to Initialize Communication on page 66.
Assign tag failure.	Communication error.	Verify tag assignment. Refer to Assign Tags on page 69.
"Capabilities File Information missing" error message appears.	Device revision/ DD revision mismatch.	Verify proper device revision/DD revision selections. Right-click the corresponding icon and choose Attributes.

Signal Anomalies

Poor signal quality can inhibit the optimization of your fieldbus network. Table 20 describes a list of common causes for poor signal quality.

Table 20 - Poor Signal Causes/Results

Cause of Poor Signal	Result
Wrong type of cable	Can attenuate the signal below the low AC cutoff limits. Also, this could lead to cable length being too long.
Too long of H1 segment	Tends to attenuate the signal below the low AC cutoff limit by inducing inductance. Also, the length, along with the number of devices, can create a power anomaly.
Missing terminators	Causes ringing, which will enlarge the signal outside the high AC cutoff limits.
Grounded /shorted signal wires	Causes the signal to be 0V.
Bad terminator or junction block	Can ground/short/load the signal, which will cause the signal to be low or 0V.
Improper shielding	Causes shorts with signal wire, which will cause the signal to be 0V. Dressing shields with shrink-wrap will prevent this situation.
Bad device or transmitter	Causes short or load down the H1 segment.
Bad connectors	Can drop transmitters off the H1 network intermittently or permanently.
Too many devices, which combined use too much current on a H1segment	Reduces the voltage below 9V DC because the power supply or power conditioner cannot supply enough power to the H1. Also results in small power dips from the AC supply. Ideally, the system should be kept at 11…12V DC at the lowest so that there is some safety margin for the devices in the event of a poor power condition.
The power supply supplies too much voltage	Can shut down devices or damage them. Make sure your power supply with the conditioner supplies only 32V DC out of the conditioner output terminals.
Noisy power supply	Causes data loss and reset of devices when the low 9V DC cutoff is reached.

An oscilloscope can be used to determine the quality of a signal. The scope should be differential or battery-operated to avoid grounding one side of the network through the scope probe. Use probes that have at least 1 MΩ input resistance and less than 1000 pf input capacitance.[1]

For more information, see page 134.

Wiring Guidelines

Review these wiring guidelines to make sure instruments are operating properly and without signal loss:[2]

- No splices or wire nuts are allowed in instrumentation wiring circuits. Wiring terminations shall be made at terminal strips.
- When pre-molded cable is used, coupler and fieldbus device ports should be protected with temporary plastic plugs to cable installation to prevent damage due to water, sand, dirt, and so forth.
- Contractor should not install spurs until both the coupler and the field device are installed.

(1)Fieldbus Foundation Wiring and Installation Application Guide, publication AG-140.

(2) FOUNDATION Fieldbus System Engineering Guidelines (8.5.1).

- Minimum cable bend radius should not be exceeded for all installations. Excess wire that occurs with pre-terminated fieldbus cables may be coiled. Tie wraps can be used to secure the excess cable. Be careful not to pinch the wire with the cable tie.
- Install individual cables to the field instruments. Complete wire tagging and wire terminations for these individual cables.
- The use of heat shrinkable tubing instead of tape is the preferred method for isolating the shield wire terminations.

Cable Checkout

The cable must comply with these requirements:

- These ratings apply for UL certification:
  – Instrument Tray cable (ITC)
  – Power Limited Tray Cable (PLTC)
  – Tray Cable (TC)
  – Metal Clad Cable (MC or MC-HL)
- Operating temperature range: -30…90 °C (-22…194 °F), min
- Characteristic impedance of each twisted pair: 100 ±20 Ω

  Characteristic impedance is determined by any one of the methods described in ASTM D4566-05 or equivalent international standard at 31.25 kHz.
- Signal attenuation of each twisted pair: 3.0 dB/km at 39 kHz, max
- Minimum trunk wire-pair size has a maximum resistance of 23.5 Ω/ km at 20 °C (68 °F) (18 AWG) per conductor.
- Minimum spur wire-pair size has a maximum resistance of 59.4 Ω/km at 20 °C (68 °F) (22 AWG) per conductor.

Network and Segment Checkout

With segment wiring in place and tested for correctness, commissioning of the devices may begin. See Table 18 on page 145 for a segment testing form.

The methods for commissioning the field devices may vary with the host system being used. Once connected to the segment with system power available and the LAS running, the device can be ‘assigned’ to its permanent node address.

The device also requires a combination of uploading information, which is unique to the device and to the host system database, and then downloading preconfigured information from the host system database to the device. The methods for data reconciliation vary with the host system being used.

Be careful that data is not overwritten inadvertently. With these procedures completed, the device is ready for 'loop-checking'.

IMPORTANT	Segments often contain multiple loops, and because of this, it is advisable to have all field devices either permanently wired or make provisions to be sure that testing in stages does not compromise portions of the segment that have been 'loop checked'.

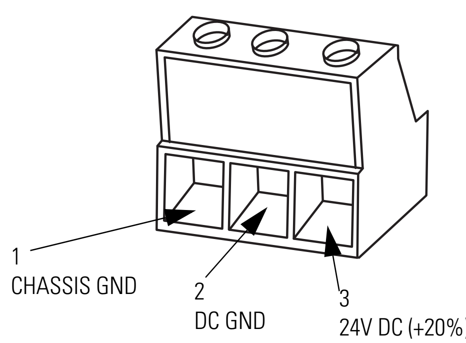
Power and Grounding Anomalies

Fieldbus devices, such as the 1757-FFLD and 1757-FFLDC linking devices, should not connect either conductor of the twisted pair to earth/ground at any point in the network. The earthing/grounding of either conductor could cause some or all devices on the bus segment to loss communication intermittently or completely for the period that the conductor is earthed/grounded.

If an instrument safety earth/ground is required, it must be through a separate conductor. The conductor may be the same cable as the instrument signal conductors and shield, but it must be located outside the shield within this cable(1).

Use these procedures to ground a 1757-FFLD or 1757-FFLDC linking device.

1. Insert the following wires into the corresponding connector and tighten the screws to 0.34 N•m (3 lb•in):
   - Chassis ground to connector 1 - CHASSIS GND
   - 24V common to connector 2 - DC GND
   - +24V DC input power to connector 3 - 24V DC (±20%)



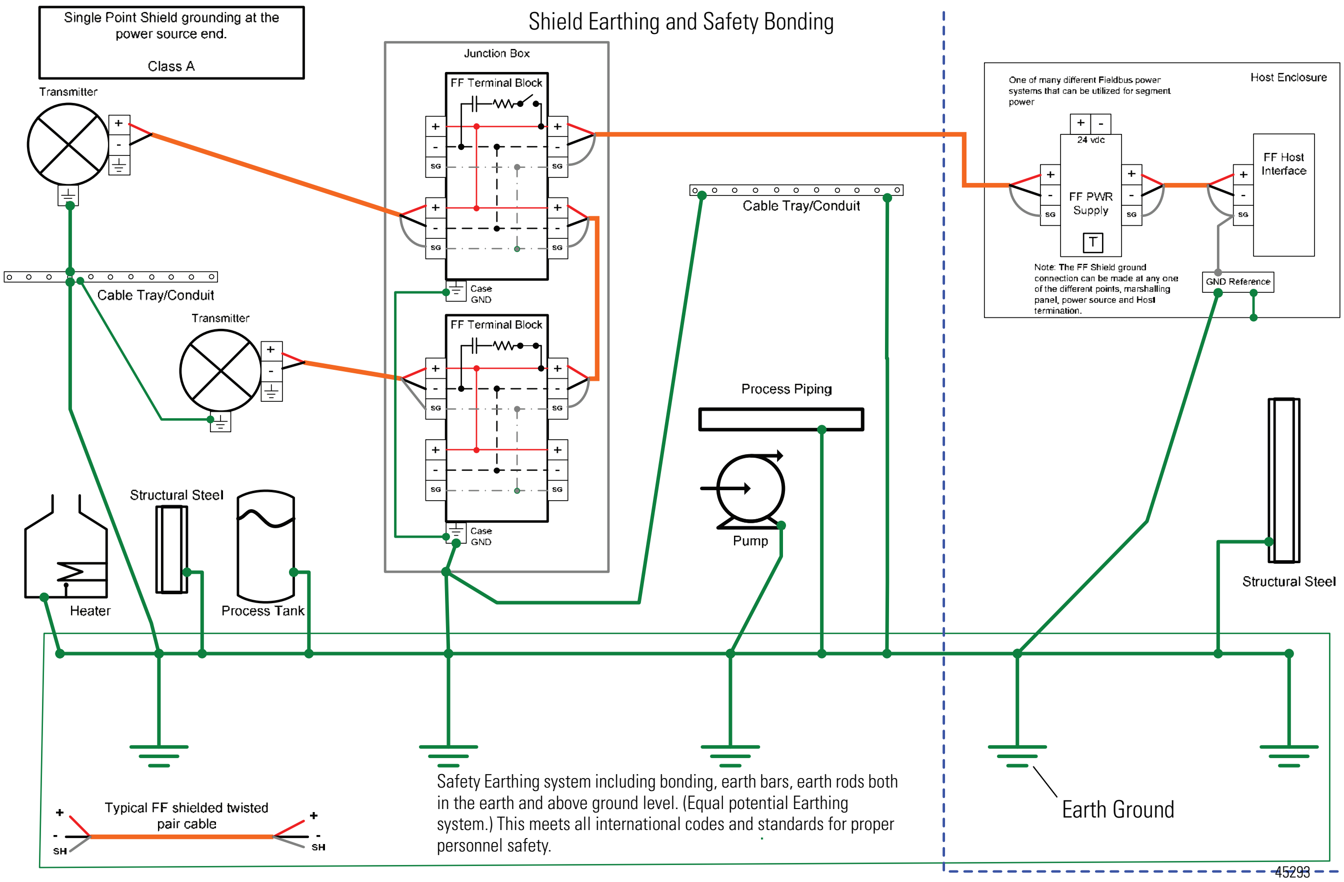
2. Apply power to the linking device.

(1) FOUNDATION Fieldbus System Engineering Guidelines (7.3.3).

Shielding Options

Fieldbus cable should be shielded to reduce or eliminate electromagnetic noise. The illustrations in the following pages show the shielding types (Class A…D). Class A (shown in Figure 32) is recommended in most plants, but check with an electrical engineer for safety considerations. Some regions, such as Europe, prefer using Class B design in areas where equipotential grounding is assured.

Figure 32 - Class A - Single-point Shielding



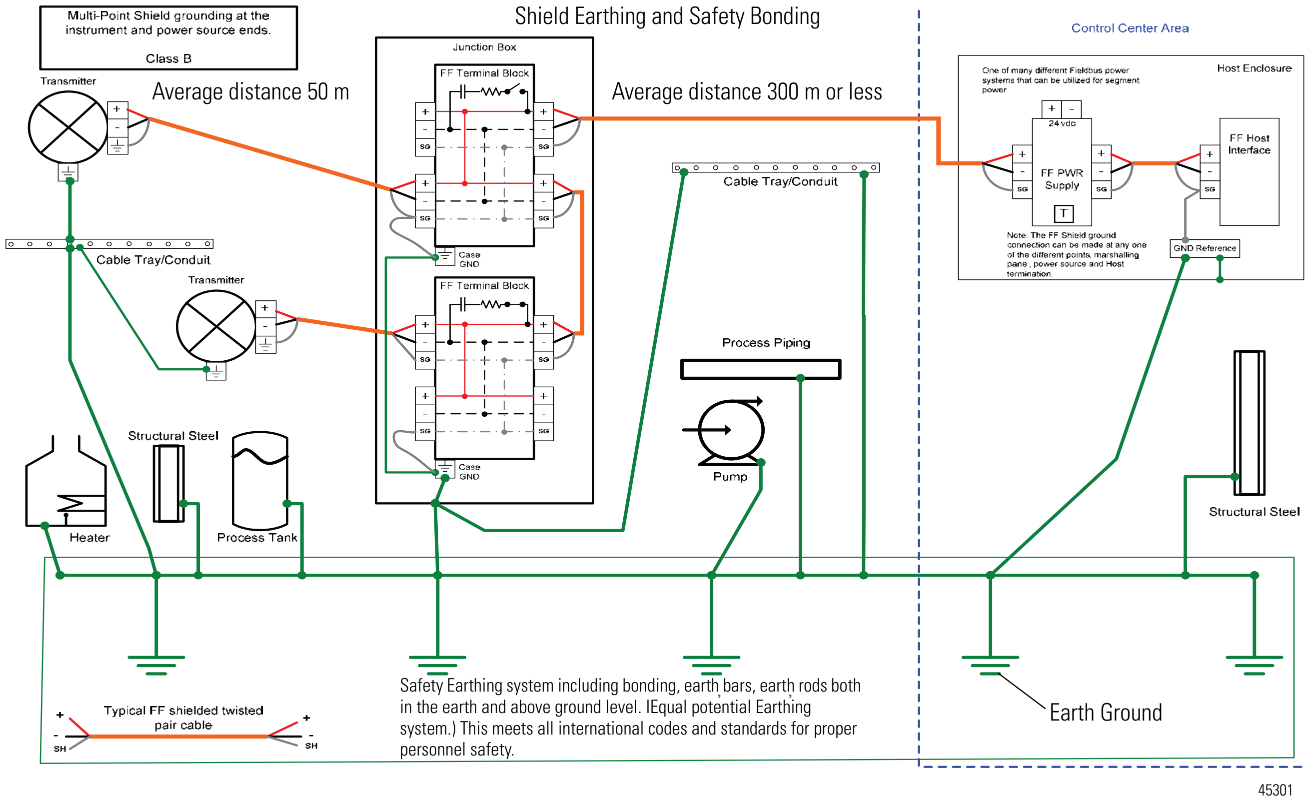
Single-point shielding (Class A) requires that the shield be connected to ground at only one location on a segment. IEC 61158-2[1] recommends single-point shielding installation. The cable shield is usually connected to the common system referencing ground (GND Reference) through the fieldbus power supply.

The advantages to this type of installation include the following:

- Protection against interference frequencies up to a few megahertz.
- Protection against lightning, by separating the cable shield and plant grounding the equalizing currents cannot flow over the cable shield.
- EMC protection by laying the fieldbus cable in a steel pipe (conduit) or armored cable that acts as an additional Faraday shield.

(1) FOUNDATION Fieldbus System Engineering Guidelines (7.3.4).

Figure 33 - Class B - Multi-point Shielding



Multi-point shielding (Class B) provides the greatest degree of protection against electromagnetic interference, similar to conduit or armored cable, in the upper frequency range even for interferences that are above several megahertz.

All the instrument and cable shields of the bus cable are grounded locally, which, in turn, has to be grounded in the safe area for installations in hazardous areas. Multi-point grounding provides optimal protection from a single-noise source at any location.

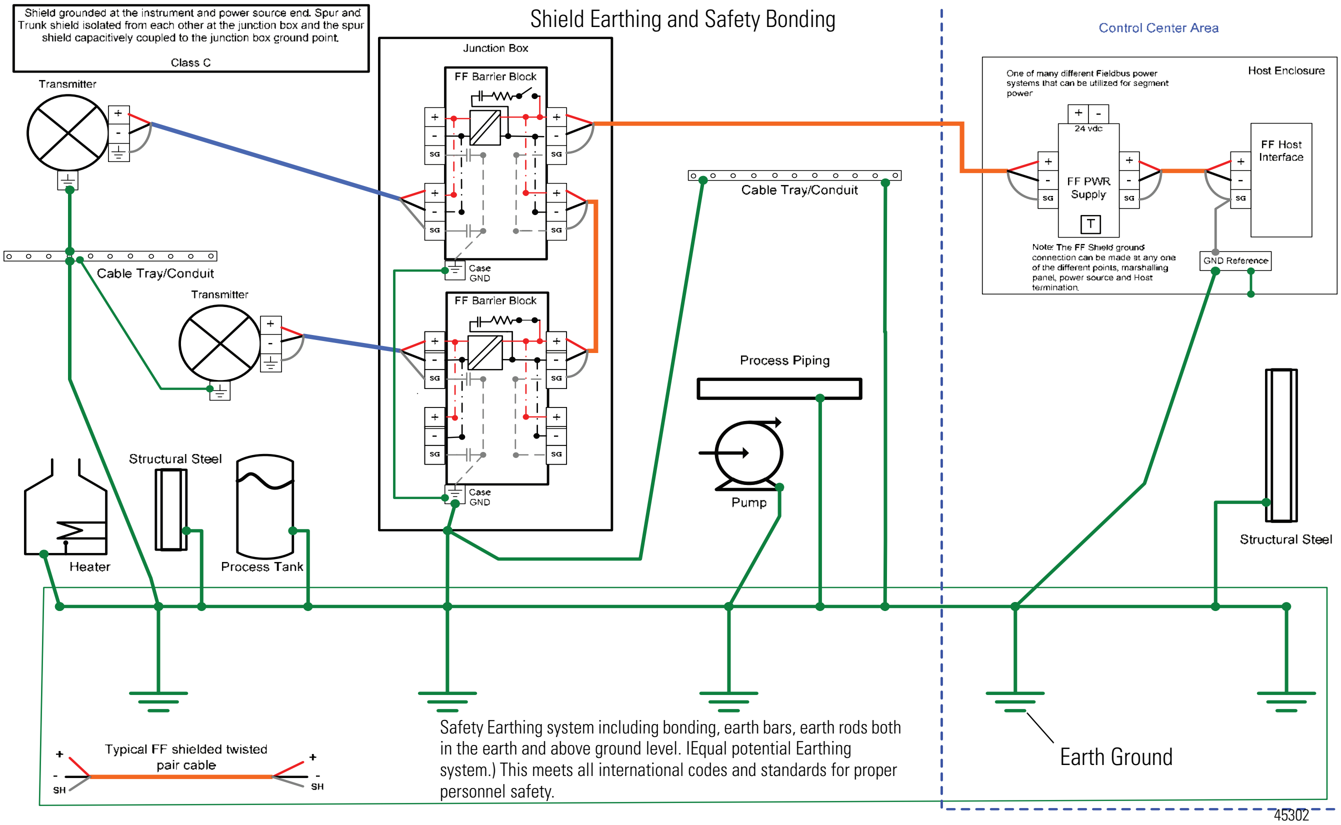
In accordance with IEC 60079-13[(1)], Class B shielding can be used if the installation provides a high degree of safety with potential matching. Under these conditions, this grounding method meets the requirements of hazardous area installation rules.

The disadvantages for this type of installation include the following:

- The shield becomes a current-carrying conductor and will induce noise into the network if there is poor equipotential ground.
- Multi-point grounding provides a direct connection for lightning surges back to the control room through the signal and shield wires and may require special attention.

(1) FOUNDATION Fieldbus System Engineering Guidelines (7.3.4).

Figure 34 - Class C - Shielding by Using Isolating Device Couplers

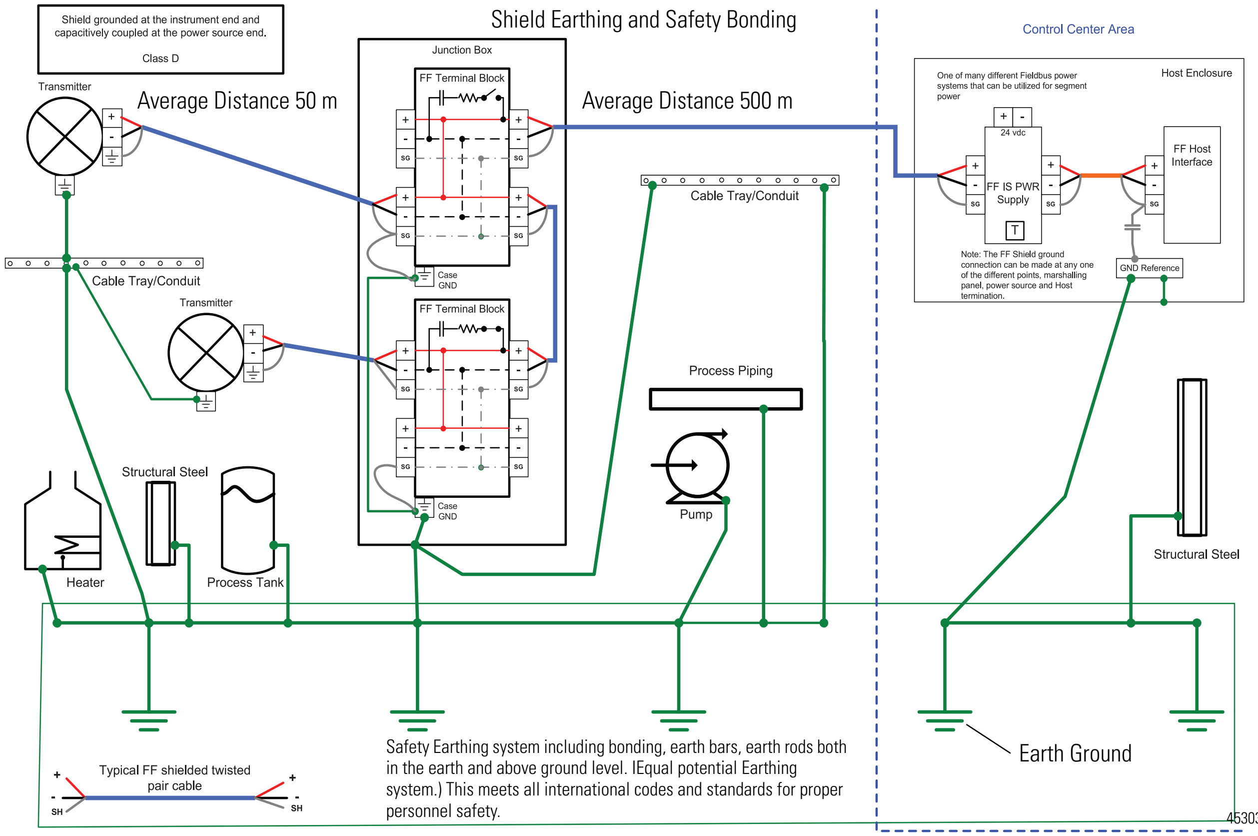


Class C shielding is a combination of topologies from Class A (single) and Class B (multi-point), with signal isolation located in the field junction box. The mixed topology breaks up paths for ground circulation currents and surges that may exist in the Class B topology.

In this concept, the shield of the trunk segment from the control room to the field junction boxes is connected to ground at a single location, typically at the fieldbus power supply. At the junction box, the trunk shield should be continuous if multiple isolated device couplers are used, but the trunk shield should not be connected to ground at the junction box.

On the field side, the shield is connected both at the instrument and connected at the isolated device coupler. This topology is common in hazardous areas that involve a mixture of increased safety and intrinsic safety and moves the barrier into the junction box to provide a maximum number of devices for the segment. The trunk side maintains all of the benefits associated with Class A, while the field side provides enhanced electromagnetic noise immunity offered by Class B.

Figure 35 - Class D - Multi-point Shielding by Using Capacitive Coupling



Class D shielding is a variation of Class B (multi-point), except that an adequate equipotential ground does not exist throughout the plant site. Similar to Class B, this topology requires the shield to be connected to ground at several points, including the instruments and field junction boxes. However, at the control center area, the shield is connected to ground through a coupling capacitor. The coupling capacitor is used to block DC ground loop currents that would result from a poor equipotential ground.

Similar to Class B, this topology offers better EMC susceptibility at high frequencies and blocks low frequency currents that would be carried by the shield in a multi-point shielding method. However, a fault condition, such as a lightning strike, could result in a high voltage being present at the host system side. A Class A, B, or C shield is preferred topology over a Class D shield.

Linking Device Anomalies

This section helps you analyze situations that may occur with a linking device.

Linking Device Does Not Appear in the HSE Live List

Do these steps if you cannot get the linking device to appear in the HSE Live List.

Are the Linking Device's Status Indicators On?

No:

1. Verify that the linking device's power connector is properly connected to the power supply.

   See the linking device's installation instructions for directions.
2. Verify that the power supply is properly connected to the AC power.
3. Verify that the proper DC voltage is present at the linking device's power connector.
4. If the linking device's status indicators still are Off, call Technical Support at http://www.rockwellautomation.com/support.

Is the Linking Device Connected to a Hub or Directly?

Hub:

1. Replace the cable between the hub and the device that does not have an active Link status indicator.
2. Replace the hub.

Direct:

1. Verify that the crossover cable is correct.
2. Verify that the Ethernet port on the Host computer is active.
3. Verify that the cable is properly connected.
4. Verify that the cable is properly connected to the linking device.

Can the Host Computer 'Ping' Itself?

No:

1. Verify that the TCP/IP protocols are installed in Windows.
2. Verify that the 'Local Connection' is active.

Can the Linking Device be 'Pinged' from the Host Computer?

Yes: Refer to Does RSLinx Software in the AB_ETHIP Driver see the Linking Device when RSWho is Running? on page 157.

Are the Linking Device and the Host Computer on the Same Sub-net?

No:

Linking Device IP address: XXX.YYY.ZZZ.abc

Host computer IP address: XXX.YYY.ZZZ.def

In most cases, the linking device and the Host computer must be on the same sub-nets. The XXX.YYY.ZZZ portion of the respective IP addresses must match.

1. Change the IP address of the Host computer to match the sub-net of the linking device.
2. If you don't know or cannot set the IP address of the linking device by using the DHCP/BOOTP server, contact Technical Support at http://www.rockwellautomation.com/support.

Does RSLinx Software in the AB_ETHIP Driver see the Linking Device when RSWho is Running?

No:

1. Verify that the AB_ETHIP-1 driver is properly configured.
2. Contact Technical Support at http://www.rockwellautomation.com/support.

Is the RSFieldbus Project Properly Configured?

Don't know:

Refer to Create a New RSFieldbus Project on page 57 and configure a project, or use a known good project file to test the operation of the linking device on HSE.

If this does not work, contact Technical Support.

Yes:

1. Remove power from the linking device.
2. On the top of the linking device, move the jumper to the leftmost contact position then back to the rightmost contact position.
3. Close RSFieldbus software.

4. On the Host computer in the C:\Program Files\Rockwell Software\RSFieldbus\OLEServers\ directory, delete the IDShellHSE.bin file.
5. Restart RSFieldbus software.
6. Load your project.
7. Apply power to the linking device.

   Allow the linking device to completely start as indicated by the H1 channel activity status indicators blinking.
8. Go online in RSFieldbus software and monitor the HSE Live List.

   The linking device should now be visible.
9. If the linking device still is not visible in the HSE Live List, contact Technical Support at http://www.rockwellautomation.com/support.

Linking Device Does Not Appear in the H1 Live List

Refer to Linking Device Does Not Appear in the HSE Live List on page 156.

In addition, do these steps.

1. Close the H1 Live List window.
2. Close the H1 network window.
3. Reopen the H1 network window.
4. Reopen the H1 Live List window.

Does the Linking Device Appear in the H1 Live List Now?

Yes: Done.

Is the Linking Device Connected to the Network?

No:

1. Verify that the network connections are correct on the linking device connector.
2. Verify that the network cable is connected to the network and that the polarity is correct.
3. Verify that there are two, and only two, terminators on the network.

Is there Power on the H1 Network?

No:

1. Check the power supply connection to the network.

IMPORTANT	Power must be applied to the network through a proper power conditioner. The power supply cannot be directly connected to the H1 network.

2. Check if there is network power on the linking device network connector.

Is there Power on the Terminal or Network Connector Block and/or Power on the Output on the Power Conditioner?

No:

1. Check that the voltage at the output of the power conditioner is 11…30V DC.
2. Repair or replace the power conditioner.

Is the RSFieldbus Project Properly Configured?

Refer to Create a New RSFieldbus Project on page 57 and configure a project, or use a known good project file to test the operation of the linking device on the H1 network.

If this does not work, contact Technical Support.

Yes:

1. Remove power from the linking device.
2. On the top of the linking device, move the jumper to the leftmost contact position then back to the rightmost contact position.
3. Close RSFieldbus software.
4. On the Host computer in the C:\Program Files\Rockwell Software\RSFieldbus\OLEServers\ directory, delete the IDShellHSE.bin file.
5. Restart RSFieldbus software.
6. Load your project.
7. Apply power to the linking device.

   Allow the linking device to completely start as indicated by the H1 channel activity status indicators blinking.
8. Go online in RSFieldbus software and monitor the H1 Live List.

The linking device should now be visible.

9. If the linking device is still not visible in the H1 Live List, contact Technical Support at http://www.rockwellautomation.com/support.

Linking Device Blinks On and Off in the H1 Live List

Check for these occurrences and do the steps.

Is the Linking Device Properly Connected to the Network?

1. Verify that there are two, and only two, terminators on the network.
2. Verify that the polarity of the network cabling is consistent (that is, red to red and black to black).
3. Verify that the network voltage is between 11…30V DC.

Are there Any Other Devices on the H1 Network?

Yes:

1. Disconnect any other devices from the network.
2. Remove power from the linking device.
3. On the top of the linking device move the jumper to the leftmost contact position then back to the right-most contact position.
4. Close RSFieldbus software.
5. On the Host computer in the C:\Program Files\Rockwell Software\RSFieldbus\OLEServers\ directory delete the IDShellHSE.bin file.
6. Restart RSFieldbus software.
7. Load your project.
8. Apply power to the linking device.

   Allow the linking device to completely start as indicated by the H1 channel activity status indicators blinking.
9. Go online in RSFieldbus software and monitor the H1 Live List.

Does the Linking Device Appear in the H1 Live List Now?

No:

1. Re-connect the individual nodes one at a time.
2. As each device is connected, verify the device appears in the H1 Live List and that the linking device remains in the H1 Live List.

All devices, including the linking device, should appear now in the H1 Live List.

If not, contact Technical Support.

Function Block Anomalies

This section helps you analyze function block anomalies.

Do these steps if you are unable to see parameter values in the function block online characterization.

1. Verify that tags have been exported.
2. Export tags.
3. Verify that the HSE download has completed.
4. Do an HSE download.
5. Verify that the H1 download has completed.
6. Do an H1 network download.

Are the Parameter Values Displayed Now?

Yes: Done.

No:

1. Perform an UPDATE command on the device.

   If the parameters values still do not appear, do these additional steps.
2. Save and close the project.
3. Close RSFieldbus software.
4. Verify that the RSFieldbus servers close.
5. End the servers execution if not closed.
6. On the Host computer in the C:\Program Files\Rockwell Software\RSFieldbus\OLEServers\ directory delete the IDShellHSE.bin file.
7. Start RSFieldbus software.
8. Load the project file.
9. Go online and do an online characterization for a function block.

Are the Parameter Values Displayed Now?

Yes: Done.

No:

1. Remove power from the linking .
2. On the top of the linking device, move the jumper to the leftmost contact position then back to the rightmost contact position.
3. Apply power to the linking device.

   Allow the linking device to completely start as indicated by the H1 channel activity status indicators blinking.
4. Go online in RSFieldbus software.
5. Perform an HSE download.
6. Perform an H1 download.
7. Go online and do an online characterization for a function block.

Parameter Status

Introduction

All input and output parameters are structures composed of status and value. Fieldbus devices can detect faults for bad measurements or some action not occurring. This data is passed along in the form of a status attribute to provide you additional data with the parameter value.

Composition of Status

When an input parameter is linked to an output parameter through the linked object, the status and value are copied (local link) or received from the bus (external link). If the input is not linked, then you can manually set the status and value.

Figure 36 - Cascade Control

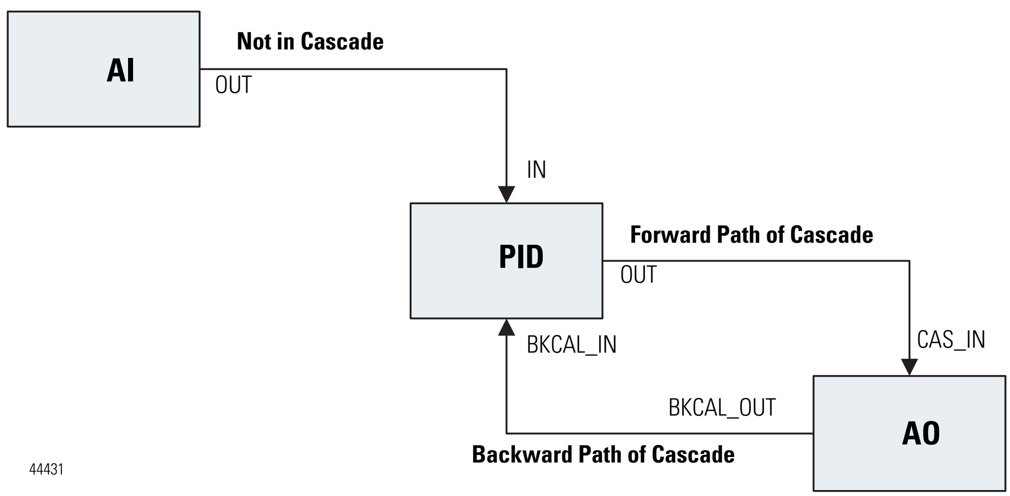


Table 21 - Sub-status Values

Quality	Sub-status	Hex Value	Not In Cascade	Forward Path Of Cascade	Backward Path Of Cascade
Bad	0 = Non-specific	0x00	X	X	X
Bad	1 = Configuration Error	0x04	X	X	X
Bad	2 = Not Connected	0x08			
Bad	3 = Device Failure	0x0C	X	X	X
Bad	4 = Sensor Failure	0x10	X	X	X
Bad	5 = No Communication, with last usable value	0x14			
Bad	6 = No Communication, with no usable value	0x18			
Bad	7 = Out of Service (highest priority)	0x1C	I	I	I

Table 21 - Sub-status Values

Quality	Sub-status	Hex Value	Not In Cascade	Forward Path Of Cascade	Backward Path Of Cascade
Uncertain	0 = Non-specific	0x40	X		
Uncertain	1 = Last Usable Value	0x44	X		
Uncertain	2 = Substitute	0x48	X		
Uncertain	3 = Initial Value	0x4C	X		
Uncertain	4 = Sensor Conversion not Accurate	0x50	X		
Uncertain	5 = Engineering Unit Range Violation	0x54	X		
Uncertain	6 = Sub-normal	0x58	X		
Good (NC)	0 = Non-specific (lowest priority)	0x80	X	X	
Good (NC)	1 = Active Block Alarm	0x84	X		
Good (NC)	2 = Active Advisory Alarm	0x88	X		
Good (NC)	3 = Active Critical Alarm	0x8C	X		
Good (NC)	4 = Unacknowledged Block Alarm	0x90	X		
Good (NC)	5 = Unacknowledged Advisory Alarm	0x94	X		
Good (NC)	6 = Unacknowledged Critical Alarm	0x98	X		
Good (C)	0 = Non-specific	0xC0		X	X
Good (C)	1 = Initialization Acknowledge (IA)	0xC4		X	
Good (C)	2 = Initialization Request (IR)	0xC8			X
Good (C)	3 = Not Invited (NI)	0xCC			X
Good (C)	4 = Not Selected (NS)	0xD0			X
Good (C)	6 = Local Override (LO)	0xD8			X
Good (C)	7 = Fault State Active (FSA)	0xDC			X
Good (C)	8 = Initiate Fault State (IFS)	0xE0		X	
Key: NC = Non-Cascade, C = Cascade, X = Permitted Status, I = Initial Status					

Third-party Device Information

Introduction

The table lists qualified devices for use with the linking device.

Table 22 - Third-party Devices

Manufacturer	Cat. No.	Firmware Revision	DD Revision
Anderson Instr.	Temperature Trans	1	010101.cff 2003,04,08 cffversion 1.5
Anderson Instr.	PRESSURE TRANS	N/A	N/A
EIM Controls	Electric Actuator M2CP	2.00.32	010101.cff 2001,4,10 cffversion 1.5
Emerson	2100 FieldQ	N/A	N/A
Endress + Hauser	FMR 240	1.02	020201.cff 2001,03,15 cffversion 1.5
Endress + Hauser	Prosonic M FMU 40	3	030101.cff 2002,03,07 cffversion 1.5
Endress + Hauser	Cerabar S PMC 731	2	020101.cff 2001,11,30 cffversion 1.5
Endress + Hauser	Promag 53 P	2	020101.cff 2001,10,19 cffversion 1.5
Endress + Hauser	Levelflex M FMP 40	3	030101.cff 2002,03,07 cffversion 1.5
Endress + Hauser	DeltaBar S	2	020101.cff 2000,11,30 cffversion 1.5
Endress + Hauser	ITEMP	4/3.45	040102.cff 2000,07,26 cffversion 1.5
Endress + Hauser	Prosonic Flow 93	1	010101.cff 2001,10,19, cffversion 1.5
Endress + Hauser	DeltaPilot S	1	010101.cff 2000,11,19, cffversion 1.5
Endress + Hauser	Promass 83 F	2	020101.cff 2001,10,19 cffversion 1.5
Flowserve	Logix 1410	1.51	FC0101.cff 2003,09,11
Foxboro	RTT 25	REV D	020201.cff 2002,12,10 cffversion 1.5
Foxboro	IASPT10	22	160101.cff 2003,04,01 cffversion 1.5
Honeywell	STT 35F	2	020101.cff 2000,10,12 cffversion 1.5
Honeywell	STG 140	4.01	080101.cff 2000,08,16 cffversion 1.5
Micro Motion	2700 Flowmeter	N/A	N/A
OVAL Corporation	Delta Flowmeter	1	010101.cff 2000,9,28 cffversion 1.5
Pepperl+Fuchs	FDO-VC-Ex4.FF	1.1	010101.cff 2000,08,14, cffversion 1.5
Rosemount	3244MV	4.01.003	040101.cff, 2001,3,26 cff version 1.5
Rosemount	3051T	2.5.7	070201.cff 2001,2,08 cffversion 1.5
Rosemount	3051S REV 20	20	140204.cff 2002,11,07 cffversion 1.5
Rosemount	8742 Flowmeter	4.1	N/A
Rosemount	848T	Pending	Pending
Rosemount	8742C	4	040105.cff (see comments)

Table 22 - Third-party Devices

Manufacturer	Cat. No.	Firmware Revision	DD Revision
Rosemount Analytical	5081pH/ORP	1.00.005	010101.cff 2002,11,05 cffversion 1.5
SMAR	TT 302	3.4.6D	040201.cff 2002,12,05 cffversion 1.5
SMAR	LD-292	3.4.6 D	040201.cff 2002,17,05 cffversion 1.5
SMAR	DC302	3.5	050201.cff 2003,01,07 cffversion 1.5
Westlock	7344-MPT	1.1.3	010101.cff 2001,10,2 cffversion 1.5
Westlock	1100	1	010101.cff 2003,01,24 cffversion 1.5
Yamatake	ATT 60	1.00.07	010201.cff 2002,11,12 cffversion 1.5
Yamatake	AVP303	N/A	N/A
Yamatake	STD920	N/A	N/A
Yokogawa	YTA320(std)	R1.05	020101.cff 2000,08,01 cffversion 1.5
Yokogawa	YTA320(LC2)	R1.01	020101.cff 2000,08,01 cffversion 1.5
Yokogawa	YVP110	N/A	N/A

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.

acyclic period Portion of the communication cycle time when information other than publisher/subscriber data is transmitted. This information includes alarms, events, maintenance, and diagnostic information.

application layer A layer in the communication stack containing the object dictionary.

automation system A process automation, control, and diagnostic system that is composed of distinct modules. These modules may be physically and functionally distributed over the plant area. The automation system contains all the modules and associated software required to accomplish the regulatory control and monitoring of a process plant. This definition of automation system excludes field instruments, remote terminal units, auxiliary systems and management information systems.

auto sense Capability by the system to automatically detect and recognize any hardware upon addition to, or removal from, the system without any user intervention.

auxiliary system A control and/or monitoring system that is standalone, performs a specialized task, and communicates with the automation system.

basic device A device that can communicate on the fieldbus, but cannot become the LAS.

block See logix block, function block.

block tag A character string name that uniquely identifies a block on a fieldbus network.

BNU Acronym for Buffered Network-Scheduled Unidirectional. One of thee classes of VCRs (see VCR).

BOOTP A protocol to boot a diskless workstation and receive the boot information from a server.

branch line A segment of an H1 network. For example, a spur is a branch line connecting to a trunk that is a final circuit.

brick See device coupler.

bridge An interface in a fieldbus network that interconnects two or more H1 networks.

bus An H1 fieldbus cable between a Host and field devices connected to multiple segments, sometimes through the use of repeaters.

bus topology A link topology in which all stations are connected single path or multiple parallel paths for power or data signals to which several devices may be connected at the same time.

capabilities file This file describes the communication objects in a fieldbus device. A configuration device can use Device Description (DD) Files and Capabilities Files to configure a fieldbus system without having the fieldbus devices online.

CF Abbreviation for capabilities files, which describes the communication objects in a fieldbus device. A configuration device can use Device Description (DD) files and capabilities files to configure a fieldbus system without having the fieldbus devices online.

CFF Abbreviation for common file format, which is an ASCII text file used by the Host to know the device detailed fieldbus capabilities without requiring the actual device. This file format is used for capabilities and value files.

channel A path for a signal.

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.

communication stack Layered software supporting communication between devices. A communication stack is device communication software that provides encoding and decoding of user-layer messages, deterministic control of message transmission, and message transfer.

configurable Capability to select and connect standard hardware modules to create a system; or the capability to change functionality or sizing of software functions by changing parameters without having to modify or regenerate software.

configuration Physical installation of hardware modules to satisfy system requirements; or the selection of software options to satisfy system requirements.

connector Coupling device used to connect the wire medium to a fieldbus device or to another segment of wire.

contained parameter An internal parameter that can not be linked to other function blocks or devices.

control loop Group of function blocks that execute at a specified rate within a FOUNDATION Fieldbus device or distributed across the fieldbus network.

control network Control of plant floor devices, such as I/O chassis, robots, and other intelligent devices.

ControlNet network An open control network that uses the producer/consumer model to combine the functionality of an I/O network and peer-to-peer network, while providing high-speed performance for both functions.

cycle Scanning of inputs, execution of algorithms and transmission of output values to devices.

deterministic Ability to measure the maximum worst-case delay in delivery of a message between any two nodes in a network. Any network protocol that depends on random delays to resolve mastership is nondeterministic.

device description Abbreviated as DD, this is a set of files (CFF, SYM, and FFO) that describes the parameter capabilities of a fieldbus device. The file information on these block parameters includes names, data types, and specifications.

device The term in this manual refers to the instruments that make up the fieldbus system.

device coupler Physical interface between a trunk and spur, and a device.

device ID An identifier for a device that the manufacturer assigns. Device IDs must be unique to the device; no two devices can have the same device ID.

device tag A character string name that uniquely identifies a device on a fieldbus network.

DI Abbreviation for discrete input; the signal is from the field device to the host system.

dielectric A nonconductor of electricity.

digital circuit A switching circuit that has only two states: on and off.

discrete control Control where inputs, algorithms, and outputs are based on logical (yes or no) values. In the case of FOUNDATION fieldbus, discrete includes any integer operation between 0…255.

DLL Abbreviation for data link layer, which controls transmission of messages onto the fieldbus, and manages access to the fieldbus through the Link Active Scheduler (See link active scheduler.)

DO Abbreviation for discrete output; signal is generated by the host system and transmitted to a field device.

dual redundancy See redundancy.

EDDL Abbreviation for electronic device description language (see http://www.eddl.org).

Ethernet Physical and data link layer defined by IEEE 802 standards used by HSE FOUNDATION fieldbus.

EtherNet/IP An open, industrial networking standard that supports both real-time I/O messaging and message exchange.

FAS Abbreviation for fieldbus access sublayer, which maps the fieldbus message specification (see FMS) onto the data link layer.

FAT Abbreviation for factory acceptance test, which is the final test at the vendor's facility of the integrated system being purchased.

FB VFD Acronym for Function Block Virtual Field Device.

FFB Abbreviation for flexible function block, which is similar to a standard function block, except that an application-specific algorithm, created by a programming tool determines the function of the block, the order and definition of the block parameters, and the time required to execute the block.

FISCO Acronym for Fieldbus Intrinsic Safe COncept. Allows more power to an IS segment for approved FISCO devices, providing for more devices per IS segment.

FMS Abbreviation for fieldbus messaging specification, which contains definitions of application layer services in FOUNDATION fieldbus. The FMS specifies services and message formats for accessing function block parameters, as well as object dictionary descriptions for those parameters defined in the virtual field device (see VFD).

FNICO Acronym for Fieldbus Non-Incendive COncept. Allows more power to a fieldbus segment in a Zone 2 area, thus enabling more devices per segment than is possible with a FISCO solution.

fieldbus A digital, two-way, multi-drop communication link among intelligent measurement and control devices. It serves as a Local Area Network (LAN) for advanced process control, remote input/output, and high-speed factory automation applications.

Fieldbus Foundation The organization that developed a fieldbus network specifically based upon the work and principles of the ISA/IEC standards committee.

FOUNDATION Fieldbus The communication network that the Fieldbus Foundation created.

function block A named block consisting of one or more input, output, and contained parameters. The block performs some control function as its algorithm. Function blocks are the core components with which you control a system. The Fieldbus Foundation defines standard sets of function blocks.

gateway Translates another protocol to FOUNDATION fieldbus or vice versa, for example HART to FOUNDATION fieldbus or Modbus to FOUNDATION fieldbus.

H1 A fieldbus segment that operates at 31.25 Kbps.

H1 field device A fieldbus device connected directly to an H1 FOUNDATION fieldbus, such as valves and transmitters.

H1 repeater An active, bus-powered or non-bus-powered device used to extend the range over which signals can be correctly transmitted and received for a given medium. A maximum of four repeaters and/or active couplers can be used between any two devices on an H1 FOUNDATION fieldbus network. Repeaters connect segments together to form larger networks.

HIST Abbreviation for Host Interoperability Support Test Profiles and Procedures performed by the Fieldbus Foundation to test host conformance to the FOUNDATION fieldbus specifications.

host Control system that has FOUNDATION fieldbus capabilities to configure and operate FOUNDATION fieldbus segments. There are several classes of Host systems:

- Class 61 - Integrated Host - Primary, or process Host that manages the communication and application configuration of all devices on the network.
- Class 62 - Visitor Host - Temporary, on process Host with limited access to device parameterization.
- Class 63 - Bench Host - Primary, off process Host for configuration and setup of a non-commissioned device.
- Class 64 - Bench host - Primary, off process Host with limited access to device parameterization of an off-line, commissioned device.
- Class 71 - Safety Integrated Host - Primary, on-process Host that manages the communication and application configuration of all safety and control and monitoring devices on a network.

HSE Acronym for High-speed Ethernet, a network with FOUNDATION Fieldbus protocol that integrates H1 for distributed process control applications with a high-speed technology for advanced hybrid, batch, and manufacturing applications, and provides for information integration with plant management systems.

HSE device Any device connected directly to High-speed Ethernet (HSE) media that contains a conformant FOUNDATION fieldbus HSE communication stack, including a configurable network management agent (NMA). For example, linking devices, I/O gateways, and HSE field devices.

HSE host Non-HSE device capable of communicating with HSE devices. For example, configurators and operator workstations.

HSE linking device Device used to interconnect FOUNDATION fieldbus H1 fieldbus networks and/or segments to High-speed Ethernet (HSE) to create a larger system.

HSE switch Standard Ethernet equipment used to interconnect multiple High-speed Ethernet (HSE) devices, such as HSE linking devices and HSE field devices to form a larger HSE network.

IEC Acronym for International Electrotechnical Commission, which is a technical standards committee that is at the same level as the ISO.

IEEE Acronym for Institute of Electrical and Electronic Engineers, which specifies a family of standards for data communication over local and metropolitan area networks.

input parameter A block parameter that receives data from another block.

input/output subsystem interface A device used to connect other types of communication protocols to fieldbus segments. See also gateway.

ISA Acronym for International Society for Measurement and Control.

instantiable Ability of function blocks to create multiple tagged function blocks of different types from a library as required by an application. Quantity per device is restricted by device memory and other resources.

interchangeability The capability to substitute a device from one manufacturer with that of another manufacturer on a fieldbus network without loss of functionality or degree of integration.

interoperability Capability for a device from one manufacturer to interact with that of another manufacturer on a fieldbus network without loss of functionality.

IS Abbreviation for intrinsic safety, a protection technique for safe operation of electronic equipment in explosive atmospheres. The concept was developed for safe operation of process control instrumentation in hazardous areas by making sure that the available electrical and thermal energy in the system is always low enough that ignition of the hazardous atmosphere cannot occur.

ITK Abbreviation for interoperability test kit, which is used by the Fieldbus Foundation to register devices and conform compliance with the relevant FOUNDATION fieldbus standards.

junction box/quick connection Junction box connection lets you quickly install multiple field instruments via terminal connectors.

LAS See link active scheduler.

link A logical link is a connection between function blocks; a physical link is a connection between fieldbus devices.

linking device As a bridge, enables peer-to-peer communication between H1 devices without the need for host system intervention. As a gateway, connects the HSE network to other plant control and information networks.

link active scheduler Abbreviated as LAS, this scheduler is responsible for coordinating all communication on the fieldbus; maintaining a list of transmission times for all data buffers in all devices that need to be cyclically transmitted. The LAS circulates tokens, distributes time, probes for new devices, and removes non-responsive devices from the link.

link master An LM is a device that contains LAS functionality that can control communication on a FOUNDATION fieldbus H1 fieldbus link.
There must be at least one LM on the H1 link; one of those LM devices is chosen as the LAS.

link objects Link object contains information to link function block input/output parameters in the same device and between different devices. The link object links directly to a virtual communication relationship (VCR)

logical component Function blocks and algorithms that control a project.

logix block Facilitates signals between a ControlLogix environment and a fieldbus environment to link control.

m Prefix meaning milli- and has a value of 10^{-3}.

mac address Unique hardware address given to each Ethernet interface chip.

macrocycle Automatically calculated time by RSFieldbus software for a fieldbus device to send and receive data. The LAS is responsible for scheduling of the segment macrocycle.

methods An optional, but highly desirable, addition to device descriptions. Methods are used to define and/or automate procedures, such as calibration, for operation of field devices.

MIB VFD Acronym for Management Information Base Virtual Field Device.

mirror function block See shadow block.

mode Control block operational condition, such as manual, automatic, or cascade.

network A network as applied in this document is the termination of one or more fieldbus segments into an interface card of the Host system.

NMA Abbreviation for network management agent, which is responsible for managing the communication within a device. The NMA and the network manager (NMgr) communicate through the use of the fieldbus messaging specification (FMS) and virtual communication relationship (VCR).

node The connection point at which media access is provided.

object dictionary Contains all function block, resource block, and transducer block parameters that are used in a device. Through these parameters, the blocks may be accessed over the fieldbus network.

OPC Acronym for OPen Connectivity, formerly Object Linking and Embedding for Process Control. It's a software application that lets a bi-directional data flow between two separate applications. These applications may be running on the same or separate servers.

offline Perform tasks while the Host system is not communicating with the field devices.

online Perform tasks, such as configuration, while the Host system is communicating with the field devices.

output parameter A block parameter that sends data to another block.

physical component The hardware of the fieldbus project.

physical layer Physical layer receives messages from the communication stack and converts the messages into physical signals on the fieldbus transmission medium, and vice-versa.

PID Acronym for Proportional Integral Derivative.

protocol A set of conventions governing the format and timing of data between communication devices.

quiescent control The device power consumption, the current drawn while the device is not transmitting. The current should be as low as possible to enable more devices and long wire lengths, particularly in intrinsic safety.

redundancy The duplication of devices for the purpose of enhancing the reliability or continuity of operations in the event of a failure without loss of a system function.

reflections The 'bounce back' of signals at the end of the cable.

regulatory control Functions of process measurement, control algorithm execution, and final control device manipulation that provide closed loop control of a plant process.

repeater See H1 repeater.

resource block Resource block describes characteristics of the fieldbus device, such as the device name, manufacturer, and serial number. There is only one resource block in a device.

ring topology A network where signals are transmitted from one station and replayed through each subsequent station in the network. Signal can travel in either direction of the ring so it creates network redundancy; if the ring breaks in one place the nodes can still communicate.

s Abbreviated unit specification for second.

segment A physical link (cable) between fieldbus devices and a pair of terminators on an H1 channel. Segments can be linked by repeaters to form a longer H1 fieldbus. A fully loaded (maximum number of connected devices) 31.25 Kbps voltage-mode fieldbus segment should have a total cable length, including spurs, between any two devices of up to 1900 m. There cannot be a non-redundant segment between two redundant systems.

self-diagnostic Capability of an electronic device to monitor its own status and indicate faults that occur within the device.

setpoint The desired value in a closed-loop feedback system, as in regulation of temperature or pressure.

shadow block A shadow function block is set up in the centralized controller to mirror the data associated with an external function black located in an external device. The control routine of the centralized controller communicates with the external function block via the shadow function block as if the external function block was being implemented by the centralized controller.

signal The event or electrical quantity that conveys information from one point to another.

SM NM VFD Acronym for System Management, Network Management Virtual Field Device.

splice A splice is an H1 spur that measures less than 1 m (3.28 ft) in length.

spur An H1 branch line connecting to the trunk that is a final circuit. A spur can vary in length from 1…120 m (3.28…394 ft)

standard function block Standard function blocks are built into fieldbus devices as needed to achieve the desired control functionality. Automation functions provided by standard function blocks include analog input (AI), analog output (AO), and proportional integral derivative (PID) control.

tag ID Unique alphanumeric code assigned to inputs, outputs, equipment items, and control blocks.

terminator Impedance-matching module used at or near each end of a transmission line that has the same characteristic impedance of the line. Terminators are used to minimize signal distortion, which can cause data errors. H1 terminators convert the current signal transmitted by one device to a voltage signal that can be received by all devices on the network.

topology The shape and design of the fieldbus network.

transducer block The transducer block decouples function blocks from the local input/output (I/O) function required to read sensors and command output hardware. Transducer blocks contain information, such as calibration date and sensor type. There is usually one transducer block for each input or output of a function block.

transmitter An active fieldbus device that contains circuitry, which applies a digital signal on the bus.

trunk The main communication highway between devices on an H1 fieldbus network. The trunk acts as a source of main supply to spurs on the network.

USB A Universal Serial Bus (USB) establishes communication between device and a host controller.

user layer Provides scheduling of function blocks as well as device descriptions that let the host system communicate with devices without the need for custom programming.

VCR Acronym for Virtual Communication Relationship. Configured application layer channels that provide for the transfer of data between applications. FOUNDATION Fieldbus describes three types of VCRs: Publisher/Subscriber, Client/Server, and Source/Sink.

VFD Abbreviation for virtual field device, which is used to remotely view local device data described in the object dictionary. A typical device will have at least two VFDs.

Notes:

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.

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

Installation Assistance

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
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

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

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

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

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

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication RSFBUS-RM001A-EN-P - June 2011
Supersedes Publication RSFBUS-AT001A-EN-E - May 2004