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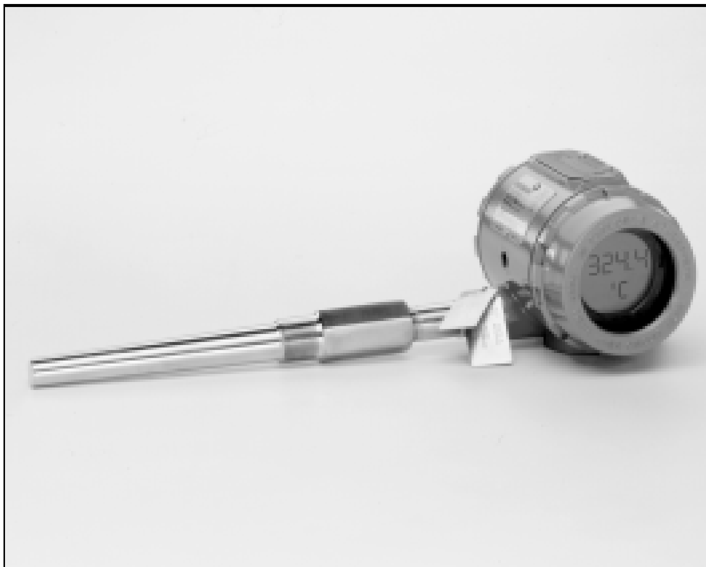
Rev. BA

Model 3244MV MultiVariable™ Temperature Transmitter with FOUNDATION™ Fieldbus

(Device Revision 3)



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ROSEMOUNT®
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Product Manual

Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION™ fieldbus

(Device Revision 3)

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using or maintaining the this product.

In the United States, Rosemount Inc. has two toll-free assistance numbers

Customer Central:
Technical Support, quoting, and order-related questions

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1–800–654–7768 (24 hours a day–includes Canada)

Outside of the United States, contact your local Rosemount® Sales Representative.

⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applicants. Using non-nuclear qualified products in application that require nuclear-qualified hardware or products may cause inaccurate readings.

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NOTE:
We are very interested in your comments and suggestions on how we can improve this product manual for the Rosemount® Model 3244MV MuliVariable Temperature Transmitter with FOUNDATION fieldbus.

Please send your comments and suggestions to the following E-Mail address
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Section 1

Introduction

USING THIS MANUAL

This manual is intended to assist in installing, operating, and maintaining the Model 3244MV MultiVariable Temperature Transmitters with FOUNDATION™ fieldbus.

Section 2: Installation

explains how to install the Model 3244MV by providing electrical, mechanical, and environmental installation considerations.

Section 3: Operation

summarizes basic transmitter operation, software functionality, and provides basic configuration procedures.

Section 4: Transducer Block

describes the Transducer Block and its operation.

Section 5: Resource Block

describes the Resource Block and its operation.

Section 6: Maintenance

describes hardware diagnostics, maintenance tasks, and hardware troubleshooting.

Section 7: Specifications and Reference Data

lists functional, performance, and physical specification data for the Model 3244MV temperature transmitter.

Section 8: Hazardous Area Approval Installation Drawings

contains the installation drawings necessary to maintain certified ratings for the Model 3244MV installed in hazardous locations.

Section 9: Options

presents options that can be ordered with the Model 3244MV.

Appendix A: Foundation™ Fieldbus Technology

describes the basic information about fieldbus and the function blocks that are common to all fieldbus devices.

Appendix B: Analog Input Function Block

describes the operation and parameters of the Analog Input function block.

Appendix C: Input Selector Function Block

describes the operation and parameters of the Input Selector function block.

Appendix D: PID Function Block

describes the operation and parameters of the Proportional/Integral/Derivative (PID) function block.

Appendix E: Arithmetic Function Block

describes the operation and parameters of the Arithmetic function block.

Appendix F: Signal Characterizer Function Block

describes the operation and parameters of the Signal Characterizer function block.

Appendix G: Operation with Fisher-Rosemount® DeltaV™

provides specific instructions for performing basic configuration operations on the Model 3244MV Temperature Transmitter using the Fisher-Rosemount DeltaV host software.

Appendix H: European ATEX Directive Information

provides information on European ATEX compliance.

SAFETY MESSAGES

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages, listed at the beginning of each section, before performing an operation preceded by this symbol.

TRANSMITTER OVERVIEW

Thank you for selecting the Rosemount Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus. We are confident you will find this to be the ultimate transmitter for measuring temperature in your control, safety, and monitoring applications. This transmitter is designed with unsurpassed quality and reliability that you have come to expect from Rosemount Inc. The Model 3244MV is among the world's first devices to be registered with the Fieldbus Foundation.

The enhanced measurement capability of the Model 3244MV allows it to communicate multiple variables to a FOUNDATION fieldbus host or configuration tool. This temperature transmitter has the ability to accept simultaneous inputs from two temperature sensing elements. These two inputs can be used for control and safety applications, which involve control, safety interlocks, or any type of critical monitoring points where sensor redundancy is desirable. With a dual-element sensor, the Model 3244MV Hot Backup® feature provides automatic sensor redundancy in case the primary sensing element fails. In addition, the differential temperature measurement capability can be used as a diagnostic to detect sensor drift in a dual-element sensor. The Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus combines the effects of transmitter drift, sensor interchangeability error, temperature effects, and reference accuracy to better account for actual process conditions and to assure maximum accuracy.

The Rosemount Model 3244MV is excellent for measuring temperature in monitoring applications involving basic process monitoring because of the transmitter's ability to simultaneously measure two separate and independent temperature points with one transmitter. With this dual input configuration, instrument costs can be reduced by as much as 50 percent. In addition, the multi-drop capability of FOUNDATION fieldbus results in additional savings through reduced wiring costs.

FOUNDATION FIELDBUS TECHNOLOGY OVERVIEW

FOUNDATION fieldbus is an all digital, serial, two-way communication system that interconnects field equipment such as sensors, actuators, and controllers. Fieldbus is a Local Area Network (LAN) for instruments that are used in both process and manufacturing automation, having the built-in capability to distribute the control application across the network. The fieldbus environment is the base level group of digital networks in the hierarchy of plant networks.

The fieldbus retains the desirable features of the 4–20 mA analog system, including standardized physical interface to the wire, bus-powered devices on a single pair of wires, and intrinsic safety options. It also enables the following capabilities:

- Increased capabilities due to full digital communication.
- Reduced wiring and wire terminations due to multiple devices on one pair of wires.
- Increased supplier selection due to interoperability.
- Reduced loading on control room equipment due to the distribution of some control and input/output functions to field devices.

Section **2**

Installation

OVERVIEW

This section contains specific information pertaining to the installation of the Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus.

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

WARNINGS

⚠WARNING

Explosions could result in death or serious injury:

- Do not remove the transmitter cover in explosive atmospheres when the circuit is live.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠WARNING

Electrical shock could cause death or serious injury. If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, high voltage may be present on transmitter leads and terminals.

- Use extreme caution when making contact with the leads and terminals.

⚠WARNING

Process leaks could result in death or serious injury:

- Install and tighten thermowells or sensors before applying pressure, or process leakage may result.
- Do not remove the thermowell while in operation. Removing while in operation may cause process fluid leaks.

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

GENERAL CONSIDERATIONS

Electrical temperature sensors, such as RTDs and thermocouples, produce low-level signals proportional to temperature. The Model 3244MV MultiVariable Temperature Transmitter converts the analog sensor signal to a digital signal that is relatively insensitive to lead length and electrical noise. This signal is then transmitted over the FOUNDATION fieldbus to the control room using two wires.

ELECTRICAL CONSIDERATIONS

Proper electrical installation is necessary to prevent errors due to sensor lead resistance and electrical noise. Shielded, twisted cable produce the best results in electrically noisy environments. Figure 2-1 on page -3 shows a typical FOUNDATION fieldbus installation.

Power Supply

The transmitter requires between 9 and 32 V dc to operate and provide complete functionality. The dc power supply should provide power with less than 2% ripple.

Power Filter

A fieldbus segment requires a power conditioner to isolate the power supply filter and decouple the segment from other segments attached to the same power supply.

Field Wiring

⚠ All power to the transmitter is supplied over the signal wiring. Signal wiring should be a shielded, twisted pair for best results. Do not run unshielded signal wiring in conduit or open trays with power wiring or near heavy electrical equipment.

⚠ If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

NOTE
Do not apply high voltage (e.g. ac line voltage) to the transmitter terminals. Abnormally high voltage can damage the unit. Sensor and transmitter power terminals are rated to 42.4 V dc.

Power Connections

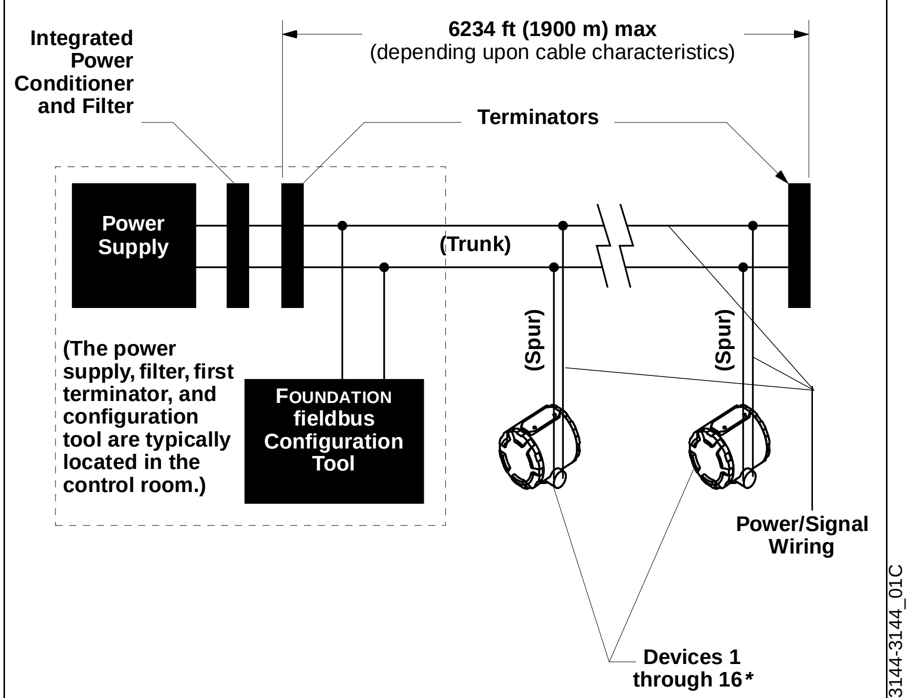
Use copper wire of sufficient size to ensure that the voltage across the transmitter power terminals is not below 9 V dc.

To connect power to the transmitter, follow the steps below:

1. Remove the transmitter cover to expose the transmitter terminal block. Do not remove transmitter covers in explosive atmospheres when the circuit is live.
2. Connect the power leads to the terminals marked “+” and “T” as shown in Figure 2-2 on page -4. The power terminals are not polar sensitive, meaning that the electrical polarity of the power leads is not significant when connecting to the power terminals. The use of crimped lugs is recommended when wiring to screw terminals.
3. Tighten the terminal screws to ensure adequate contact. No additional power wiring is needed.
4. Replace the transmitter cover, tightening the cover threads at least one-third turn after the o-ring contacts the housing. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

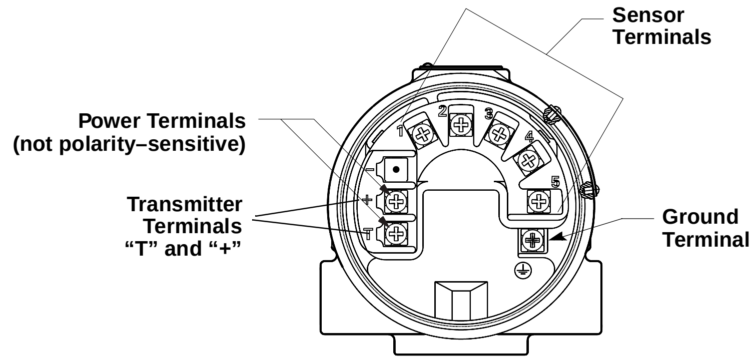
NOTE
After installation, it may take several seconds for the LCD meter to function once power is applied to the transmitter.

Figure 2-1. FOUNDATION Fieldbus Installation



* Intrinsic safe installations may allow fewer devices per I.S. barrier.

Figure 2-2. Transmitter Terminal Block



Grounding

Transmitters are electrically isolated to 500 V ac rms. If desired, you can ground the signal wiring at any single point. When using a grounded thermocouple, the grounded junction serves as this point.

NOTE
Do not ground the signal wire at both ends.

Shielded Wire

To avoid grounding the loop, the recommended grounding techniques for shielded wire usually requires a single grounding point for each shielded wire. The following examples illustrate the single grounding point technique:

Example 1

Connect the shield for the signal wiring to the shield for the sensor wiring. Verify that the two shields are tied together and electrically isolated from the transmitter housing. Ground the shield at the power supply end.

Example 2

Connect the shield for the sensor wiring to the ground terminal, which is located inside the terminal compartment of the transmitter housing. The shield for the signal wiring should be cut and isolated from the transmitter housing and should be grounded only at the power supply end. Never connect the shield for the signal wiring to the ground terminal inside the transmitter housing.

Transmitter Housing

Ground the transmitter housing in accordance with local electrical requirements. An internal ground terminal is standard. If necessary, an optional external ground lug assembly (option code G1) can be ordered. An external ground lug is installed when ordering certain hazardous locations approvals (see Figure 7-5 on page 7-10). External grounding is recommended when using the optional transient protector (option code T1).

Surges/Transients

The transmitter will withstand the electrical transients of energy level that usually occurs through static discharges or induced switching. However, high-energy transients, such as those induced by lightning strikes, can damage both the transmitter and the sensor.

To protect against high-energy transients, install the integral transient protection board (option code T1). The integral transient protection board is available as an ordered option or as an accessory. Refer to “Transient Protection (option code T1)” on page 9-2 for more information.

SWITCHES

Security

After configuring the transmitter, you may want to protect the configuration data from unwarranted changes. Each transmitter is equipped with a security switch that can be positioned “ON” to prevent the accidental or deliberate change of configuration data. This switch is located on the front side of the electronics module and is labeled SECURITY (see Figure 2-3 on page -5).

Simulate

The simulate switch is used in conjunction with the Analog Input (AI) function block. This switch is used to simulate temperature measurement and as a lock-out feature for the AI function block. To enable the simulate feature, the switch must transition from “OFF” to “ON” *after* power is applied to the transmitter. When the LCD meter is installed, the simulate feature is enabled with a jumper (see Figure 2-3 on page 2-5). This feature prevents the transmitter from being left in simulator mode.

Figure 2-3. Transmitter Switch Locations.

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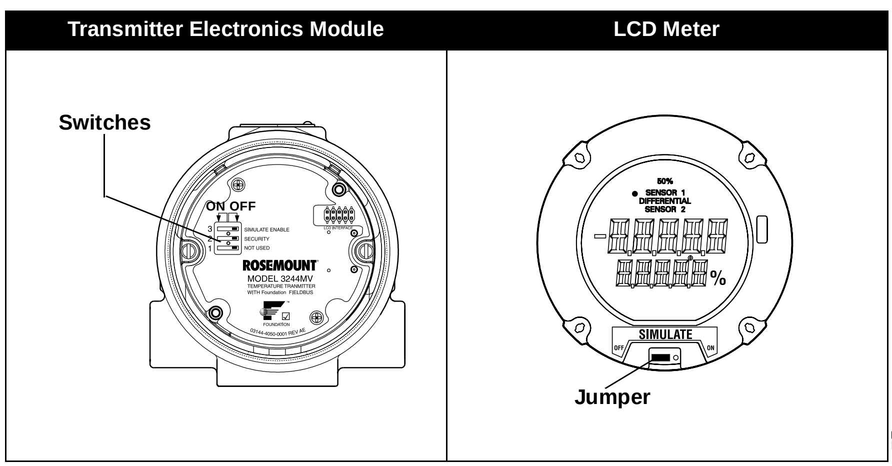


SENSOR CONNECTIONS

The Model 3244MV is compatible with a number of RTD and thermocouple sensor types. Figure 2-4 on page 2-6 shows the correct input connections to the sensor terminals on the transmitter. To ensure an adequate sensor connection, anchor the sensor lead wires beneath the flat washer on the terminal screw. Do not remove the transmitter cover in explosive atmospheres when the circuit is live. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠ If the sensor is installed in a high voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

RTD or Ohm Inputs

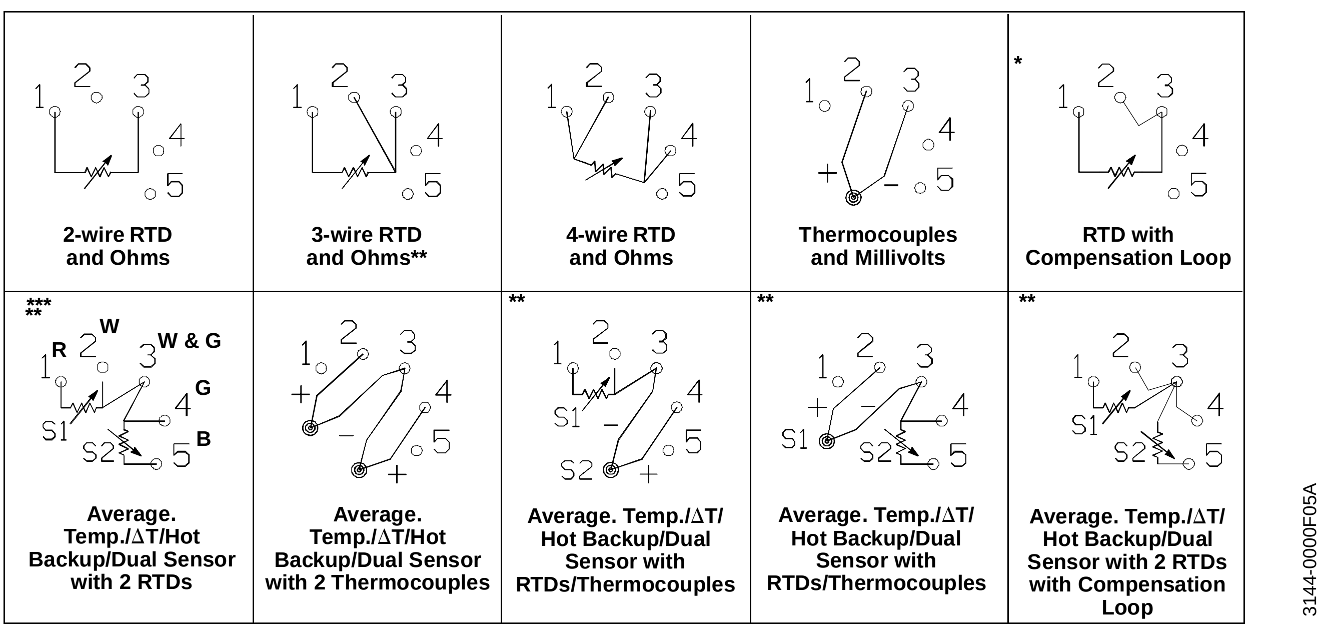
Various RTD configurations, including 2-wire, 3-wire, 4-wire, and compensation loop designs, are used in industrial applications. When the transmitter is mounted remotely from a 3- or 4-wire RTD, it will operate within specifications, without recalibration, for lead wire resistances of up to 10 ohms per lead (equivalent to 1,000 feet of 20 AWG wire). In this case, the leads between the RTD and transmitter should be shielded. When using only two leads (or a compensation loop lead wire configuration), both RTD leads are in series with the sensor element. Significant errors can occur if the lead lengths exceed one foot of 20 AWG wire.

Thermocouple or Millivolt Inputs

For direct-mount applications, connect the thermocouple directly to the transmitter. When mounting the transmitter remotely from the sensor, use appropriate thermocouple extension wire. Make connections for millivolt inputs with copper wire. Use shielding for long runs of wire.

NOTE
The use of two grounded thermocouples with the Model 3244MV is not recommended. For applications in which the use of two thermocouples is desired, connect either two ungrounded thermocouples, one grounded and one ungrounded thermocouple, or one dual element thermocouple.

Figure 2-4. Transmitter Sensor Wiring Diagram.



** Transmitter must be configured for a 3-wire RTD in order to recognize an RTD with a compensation loop.*
*** Rosemount provides 4-wire sensors for all single-element RTDs. You can use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*
**** Typical wiring configuration of a Rosemount dual-element RTD is shown (R=Red, W=White, G=Green, B=Black*

MECHANICAL CONSIDERATIONS

Using an optional mounting bracket (see Figure 2-7 on page 2-10), you can attach the Model 3244MV to:

- directly to a sensor
- apart from the sensor
- to a flat surface
- to a 2-inch diameter pipe

Installing the LCD Meter

Transmitters ordered with the LCD meter option (option code M5) are shipped with the meter installed. If later installation of the LCD meter is desired, a small instrument screwdriver and a LCD meter with the Meter Cover Kit are required (see "Spare Parts List" on page 7-13). The Meter Cover Kit includes:

- LCD meter display
- Meter cover with o-ring in place
- Captive mounting screws (quantity 2)
- 10-pin interconnection header

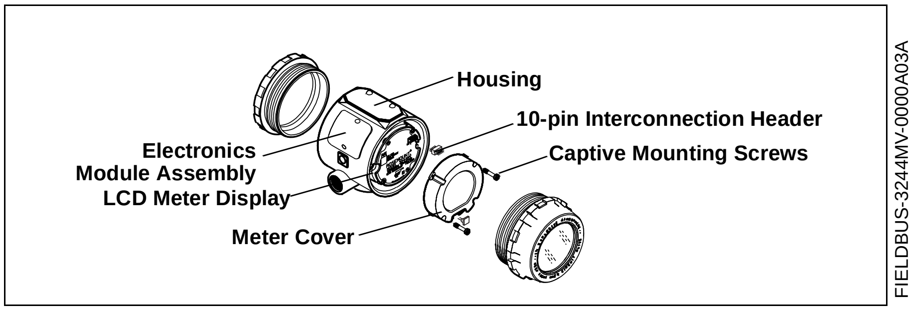
To install the LCD Meter with Meter Cover Kit refer to Figure 2-5 and Figure 2-7 while following the steps below.

1. Remove the transmitter cover to expose the transmitter electronics. Do not remove the transmitter covers in explosive atmospheres when the circuit is live.
2. Ensure that the transmitter SECURITY switch is set to the "OFF" position.
3. Insert the long pins on the interconnection header into the ten-pin socket located on the face of the electronics module assembly.
4. Orient the LCD meter. The LCD meter can be rotated in 90-degree increments for easy viewing. Position one of the four ten-pin sockets into the back of the meter to accept the interconnection header. Insert the captive mounting screws into the two holes on the meter that coincide with the appropriate holes on the electronics module assembly.
5. Attach the meter to the electronics with the captive mounting screws.
6. Insert the SIMULATE jumper into the three pin socket located on the face of the meter.
7. Thread the meter cover onto the housing. Be sure to tighten the cover threads at least one-third turn after the o-ring contacts the housing. Both transmitter covers must be fully engaged to meet explosion-proof requirements.
8. When power is applied to the transmitter, the LCD meter will need to be configured by setting the DISPLAY_MODE parameter (see **Section 5: Resource Block** for more details on configuring the LCD meter).

NOTE
Observe the following LCD meter temperature limits:
Operating: –4 to 185 °F (–20 to 85 °C)
Storage: –50 to 185 °F (–45 to 85 °C)

NOTE
Option code M5 can be added to the Model 3244MV Rev. 2 without upgrading the device software.

Figure 2-5. Transmitter and Meter Exploded View



Mounting

The transmitter may require supplementary support under high-vibration conditions, particularly if used with extensive thermowell lagging or long extension fittings. Pipe stand mounting, using one of the optional mounting brackets, is recommended for use in high-vibration applications.

Access Requirements

Take into account the need to access the transmitter when choosing an installation location and position.

Housing Rotation

You may rotate the electronics housing up to 90 degrees in either direction to improve field access to the two compartments.

Terminal Block Side of the Housing

Mount the transmitter so the terminal block side is accessible. Allow adequate clearance for cover removal. Make wire connections through the conduit openings on the bottom of the housing.

Electronics Side of the Housing

Mount the transmitter so the electronics-side is accessible. Provide adequate clearance for cover removal and leave additional room if an LCD meter is installed.

NOTE
If you consider adding a LCD Meter at a later date, the electronics-side of the transmitter should be mounted in a visible position

Tagging

Commissioning Tag

The transmitter has been supplied with a removable commissioning tag that contains both the Device ID and a space to record the device tag. The Device ID is a unique code that identifies a particular device in the absence of a device tag. The device tag is used as an operational identification for the device and is usually defined by the Piping and Instrumentation Diagram (P & ID).

When commissioning more than one device on a fieldbus segment, it can be difficult to identify which device is at a particular location. The removable tag provided with the transmitter can aid in this process by linking the Device ID and a physical location for each transmitter on the segment. The installer should note the transmitter's physical location on both the removable commissioning tag and the bottom portion of the tag, which can be torn off. The bottom portion of the tags can be used for commissioning the segment in the control system.

Figure 2-6. Commissioning Tag

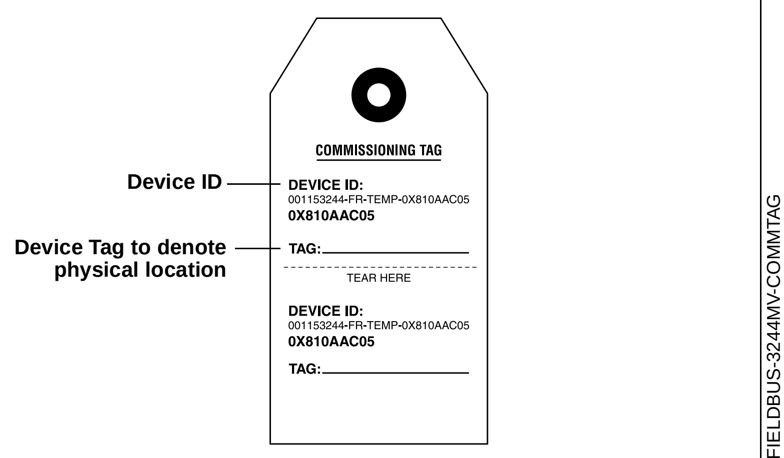
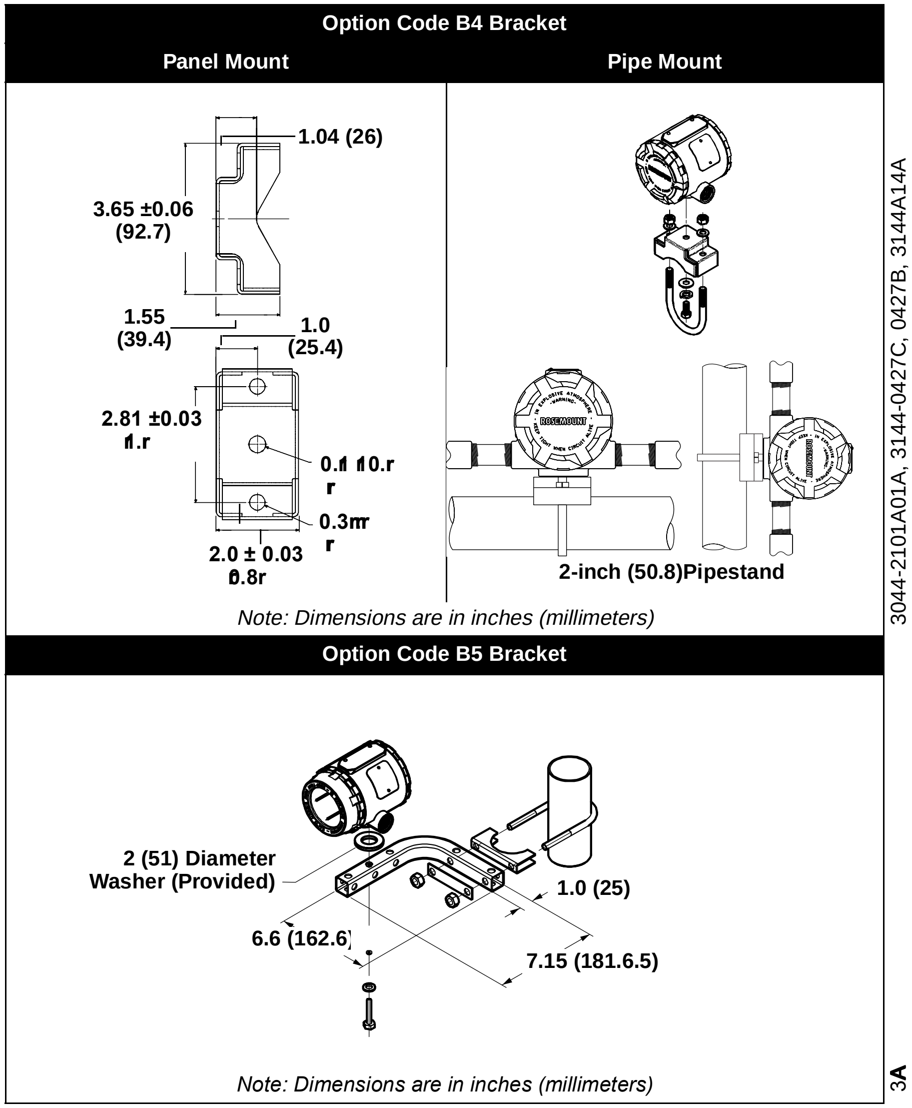


Figure 2-7.
Option Code B4 and B5
Mounting Bracket



ENVIRONMENTAL CONSIDERATIONS

Temperature Effects

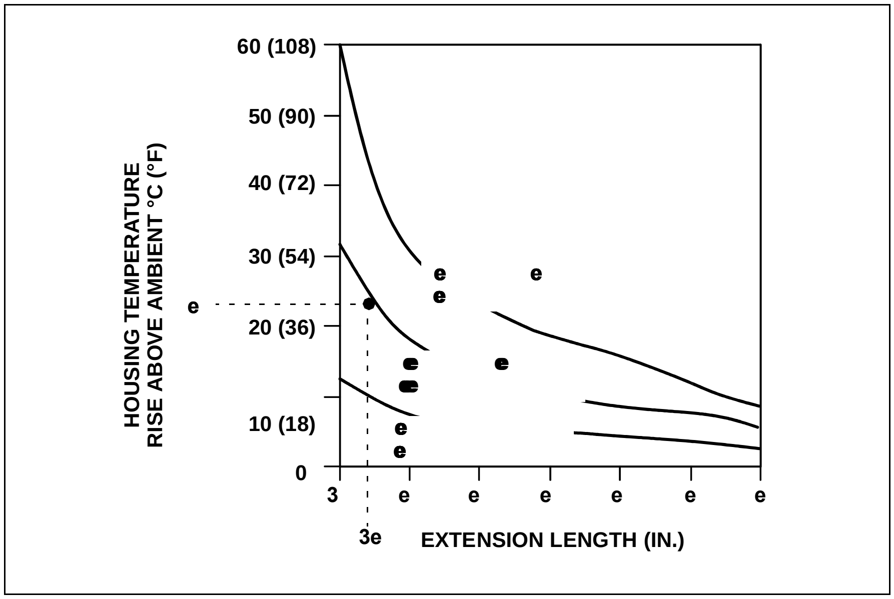
See Table 2-1.

Aside from ambient temperature variations, process-induced temperature in a direct mounting configuration is transferred from the thermowell to the transmitter housing. If the expected process temperature is near or beyond specification limits, consider using an additional thermowell lagging, an extension nipple, or a remote mounting configuration to isolate the transmitter from these excessive temperatures. Figure 2-8 provides an example of the relationship between transmitter housing temperature rise and extension length. Use Figure 2-8 and the accompanying example to determine adequate thermowell extension length.

TABLE 2-1. Temperature Ranges for Transmitter Operation

With LCD Meter	Without LCD Meter
–4 to 185 °F (–20 to 85 °C)	–40 to 185 °F (–40 to 85 °C)

Figure 2-8. Model 3244MV Transmitter Housing Temperature Rise versus Extension Length for a Test Installation



EXAMPLE:

The maximum permissible housing temperature rise (T) can be calculated by subtracting the maximum ambient temperature (A) from the transmitter's ambient temperature specification limit (S). For instance, suppose A = 40 °C

T = S – A

T = 85 °C – 40 °C

T = 45 °C

For a process temperature of 540 °C, an extension length of 3.6 inches yields a housing temperature rise (R) of 22 °C, which provides a safety margin of 23 °C. A six-inch extension length (R = 10 °C) would offer a higher safety margin (35 °C) and would reduce temperature-effect errors but would probably require extra support for the transmitter. Gauge the requirements for individual applications along this scale. If a thermowell with lagging is used, the extension length may be reduced by the length of the lagging.

Moist or Corrosive Environments

The Model 3244MV has a highly reliable, dual-compartment housing designed to resist moisture and corrosives. The electronics module assembly is mounted in a compartment that is isolated from the terminal side conduit entries. When covers are installed correctly, o-ring seals protect the interior of each compartment from the environment. However, in humid environments it is possible for moisture to accumulate in conduit lines and drain into the housing.

Proper installation of the transmitter ensures maximum operation and service life. It can also have a significant impact on preventing moisture from accumulating in the housing. Refer to Figure 2-9 before mounting the transmitter.

If possible, mount the transmitter at a high point in the conduit run so moisture from the conduits will not drain into the housing. If the transmitter is mounted at a low point, the terminal compartment could fill with water. In some instances the installation of a poured conduit seal, such as the one pictured in Figure 2-10, is advisable. Periodically remove the terminal compartment cover and inspect the transmitter for moisture and corrosion.

Figure 2-9. Incorrect Conduit Installation

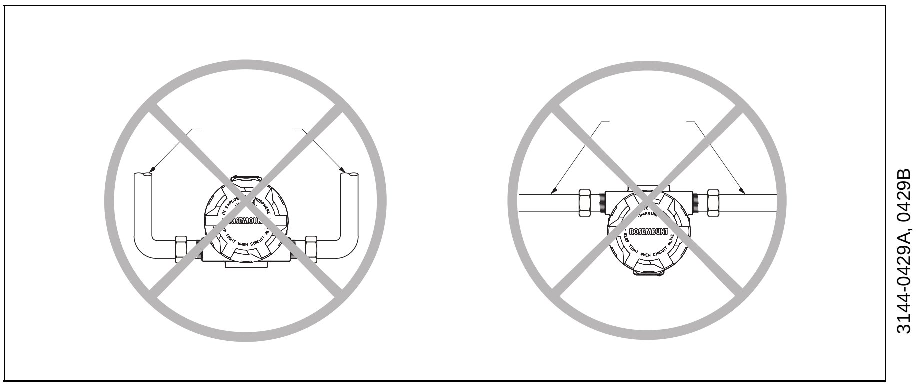
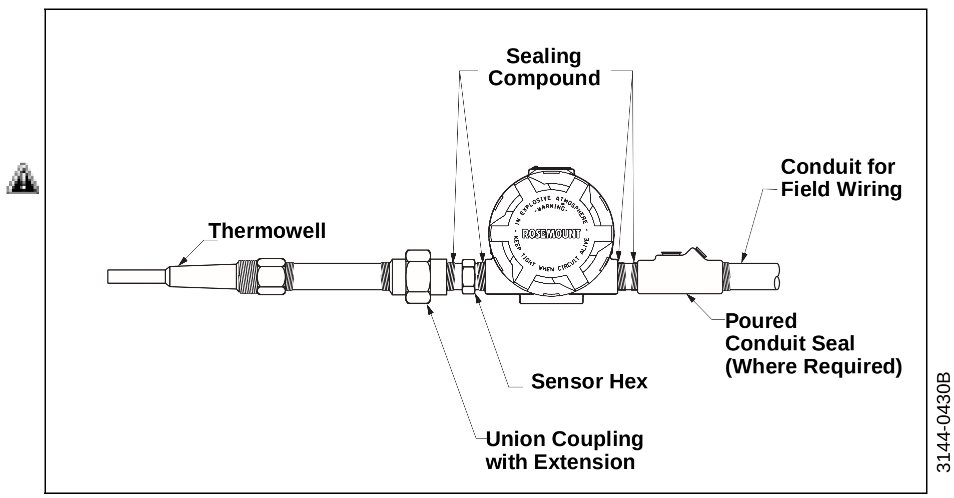


Figure 2-10. Process Mounting with Drain Seal



Hazardous Location Installations

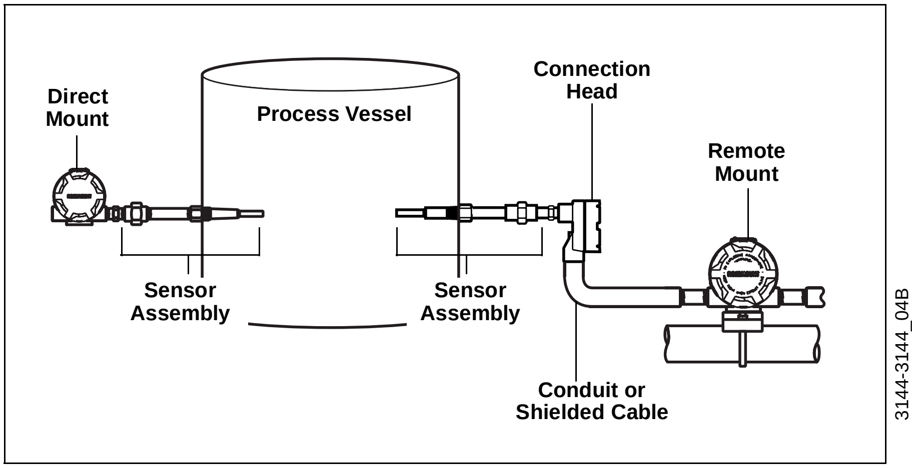
The Model 3244MV is designed with an explosion-proof housing and circuitry suitable for intrinsically safe and non-incendive operation. When specified, each transmitter is marked with an approval label. To maintain certified ratings, install in accordance with all applicable installation codes and approval drawings (Section 8: Hazardous Area Approval Installation Drawings). Verify that the atmosphere in which the transmitter operates is consistent with the appropriate hazardous location certifications. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

NOTE
Once a transmitter labeled with multiple approval types is installed, it should not be reinstalled using any other labeled approval types. To ensure this, the approval label should be permanently marked to distinguish the used from the unused approval types.

INSTALLATION PROCEDURES

Installation of the transmitter consists of mounting the transmitter, the sensor, and making the electrical connections. You can mount the transmitter directly to the sensor assembly or you can mount it remotely (Figure 2-11). For a remote mount, use conduit or suitable shielded cable with cable glands. The remainder of this section provides the installation procedures for typical configuration in North America and Europe.

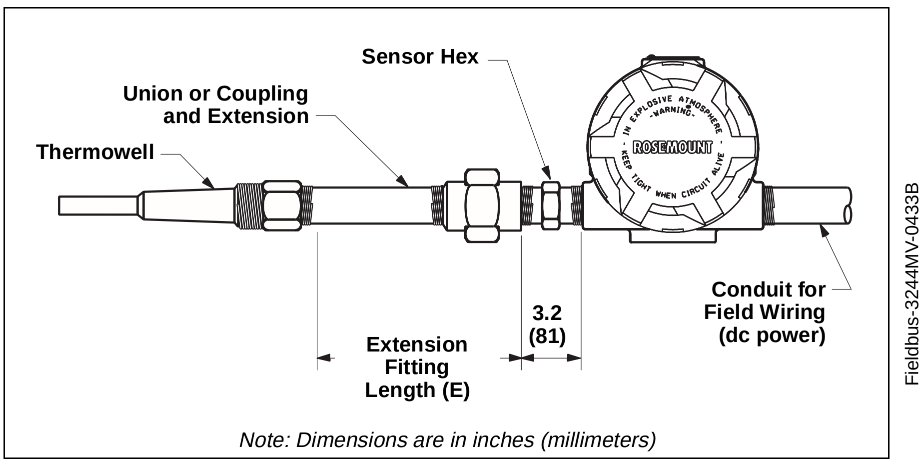
Figure 2-11. Direct Mount and Remote Mount Examples



Typical North American Configuration

1. Mount the thermowell to the pipe or process container wall. Be sure to install and tighten thermowells and sensors. Perform a leak check before applying pressure.
2. Attach any necessary unions (or couplings) and extension fittings. Seal the fitting threads with silicone or tape (if required).
3. Screw the sensor into the thermowell.
4. Verify all sealing requirements for severe environments or to satisfy code requirements.
5. Attach the transmitter to the thermowell assembly. Seal all threads with silicone or tape (if required).
6. Pull sensor leads through the extensions and unions (or couplings) into the terminal side of the transmitter housing.
7. Install conduit for field wiring to the remaining conduit entry of the transmitter.
8. Pull the field wiring leads into the terminal side of the transmitter housing. Avoid contact with leads and terminals.
9. Attach the sensor leads to the transmitter sensor terminals. Attach the power leads to the transmitter power terminals. Avoid contact with the leads and the terminals.
10. Attach and tighten both transmitter covers. Both transmitter covers must be fully engaged to meet explosion-proof requirements

Figure 2-12. Typical North American Process Mounting Configuration

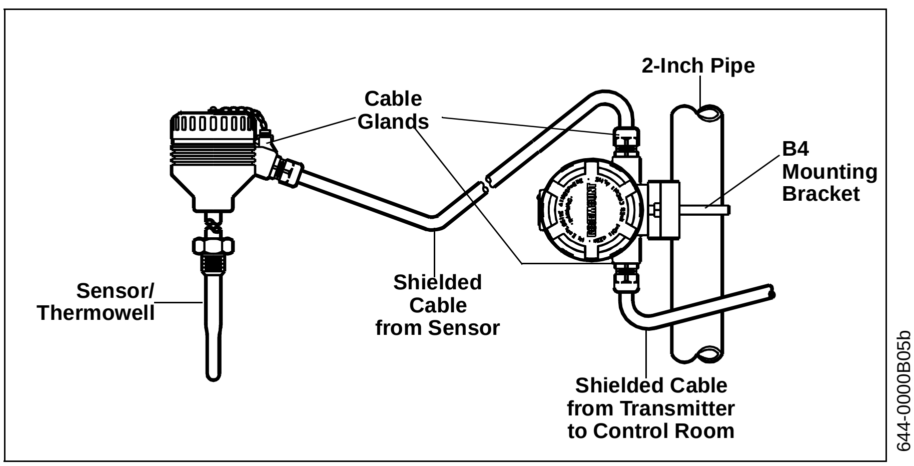


NOTE
To prevent process fluid from entering the electrical conduit and continuing to the control room, the National Electrical Code requires that a barrier or seal be used in addition to the primary (sensor) seal. Professional safety assistance is recommended for installations in potentially hazardous processes.

Typical European Configuration

1. Mount the thermowell to the pipe or the process container wall. Install and tighten thermowells and sensors. Perform a leak check before applying process pressure.
2. Attach the connection head to the thermowell.
3. Insert the sensor into the thermowell and attach it to the connection head.
4. Mount the transmitter to a 2-inch pipe or a suitable panel using one of the optional mounting brackets (see Figure 2-7 on page -10). The B4 mounting bracket is shown in Figure 2-13.
5. Attach cable glands to the shielded cable running from the connection head to the transmitter and from the transmitter to the control room.
6. Insert the shielded cable leads into the connection head and the transmitter through the cable entries. Connect and tighten the cable glands.
7. Connect the shielded cable leads to the sensor wiring leads inside of the connection head, and the sensor wiring terminals inside of the transmitter housing. Avoid contact with the leads and the terminals.
8. Connect the shielded cable leads to the transmitter power terminals. Avoid contact with the leads and the terminals.

Figure 2-13. Typical European Process Mounting Configuration

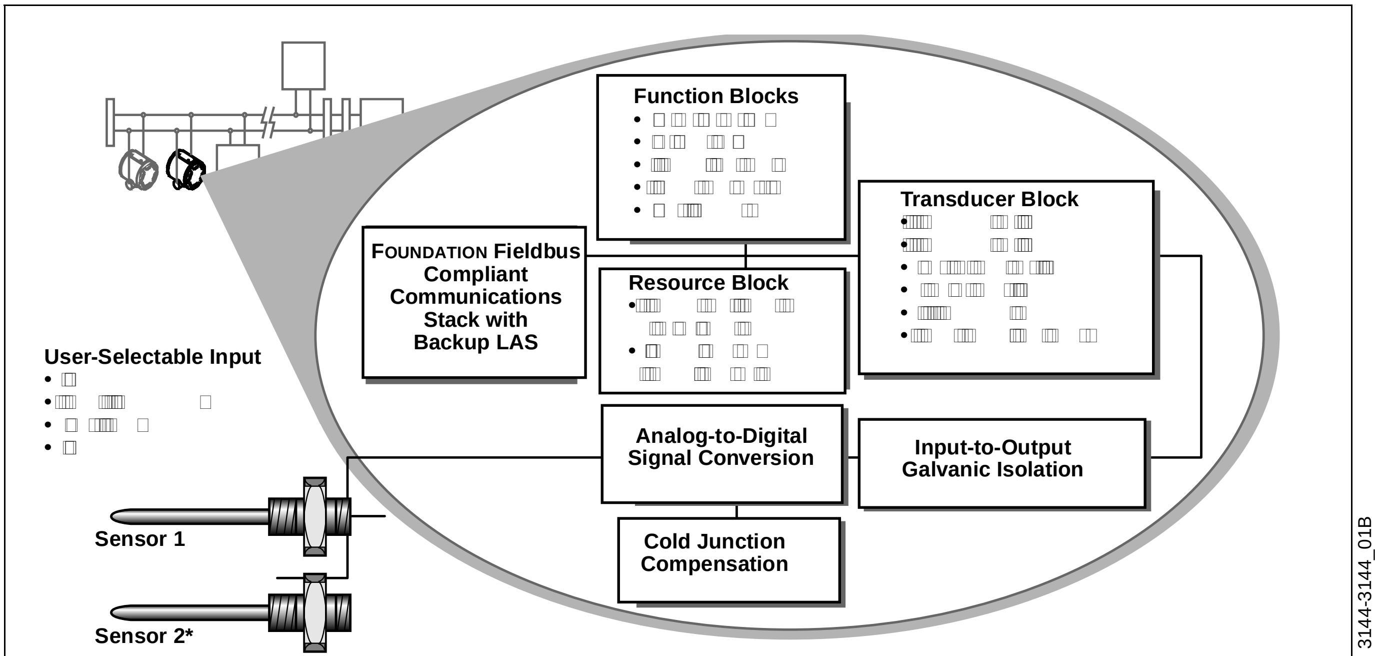


Section 3 Operation

OVERVIEW

This section covers basic operation and configuration procedures for the Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus (Device Revision 3). The device revision number can be found in the Resource Block DEV_REV parameter. Figure 3-1 illustrates how the temperature signal is channeled through the transmitter.

Figure 3-1. Block Diagram for the Model 3244MV with FOUNDATION Fieldbus



* Sensor 2 is optional. Can be used as a secondary sensing element in a dual-element sensor.

Each FOUNDATION fieldbus host or configuration tool has a different way of displaying and performing configurations. Some will use Device Descriptions (DD) and DD Methods to make configurations and to display data consistently across platforms. There is no requirement that a host or configuration tool support these features.

NOTE
The information in this section will describe how to manually configure the Model 3244MV. For information regarding the implementation of these common functions using the DeltaV System with *AMSinside* from Fisher-Rosemount, refer Appendix G: Operation with Fisher-Rosemount® DeltaV™.

For more information about the FOUNDATION fieldbus technology and the function blocks used in the Model 3244MV, refer to Section 4: Transducer Block, Section 5: Resource Block, and Appendix A: Foundation™ Fieldbus Technology through Appendix H: European ATEX Directive Information.

DEVICE TAG AND NODE ADDRESS

Unless a device tag name is specifically ordered, the transmitter is shipped with a default device tag. All devices are shipped with a temporary address (between 25P and 25I). This allows the host to automatically commission the transmitter. If the tag or address changes, use the configuration tool to perform the following functions:

1. Change the address to a temporary address (between 248 and 251).
2. Change the tag to a new value.
3. Change the address to a new address.

When the device is at a temporary address, only the tag and address can be changed or written to. The resource, transducer, and function blocks are all disabled.

TEMPERATURE SPECIFIC BLOCK CONFIGURATION

Only the Transducer Block, Analog Input function blocks, and Input Selector function block have configurations for temperature-specific parameters. Other function blocks that are used for control and/or monitoring applications are configured by links made from the Analog Input (and/or Input Selector) block. See Appendix B: Analog Input Function Blockfor specific application examples.

Transducer Block

The sensor type and connections for the Transducer Block have been preconfigured at the factory according to customer selected specifications (see below table).

Sensor Type	Connections	Configuration
Pt 100, α = 0.00385 RTD	4-wire	Standard
Pt 100, α = 0.00385 RTD	two 3-wire	U1, U4, U5, U6, U7, U8 or U9

NOTE:
This table does not reflect modifications you may have using the Configuration Data Sheet.

It may be necessary to change these settings in the field depending on what type of sensor is being connected. This is done using any FOUNDATION fieldbus host or configuration tool that supports DD methods. For a description of the sensor connection method, “Changing the Sensor Configuration” on page 4-8.

NOTE
If only one single-element sensor is used but both sensor 1 and sensor 2 are configured, PRIMARY_VALUE_2 will have a status of *bad* and a substatus of *sensor failure* and DIFFERENTIAL_TEMPERATURE will have a status of *bad* and substatus of *not specific*.

See **Section 4: Transducer Block** for more details on configuring and troubleshooting the Transducer Block.

Back-up LAS

The model 3244MV comes as a Link Master (LM) class device. With this feature, the Model 3244MV can become a fully functioning Link Active Scheduler (LAS) in the event that the primary LAS (typically the host system) fails. Appendix A: Foundation™ Fieldbus Technology provides a detailed explanation of the communications and LAS features and parameters.

Analog Input Function Block

The Analog Input (AI) function block provides the link that communicates the temperature measurement in the transducer block to the FOUNDATION fieldbus. The interface between each AI block and the transducer block is through the three parameters that are listed below. These parameters have already been preconfigured at the factory according to your specified configuration. They can be changed in the field using any FOUNDATION fieldbus host or configuration tool that supports DD methods.When necessary, use the order indicated below to change these parameters:

1. **CHANNEL:** Defines which transducer block measurement is used by the AI block.
   For example, CHANNEL parameters for option code U1: Hot Backup (Control and Safety Applications) would be as follows:
   AI1.CHANNEL = 1 (T1)
   AI4 .CHANNEL = 4 (T4)
   AI4 .CHANNEL = 4 (ΔT)
2. **XD_SCALE.UNITS_INDX:** Defines the engineering units associated with the channel input value. Default configuration is °C for all AI blocks
3. **L_TYPE:** Determines whether the field value is used directly (Direct), converted linearly (Indirect), or is converted with the square root (Indirect Square Root). Since the temperature measurement from the transducer block is in the correct units, L_TYPE is configured as Direct. L_TYPE is usually only changed to Indirect or Indirect Square Root if the measurement type changes. For example, changing mV into temperature.

See Appendix B: Analog Input Function Block for more details on configuring and troubleshooting the AI blocks.

Input Selector Function Block

The Input Selector (ISEL) function block is used to output a specific selection strategy using inputs from AI function blocks. The ISEL block has already been preconfigured at the factory according to your specified transmitter configuration (see below table). The configuration can easily be changed in the field using any FOUNDATION fieldbus host or configuration tool that supports DD methods.

Configuration	Select _Type Parameter	IN_1 Parameter	IN_2 Parameter
U1	Hot Backup®	AI1 OUT	AI2 OUT
U6	AVG = Average	AI1 OUT	AI2 OUT
U7	First Good	AI1 OUT	AI2 OUT
U8	MIN = Minimum	AI1 OUT	AI2 OUT
U9	MAX = Maximum	AI1 OUT	AI2 OUT

NOTE
The links from the AI blocks to the ISEL block must be configured for the transmitter to execute properly in your application
(see "Configuring Links and Scheduling Block Execution" on page 3-4).

See **Appendix C: Input Selector Function Block**for more details on configuring and troubleshooting the ISEL block.

NOTE
The factory default configuration can be replaced by downloading the default configuration from any FOUNDATION fieldbus host.

CONFIGURING LINKS AND SCHEDULING BLOCK EXECUTION

For your application to work properly, you must configure the links between the function blocks and schedule the order of their execution. The Graphical User Interface (GUI) provided by your FOUNDATION fieldbus host and/or configuration tool will allow you to easily perform these configurations.

Your Model 3244MV was preconfigured at the factory according to your specifications. The measurement and control strategies shown below represent some of the common types of configurations available in the Model 3244MV. Although the appearance of your GUI screens will vary from host to host, the configuration logic is the same for all hosts.

NOTE
If configured improperly, your FOUNDATION fieldbus host or configuration tool could overwrite the default transmitter configuration. Please ensure that your host system or configuration tool is properly configured prior to downloading the transmitter configuration.

Hot Backup Configuration (option code U1)

Configure the links and block execution order as shown in Figure 3-2 and 3-3. This configuration optimizes your transmitter for use in a control and safety application.

The use of a dual-element sensor is recommended with this configuration. The ISEL Block SELECT_TYPE parameter = Hot Backup. The AI3 Block alarm parameters are set to detect sensor drift. For more details on how to configure these parameters, see “Sensor Drift Alert Configuration” on page -13.

Figure 3-2. Hot Backup Link Configuration

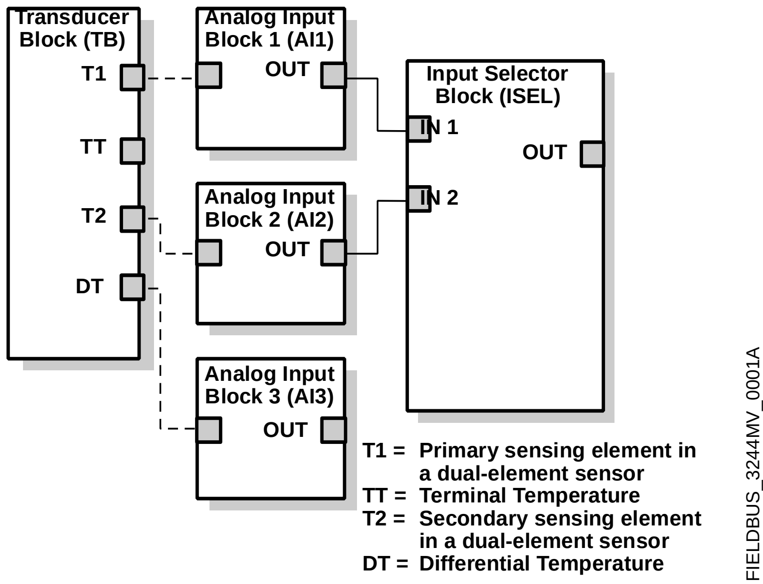
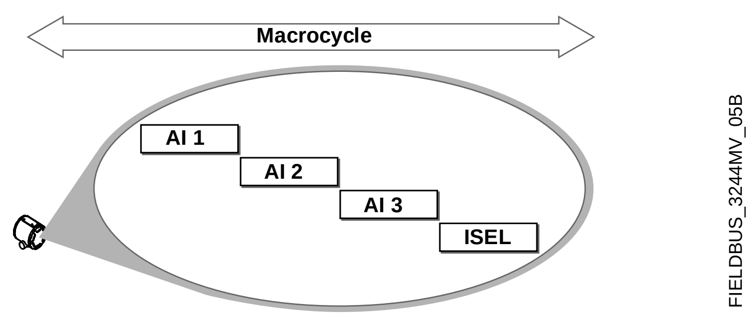


Figure 3-3. Hot Backup Block Execution Order



Two Independent Sensors Configuration (option code U4)

Configure the links and block execution order as shown in Figure 3-4 and Figure 3-5. This configuration optimizes your transmitter for use in a monitoring application.

The use of two single-element sensors is recommended with this configuration.

Figure 3-4. Two Independent Sensors Link Configuration

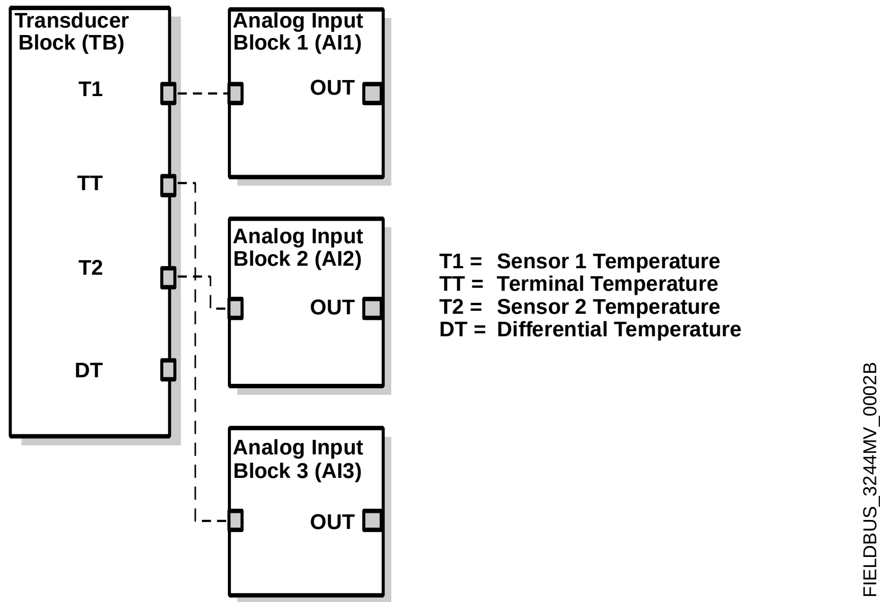
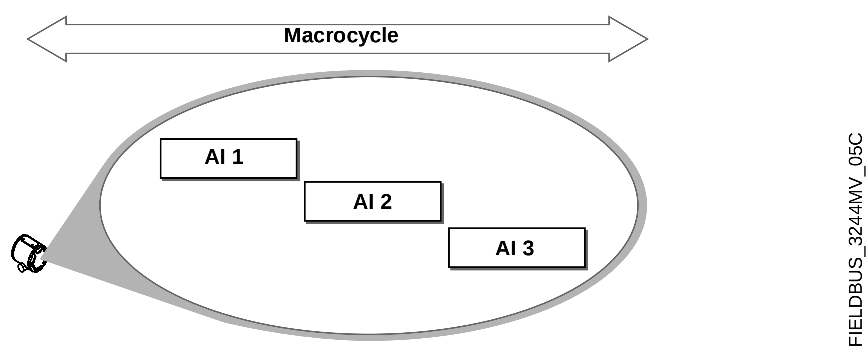


Figure 3-5. Two Independent Sensors Block Execution Order



Differential Temperature Configuration (option code U5)

Configure the links and block execution order as shown in Figure 3-6 and Figure 3-7. This configuration is used to measure the differential temperature between two processes.

Figure 3-6. Differential Temperature Link Configuration

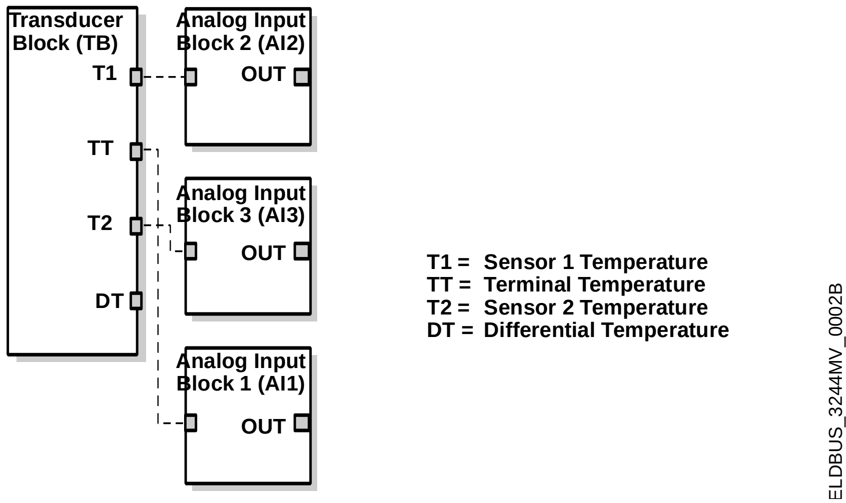
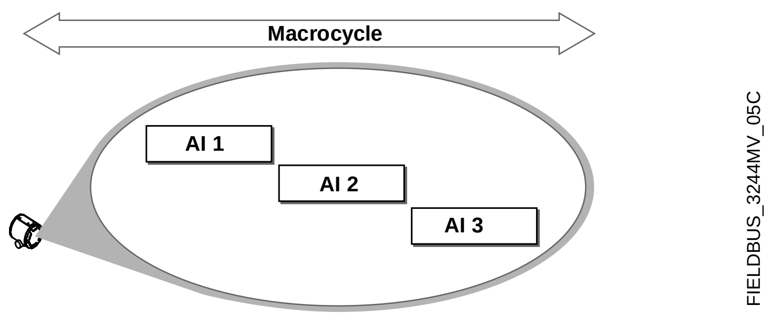


Figure 3-7. Differential Temperature Block Execution Order



Average Temperature Configuration (Option Code U6)

This configuration is used to measure the average temperature between two processes.

First Good Temperature Configuration (Option Code U7)

This configuration is used to output the first sensor measurement with a status of “GOOD.”

Minimum Temperature Configuration (Option Code U8)

This configuration is used to output the minimum temperature between two sensors.

Maximum Temperature Configuration (Option Code U9)

This configuration is used to output the maximum temperature between two sensors.

Configure the links and block execution order as shown in Figure 3-8 and Figure 3-9 for the Average, First Good, Minimum and Maximum Temperature Configurations.

Refer to “Input Selector Function Block” on page -3 to determine the corresponding SELECT_TYPE parameter settings. The AI3 Block alarm parameters are set to detect sensor drift. For more details on how to configure these parameters, see “Sensor Drift Alert Configuration” on page -13.

Figure 3-8. Average, First Good, Minimum, and Maximum Temperature Link Configuration

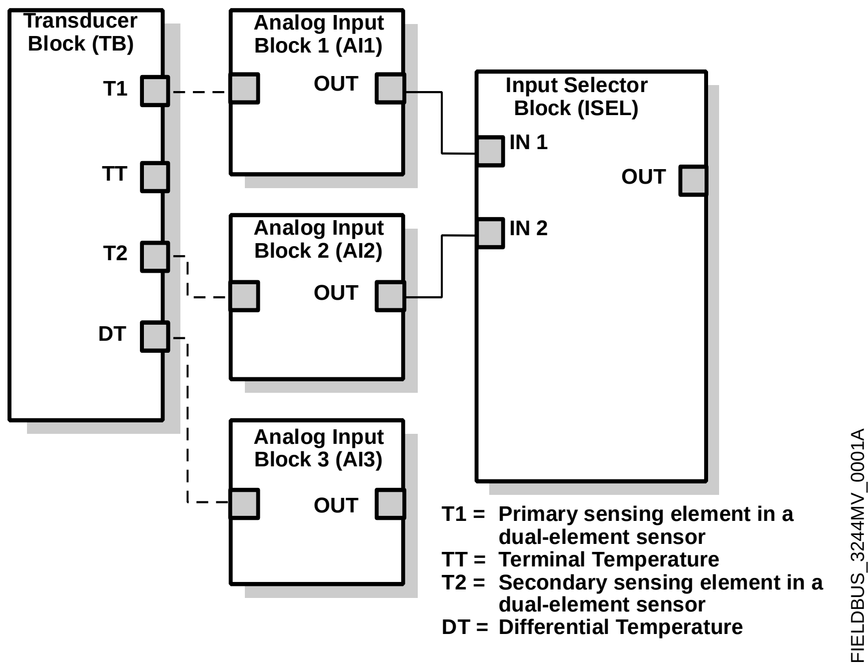
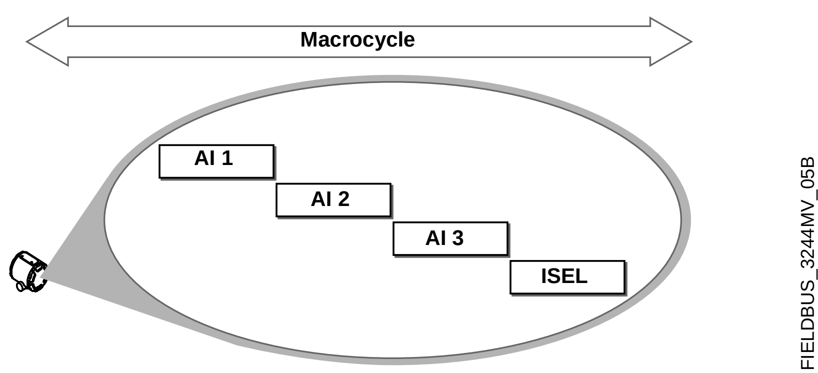


Figure 3-9. Average, First Good, Minimum, and Maximum Temperature Block Execution Order



Single Sensor Configuration (standard)

Configure the links and block execution order as shown in Figure 3-10 and Figure 3-11.

Figure 3-10. Single Sensor Link Configuration

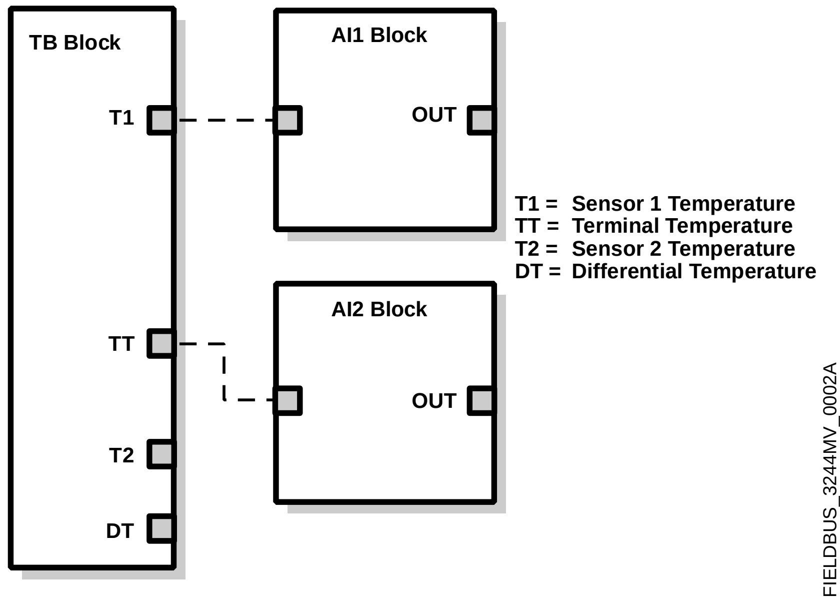
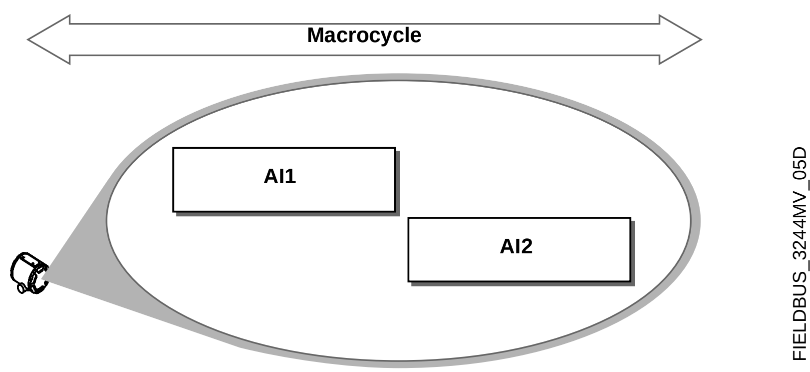


Figure 3-11. Single Sensor Block Execution Order

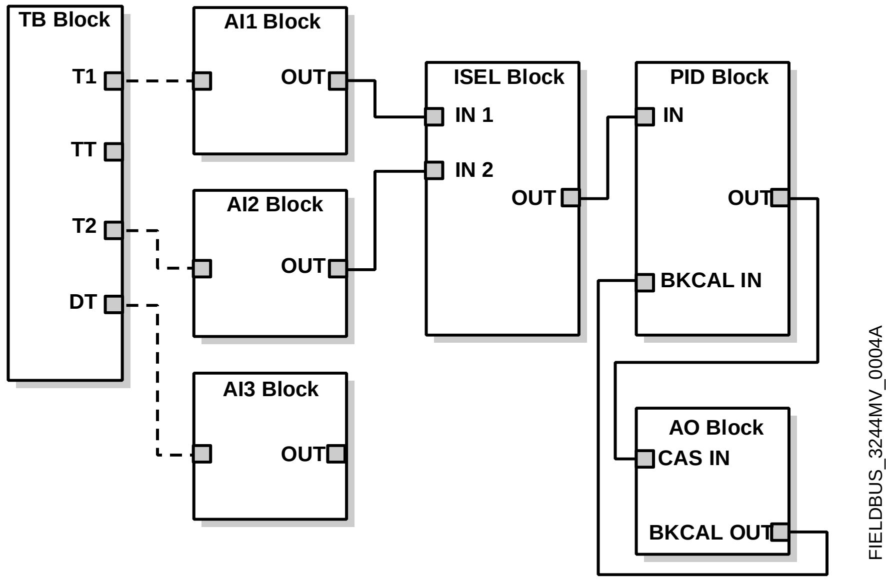


Critical Control Application

Configure the links and block execution order as shown in Figure 3-12 and Figure 3-13. This configuration optimizes your transmitter for use in a critical control application. This type of application requires a redundant sensor that allows the process to continue if one of the temperature sensing elements fail. The Model 3244MV MultiVariable Temperature Transmitter Hot Backup feature or First Good configuration is ideal for this application.

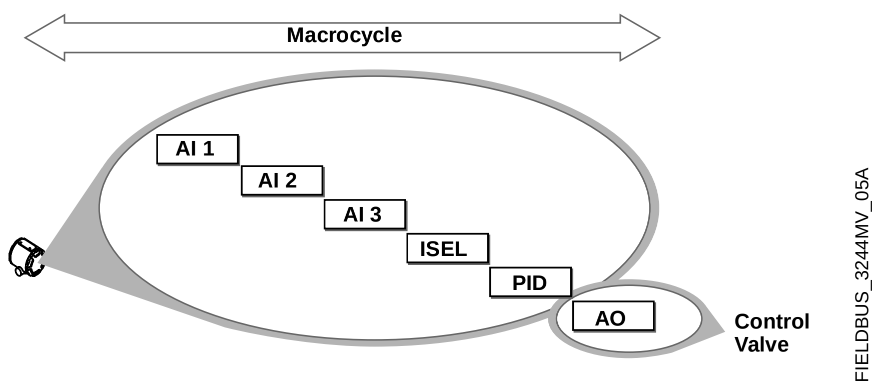
The use of a dual-element sensor is recommended with this configuration. The ISEL Block SELECT_TYPE parameter = Hot Backup or First Good. The AI3 Block alarm parameters are set to detect sensor drift. For more details on how to configure these parameters, see “Sensor Drift Alert Configuration” on page -13.

Figure 3-12. Critical Control Link Configuration



T1 = **Primary sensing element in a dual-element sensor**
TT = **Terminal Temperature**
T2 = **Secondary sensing element in a dual-element sensor**
DT = **Differential temperature used to detect sensor drift.**

Figure 3-13. Critical Control Block Execution Order



Cascade Control Application

Configure the links and block execution order as shown in Figure 3-14 and Figure 3-15. This configuration optimizes your transmitter for use in a cascade temperature control application. The use of two single-element sensors is recommended with this configuration.

Figure 3-14. Cascade Control Link Configuration

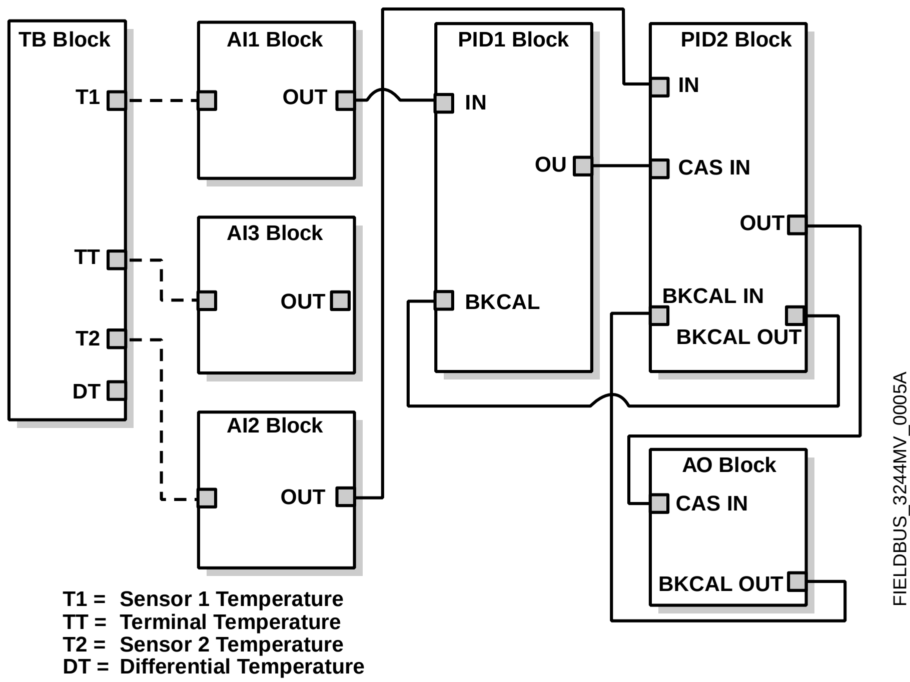
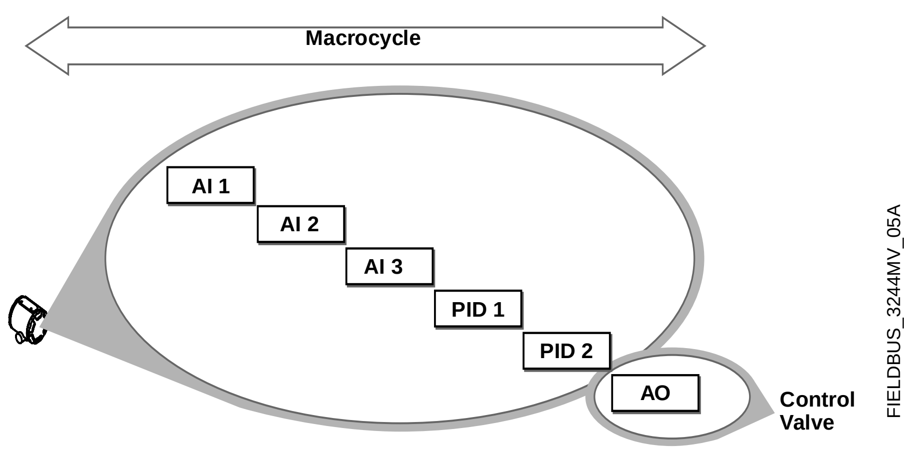


Figure 3-15. Cascade Control Block Execution Order

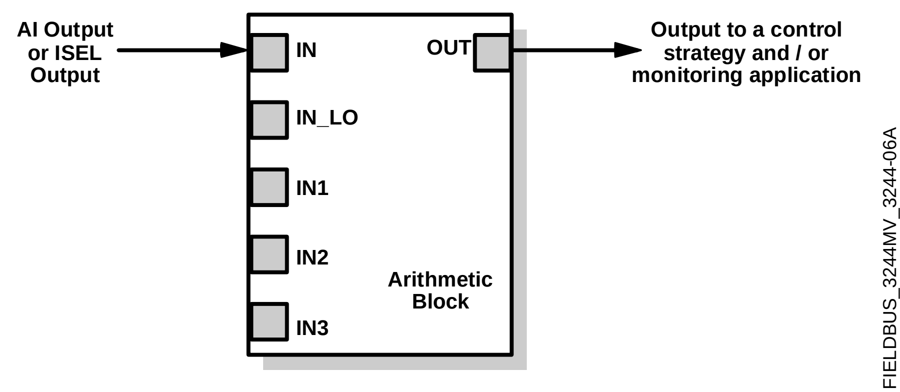


Fluid Density Application

The Model 3244MV available with an Arithmetic Function Block, which is useful in many types of temperature applications, such as calculating fluid density. Since many liquids are virtually incompressible fluids, temperature is often used as the main variable for determining fluid density. The temperature of the fluid can be converted into density by using the fourth order polynomial capability of the Arithmetic block.

Figure 3-16 shows the applicable links for the Arithmetic Function Block. In this example, the ARITH-TYPE parameter = Fourth order polynomial.

Figure 3-16. Arithmetic Function Block Link Configuration

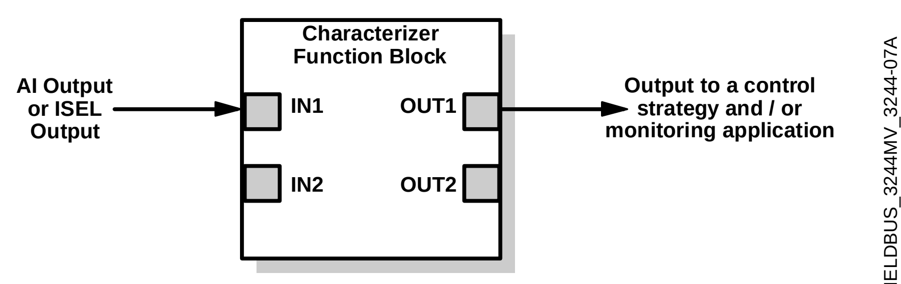


Infrared Sensor Input Application

The transmitter is available with a Signal Characterizer Function Block which is useful in many types of temperature applications, such as converting mV to temperature for an IR sensor. Since this conversion is typically a non-linear function, the Signal Characterizer block is ideal with its X–Y coordinate input capability.

Figure 3-17 shows the application links for the Signal Characterizer Function Block.

Figure 3-17. Signal Characterizer Function Block Link Configuration



Sensor Drift Alert Configuration

The Sensor Drift Alert configuration feature aids in the prediction of sensor failures. This feature should be used when measuring the same process temperature, such as with a dual-element sensor.

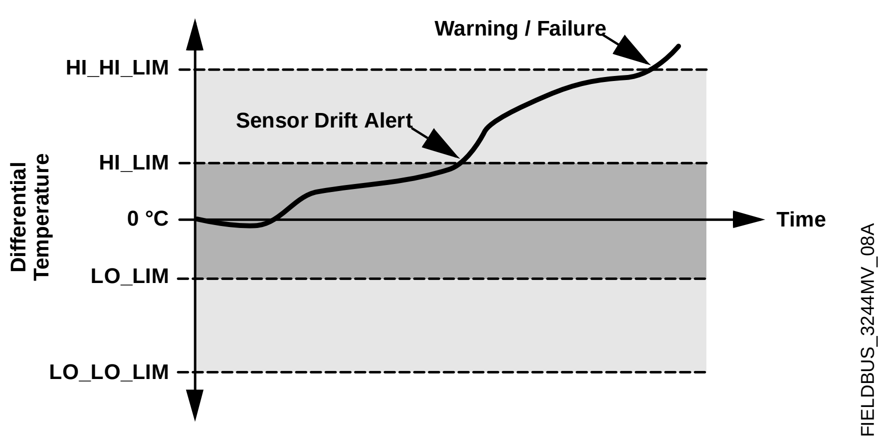
Use the following steps to set up Sensor Drift Alert:

1. Assign an AI block to the differential temperature measurement in the Transducer Block. When the sensors are working properly, the differential temperature should be near zero.
2. Set the maximum allowable temperature difference (drift) between sensor 1 and sensor 2 by setting the alarm limit parameters HI_LIM and LO_LIM in the AI block.

NOTE:
If Custom Configuration Options U1, U6, U7, U8, or U9 are ordered, the AI3 alarm parameters are preconfigured as follows:
HI_LIM = 5.4 °F (3.0 °C)
LO_LIM = –5.4 °F (–3.0 °C)

3. An alert is generated when the transmitter detects a temperature difference that exceeds the alarm limits.
4. Additional bands of drift can be configured by using HI_HI_LIM and LO_LO_LIM. This is done to identify warning and failure points in a temperature application.

Figure 3-18. Sensor Drift Alert Diagram



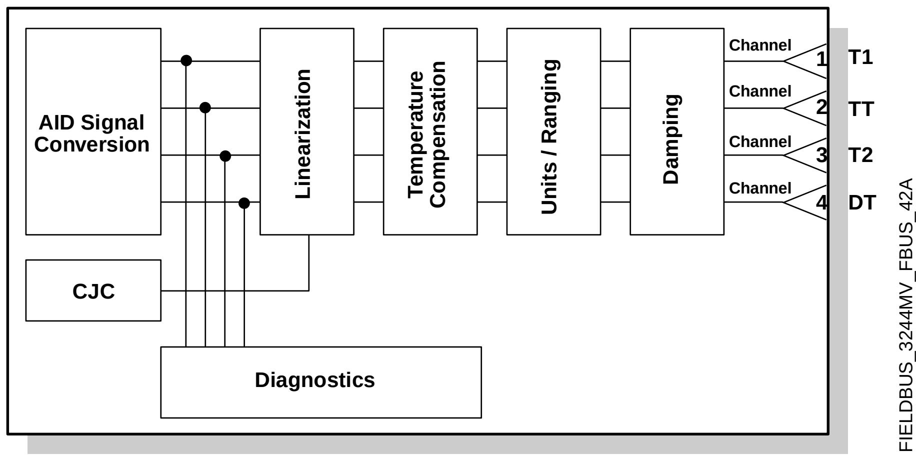
Section 4

Transducer Block

OVERVIEW

This section contains information about the Model 3244MV MultiVariable Temperature Transmitter Transducer Block (TB) and its parameters, errors, and diagnostics. Modes, alarm detection, status handling, application information, and troubleshooting are also discussed.

Figure 4-1. Transducer Block Diagram



Definition

The Transducer Block contains temperature measurement data, including Sensor 1, Sensor 2, differential, and terminal temperatures. Channels 1–4 are assigned to these temperature measurements (see Figure 4-1 above). The Transducer Block also includes information about sensor type, engineering units, linearization, reranging, damping, temperature compensation, and diagnostics.

Channel Definitions

The Model 3244MV supports multiple sensor inputs. Each input has a channel assigned to it that allows the AI block to link to it. The channels for the Model 3244MV are as follows:

- Channel T1 (Sensor 1 temperature)[(1)]
- Channel TT (Terminal temperature)
- Channel T2 (Sensor 2 temperature)[(2)]
- Channel DT = $T_1 - T_2$ (Differential temperature)

NOTE
Whenever the transducer block is configured with 2 inputs the Differential Temperature (DT) is calculated.

(1) T1 is the primary sensing element in a dual-element sensor.

(2) T2 is the secondary sensing element in a dual-element sensor.

Parameters and Descriptions

TABLE 4-1. Transducer Block Parameters

Parameter	Index Number	Description
A2D_BRD_HRDWR_REV	65	A/D board hardware revision.
A2D_BRD_SN	64	A/D board serial number.
A2D_CONVERSION_INFO	69	Indicate whether your input power has 60Hz or 50Hz line cycle. 0 = “60 Hz”, “Choose this if your input power has 60Hz line cycle”, 1 = “50 Hz”, “Choose this if your input power has 50Hz line cycle”
A2D_SOFTWARE_REVISION	67	Software revision.
A2D_SOFTWARE_REV_NUM	66	A/D software rev number.
ALERT_KEY	04	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	08	The block alarm is used for all configuration, hardware, connection failure or system problems 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 parameter. 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.
BLOCK_ERR	06	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.
CALIBRATOR_MODE	71	Calibrator mode. Used to determine the mode of the calibration logic. 0 = “Disabled,” “Choose this if you are doing an input trim to minimize interaction between the device and the calibration hardware”, 1 = “Enabled”, “Choose this for normal operation and the best open sensor diagnostics”
CAL_MIN_SPAN (_2)(1)	18, 40	The minimum span that must be used between the calibration high and low points.
CAL_POINT_HI (_2)(1)	16, 38	The value of the Primary Value measurement used for the high calibration point.
CAL_PT_HI_LIMIT (_2)(1)	21, 43	High calibration point limit. A value greater than this should not be used for the CAL_POINT_HI.
CAL_POINT_LO (_2)(1)	17, 39	The value of the Primary Value measurement used for the low calibration point.
CAL_PT_LO_LIMIT (_2)(1)	22, 44	Low calibration point limit. A value less than this should not be used for the CAL_POINT_LO.
CAL_UNIT (_2)(1)	19, 41	The units used for the calibration inputs.Valid calibration units are the following: 1000 = K 1001 = °C 1002 = °F 1003 = °R 1243 = mV 1281 = ohm
CJC_CALIBrATION_VALUE	68	The CJC calibration value.
CJC_MODE	72	CJC mode.
COLLECTION_DIRECTORY	12	A directory that specifies the number starting indices and DD Item ID's of the data collections in each transducer within a transducer block.
DAMPING (_2)(1)	20, 42	Sampling interval used to smooth output using a 1st order linear filter.
DIFFERENTIAL_DAMPING	75	Differential damping.
DIFFERENTIAL_LIMITS	77	Differential limits.
DIFFERENTIAL_RANGE	76	Differential range.

Continued on Next Page

(1) “Special sensor matching coefficients A, B, C, and R_0 are used by the Model 3244MV Transducer Block. Callendar-Van Dusen sensor matching constants alpha (α), delta (δ), beta (β) and R_0 can be entered using the DD method.

DIFFERENTIAL_TEMPERATURE	74	Differential temperature (channel output #4).
MODE_BLK	05	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
MODULE_SN	59	The A/D module serial number.
NUMBER_OF_INPUTS	78	Number of inputs.
PRIMARY_VALUE_RANGE (_2)(1)	15, 37	The High and Low range limit values, the engineering units code, and the number of digits to the right of the decimal point to be used to display the Primary Value. Valid engineering units are the following: 1000 = K 1001 = °C 1002 = °F 1003 = °R 1243 = mV 1281 = ohm
PRIMARY_VALUE	14	The value of the measurement, i.e. temperature sensor input #1 (channel output #1).
PRIMARY_VALUE_2	36	The value of the measurement, i.e. temperature sensor input #2 (channel output #3).
PRIMARY_VALUE_TYPE (_2)(1)	13, 35	Type of measurement of the primary value. 104 = process temperature
RTD_OFFSET_COMPENSATION	70	RTD offset compensation. 0 = “Disabled”, “Choose this if you want offset compensation disabled”, 1 = “Enabled”, “Choose this for normal operation and the best sensor measurement accuracy possible”
SECONDARY_VALUE	57	The secondary value, i.e. terminal temperature (channel output #2).
SECONDARY_VALUE_DAMPING	62	Secondary value damping.
SECONDARY_VALUE_LIMITS	61	Secondary value limits.
SECONDARY_VALUE_RANGE	60	Secondary value range.
SECONDARY_VALUE_UNIT	58	Engineering units to be used with SECONDARY_VALUE.
SENSOR_CAL_DATE (_2)(1)	28, 50	The last date on which the calibration was performed.
SENSOR_CAL_LOC (_2)(1)	27, 49	The last location of the sensor calibration.
SENSOR_CAL_METHOD (_2)(1)	26, 48	The last method used to calibrate the device, e.g. factory calibration or user specific. 103 = factory trim standard 104 = user trim standard
SENSOR_CAL_WHO (_2)(1)	29, 51	The name of the person responsible for the last sensor calibration.
SENSOR_CONNECTION (_2)(1)	30, 52	The number of wires for the temperature probe. Valid values are: 2 = 2 wire sensor 3 = 3 wire sensor 4 = 4 wire sensor
SENSOR_RANGE (_2)(1)	24, 46	The High and Low range limit values, the engineering units code, and the number of digits to the right of the decimal point for the sensor. These represent the nominal high and low range values for the sensor type.
SENSOR_SN (_2)(1)	25, 47	Serial number of the sensor.

Continued on Next Page

(1) Special sensor matching coefficients A, B, C, and R_0 are used by the Model 3244MV Transducer Block. Callendar-Van Dusen sensor matching constants alpha (α), delta (δ), beta (β) and R_0 can be entered using the DD method.

SENSOR_TYPE (–2)(1)	23, 45	Type of sensor on input #1. Valid ones are ohms, mV, PT-(many), TC-(many). Valid sensor types are the following: 103 = mV 104 = Ohms 128 = PT100_A_385 (IEC 751) 129 = PT100_A_392 (JIS 1604) 130 = PT200_A_385 (IEC 751) 131 = PT500_A_385 (IEC 751) 132 = NI120, Edison #7 133 = Cu10, Edison #15 134 = T/C Type B (IEC 584-1, NIST 175) 136 = T/C Type E (IEC 584-1, NIST 175) 137 = T/C Type J (IEC 584-1, NIST 175) 138 = T/C Type K (IEC 584-1, NIST 175) 139 = T/C Type N (IEC 584-1, NIST 175) 140 = T/C Type R (IEC 584-1, NIST 175) 141 = T/C Type S (IEC 584-1, NIST 175) 142 = T/C Type T (IEC 584-1, NIST 175) 145 = PT1000_A_385 (IEC 751) 146 = User-defined—Calvandu 147 = User-defined—RTD/Ohms 148 = User-defined—T/C, mV 65534 = Not used
SPECIAL_SENSOR_A (_2)(1)	32, 54	Special sensor matching coefficients—A Value(2)
SPECIAL_SENSOR_B (_2)(1)	33, 55	Special sensor matching coefficients—B Value(2)
SPECIAL_SENSOR_C (_2)(1)	34, 56	Special sensor matching coefficients—C Value(2)
SPECIAL_SENSOR_R0 (_2)(1)	31, 53	Special sensor matching coefficients—R_0 Value(2)
STRATEGY	03	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	The user description of the intended application of the block.
TB_COMMAND_STATUS	63	Transducer board command status. 0 = No Command Active 1 = Command Executing 2 = Command Done 3 = Command Done: Errors
TB_ELECTRONICS_STATUS	73	TB electronics status. See Diagnostics below.
TRANSDUCER_DIRECTORY	09	Directory that specifies the number and starting indices of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer that follows.
UPDATE_EVT	07	This alert is generated by any change to the static data.
XD_ERROR	11	A transducer block alarm subcode.

(1) "_2" is added to the given parameter for sensor 2 (secondary sensing elements).
(2) Special sensor matching coefficients A, B, c and R_0 are used by the Model 3244MV Transducer Block. Callendar-VanDusen sensor matching constants alpha (α), delta (δ), beta (β), and R_0 can be entered using the DD method.

Block/Transducer Errors

The following conditions are reported in the BLOCK_ERR and XD_ERROR parameters. Conditions in *italics* are inactive for the Transducer block and are given here only for your reference.

TABLE 4-2. BLOCK_ERR and XD_ERR Conditions

Condition Number	Condition Name and Description
0	*Other*
1	*Block Configuration Error*
2	*Link Configuration Error*
3	*Simulate Active*
4	*Local Override*
5	*Device Fault State Set*
6	**Device Needs Maintenance Soon**
7	**Input failure/process variable has bad status**
8	*Output Failure*
9	*Memory Failure*
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	**Device Needs Maintenance Now**
14	**Power Up**: The device was just powered-up.
15	**Out of Service**: The actual mode is out of service.
16	**Unspecified error**: An unidentified error occurred.
17	**General Error**: A general error that cannot be specified below occurred
18	**Calibration Error**: An error occurred during calibration of the device or a calibration error was detected during normal operations.
19	**Configuration Error**: An error occurred during configuration of the device or a configuration error was detected during normal operations.
20	**Electronics Failure**: An electrical component failed.
21	**Mechanical Failure**: A mechanical component failed.
22	**I/O Failure**: An I/O failure occurred.
23	**Data Integrity Error**: Data stored in the device is no longer valid due to a non-volatile memory checksum failure, a data verify after write failure, etc.
24	**Software Error**: The software has detected an error due to an improper interrupt service routine, an arithmetic overflow, a watchdog time-out, etc.
25	**Algorithm Error:** The algorithm used in the transducer block produced an error due to overflow, data reasonableness failure, etc.

Diagnostics

In addition to the BLOCK_ERR and XD_ERROR parameters, more detailed information on the measurement status can be obtained via TB_ELECTRONICS_STATUS. Table 4-3 lists the potential errors and the possible corrective actions for the given values. The corrective actions are in order of increasing system level compromises.

The first step should always be to reset the transmitter and then, if the error persists, move to the next step as indicated in Table 4-3.

TABLE 4-3. TB_ ELECTRONICS_STATUS Descriptions and Corrective Actions

Value and Name	Name and Description	Corrective Actions
0x00000040	RAM_FAILURE: “The device has detected a RAM failure which is usually fatal”	1. Restart the Processor. 2. Send to Service Center.
0x00000020	RAM_CHKSUM_FAILURE: “The device has detected a RAM data integrity error which may be a checksum error or a data consistency error”	1. Restart the Processor.
0x00000010	ROM_FAILURE: “The device has detected a ROM failure which is usually fatal”	1. Restart the Processor. 2. Send to Service Center.
0x00000004	CONFIGURATION_INVALID: “The device has detected invalid data in the EEPROM even though all other tests passed”	1. Restart the Processor. 2. Restart with Defaults.
0x00000002	EEPROM_WRITE_FAILED: “The device has detected that a write to EPROM has failed”	1. Restart the Processor. 2. Send to Service Center
0x00000001	EEPROM_CHKSUM_FAILURE: “The device has detected an EEPROM data integrity error which may be a checksum error or a data consistency error”	1. Restart the Processor.
0x00008000	A2D_ASIC_RX_ERR: “The transducer block has detected an A/D ASIC receive error”	1. Restart the Processor.
0x00004000	A2D_ASIC_TX_ERR: “The transducer block has detected an A/D ASIC transmission error”	1. Restart the Processor.
0x00002000	A2D_ASIC_CONVERT_ERR: “The transducer block has detected an A/D ASIC had a conversion overflow error”	1. Restart the Processor.
0x00001000	A2D_ASIC_REF_ERR: “The transducer block has detected an A/D reference error”	1. Restart the Processor.
0x00000800	A2D_ASIC_NO_IRQ: “The transducer block has detected that the A/D ASIC has stopped interrupting for service”	1. Restart the Processor.
0x00000400	A2D_ASIC_INVALID_IRQ: “The transducer block has detected that the A/D ASIC interrupt came at the wrong time”	1. Restart the Processor.
0x00000200	A2D_ASIC_AUTOCAL_ERR: “The transducer block has detected an A/D ASIC auto calibration error”	1. Restart the Processor.
0x00000100	A2D_ASIC_FAILURE: “The transducer has detected an A/D ASIC general failure”	1. Restart the Processor.
0x00080000	HOUSING_FAILURE: “The device has detected a failure in the device housing”	1. Restart the Processor. 2. Replace the Housing.
0x00100000	SENSOR_FAILURE: “The device has detected a failure in one or both sensors connected to the device”	1. Restart the Processor. 2. Replace the Sensor.
0x00010000	A2D_SOFTWARE_COMPAT_ERR: “The device has detected an incompatible version of software in the A/D board.	1. Restart the Processor. 2. Send to Service Center.
0x40000000	A2D_BRD_COMM_FAILED: “The device has detected that the A/D board is not communicating properly”	1. Restart the Processor. 2. Send to Service Center.
0x10000000	A2D_BRD_DATABASE_FAILED: “The device detected that the A/D board and output board databases were inconsistent”	1. Restart the Processor. 2. Send to Service Center.

Value and Name	Name and Description	Corrective Actions
0x20000000	A2D_BRD_UPDATE_FAILED: "The device has detected that the A/D board is generating interrupts therefore not updating the sensor value"	1. Restart the Processor. 2. Send to Service Center.
0x08000000	A2D_BRD_EXCESS_EMF: "The device has detected that the excess EMF correction in Offset Compensation mode on the A/D board"	1. Restart the Processor. 2. Check the Shielding.
0x04000000	A2D_BRD_COLD_START: "The device has detected that the A/D board has gone through a cold start or equivalent.	1. No Action Necessary.
0x02000000	A2D_BRD_CONFIG_CHANGED: "The device has detected that the A/D board's configuration changed"	1. No Action Necessary.
0x01000000	A2D_BRD_GENERAL_FAILURE: "The device has detected that the A/D board has failed"	1. Restart the Processor. 2. Send to Service Center

Modes

The transducer block supports two modes of operation as defined by the MODE_BLK Parameter:

Automatic (Auto)—The channel outputs reflect the analog input measurement.

Out of Service (O/S)—The block is not processed. Channel outputs are not updated and the status is set to Bad: Out of Service for each channel. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

Alarm Detection

Alarms are not generated by the transducer block. By correctly handling the status of the channel values, the down stream block (AI) will generate the necessary alarms for the measurement. The error that generated this alarm can be determined by looking at BLOCK_ERR and XD_ERROR.

Status Handling

Normally, the status of the output channels reflects the status of the measurement value, the operating condition of the measurement electronics card, and any active alarm condition.

In Auto mode, OUT reflects the value and status quality of the output channels.

Transmitter-Sensor Matching

Callendar-Van Dusen constants from a calibrated RTD schedule can be loaded into the Model 3244MV. A special curve is generated in the device that matches the specific sensor to the measured input of the RTD. This sensor matching enhances the accuracy of temperature sensor measurement. The Callendar-Van Dusen constants are input using the Sensor Type DD method. Selecting the User Defined sensor type will allow you to enter the constants. These can either be entered in the form of R_0, Alpha, Beta, Delta, or the form of R_0, A, B, C. See the section on page 8 for more details on selecting the sensor type.

Methods

Changing the Sensor Configuration

The following steps illustrate how change the sensor configuration using the sensor connection method:

1. Set TB.MODE_BLK.TARGET = OOS.
2. Set SENSOR_CONNECTION to appropriate value (2,3,4).
3. Set SENSOR_TYPE to appropriate value (TC-x, PT-xxx, mV, Ohms, Callandar-Van Dusen).
4. If a you are entering Callandar-Van Dusen sensor-matching constants, set alpha (α), delta (δ), beta (β), and R_0.
5. Set TB.MODE_BLK.TARGET = AUTO.
6. Put appropriate AI block in OOS by setting AIn.MODE_BLK.TARGET = OOS.
7. Verify AI.CHANNEL is set to correct channel number.
8. Set AIn.XD_SCALE.UNIT_INDX = appropriate value (K, °C, °F, mV, ohm).
9. Set AIn.MODE_BLK.TARGET = AUTO.

Sensor Calibration

The following steps illustrate how to calibrate the sensor suing the user calibration method:

1. Set MODE_BLK.TARGET = OOS.
2. Set SENSOR_CAL_METHOD(_2) = to be specified by user.
3. Set the input value of the sensor simulator to be within the range defined by CAL_PT_LO_LIMIT(_2) and CAL_PT_HI_LIMIT(_2).
4. Set CAL_POINT_LO(_2) to the value set at the sensor simulator.
5. Read TB_COMMAND_STATUS and wait until it reads Command Done.
6. Set SENSOR_CAL_METHOD(_2) = to be specified by user.
7. Set the input value of the sensor simulator to be within the range defined by CAL_PT_LO_LIMIT(_2) and CAL_PT_HI_LIMIT(_2).

NOTE:
The difference in values between the input used in steps 3 and 6 must be greater than CAL_MIN_SPAN(_2).

8. Set CAL_POINT_HI(_2) to the value set at the sensor simulator.
9. Read TB_COMMAND_STATUS and wait until it reads Command Done.
10. Set MODE_BLK.TARGET = AUTO.

TROUBLESHOOTING

Refer to Table 4-4 to troubleshoot any problems that you encounter.

TABLE 4-4. Troubleshooting

Symptom	Possible Causes	Corrective Action
Mode will not leave OOS	1. Target mode not set.	• Set target mode to something other than OOS.
	2. A/D board check sum error	• The A/D board has a checksum error. see “Diagnostics” on page -6
	3. Resource block	• The actual mode of the Resource block is OOS. See Resource Block Diagnostics for corrective action.
Primary, Secondary, Primary2, or Differential status is BAD	1. Measurement	• See “Diagnostics” on page -6

Section **5**

Resource Block

OVERVIEW

This section contains information about the Model 3244MV MultiVariable Temperature Transmitter Resource Block and its parameters, errors, and diagnostics. Modes, alarm detection, status handling, Virtual Communication Relationships (VCRs), and troubleshooting are also discussed.

DEFINITION

The resource block defines the physical resources of the device including type of measurement, memory, etc. The resource block also defines functionality, such as shed times, that is common across multiple blocks. The block has no linkable inputs or outputs and it performs memory-level diagnostics.

PARAMETERS AND DESCRIPTIONS

Table lists all of the configurable parameters of the Resource Block, including the descriptions and index numbers for each.

TABLE 5-1. Resource Block Parameters

Parameter	Index Number	Description
ACK_OPTION	38	Selection of whether alarms associated with the function block will be automatically acknowledged.
ALARM_SUM	37	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block. In the Model 3244MV, the two resource block alarms are write alarm and block alarm.
ALERT_KEY	04	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	36	The block alarm is used for all configuration, hardware, connection failure or system problems 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 parameter. 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.
BLOCK_ERR	06	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.
CONFIRM_TIME	33	The minimum time between retries of alert reports.
MESSAGE_DATE	52	Date associated with the MESSAGE_TEXT parameter.
SUMMARY_STATUS	51	An enumerated value of repair analysis.
CYCLE_SEL	20	Used to select the block execution method for this resource. The Model 3244MV supports the following: Scheduled: Blocks are only executed based on the schedule in FB_START_LIST. Block Execution: A block may be executed by linking to another blocks completion.
CYCLE_TYPE	19	Identifies the block execution methods available for this resource.
DD_RESOURCE	09	String identifying the tag of the resource which contains the Device Description for this resource.

Continued on Next Page

DD_REV	13	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource.
DEFINE_WRITE_LOCK	55	Enumerated value describing the implementation of the WRITE_LOCK.
DETAILED_STATUS	50	Additional status bit string.
DEV_REV	12	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
DEV_TYPE	11	Manufacturer's model number associated with the resource - used by interface devices to locate the DD file for the resource.
DISPLAY_MODE	63	Enables display of the measurement parameters.
DOWNLOAD_MODE	62	Gives access to the boot block code for over-the-wire downloads.
FEATURES	17	Used to shows supported resource block options.
FEATURES_SEL	18	Used to show selected resource block options. The Model 3244MV supports the following: Unicode: Tells host to use unicode for string values Reports: Enables alarms. Must be set for alarming to work Software Lock: Software write locking enabled but not active. WRITE_LOCK must be set to activate. Hardware Lock: Hardware write locking enabled but not active. WRITE_LOCK follows the status of the security switch
FINAL_ASSEMBLY_NUMBER	49	Final Assembly Number - Number that is used for identification purposes, and is associated with the overall Field Device.
FREE_TIME	25	Percent of the block processing time that is free to process additional blocks.
FREE_SPACE	24	Percent of memory available for further configuration. Zero in a preconfigured device.
GRANT_DENY	14	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HARD_TYPES	15	The types of hardware available as channel numbers. For the Model 3244MV, this is limited to Scalar (i.e. analog) inputs.
HARDWARE_REVISION	47	Hardware revision of the hardware that has the resource block in it.
LISCENSE_STRING	42	This will determine which of the downloaded function blocks are active.
LIM_NOTIFY	32	Maximum number of unconfirmed alert notify messages allowed.
MANUFAC_ID	10	Manufacturer identification number – used by an interface device to locate the DD file for the resource. 001151 for Rosemount.
MAX_NOTIFY	31	Maximum number of unconfirmed alert notify messages possible.
MEMORY_SIZE	22	Available configuration memory in the empty resource. To be checked before attempting a download.
MESSAGE_TEXT	53	Used to indicated changes made by the user to the device's installation, configuration, or calibration.
MIN_CYCLE_T	21	Time duration of the shortest cycle interval of which the resource is capable.
MODE_BLK	05	The actual, target, permitted, and normal modes of the block: Target: The mode to "go to" Actual: The mode the "block is currently in Permitted: Allowed modes that target may take on Normal: Most common mode for actual
NV_CYCLE_T	23	Interval between writing copies of NV parameters to non-volatile memory. Zero means never.
OUTPUT_BOARD_SN	48	Output board serial number.
SELF_TEST	54	Instructs resource block to perform self-test.
PRIVATE_LABEL_DISTRIBUTOR	41	Private Label Distributor - References the company that is responsible for the distribution of this Field Device to customers.

Continued on Next Page

RESTART	16	Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following: 1 Run – nominal state when not restarting 2 Restart resource – not used 3 Restart with defaults – set parameters to default values. See start_with_defaults below for which parameters are set. 4 Restart processor – does a warm start of CPU.
RS_STATE	07	State of the function block application state machine.
SAVE_CONFIG_BLOCKS	57	Number of EEPROM blocks that have been modified since last burn. This value will count down to zero when the configuration is saved.
SAVE_CONFIG_NOW	56	Controls saving of configuration in EEPROM.
SECURITY_JUMPER	60	Status of security jumper/switch.
SHED_RCAS	26	Time duration at which to give up on computer writes to function block RCas locations.
SHED_ROUT	27	Time duration at which to give up on computer writes to function block ROut locations.
SIMULATE_STATE	61	The state of the simulate function.
SIMULATE_JUMPER	59	Status of simulate jumper/switch.
SOFTWARE_REVISION_ALL	46	Software revision string containing the following fields: major revision, minor revision, build, time of build, day of week of build, month of build, day of month of build, year of build, initials of builder.
SOFTWARE_REVISION_BUILD	45	Build of software that the resource block was created with.
SOFTWARE_REVISION_REVISION	43	Major revision of software that the resource block was created with.
SOFTWARE_REVISION_MINOR	44	Minor revision of software that the resource block was created with.
START_WITH_DEFAULTS	58	Controls what defaults are used at power-up.
STRATEGY	03	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	The user description of the intended application of the block.
TEST_RW	08	A parameter for a host to use to test reading and writing. Not used by the device at all.
UPDATE_EVT	35	This alert is generated by any change to the static data.
WRITE_ALM	40	This alert is generated if the write lock parameter is cleared.
WRITE_LOCK	34	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated.
WRITE_PRI	39	Priority of the alarm generated by clearing the write lock.

Block Errors

Table 5-2 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the Resource block and are given here only for your reference.

TABLE 5-2. BLOCK_ERR Conditions

Condition Number	Condition Name and Description
0	*Other*
1	**Block Configuration Error:** A feature in FEATURES_SEL is set that is not supported by FEATURES or an execution cycle in CYCLE_SEL is set that is not supported by CYCLE_TYPE.
2	**Link Configuration Error:** A link used in one of the function blocks is improperly configured.
3	**Simulate Active:** This indicates that the simulation jumper is in place. This is not an indication that the I/O blocks are using simulated data.
4	*Local Override*
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	*Input failure/process variable has bad status*
8	*Output Failure: The output is bad based primarily upon a bad input.*
9	**Memory Failure:** A memory failure has occurred in FLASH, RAM, or EEROM memory.
10	**Lost Static Data:** Static data that is stored in non-volatile memory has been lost.
11	**Lost NV Data**: Non-volatile data that is stored in non-volatile memory has been lost.
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	**Power Up:** The device was just powered-up.
15	**Out of Service:** The actual mode is out of service.

Modes

The resource block supports two modes of operation as defined by the MODE_BLK parameter:

- **Automatic (Auto)** The block is processing its normal background memory checks.
- **Out of Service (O/S)** The block is not processing its tasks. When the resource block is in O/S, all blocks within the resource (device) are forced into O/S. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

Alarm Detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the resource block are defined above. A write alarm is generated whenever the WRITE_LOCK parameter is cleared. The priority of the write alarm is set in the following parameter:

- WRITE_PRI

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Status Handling

There are no status parameters associated with the resource block.

LCD Meter Display

The Model 3244MV has the ability to locally display all measurements in the Transducer Block including Sensor 1, Sensor 2, differential and terminal temperatures. The display alternates between the selected measurements. The meter can display up to five digits in engineering units (°F, °C, °R, K, Ω, and millivolts) and milliamperes (mA).

Display settings are preconfigured at the factory according to the transmitter configuration (standard or custom). The decimal point default configuration is a floating point value. These settings can be reconfigured in the field using a FOUNDATION fieldbus configuration tool. This is done by selecting from the following list of DISPLAY_MODE parameter values.

- T1 (Sensor 1 temperature)
- T2 (Sensor 2 temperature)
- Diff T (Differential Temperature)
- PRT (Terminal Temperature)
- 1 Decimal Place
- 2 Decimal Places
- 3 Decimal Places
- 4 Decimal Places

NOTE
When ordering a spare electronics module assembly, the DISPLAY_MODE parameter will not be configured and the LCD meter will display "Set up Display." Configure the DISPLAY_MODE parameter to remove this message from the display.

In addition to the configuration of the meter, sensor diagnostic data is displayed. If the status of the measurement is Good, the measured value is shown. If the status of the measurement is Uncertain, the status indicating uncertain is show in addition to the measured value.If the status of the measurement is BAd, the reason for the bad measurement is shown, primarily sensor failure, out of service.

TROUBLESHOOTING

Refer to Table 5-3 to troubleshoot any problems that you encounter.

TABLE 5-3. Troubleshooting

Symptom	Possible Causes	Corrective Action
Mode will not leave OOS	Target model not set	• Set target mode to something other than OOS.
	Memory Failure	• BLOCK_ERR will show the lost NV Data or Lost Static Data bit set. Restart the device by setting RESTART to Processor. If the block error does not clear, call the factory.
Block Alarms Will not work	Features	• FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	• LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	• STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.

Section 6

Maintenance

OVERVIEW

This section contains hardware diagnostics and maintenance information for the Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus.

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions could result in death or serious injury:

- Do not remove the transmitter cover in explosive atmospheres when the circuit is live.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠WARNING

Electrical shock could cause death or serious injury. If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, high voltage may be present on transmitter leads and terminals.

- Use extreme caution when making contact with the leads and terminals.

⚠WARNING

Process leaks could result in death or serious injury:

- Install and tighten thermowells or sensors before applying pressure, or process leakage may result.
- Do not remove the thermowell while in operation. Removing while in operation may cause process fluid leaks.

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

HARDWARE DIAGNOSTICS

If you suspect a malfunction despite the absence of diagnostic messages, follow the procedures described in Table 6-1 to verify that transmitter hardware and process connections are in good working order. Specific suggestions for solving problems are offered under each of the four major symptoms. Attend to the most likely and easiest-to-check conditions first.

TABLE 6-1. Troubleshooting

SYMPTOM	POTENTIAL SOURCE	CORRECTIVE ACTION
Transmitter does not Communicate with the Configuration Interface	Loop Wiring	• Check for adequate voltage to the transmitter. The transmitter requires between 9.0 and 32.0 V at the terminals to operate and provide complete functionality • Check for intermittent wire shorts, open circuits, and multiple grounds.
	Network parameters	• See page Table 7-2 on page 7-3
High Output	Sensor Input Failure or Connection	• Enter the transmitter test mode to isolate a sensor failure. • Check for a sensor open circuit. • Check the process variable to see if it is out of range.
	Loop Wiring	• Check for dirty or defective terminals, interconnecting pins, or receptacles.
	Electronics Module	• Enter the transmitter test mode to isolate a module failure. • Check the sensor limits to ensure calibration adjustments are within the sensor range.
Erratic Output	Loop Wiring	• Check for adequate voltage to the transmitter. The transmitter requires between 9.0 and 32.0 V at the terminals to operate and provide complete functionality • Check for intermittent wire shorts, open circuits, and multiple grounds.
	Electronics Module	• Enter the transmitter test mode to isolate module failure.
Low Output or No Output	Sensor Element	• Enter the transmitter test mode to isolate a sensor failure. • Check the process variable to see if it is out of range.
	Loop Wiring	• Check for adequate voltage to the transmitter. The transmitter requires between 9.0 and 32.0 V at the terminals to operate and provide complete functionality • Check for wire shorts and multiple grounds. • Check the loop impedance. • Check wire insulation to detect possible shorts to ground.
	Electronics Module	• Check the sensor limits to ensure calibration adjustments are within the sensor range. • Enter the transmitter test mode to isolate an electronics module failure.

HARDWARE MAINTENANCE

The Model 3244MV transmitter has no moving parts and requires a minimum amount of scheduled maintenance. The transmitter features a modular design for easy maintenance. If you suspect a malfunction, check for an external cause before performing the diagnostics presented below.

Sensor Checkout

If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

To determine whether the sensor is causing the malfunction, either replace it with another Rosemount sensor or connect a test sensor locally at the transmitter. This can be very useful, especially when checking the wiring for a remote mounted sensor. Please consult your local Rosemount representative for additional assistance with your temperature sensor and accessory needs.

Disassembling the Electronics Housing

The transmitter is designed with a dual-compartment housing; one compartment contains the FOUNDATION fieldbus electronics module assembly, and the other contains the sensor, power/communication, and internal ground lug terminals.

The transmitter's electronics module assembly is located in the compartment opposite the terminal block (see Figure 6-1 on page -3).

Removing the FOUNDATION Fieldbus Electronics Module Assembly

Use the following procedure to remove the FOUNDATION fieldbus electronics module assembly:

NOTE
Part of the electronics are sealed in a moisture-proof plastic enclosure referred to as the electronics module. The module is a non-repairable unit; if a malfunction occurs the entire unit must be replaced.

1. Disconnect the power to the transmitter.
2. Remove the cover from the electronics side of the transmitter housing (see Figure 6-1 on page 6-3). Do not remove any covers in explosive atmospheres when the circuit is live.
3. Loosen the two screws that anchor the electronics module assembly to the transmitter housing.
4. Firmly grasp the screws and assembly and pull it straight out of the housing, taking care not to damage the interconnecting pins.

NOTE
Take note of the transmitter's security switch position (ON or OFF). If you are replacing the electronics module with a new one, make sure the security switch is set in the same position.

Transmitter Security Switch

The transmitter security switch is located on the front of the electronics module assembly, as shown in Figure 6-2 on page 6-4. See "Security" on page 2-5 for more information.

Figure 6-1. Transmitter Exploded View

Transmitter Exploded View

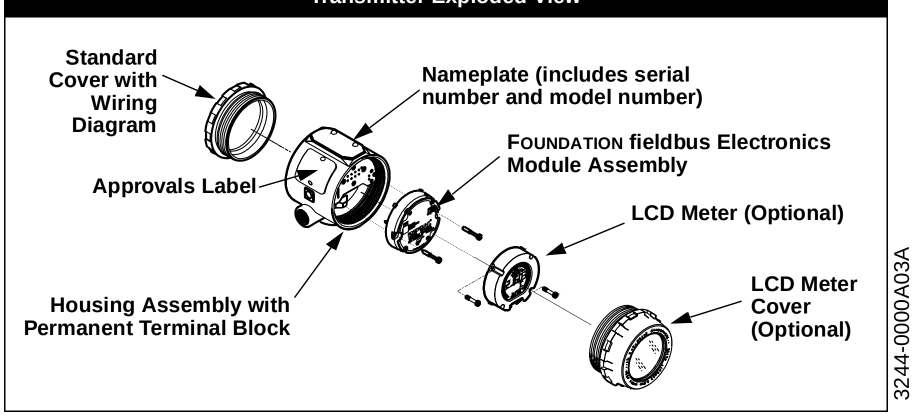
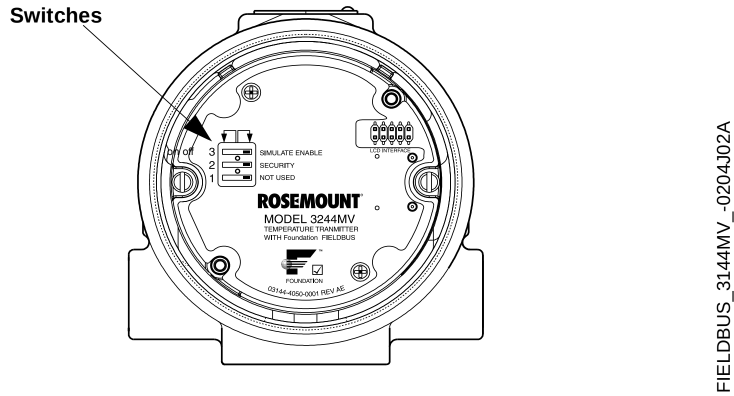


Figure 6-2. Electronics Module



Assembling the Electronics Housing

Replacing the FOUNDATION Fieldbus Electronics Module Assembly

Use the following procedure to reassemble the FOUNDATION fieldbus electronics module assembly.

1. Ensure that the transmitter security switch on the electronics module assembly is in the same position as the one that is being replaced.
2. Carefully insert the electronics module assembly into the interconnecting pins with the necessary receptacles on the electronics board attached to the housing.
3. Tighten the two mounting screws.
4. Replace the cover. Tighten the cover 1/6 of a revolution after the cover begins to compress the o-ring. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Section **7**

Specifications and Reference Data

OVERVIEW

This section contains specification and reference data for the Model 3244MV MultiVariable Temperature Transmitter.

FUNCTIONAL SPECIFICATIONS

Inputs

User-selectable. See Table 7-3 on page 7-7.
(sensor terminals are rated to 42.4 V dc.)

Outputs

Manchester-encoded digital signal that conforms to IEC 1158-2 and ISA 50.02.

Isolation

Input/output isolation tested to 500 V rms (707 V dc).

Power Supply

External power supply required. Transmitter operates between 9.0 and 32.0 V dc, 17.5 mA maximum. (Transmitter power terminals are rated to 42.4 V dc).

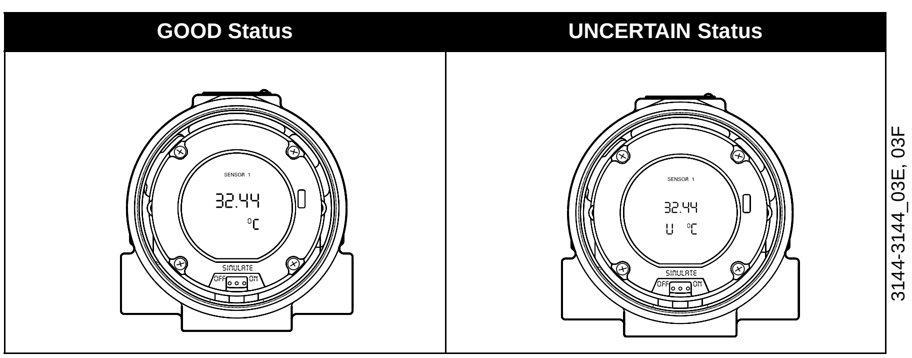
Local Display

Optional five-digit LCD meter includes display options for engineering units (°F, °C, °R, K, Ω, and millivolts) and milliamperes. The display can alternate between selected measurements, including Sensor 1, Sensor 2, differential, and terminal temperatures. Digits are 0.4 inches (8 mm) high.

Display settings are preconfigured at the factory according to the transmitter configuration. The display settings can be reconfigured in the field using a FOUNDATION fieldbus configuration tool.

Figure 7-1 illustrates the temperature display when status is GOOD and when it is UNCERTAIN.

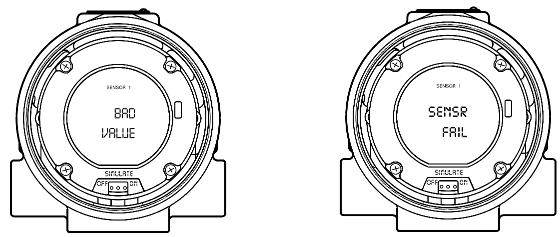
Figure 7-1. LCD - Measurement with GOOD and UNCERTAIN Status



If the measurement status goes BAD, the LCD toggles between the screens illustrated in Figure 7-2, which shows the BAD status and substatus diagnostic.

Figure 7-2. LCD - BAD Status and Substatus Diagnostic

BAD Status and Substatus Diagnostic



Temperature Limits

	Ambient Limit	Storage Limit
Without LCD Meter	–40 to 185 °F (–40 to 85 °C)	–60 to 250 °F (–50 to 120 °C)
With LCD Meter	–4 to 185 °F (–20 to 85 °C)	–50 to 185 °F (–45 to 85 °C)

Alarms

The AI block allows the user to configure the alarm to HI-HI, HI, LO, or LO-LO, with a variety of priority levels and hysteresis

Status

If self-diagnostics detect a sensor burnout or a transmitter failure, the status of the measurement will be updated accordingly. Status may also send the PID output to a safe value.

Humidity Limits

0–100% relative humidity.

Turn-on Time

Performance within specifications is achieved less than 30.0 seconds after power is applied to the transmitter.

Update Time

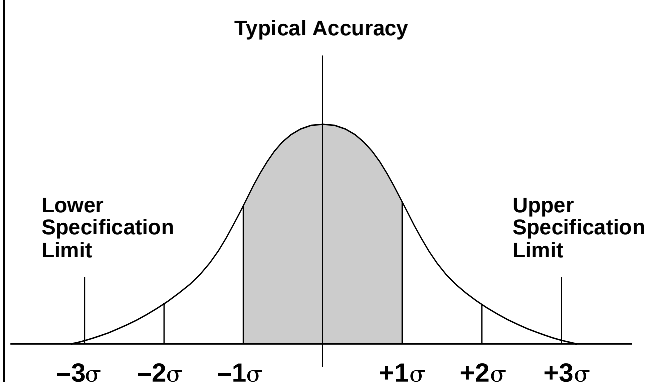
Approximately 0.5 seconds for a single sensor (1.0 second for two sensors).

Rosemount Conformance to SpecificationS

You can be confident that a Rosemount product not only meets its published specifications, but most likely exceeds them. Our advanced manufacturing techniques and use of Statistical Process Control provide specification conformance to at least ± 3σ(1). In addition, our commitment to continual improvement ensures that product design, reliability, and performance get better every year.

For example, the Reference Accuracy distribution for the Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus is shown to the right.(2) Our Specification Limits are ± 0.10 °C, but, as the shaded area shows, approximately 68% of the units perform three times better than the limits. Therefore, it is very likely that you will receive a device that performs much better than our published specifications.

Conversely, a vendor who “grades” product without using Process Control, or who is not committed to ± 3σ performance, will ship a much higher percentage of units that are barely within (or even outside of) advertised specification limits.



(1) Sigma (σ) is the Standard Deviation of a statistical distribution, and describes the dispersion (spread) of the distribution.
(2) Accuracy distribution shown is for Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus, Pt 100 RTD sensor, range 0 to 100 °C.

FOUNDATION Fieldbus Specifications

Schedule Entries

Ten (10)

Links

Twenty (20)

Virtual Communications Relationships (VCRs)

Twelve (12)

TABLE 7-1. Function Block Information

Block	Base Index	Execution Time (milliseconds)
Resource (RB)	300	–
CrCCsOucer (CB)	400	–
CCC6C CCCuC (CCC)	1000	50
CCC6C CCCuC (CCC)	1100	50
CCC6C CCCuC (CCC)	1200	50
CCCuCeGcOr (CCCC)	11400	30
CroCorCGCCCCC GCCrCCCerCCCCe C (CCCC)	10000	100
CroCorCGCCCCC GCCrCCCerCCCCe C (CCCC)	11000	100
CrCCC eCC (CRCCC)	11800	100
CCCCCCCOrCcGr (CCCR)	11500	100

TABLE 7-2. Link Active Scheduler Information

Parameter	Value
Slot Time (ST)	8
Maximum Response Delay (MRD)	3
Maximum Inactivity to Claim LAS Delay (MICD)	90
Minimum Inter DLPDU Delay (MID)	12
Time Sync Class (TSC)	4
Max Scheduling Overhead (MSO)	21
Per DLPDU Physical Layer Overhead (PhLO)	4
Link Active Scheduler size = 320 bytes	

Hazardous Locations Certifications

Factory Mutual (FM) Approvals

E5 Explosion-proof for Class I, Division 1, Groups A, B, C, and D. Dust-Ignition Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition Proof for Class III, Division 1 hazardous locations. Non-Incendive for Class I, Division 2, Groups A, B, C, and D (T4). Indoor and outdoor use. Ambient Temperature Limit: –50 to 85 °C. Explosion-proof approval only when connected in accordance with Rosemount drawing 03144-0220. For Group A, seal all conduits within 18 inches of enclosure; otherwise, conduit seal not required for compliance with NEC 501-5a(1).

I5 Intrinsically Safe for Class I, II, and III, Division 1, Groups A, B, C, D, E, F, and G. Non-Incendive Field Circuit for Class I, II, III; Division 2, Groups A, B, C, D, F, and G. Ambient Temperature Limit: –60 to 60 °C. Intrinsically safe and Non-Incendive field circuit approval only when installed in accordance with Rosemount drawing 03144-0221.

K5 Combination of E5 and I5.

Canadian Standards Association (CSA) Approvals

E6 Explosion-proof for Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 hazardous locations. Class I, Division 2, Groups A, B, C, and D. Factory sealed. Ambient Temperature Limit: –50 to 85 °C.

I6 Intrinsically Safe for Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 hazardous locations when installed in accordance with Rosemount drawing 03144-0222. Ambient Temperature Limit: –60 to 60 °C.

C6 Combination of E6 and I6.

FM and CSA Combinations of Approvals

KB Combination of K5 and C6.

Institut Scientifique de Service Public (ISSeP)/CENELEC Flameproof Approval

E9 EEx d IIC T6 (T_{amb} = –20 to 60 °C).

Certification Number 95D.103.1211.

British Approvals Service for Electrical Equipment in Flammable Atmospheres (BASEEFA) / CENELEC Approvals

N1 CENELEC Type n
EEx nL IIC T5 (T_{amb} = –40 to 70 °C)
Cert No. BAS98ATEX 3358 X

Special Conditions for Safe Use (x):

A transmitter fitted with the transient protection terminal block is not capable of withstanding the electrical strength test required by Clause 9.1 of EN 50021: 1998. This condition must be taken into account during installation.

I1 CENELEC Intrinsic Safety,
EEx ia IIC T4 (T_{amb} = –60 to 60 °C)
Cert. No. BAS98ATEX 1357 X

Input Entity Parameters:
Power/Communications
$U_{max:in}$ = 30 V dc
$I_{max:in}$ = 300 mA
$P_{max:in}$ = 1.3 W
C_{eq} = 0.005 μF
L_{eq} = 20 μH

Special Conditions for Safe Use (x):

A transmitter fitted with the transient protection terminal block is not capable of withstanding the insulation test required by EN50 020, Clause 5.7 (1977). This condition must be taken into account during installation.

NOTE
Additional Approvals Pending.

PERFORMANCE SPECIFICATIONS

The transmitter maintains a specification conformance of at least 3σ

Accuracy

Refer to Table 7-3 on page 7-7.

Stability

±0.1% of reading or 0.1 °C (0.18 °F), whichever is greater, for 2 years for RTDs.

±0.1% of reading or 0.1 °C (0.18 °F), whichever is greater, for 1 year for thermocouples.

Five-Year Stability

± 0.15% of reading or 0.15 °C (0.27 °F), whichever is greater, for 5 years for RTDs.

±0.5% of reading or 0.5 °C (0.9 °F), whichever is greater for 5 years for thermocouples.

RFI Effect

Worst case RFI Effect is equivalent to the transmitter's nominal accuracy specification per Table 7-3 when tested in accordance with EN 61000-4-3, 10 V/m, 80 to 1000 MHz, and 30 V/m, 26-500 MHz (Increased NAMUR), with twisted shielded cables (Type A FOUNDATION fieldbus type).

Vibration Effect

Transmitters tested to the following specifications with no effect on performance:

Frequency	Acceleration
10–60 Hz	0.21 mm peak displacement
60–2000 Hz	3 g

Self Calibration

The analog-to-digital circuitry automatically self-calibrates for each temperature update. The circuitry compares the dynamic measurement to the extremely stable and accurate internal reference elements.

Ambient Temperature Effect

Refer to Table 7-4, Table 7-5, and Table 7-6 on page 7-8.

The Model 3244MV can be installed in locations where the ambient temperature is between –40 and 85 °C (–40 and 185 °F). At the factory each transmitter is individually characterized over this ambient temperature range to maintain excellent accuracy performance in dynamic industrial environments. This special manufacturing technique is accomplished through extreme hot and cold temperature profiling with individual adjustment factors programmed into each transmitter. The transmitter automatically adjusts to encompass component drift caused by changing environmental conditions.

PHYSICAL SPECIFICATIONS

Conduit Connections

½–14 NPT, PG13.5 (PG11), M20 x 1.5 (CM20), or JIS G ½ conduit.

Materials of Construction

Electronics Housing

Low-copper aluminum or CF-8M (cast version of 316 Stainless Steel).

Paint

Polyurethane.

Cover o-rings

Buna-N.

Mounting

Transmitters may be attached directly to the sensor or optional mounting brackets permit remote mounting (see Figure 7-4 on page -10).

Weight

Aluminum: 3.2 lb (1.4 kg).
Stainless Steel: 7.9 lb (3.6 kg).

Add 0.3 lb (0.1 kg) for LCD Meter options.

Add 0.7 lb (0.3 kg) for B4 bracket option.

Add 1.5 lb (0.7 kg) for B5 bracket options.

Enclosure Ratings

NEMA 4X and CSA Enclosure Type 4X, IP66, and IP68.

REFERENCE DATA

TABLE 7-3. Input Options/Accuracy

Sensor Options	Sensor Reference	Input Ranges °C	Input Ranges °F	Accuracy Over Range(s) °C	Accuracy Over Range(s) °F
2-, 3-, 4-Wire RTDs					
Pt 100 (α = 0.00385)	IEC 751; α = 0.00385, 1995	–200 to 850	–328 to 1562	± 0.10	± 0.18
Pt 100 (α = 0.003916)	JIS 1604, 1981	–200 to 645	–328 to 1193	± 0.10	± 0.18
Pt 200	IEC 751; α = 0.00385, 1995	–200 to 850	–328 to 1562	± 0.22	± 0.40
Pt 500	IEC 751; α = 0.00385, 1995	–200 to 850	–328 to 1562	± 0.14	± 0.25
Pt 1000	IEC 751; α = 0.00385, 1995	–200 to 300	–328 to 572	± 0.08	± 0.14
Ni 120	Edison Curve No. 7	–70 to 300	–94 to 572	± 0.08	± 0.14
Cu 10	Edison Copper Winding No. 15	–50 to 250	–58 to 482	± 1.00	± 1.80
Thermocouples—Cold Junction Adds + 0.25 °C to Listed Accuracy					
NIST Type B (Accuracy varies according to input range)	NIST Monograph 175	100 to 300 301 to 1820	212 to 572 573 to 3308	± 3.0 ± 0.75	± 5.4 ± 1.35
NIST Type E	NIST Monograph 175	–50 to 1000	–58 to 1832	± 0.20	± 0.36
NIST Type J	NIST Monograph 175	–180 to 760	–292 to 1400	± 0.25	± 0.45
NIST Type K	NIST Monograph 175	–180 to 1372	–292 to 2502	± 0.50	± 0.90
NIST Type N	NIST Monograph 175	0 to 1300	32 to 2372	± 0.40	± 0.72
NIST Type R	NIST Monograph 175	0 to 1768	32 to 3214	± 0.60	± 1.08
NIST Type S	NIST Monograph 175	0 to 1768	32 to 3214	± 0.50	± 0.90
NIST Type T	NIST Monograph 175	–200 to 400	–328 to 752	± 0.25	± 0.45
Millivolt Input—Not approved for use with CSA option code I6		–10 to 100 mV		± 0.015 mV	
2-, 3-, 4-Wire Ohm Input		0 to 2000 ohms		±0.35 ohm	

Accuracy Notes

Differential capability exists between any two sensor types:

- For all differential configurations, the input range is X to +Y where

  X = Sensor 1 minimum – Sensor 2 maximum
  Y = Sensor 1 maximum – Sensor 2 minimum

Accuracy for differential configurations:

- If sensor types are similar (for example, both RTDs or both thermocouples), the accuracy = 1.5 times worst case accuracy of either sensor type.
- If sensor types are dissimilar (for example, one RTD and one thermocouple), the accuracy = Sensor 1 accuracy + Sensor 2 accuracy.

Using Thermocouples in noncritical and differential temperature applications:

- Two independently-grounded thermocouples could create ground loops, resulting in measurement errors. Avoid using two independently grounded thermocouples.

TABLE 7-4. Ambient Temperature Effects on RTDs

Sensor Type	Accuracy per 1.0 °C (1.8 °F) Change in Ambient Temperature(1)(1)
Pt 100 (α = 0.00385), Pt 100 (α = 0.003916), Pt 500	0.0015 °C (0.0027 °F)
Pt 200	0.0023 °C (0.0041 °F)
Ni 120, Pt 1000	0.0010 °C (0.0018 °F)
Cu 10	0.015 °C (0.027 °F)

TABLE 7-5. Ambient Temperature Effects on Thermocouples (R = the value of the reading)

NIST Type	Accuracy per 1.0 °C (1.8 °F) Change in Ambient Temperature(1)(1)	Temperature Range (°C)
B	0.014	R ≥ 1000
	0.029 °C – (0.0021% of (R – 300))	300 ≤ R < 1000
	0.046 °C – (0.0086 % of (R –100))	100 ≤ R < 300
E	0.004 °C + (0.00043 % of R)	All
J	0.004 °C + (0.00029 % of R)	R ≥ 0
	0.004 °C + (0.0020% of R)	R < 0
K	0.005 °C + (0.00054 % of R)	R ≥ 0
	0.005 °C + (0.0020% of R)	R < 0
N	0.005 °C + (0.00036 % of R)	All
R, S	0.015 °C	R ≥ 200
	0.021 °C – (0.0032 % of R)	R < 200
T	0.005 °C	R ≥ 0
	0.005 °C + (0.0036% of R)	R < 0

TABLE 7-6. Ambient Temperature Effects on Millivolt or Ohm Input

Input Type	Accuracy per 1.0 °C (1.8 °F) Change in Ambient Temperature(1)(1)
Millivolt	0.00025 mV
2-, 3-, and 4-wire Ohm	0.007 Ω

Temperature Effects Example (see Tables 7-4, 7-5, and 7-6)

- When using a Pt 100 (α = 0.00385) sensor input with a 30° C ambient temperature, temperature effects would be 0.0015 °C × (30 – 20) = 0.015 °C.
- Worst case error would be Sensor Accuracy + Temperature Effects = 0.10 °C + 0.015 = 0.115 °C
- Total Probable Error = $\sqrt{0.10^2 + 0.015^2} = 0.101\ ^\circ C$

(1) Change in ambient is in reference to the calibration temperature of the transmitter (20 °C (68 °F) typical from factory).

TRANSMITTER DIMENSIONAL DRAWINGS

Figure 7-3. Transmitter Exploded View.

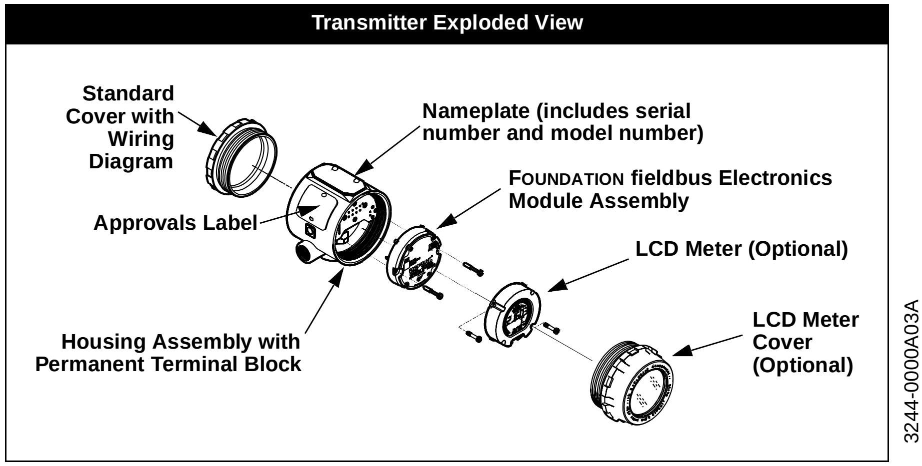
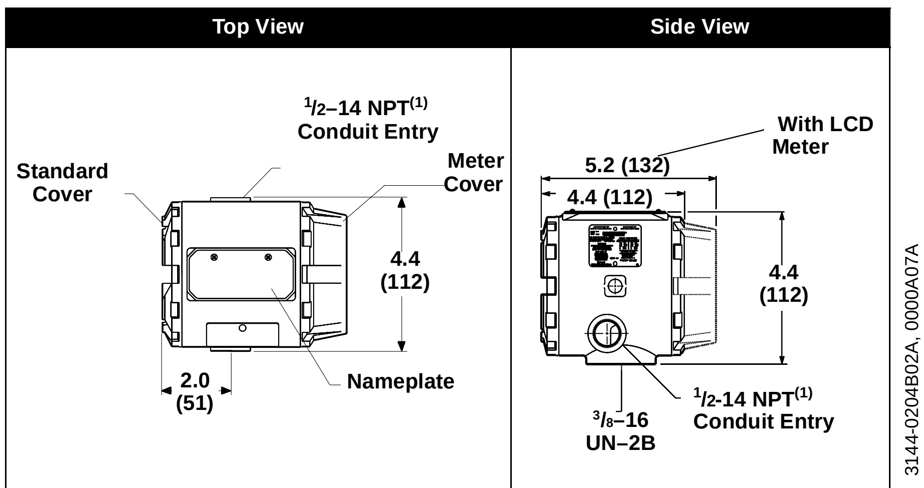


TABLE 7-7. Transmitter Dimensional Drawings



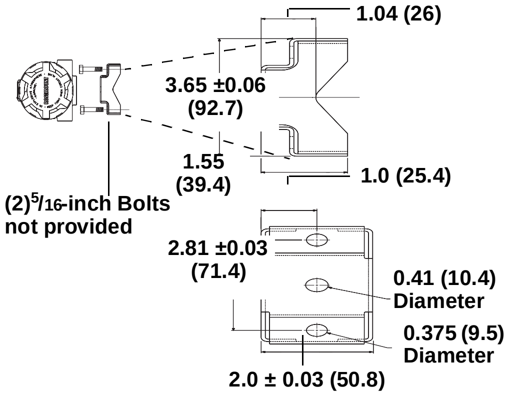
Note: Dimensions are in inches (millimeters)

1) M20 x 1.5 (CM20), PG 13.5 (PG 11), and JIS G1/2 threads made with adapter that extends approximately one inch from housing.

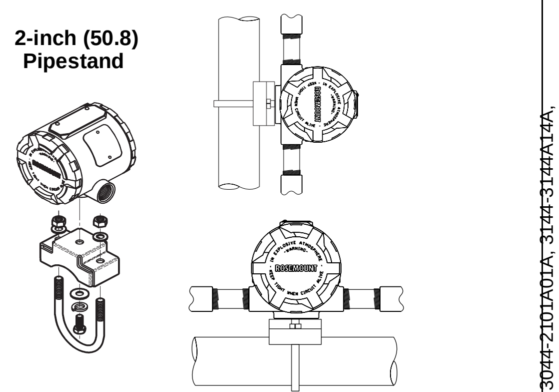
Figure 7-4. Optional Transmitter Mounting Brackets

Option Code B4 Mounting Bracket

Panel Mount

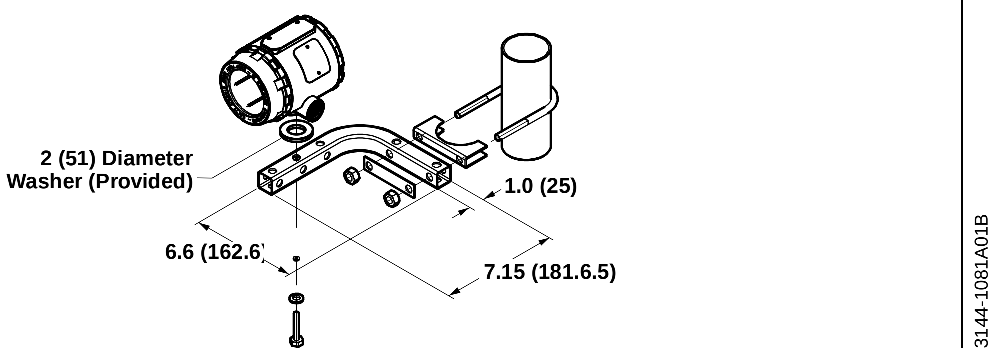


Pipe Mount



Note: Dimensions are in inches (millimeters)

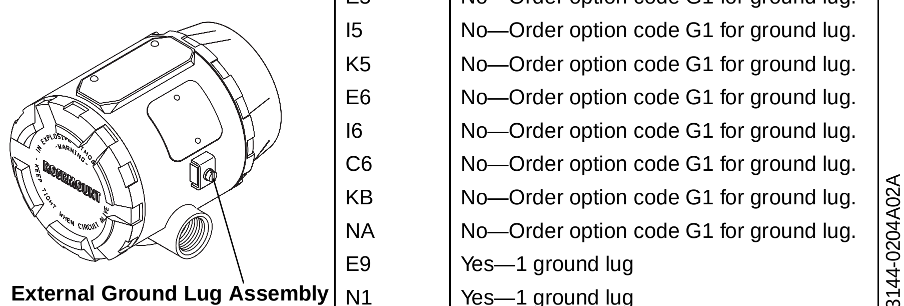
Option Code B5 Bracket



Note: Dimensions are in inches (millimeters)

Figure 7-5. Option Code G1 External Ground Lug Assembly

Use the following chart to determine if the ground lug is included with an option code:



Approval Type	Ground Lug Included?
E5	No—Order option code G1 for ground lug.
I5	No—Order option code G1 for ground lug.
K5	No—Order option code G1 for ground lug.
E6	No—Order option code G1 for ground lug.
I6	No—Order option code G1 for ground lug.
C6	No—Order option code G1 for ground lug.
KB	No—Order option code G1 for ground lug.
NA	No—Order option code G1 for ground lug.
E9	Yes—1 ground lug
N1	Yes—1 ground lug
I1	Yes—1 ground lug

ORDERING INFORMATION

Model	Product Description	
3244MVF	Temperature Transmitter with Dual Sensor Input and FOUNDATION™ fieldbus Digital Signal Includes 3 Analog Input function blocks, 1 Input Selector function block, and Backup Link Active Scheduler.	
Code	**Housing**	**Conduit Thread**
1	Aluminum	½–14 NPT
2	Aluminum	M20 × 1.5 (CM20)
7	SST	PG 13.5 (PG 11)
8	SST	JIS G ½
Code	**Hazardous Locations Certifications**	
E5	FM Explosion-Proof and Non-Incendive Approval	
I5	FM Intrinsic Safety and Non-Incendive Field Circuit Approval	
K5	FM Intrinsic Safety, Explosion-Proof, and Non-Incendive Approval Combination	
E6	CSA Explosion-Proof and Non-Incendive Approval	
I6	CSA Intrinsic Safety and Non-Incendive Field Circuit Approval	
C6	CSA Intrinsic Safety, Explosion-Proof, and Non-Incendive Approval Combination Field Circuit Approval	
KB	FM and CSA Intrinsic Safety, Explosion-Proof, and Non-Incendive Approval Combination	
E9	ISSeP/CENELEC Flameproof Approval	
N1	BASEEFA Type N Approval	
I1	BASEFFA/CENELEC Intrinsic Safety Approval	
NA	No Approval Required	
Note: Additional approvals pending - Please Contact Rosemount® Customer Central for more information		
Code	**Options**	
	PlantWeb® Software Functionality	
A01	Basic Control: Two (2) Proportional / Integral / Derivative (PID) Function Blocks	
B01	Regulatory Control Suite: preconfigured with the Following Function Blocks: 2 PIDs, 1 Signal Characterizer, and 1 Arithmetic	
	Accessory Options	
B4	Universal Mounting Bracket for 2-inch Pipe Mounting and for panel Mounting–Stainless Steel Bracket and Bolts	
B5	Universal "L" Mounting Bracket for 2-inch Pipe Mounting–Stainless Steel Bracket and bolts	
M5	LCD Meter	
G1	External Ground Lug Assembly	
T1	Integral Transient Protector	
	Custom Configuration Options	
U1	Hot Backup™	
U4	Two Independent Sensors	
U5	Differential Temperature	
U6	Average Temperature	
U7	First Good Temperature	
U8	Minimum Temperature	
U9	Maximum Temperature	
Note: Option codes U1, J6, U7, U8 and U9 will have drift alert enabled on Analog Input function blocks #3 (AI3)		
C1	Factory configuration of date, descriptor, and message fields (complete CDS 00806-0100-4769 required with order)	
C2	Trim to specific Rosemount RTD Calibrated Schedule (Transmitter-Sensor Matching)	
C4	5-point calibration (use option Q4 to generate a calibration certificate)	
C7	Trim to specific non-standard sensor (special sensor - customer must provide sensor information)	
F5	50 Hz line voltage filter	
	Assembly Options	
X1	Assemble transmitter to a sensor assembly (hand tight, Teflon® (PTFE) tape where appropriate, fully wired)	
X2	Assemble transmitter to a sensor assembly (hand tight, no Teflon tape, unwired)	
X3	Assemble transmitter to a sensor assembly (hand tight, Teflon tape where appropriate, fully wired)	
Note: Option codes X1 and X3 are not available with CSA approvals		
	Calibration Certification Options	
Q4	Calibration Certificate (3-Point standard; use C4 with Q4 option for a 5-Point Calibration Certificate)	
Typical Model Number: 3244MVF 1 K5 A01 B4 M5 U1		

TRANSMITTER CONFIGURATION

The transmitter is shipped from the factory with either the standard configuration or one of the custom configuration options when specified in the model number.

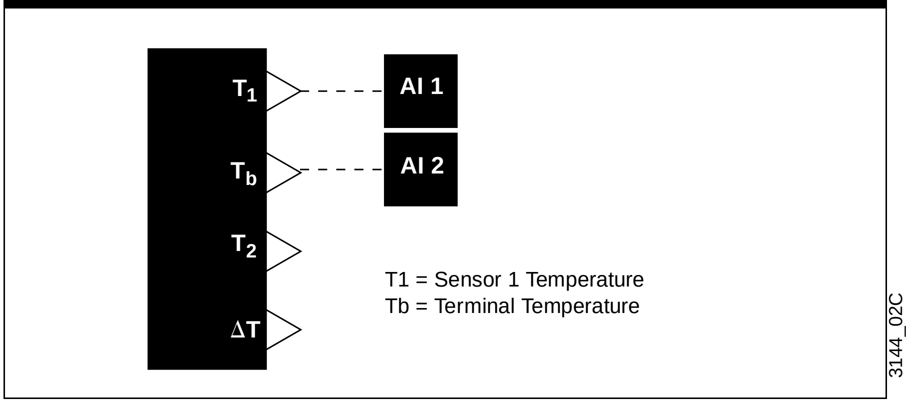
The configuration settings and block configuration may be changed in the field with the Fisher-Rosemount DeltaV® with AMS*inside*® or other FOUNDATION fieldbus host or configuration tool.

Standard Configuration

Unless otherwise specified, your transmitter will be shipped as follows:

Standard Configuration Settings	
Sensor Type:	4-wire Pt 100 α = 0.00385 RTD
Damping:	2.0 seconds
Units of Measurement:	Degrees Celsius (°C)
Line Voltage Filter:	60 Hz
Software Tag:	See "Tagging" on page 2-9
Function Block Tags:	
Analog Input Blocks	AI1, AI2
Input Selector Block	(Not Applicable)
Transducer Block	TB
Resource Block	RB
Alarm Range:	0 to 100 °C (32 to 212 °F)
Alarm Limits of AI1 and AI2:	
HI-HI	100 °C (212 °F)
HI	95 °C (203 °F)
LO	5 °C (41 °F)
LO-LO	0 °C (32 °F)
Local Display (when installed):	Engineering Units

Standard Block Configuration



SPARE PARTS LIST

Part Description	Part Number
FOUNDATION fieldbus Electronics Module Assembly	03144-4220-0003
LCD Meter – (includes meter display, captive mounting hardware, and 10-pin interconnection header)	03144-3020-1002
Aluminum Meter Cover Kit (includes o-ring)	03144-1043-0001
Stainless Steel Meter Cover Kit (includes o-ring)	03144-1043-0011
LCD Meter with Meter Cover Kit - Aluminum (includes meter display, captive mounting hardware, 10-pin interconnection, header, and cover kit)	03144-3020-1001
LCD Meter with Meter Cover Kit - Stainless Steel (includes meter display, captive mounting hardware, 10-pin interconnection, header, and cover kit)	03144-3020-1011
B4 Mounting Bracket Kit	03044-2131-0001
B5 Mounting Bracket Kit	03144-1081-0001
Aluminum Standard Cover (includes o-ring and wiring diagram label)	03144-4223-0001
Stainless Steel Standard Cover (includes o-ring and wiring diagram label)	03144-4223-0011
O-ring for Cover (package of 12)	01151-0033-0003
Aluminum Housing Kit (does not include covers)	03144-4224-0001
Aluminum Housing Kit with External Ground Lug Assembly (does not include covers)	03144-4224-0002
Stainless Steel Housing Kit (does not include covers)	03144-4224-0011
Stainless Steel Housing Kit with External Ground Lug Assembly (does not include covers)	03144-4224-0012
Screw/Washer Combination for Sensor/Power Terminals (package of 12)	03144-1044-0001
External Ground Lug Assembly (package of 12)	03144-1047-0001

Section 8

Hazardous Area Approval Installation Drawings

OVERVIEW

This section contains the Factory Mutual Explosion-proof Installation Drawing. You must follow the installation guidelines presented by this drawing in order to maintain certified ratings for installed transmitters.

This section contains the following drawing:

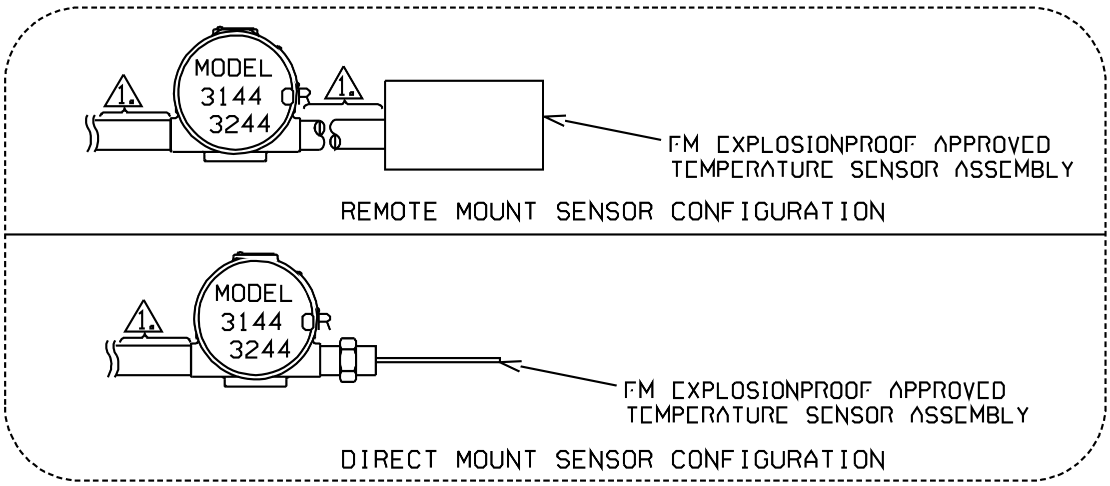
Rosemount Drawing 03144-0220, 1 Sheet:
Factory Mutual Explosion-Proof Installation Drawing.

Figure 8-1. Factory Mutual
Explosion-Proof Installation Drawing
03144-0220, Rev. D.

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
D	CHG 544 TO 3244, NOTE 1.	665976	J.D.J.	4/19/95

HAZARDOUS (CLASSIFIED) LOCATION



5. MODEL 3144 AND MODEL 3244 FM APPROVAL CLASSIFICATION:
EXPLOSION PROOF FOR CLASS I, DIV. 1, GROUPS A, B, C, & D
DUST-IGNITION PROOF FOR CLASS II/III, DIV. 1, GROUPS E, F, & G;
NONINCENDIVE FOR CLASS I, DIV. 2, GROUPS A, B, C, & D (T4A).
NEMA ENCLOSURE TYPE 4X
AMBIENT TEMP. LIMITS: -50°C TO +85°C.

4. FOR FIELD WIRING CONNECTIONS IN AMBIENT TEMPERATURES ABOVE 60°, USE WIRING RATED FOR AT LEAST 90°C.

3. TEMPERATURE SENSOR ASSEMBLY MUST BE FM APPROVED FOR APPROPRIATE AREA CLASSIFICATION.

2. ALL CONDUIT THREADS MUST BE ASSEMBLED WITH A MINIMUM OF FIVE FULL THREADS ENGAGEMENT.

1. (△) INSTALL PER NATIONAL ELECTRICAL CODE (NEC). FOR GROUP A, SEAL ALL CONDUITS WITHIN 18 INCHES OF ENCLOSURE; OTHERWISE, CONDUIT SEAL NOT REQUIRED FOR COMPLIANCE WITH NEC 501-5a(1).

NOTES:

CAD Maintained, (MICROSTATION)

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125	CONTRACT NO.		ROSEMOUNT® MEASUREMENT / FISHER-ROSEMOUNT / ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA
-TOLERANCE- .X ± .1 [2.5] .XX ± .02 [0.5] .XXX ± .010 [0.25] FRACTIONS ± 1/32 ANGLES ± 2°	DR. C. SCRIBNER	8/1/94	TITLE INSTALLATION DRAWING: MODEL 3144 & 3244, FACTORY MUTUAL (FM) EXPLOSIONPROOF
	CHK'D		
	APP'D. J. D. JOHNSON	9/9/94	
			SIZE A / FSCM NO / DWG NO. 03144-0220
DO NOT SCALE PRINT	APP'D. GOVT.		SCALE N/A / WT. ——— / SHEET 1 OF 1

Section **9**

Options

OVERVIEW

This section contains descriptions of the options available with the Model 3244MV MultiVariable Temperature Transmitter with FOUNDATION fieldbus. These options enhance operation and facilitate various installation configurations.

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions could result in death or serious injury:

- Do not remove the transmitter cover in explosive atmospheres when the circuit is live.
- Before connecting a FOUNDATION fieldbus host or configuration tool in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

OPTION DESCRIPTIONS

Basic Control (option code A01)

Option code A01 gives you additional PlantWeb software functionality with the ability to perform basic control functions in the transmitter. By ordering this option you will receive two PID function blocks that provide a sophisticated implementation of the universal PID algorithm. These two PID blocks allow the transmitter to perform cascade or feedforward control applications.

Regulatory Control Suite (option code B01)

Option code B01 provides you with the ultimate PlantWeb® software functionality, the ability to perform Regulatory Control functions in the transmitter. By ordering this option you will receive two PID function blocks, one Signal Characterizer function block, and one Arithmetic function block. These blocks allow you to use the transmitter in a number of advanced control applications.

Mounting Brackets (option codes B4 and B5)

The transmitter can be mounted directly to the sensor or in a remote location using one of the two stainless steel mounting bracket options available (see Figure 7-4 on page 7-10). These brackets and their stainless steel bolts facilitate mounting to a panel or a 2-inch pipe. When installing the transmitter with a bracket, torque the bolts to 125 in-lb (14 n-m).

LCD Meter (Option Code M5)

Option code M5 specifies that the LCD Meter be assembled to the transmitter. With this option you will have local indication of the temperature measurement and diagnostics including sensor failure and measurement status.

External Ground Lug Assembly (option code G1)

The external ground-lug assembly provides an auxiliary grounding point for the transmitter housing. The lug attaches to either side of the housing. See Figure 7-5 on page 7-10 to determine if the ground lug is included with an option code.

Transient Protection (option code T1)

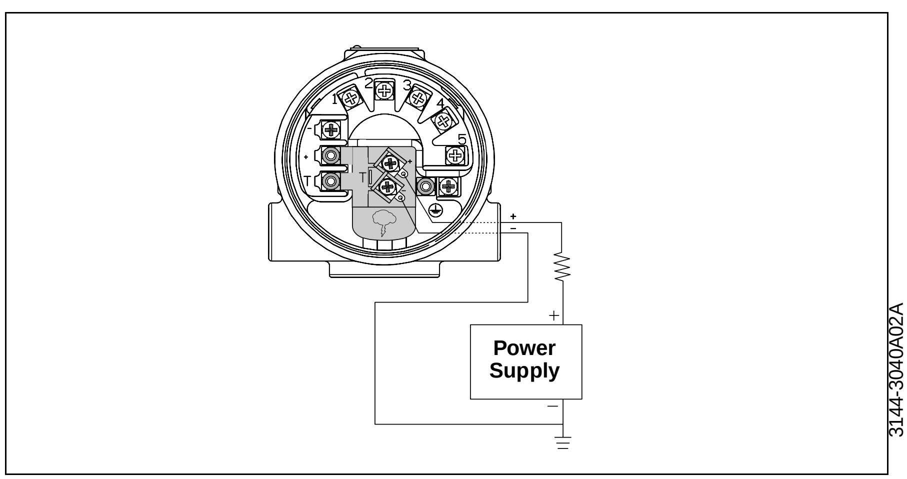
The transient protector helps to prevent damage to the transmitter from transients induced on the loop wiring by lightening, welding, heavy electrical equipment, or switch gears. The transient protection electronics are contained in an add-on assembly that attaches to the standard transmitter terminal block. The transient protector has been tested according to the following standard:

- ANSI.IEEE C62,41-1991 (IEEE 587), Location Categories A2, B3,.
- 1 kV peak (10 3 1000 mS Wave)
- 6 kV / 3 kA peak (1.2 3 50 mS Wave 8 3 20 mS Combination Wave)
- 6 kV / 0.5 kA peak (100 kHz Ring Wave)
- 4 kV peak EFT (5 3 50 nS Electrical Fast Transient)

Loop resistance added by protector:	22 ohms maximum
Nominal clamping voltages:	90 V (common mode
Nominal clamping voltages:	77 V (normal mode)

NOTE
With the transient protector installed, the connection becomes polarity sensitive. The lift off voltage for a device using a transient protector is 10 V.

Figure 9-1.
Transmitter Terminal Block with Transient Protector Installed



Hot Backup (option code U1)

This configuration optimizes the transmitter for use in applications involving control, safety interlocks, or any type of critical monitoring points. A dual-element sensor should be used with this option. AI3 is used to detect sensor drift.

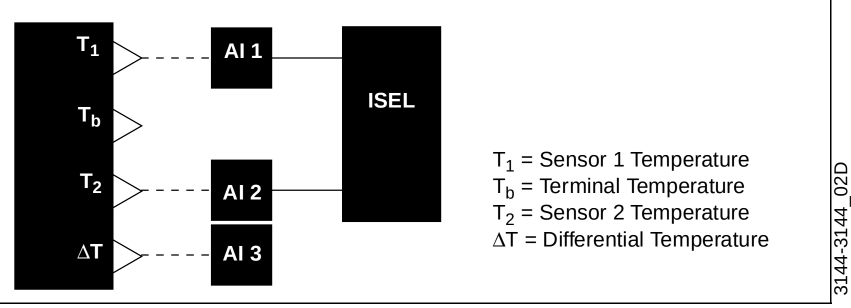
When this option is ordered, the transmitter is shipped with the standard configuration settings, including the following changes / additions.

TABLE 9-1.
Option Code U1. Custom Configuration Settings

Option Code U1 Custom Configuration Settings	
Sensor Type	
Sensor 1 (primary element)	3-wire Pt 100 α = 0.00385 RTD
Sensor 2 (secondary element)	3-wire Pt 100 α = 0.00385 RTD
Function Block Tags	
Analog Input Blocks	AI1, AI2, AI3
Input Selector Block	ISEL
Transducer Block	TB
Resource Block	RB
Input Selector Function Block Configuration	Hot Backup
Alarm Range	
Sensor 1	32 to 212 °F (0 to 100 °C)
Sensor 2	32 to 212 °F (0 to 100 °C)
Sensor Drift Alert Configuration (AI3 ΔT Limit)	5.4 °F (3.0 °C)

Figure 9-2.
Option Code U1, Custom Block Configuration

Option Code U1 Custom Block Configuration



Two Independent Sensors (option code U4)

This configuration optimizes the transmitter for use in non-critical applications involving basic process monitoring. Two single-element sensors are used with this option.

When this option is ordered, the transmitter is shipped with the standard configuration settings, including the following changes / additions.

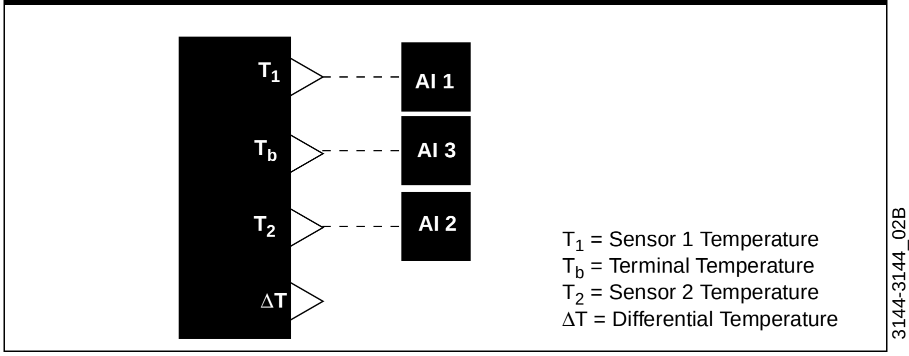
TABLE 9-2.
Option Code U4, Custom Configuration Settings

Option Code U4 Custom Configuration Settings	
Sensor Type	
Sensor 1	3-wire Pt 100 α = 0.00385 RTD
Sensor 2	3-wire Pt 100 α = 0.00385 RTD
Function Block Tags	
Analog Input Blocks	AI1, AI2, AI3
Input Selector Block	Not Applicable

Transducer Block	TB
Resource Block	RB
Alarm Range	
Sensor 1	32 to 212 °F (0 to 100 °C)
Sensor 2	32 to 212 °F (0 to 100 °C)

Figure 9-3.
Option Code U4, Custom Block Configuration

Option Code U4
Custom Block Configuration



Differential Temperature (option code U5)

This configuration is used to measure the differential between two process temperatures.

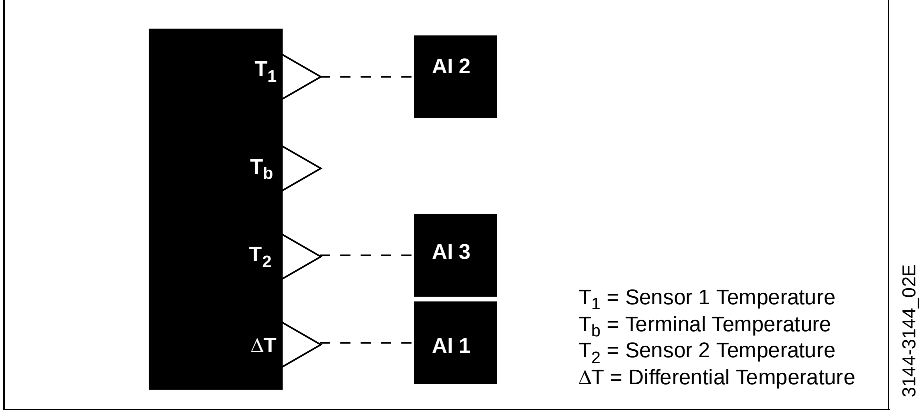
When this option is was ordered, the transmitter is shipped with the standard configuration settings, including the following changes / additions.

TABLE 9-3.
Option Code U5, Custom Configuration Settings

Option Code U5 Custom Configuration Settings	
Sensor Type	
Sensor 1	3-wire Pt 100 α = 0.00385 RTD
Sensor 2	3-wire Pt 100 α = 0.00385 RTD
Function Block Tags	
Analog Input Blocks	AI1, AI2, AI3
Input Selector Block	Not Applicable
Transducer Block	TB
Resource Block	RB
Alarm Range	
Sensor 1	32 to 212 °F (0 to 100 °C)
Sensor 2	32 to 212 °F (0 to 100 °C)

Figure 9-4.
Option Code U5, Custom Block Configuration

Option Code U5 Custom Block Configuration



Average Temperature (option code U6)

This configuration is used to measure the average between two process temperatures. AI3 is used to detect sensor drift.

First Good Temperature (option code U7)

This configuration is used to output the first sensor measurement with a status of "GOOD." AI3 is used to detect sensor drift.

Minimum Temperature (option code U8)

This configuration is used to output the minimum temperature between two sensors. AI3 is used to detect sensor drift.

Maximum Temperature (option code U9)

This configuration is used to output the maximum temperature between two sensors. AI3 is used to detect sensor drift.

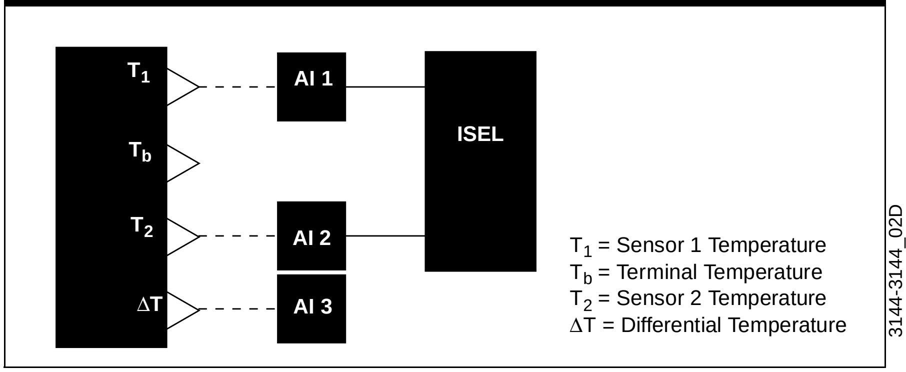
When options U6, U7, U8, and U9 are ordered, the transmitter is shipped with the standard configuration settings, including the following changes / additions:

TABLE 9-4.
Option Codes U6, U7, U8 and U9, Custom Configuration Settings

Option Code U6, U7, U8, and U9 Custom Configuration Settings	
Sensor Type	
Sensor 1	3-wire Pt 100 α = 0.00385 RTD
Sensor 2	3-wire Pt 100 α = 0.00385 RTD
Function Block Tags	
Analog Input Blocks	AI1, AI2, AI3
Input Selector Block	ISEL
Transducer Block	TB
Resource Block	RB
Input Selector Function Block Configuration	
Option code U6	Average
Option code U7	First Good
Option code U8	Minimum
Option code U9	Maximum
Sensor Drift Alert Configuration: (AI3 ΔT Limit)	5.4 °F (3.0 °C)
Alarm Range	
Sensor 1	32 to 212 °F (0 to 100 °C)
Sensor 2	32 to 212 °F (0 to 100 °C)

Figure 9-5. Option Codes U6, U7, U8, U9, Custom Block Configuration

Option Code U6, U7, U8, and U9 Custom Block Configuration



Custom Transmitter Configuration (option code C1)

Option code C1 allows you to specify the following data in addition to the standard configuration parameters.

Date:	day, month, year
Descriptor:	□□ a□han□mer□□ □hara□ter□
Message:	□□ a□han□mer□□ □hara□ter□

Trim to Specific Rosemount RTD Calibration Schedule (Transmitter-Sensor Matching) (option code C2)

Option code C2 allows you to order the transmitter trimmed to a specific calibration schedule. This option requires that you order a Rosemount Series 65, 68, or 78 RTD sensor with a special calibration schedule. For additional information on ordering sensors calibrated to specific calibration schedules, refer to the Rosemount Sensors and Accessories for Temperature Transmitter Assemblies Product Data Sheets Volume 1 (document number 00813-0100-2654) or Volume 2 (document number 00813-0101-2654).

Five Point Calibration (option code C4)

Option code C4 specifies that the transmitter be calibrated and verified at five-points: 0, 25, 50, 75, and 100% digital output points.

Trim to Special non-Standard Sensor (option code C7)

You may order option code C7 when connecting a non-standard sensor, adding a special sensor, or expanding input ranges on a standard sensor. Refer to Table 7-3 on page 7-7 for a list of standard sensor types.

A characterization schedule for any RTD can be entered using Callandar-Van Dusen constants with a FOUNDATION fieldbus configuration tool. The constants can be entered on site or at the factory. For information on ordering sensors matched to the transmitter using Callandar-Van Dusen constants, refer to the Rosemount Sensors and Accessories for Temperature Transmitter Assemblies Product Data Sheet Volume 1 (document number 00813-0100-2654) or Volume 2 (document number 00813-0101-2654).

When a non-standard sensor is used as the input to the transmitter, the resistance versus temperature curve for a non-standard RTD) or the millivolt versus temperature curve (for a non-standard thermocouple) is stored in the transmitter memory. This process is performed at the factory because the transmitter must be configured for a “special” sensor calibration to access the special curve. Otherwise, any standard input can be used when the transmitter is configured for a “standard” sensor.

50 Hz Line Voltage Filter (option code F5)

Option code F5 specifies that the transmitter be calibrated to a 50 Hz line voltage filter instead of the standard 60 Hz. Option code F5 is recommended for transmitters in Europe and other areas where 50 Hz ac power is standard.

Assembly Options (option codes X1, X2, and X3)

Option code X1, X2, or X3 specifies that the transmitter be assembled to a sensor. The same option code must be included on the Rosemount sensor model number.

TABLE 9-5.
Assembly Description for Code X1, X2, and X3

Code	Description
X1[1]	[illegible] *Teflon* [illegible]
X)	[illegible] *Teflon* [illegible]
X)[1]	[illegible] *Teflon* [illegible]

(1) X1 and X3 are not available with CSA Approvals Option (Code C6 and I6).

Calibration Certificate (option code Q4)

Option code Q4 specifies that a calibration certificate be shipped with the transmitter. If a Five-Point Calibration (option code C4) is also ordered, calibration data for five points will be included on the calibration certificate. If option code C4 is not ordered, only three points (0, 50, and 100% analog and digital output points) will be on the certificate.

Appendix A

FOUNDATION™ Fieldbus Technology

OVERVIEW

This section introduces fieldbus systems that are common to all fieldbus devices.

INTRODUCTION

A fieldbus system is a distributed system composed of field devices and control and monitoring equipment integrated into the physical environment of a plant or factory. Fieldbus devices work together to provide I/O and control for automated processes and operations. The Fieldbus Foundation provides a framework for describing these systems as a collection of physical devices interconnected by a fieldbus network. One of the ways that the physical devices are used is to perform their portion of the total system operation by implementing one or more function blocks.

Function Blocks

Function blocks within the fieldbus device perform the various functions required for process control. Because each system is different, the mix and configuration of functions are different. Therefore, the Fieldbus FOUNDATION has designed a range of function blocks, each addressing a different need.

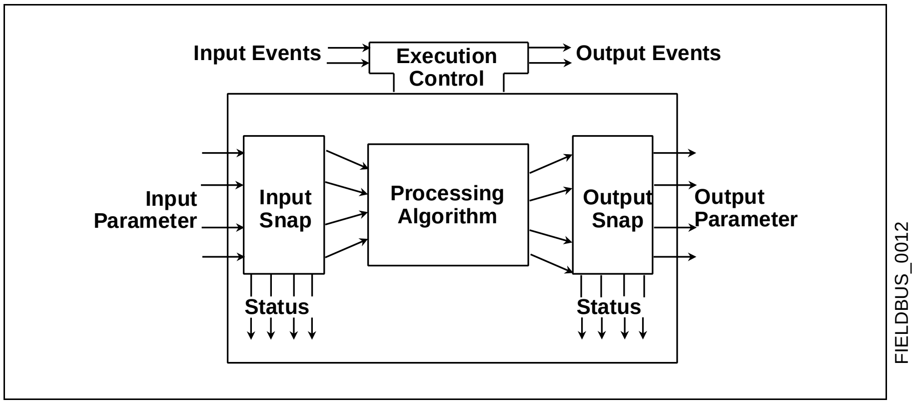
Function blocks perform process control functions, such as analog input (AI) and analog output (AO) functions as well as proportional-integral-derivative (PID) functions. The standard function blocks provide a common structure for defining function block inputs, outputs, control parameters, events, alarms, and modes, and combining them into a process that can be implemented within a single device or over the fieldbus network. This simplifies the identification of characteristics that are common to function blocks.

The Fieldbus FOUNDATION has established the function blocks by defining a small set of parameters used in all function blocks called universal parameters. The FOUNDATION has also defined a standard set of function block classes, such as input, output, control, and calculation blocks. Each of these classes also has a small set of parameters established for it. They have also published definitions for transducer blocks commonly used with standard function blocks. Examples include temperature, pressure, level, and flow transducer blocks.

The FOUNDATION specifications and definitions allow vendors to add their own parameters by importing and subclassing specified classes. This approach permits extending function block definitions as new requirements are discovered and as technology advances.

Figure A-1 illustrates the internal structure of a function block. When execution begins, input parameter values from other blocks are snapped-in by the block. The input snap process ensures that these values do not change during the block execution. New values received for these parameters do not affect the snapped values and will not be used by the function block during the current execution.

Figure A-1. Function Block Internal Structure



Once the inputs are snapped, the algorithm operates on them, generating outputs as it progresses. Algorithm executions are controlled through the setting of contained parameters. Contained parameters are internal to function blocks and do not appear as normal input and output parameters. However, they may be accessed and modified remotely, as specified by the function block.

Input events may affect the operation of the algorithm. An execution control function regulates the receipt of input events and the generation of output events during execution of the algorithm. Upon completion of the algorithm, the data internal to the block is saved for use in the next execution, and the output data is snapped, releasing it for use by other function blocks.

A block is a tagged logical processing unit. The tag is the name of the block. System management services locate a block by its tag. Thus the service personnel need only know the tag of the block to access or change the appropriate block parameters.

Function blocks are also capable of performing short-term data collection and storage for reviewing their behavior.

Device Descriptions

Device Descriptions are specified tool definitions that are associated with the function blocks. Device descriptions provide for the definition and description of the function blocks and their parameters.

To promote consistency of definition and understanding, descriptive information, such as data type and length, is maintained in the device description. Device Descriptions are written using an open language called the Device Description Language (DDL). Parameter transfers between function blocks can be easily verified because all parameters are described using the same language. Once written, the device description can be stored on an external medium, such as a CD-ROM or diskette. Users can then read the device description from the external medium. The use of an open language in the device description permits interoperability of function blocks within devices from various vendors. Additionally, human interface devices, such as operator consoles and computers, do not have to be programmed specifically for each type of device on the bus. Instead their displays and interactions with devices are driven from the device descriptions.

Device descriptions may also include a set of processing routines called methods. Methods provide a procedure for accessing and manipulating parameters within a device.

BLOCK OPERATION

In addition to function blocks, fieldbus devices contain two other block types to support the function blocks. These are the resource block and the transducer block. The resource block contains the hardware specific characteristics associated with a device. Transducer blocks couple the function blocks to local input/output functions.

Instrument- Specific Function Blocks

Resource Blocks

Resource blocks contain the hardware specific characteristics associated with a device; they have no input or output parameters. The algorithm within a resource block monitors and controls the general operation of the physical device hardware. The execution of this algorithm is dependent on the characteristics of the physical device, as defined by the manufacturer. As a result of this activity, the algorithm may cause the generation of events. There is only one resource block defined for a device. For example, when the mode of a resource block is "out of service," it impacts all of the other blocks.

Transducer Blocks

Transducer blocks connect function blocks to local input/output functions. They read sensor hardware and write to effector (actuator) hardware. This permits the transducer block to execute as frequently as necessary to obtain good data from sensors and ensure proper writes to the actuator without burdening the function blocks that use the data. The transducer block also isolates the function block from the vendor specific characteristics of the physical I/O.

Alerts

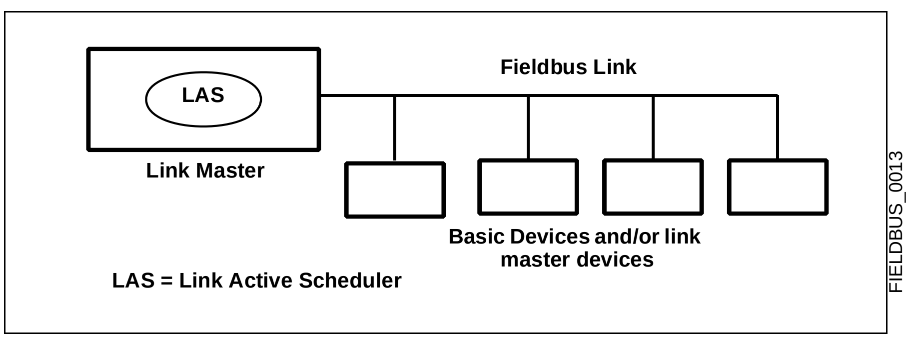
When an alert occurs, execution control sends an event notification and waits a specified period of time for an acknowledgment to be received. This occurs even if the condition that caused the alert no longer exists. If the acknowledgment is not received within the pre-specified time-out period, the event notification is retransmitted. This assures that alert messages are not lost.

Two types of alerts are defined for the block, events and alarms. Events are used to report a status change when a block leaves a particular state, such as when a parameter crosses a threshold. Alarms not only report a status change when a block leaves a particular state, but also report when it returns back to that state.

NETWORK COMMUNICATION

Figure A-2 illustrates a simple fieldbus network consisting of a single segment (link).

Figure A-2. Simple, Single-Link Fieldbus Network



Link Active Scheduler (LAS)

All links have one and only one Link Active Scheduler (LAS). The LAS operates as the bus arbiter for the link. The LAS does the following:

- recognizes and adds new devices to the link.
- removes non-responsive devices from the link.
- distributes Data Link (DL) and Link Scheduling (LS) time on the link. Data Link Time is a network-wide time periodically distributed by the LAS to synchronize all device clocks on the bus. Link Scheduling time is a link-specific time represented as an offset from Data Link Time. It is used to indicate when the LAS on each link begins and repeats its schedule. It is used by system management to synchronize function block execution with the data transfers scheduled by the LAS.
- polls devices for process loop data at scheduled transmission times.
- distributes a priority-driven token to devices between scheduled transmissions.

Any device on the link may become the LAS, as long as it is capable. The devices that are capable of becoming the LAS are called link master devices. All other devices are referred to as basic devices. When a segment first starts up, or upon failure of the existing LAS, the link master devices on the segment bid to become the LAS. The link master that wins the bid begins operating as the LAS immediately upon completion of the bidding process. Link masters that do not become the LAS act as basic devices. However, the link masters can act as LAS backups by monitoring the link for failure of the LAS and then bidding to become the LAS when a LAS failure is detected.

Only one device can communicate at a time. Permission to communicate on the bus is controlled by a centralized token passed between devices by the LAS. Only the device with the token can communicate. The LAS maintains a list of all devices that need access to the bus. This list is called the “Live List.”

Two types of tokens are used by the LAS. A time-critical token, compel data (CD), is sent by the LAS according to a schedule. A non-time critical token, pass token (PT), is sent by the LAS to each device in ascending numerical order according to address.

There may be many Link Master (LM) devices on a segment but only the LAS is actively controlling communication traffic. The remaining LM devices on the segment are in a stand-by state, ready to take over if the primary LAS fails. A secondary LM device becomes the primary LAS if it recognizes that the primary LAS device fails. This is achieved by constantly monitoring the communication traffic on the bus and determining if activity is not present. Since there can be multiple LM devices on the segment when the primary LAS fails, the device with the lowest node address (described below) will become the primary LAS and take control of the bus. Using this strategy, multiple LAS failures can be handled with no loss of the LAS capability of the communications bus.

Device Addressing

Fieldbus uses addresses between 0 and 255. Addresses 0 through 15 are reserved for group addressing and for use by the data link layer. For all Fisher-Rosemount fieldbus devices addresses 20 through 35 are available to the device. If there are two or more devices with the same address, the first device to start will use its programmed address. Each of the other devices will be given one of four temporary addresses between 248 and 251. If a temporary address is not available, the device will be unavailable until a temporary address becomes available.

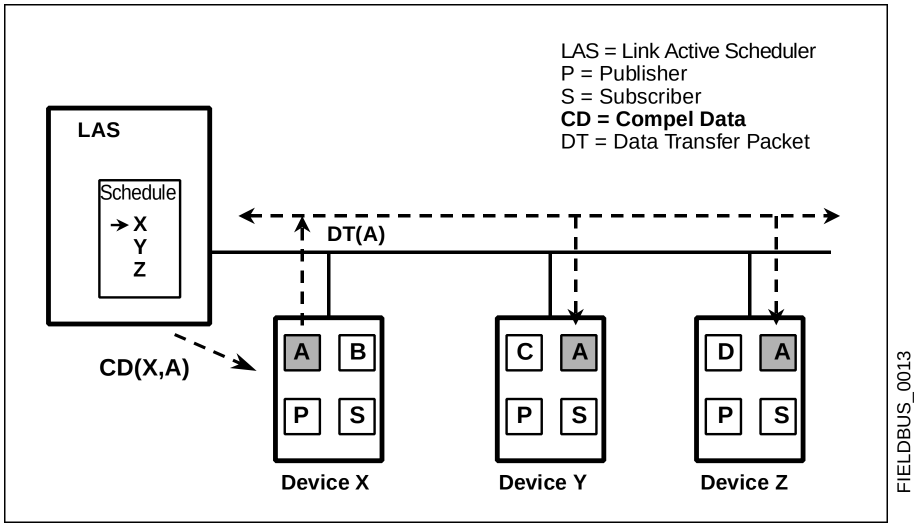
Scheduled Transfers

Information is transferred between devices over the fieldbus using three different types of reporting.

- **Publisher/Subscriber:** This type of reporting is used to transfer critical process loop data, such as the process variable. The data producers (publishers) post the data in a buffer that is transmitted to the subscriber (S), when the publisher receives the Compel data. The buffer contains only one copy of the data. New data completely overwrites previous data. Updates to published data are transferred simultaneously to all subscribers in a single broadcast. Transfers of this type can be scheduled on a precisely periodic basis.
- **Report Distribution:** This type of reporting is used to broadcast and multicast event and trend reports. The destination address may be predefined so that all reports are sent to the same address, or it may be provided separately with each report. Transfers of this type are queued. They are delivered to the receivers in the order transmitted, although there may be gaps due to corrupted transfers. These transfers are unscheduled and occur in between scheduled transfers at a given priority.
- **Client/Server:** This type of reporting is used for request/response exchanges between pairs of devices. Like Report Distribution reporting, the transfers are queued, unscheduled, and prioritized. Queued means the messages are sent and received in the order submitted for transmission, according to their priority, without overwriting previous messages. However, unlike Report Distribution, these transfers are flow controlled and employ a retransmission procedure to recover from corrupted transfers.

Figure A-3 diagrams the method of scheduled data transfer. Scheduled data transfers are typically used for the regular cyclic transfer of process loop data between devices on the fieldbus. Scheduled transfers use publisher/subscriber type of reporting for data transfer. The Link Active Scheduler maintains a list of transmit times for all publishers in all devices that need to be cyclically transmitted. When it is time for a device to publish data, the LAS issues a Compel Data (CD) message to the device. Upon receipt of the CD, the device broadcasts or "publishes" the data to all devices on the fieldbus. Any device that is configured to receive the data is called a "subscriber."

Figure A-3. Scheduled Data Transfer

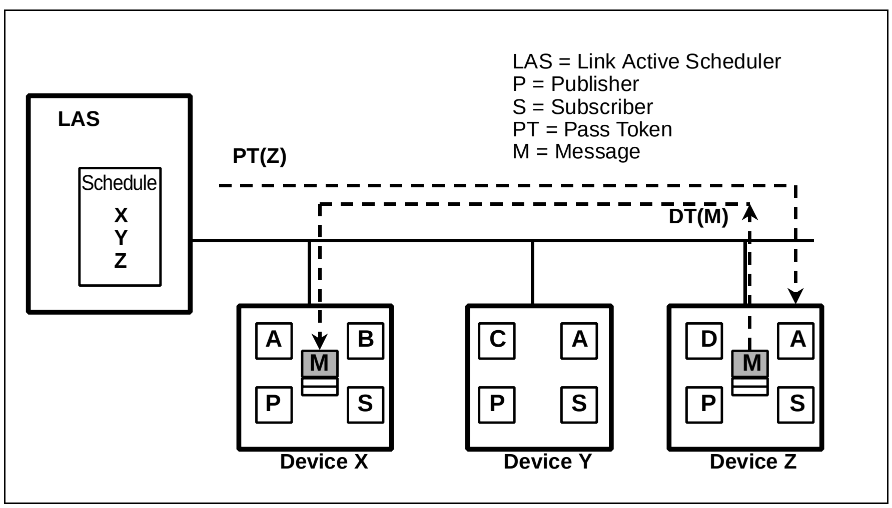


Unscheduled Transfers

Figure A-4 diagrams an unscheduled transfer. Unscheduled transfers are used for things like user-initiated changes, including set point changes, mode changes, tuning changes, and upload/download. Unscheduled transfers use either report distribution or client/server type of reporting for transferring data.

All of the devices on the fieldbus are given a chance to send unscheduled messages between transmissions of scheduled data. The LAS grants permission to a device to use the fieldbus by issuing a pass token (PT) message to the device. When the device receives the PT, it is allowed to send messages until it has finished or until the “maximum token hold time” has expired, whichever is the shorter time. The message may be sent to a single destination or to multiple destinations.

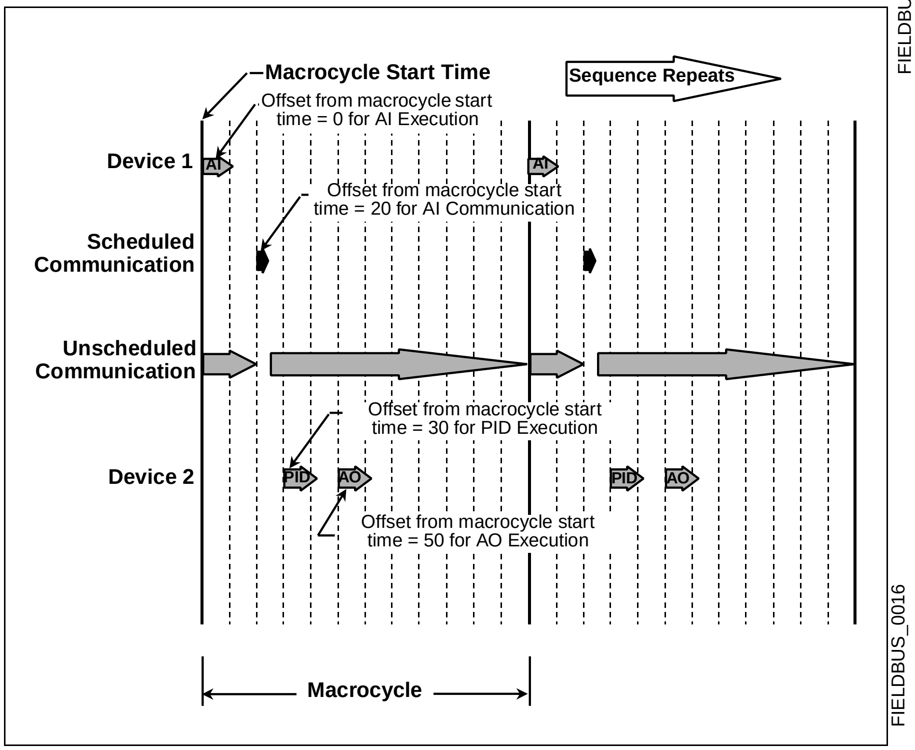
Figure A-4. Unscheduled Data Transfer



Function Block Scheduling

Figure A-5 shows an example of a link schedule. A single iteration of the link-wide schedule is called the macrocycle. When the system is configured and the function blocks are linked, a master link-wide schedule is created for the LAS. Each device maintains its portion of the link-wide schedule, known as the Function Block Schedule. The Function Block Schedule indicates when the function blocks for the device are to be executed. The scheduled execution time for each function block is represented as an offset from the beginning of the macrocycle start time.

Figure A-5. Example Link Schedule Showing Scheduled and Unscheduled Communication



To support synchronization of schedules, periodically Link Scheduling (LS) time is distributed. The beginning of the macrocycle represents a common starting time for all Function Block schedules on a link and for the LAS link-wide schedule. This permits function block executions and their corresponding data transfers to be synchronized in time.

LAS Parameters

There are many bus communication parameters but only a few are used. For standard RS-232 communications, the configuration parameters are baud rate, start / stop bits, and parity. The key parameters for H1 Fieldbus are Slot Time (ST), Minimum Inter-PDU Delay (MID), Maximum Response (MRD), and Time Synchronization Class (TSC).

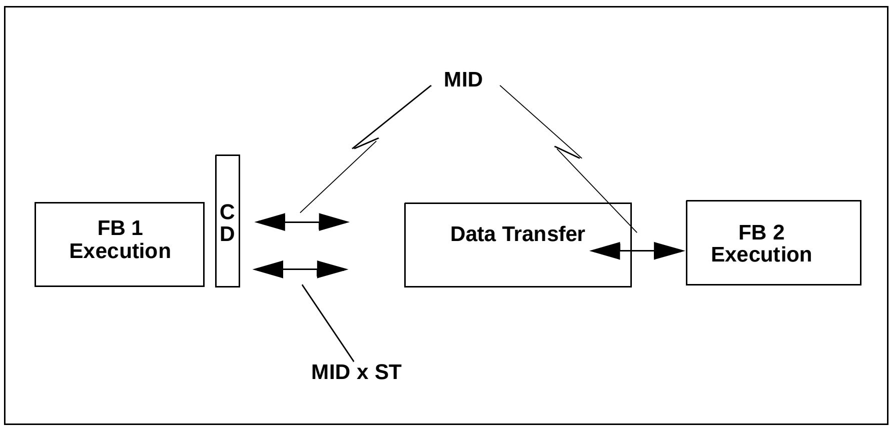
ST is used during the bus master election process. It is the maximum amount of time permitted for device A to send a Fieldbus message to device B. Slot time is a parameter which defines a worst case delay which includes internal delay in the sending device and the receiving device. Increasing the value of ST slows down bus traffic because a LAS device must wait longer prior to determining that the LM is down.

MID is the minimum gap between two messages on the Field bus segment or it is the amount of time between the last byte of one message and the first byte of the next message. The units of the MID are octets. An octet is 256 µs, hence the units for MID are approximately ¼ ms. This would mean an MID of 16 would specify approximately a minimum of 4 ms between messages on the Fieldbus. Increasing the value of MID slows down bus traffic because a larger "gap" between messages occurs.

MRD defines the maximum amount of time permitted to respond to an immediate response request, e.g. CD, PT. When a published value is requested using the CD command, the MRD defines how long before the device publishes the data. Increasing this parameter will slow down the bus traffic by slowing down how fast CDs can be put onto the network. The MRD is measured in units of ST.

TSC is a variable that defines how long the device can estimate its time before drifting out of specific limits. The LM will periodically send out a time update messages to synchronize devices on the segment. Decreasing the parameter number increases the amount of time that a messages must be published, increasing bus traffic and overhead for the LM device. See Figure A-6.

Figure A-6. LAS Parameter diagram



Back-up Las

A Link Master (LM) device is one that has the ability to control the communications on the bus. The Link Active scheduler (LAS) is the LM capable device that is currently in control of the bus. While there can be many LM devices acting as back-ups, there can only be one LAS. The LAS is typically a host system but for stand-alone applications, a device may be providing the role of primary LAS.

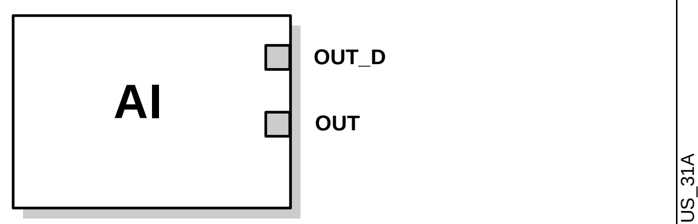
TROUBLESHOOTING

TABLE A-1. Troubleshooting

Symptom	Possible Cause	Corrective Action
Device does not show up in the live list	Network configuration parameters are incorrect	Set the network parameters of the LAS (host system) according to the FF Communications Profile ST = 8 MRD = 10 DLPDU PhLO = 4 MID = 16 TSC = 4 (1 ms) T1 = 0x1D4C00 (60 s) T2 = 0x57E400 (180 s) T3 = 0x75300 (15 s)
	Network address is not in polled range	Set first Unpolled Node and Number of UnPolled Nodes so that the device address is within range
	Power to the device is below the 9V minimum	Increase the power to at least 9V
	Noise on the power/communication is too high	• Verify terminators and power conditioners are within specification • Verify that the shield is properly terminated and not grounded at both ends. It is best to ground the shield at the power conditioner
Device that is acting as a LAS does not send out CD	LAS Scheduler was not downloaded to the Back-up LAS device	Ensure that all of the devices that are intended to be a Back-up LAS are marked to receive the LAS schedule
All devices go off live list and then return	Live list must be reconstructed by Back-up LAS device	Current link setting and configured links settings are different. Set the current link setting equal to the configured settings.

Appendix B

Analog Input Function Block



OUT=The block output value and status
OUT_D=Discrete output that signals a selected alarm condition

The Analog Input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes.

The AI block supports alarming, signal scaling, signal filtering, signal status calculation, mode control, and simulation. In Automatic mode, the block's output parameter (OUT) reflects the process variable (PV) value and status. In Manual mode, OUT may be set manually. The Manual mode is reflected on the output status. A discrete output (OUT_D) is provided to indicate whether a selected alarm condition is active. Alarm detection is based on the OUT value and user specified alarm limits. Figure B-4 illustrates the internal components of the AI function block, and Table B-1 on page -2 lists the AI block parameters and their units of measure, descriptions, and index numbers.

TABLE B-1. Definitions of Analog Input Function Block System Parameters

Parameter	Index Number	Units	Description
ACK_OPTION	23	None	Used to set auto acknowledgment of alarms.
ALARM_HYS	24	Percent	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears.
ALARM_SEL	38	None	Used to select the process alarm conditions that will cause the OUT_D parameter to be set.
ALARM_SUM	22	None	The summary alarm is used for all process alarms 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 parameter. 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.
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	21	None	The block alarm is used for all configuration, hardware, connection failure or system problems 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 parameter. 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.
BLOCK_ERR	06	None	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.
CHANNEL	15	None	The CHANNEL value is used to select the measurement value. Refer to the appropriate device manual for information about the specific channels available in each device. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter.
FIELD_VAL	19	Percent	The value and status from the transducer block or from the simulated input when simulation is enabled.
GRANT_DENY	12	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HI_ALM	34	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_ALM	33	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_LIM	26	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition.
HI_HI_PRI	25	None	The priority of the HI HI alarm.
HI_LIM	28	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition.
HI_PRI	27	None	The priority of the HI alarm.
IO_OPTS	13	None	Allows the selection of input/output options used to alter the PV. Low cutoff enabled is the only selectable option.
L_TYPE	16	None	Linearization type. Determines whether the field value is used directly (Direct), is converted linearly (Indirect), or is converted with the square root (Indirect Square Root).
LO_ALM	35	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LIM	30	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
LO_LO_ALM	36	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LO_LIM	32	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition.
LO_LO_PRI	31	None	The priority of the LO LO alarm.
LO_PRI	29	None	The priority of the LO alarm.
LOW_CUT	17	%	If percentage value of transducer input fails below this, PV = 0.

Parameter	Index Number	Units	Description
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block. Actual: The mode the "block is currently in" Target: The mode to "go to" Permitted: Allowed modes that target may take on Normal: Most common mode for target
OUT	08	EU of OUT_SCALE	The block output value and status.
OUT_D	37	None	Discrete output to indicate a selected alarm condition.
OUT_SCALE	11	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
PV	07	EU of XD_SCALE	The process variable used in block execution.
PV_FTIME	18	Seconds	The time constant of the first-order PV filter. It is the time required for a 63% change in the IN value.
SIMULATE	09	None	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/disable bit.
STATUS_OPTS	14	None	Allows you to select options for status handling and processing. The options supported in the AI block are the following: Propogate fault forward Uncertain if limited Bad if limited Uncertain if Manual mode.
STRATEGY	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	None	The user description of the intended application of the block.
UPDATE_EVT	20	None	This alert is generated by any change to the static data.
STDDEV	39	% of OUT Range	Standard deviation of the measurement.
CAP_STDDEV	40	Seconds	Capability standard deviation, the best deviation that can be achieved.
XD_SCALE	10	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the channel input value. The XD_SCALE units code must match the units code of the measurement channel in the transducer block. If the units do not match, the block will not transition to MAN or AUTO.

Simulation

To support testing, you can either change the mode of the block to manual and adjust the output value, or you can enable simulation through the configuration tool and manually enter a value for the measurement value and its status. In both cases, you must first set the ENABLE jumper on the field device.

NOTE
All fieldbus instruments have a simulation jumper. As a safety measure, the jumper has to be reset every time there is a power interruption. This measure is to prevent devices that went through simulation in the staging process from being installed with simulation enabled.

With simulation enabled, the actual measurement value has no impact on the OUT value or the status.

Figure B-1. Analog Input Function Block Schematic

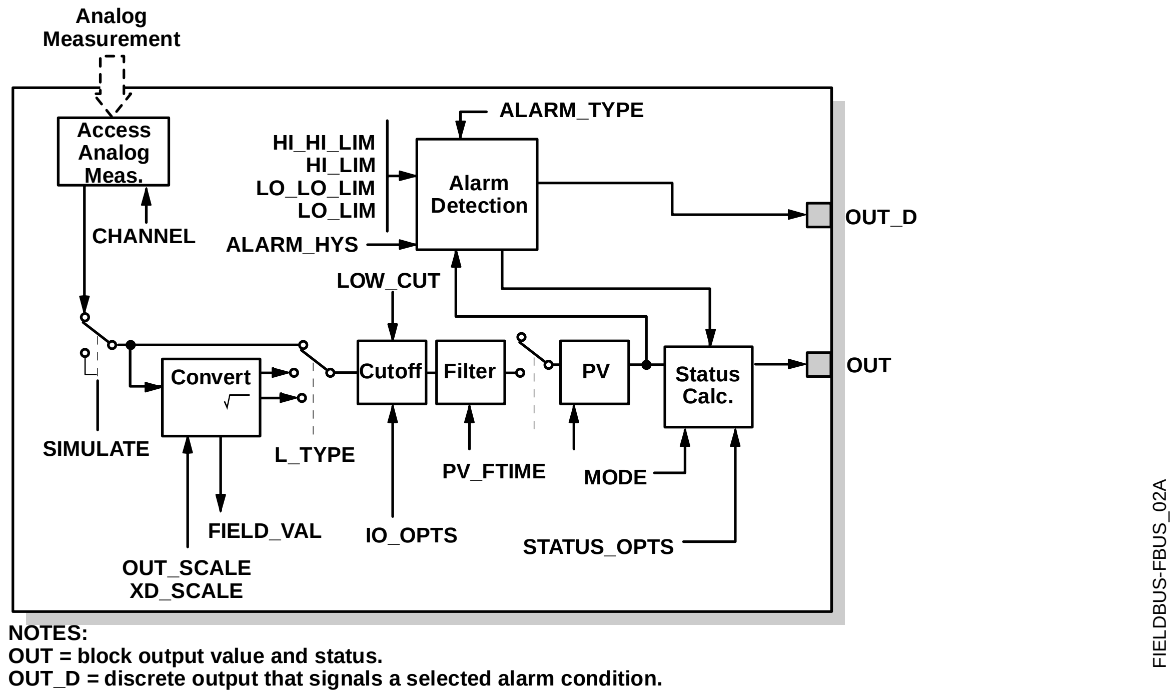
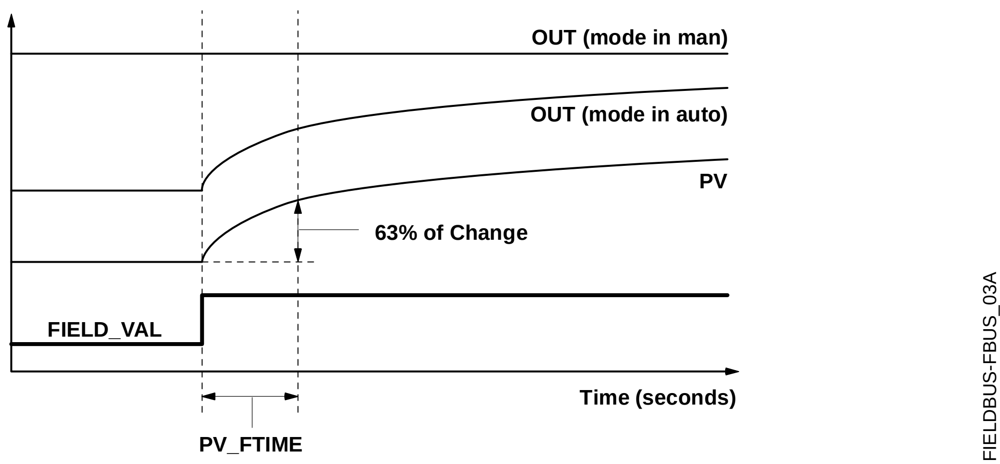


Figure B-2. Analog Input Function Block Timing Diagram



Filtering

The filtering feature changes the response time of the device to smooth variations in output readings caused by rapid changes in input. You can adjust the filter time constant (in seconds) using the PV_FTIME parameter. Set the filter time constant to zero to disable the filter feature.

Signal Conversion

You can set the signal conversion type with the Linearization Type (L_TYPE) parameter. You can view the converted signal (in percent of XD_SCALE) through the FIELD_VAL parameter.

$$\text{FIELD\_VAL} = \frac{100 \times (\text{Channel Value} - \text{EU*@0\%})}{(\text{EU*@100\%} - \text{EU*@0\%})}$$

*** XD_SCALE values**

You can choose from direct, indirect, or indirect square root signal conversion with the L_TYPE parameter.

Direct

Direct signal conversion allows the signal to pass through the accessed channel input value (or the simulated value when simulation is enabled).

$$\text{PV} = \text{Channel Value}$$

Indirect

Indirect signal conversion converts the signal linearly to the accessed channel input value (or the simulated value when simulation is enabled) from its specified range (XD_SCALE) to the range and units of the PV and OUT parameters (OUT_SCALE).

$$\text{PV} = \left(\frac{\text{FIELD\_VAL}}{100}\right) \times (\text{EU**@100\%} - \text{EU**@0\%}) + \text{EU**@0\%}$$

**** OUT_SCALE values**

Indirect Square Root

Indirect Square Root signal conversion takes the square root of the value computed with the indirect signal conversion and scales it to the range and units of the PV and OUT parameters.

$$\text{PV} = \sqrt{\left(\frac{\text{FIELD\_VAL}}{100}\right)} \times (\text{EU**@100\%} - \text{EU**@0\%}) + \text{EU**@0\%}$$

**** OUT_SCALE values**

When the converted input value is below the limit specified by the LOW_CUT parameter, and the Low Cutoff I/O option (IO_OPTS) is enabled (True), a value of zero is used for the converted value (PV). This option is useful to eliminate false readings when the differential pressure measurement is close to zero, and it may also be useful with zero-based measurement devices such as flowmeters.

NOTE
Low Cutoff is the only I/O option supported by the AI block. You can set the I/O option in Manual or Out of Service mode only.

Block Errors

Table B-2 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the AI block and are given here only for your reference.

TABLE B-2. BLOCK_ERR Conditions

Condition Number	Condition Name and Description
0	*Other*
1	**Block Configuration Error:** the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.
2	*Link Configuration Error*
3	**Simulate Active:** Simulation is enabled and the block is using a simulated value in its execution.
4	*Local Override*
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	**Input Failure/Process Variable has Bad Status:** The hardware is bad, or a bad status is being simulated.
8	**Output Failure:** The output is bad based primarily upon a bad input.
9	*Memory Failure*
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	*Power Up*
15	**Out of Service:** The actual mode is out of service.

Modes

The AI Function Block supports three modes of operation as defined by the MODE_BLK parameter:

- **Manual (Man)** The block output (OUT) may be set manually
- **Automatic (Auto)** OUT reflects the analog input measurement or the simulated value when simulation is enabled.
- **Out of Service (O/S)** The block is not processed. FIELD_VAL and PV are not updated and the OUT status is set to Bad: Out of Service. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

Alarm Detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the AI block are defined above.

Process Alarm detection is based on the OUT value. You can configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

In order to avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter. The priority of each alarm is set in the following parameters:

- HI_PRI
- HI_HI_PRI
- LO_PRI
- LO_LO_PRI

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Status Handling

Normally, the status of the PV reflects the status of the measurement value, the operating condition of the I/O card, and any active alarm condition. In Auto mode, OUT reflects the value and status quality of the PV. In Man mode, the OUT status constant limit is set to indicate that the value is a constant and the OUT status is *Good*.

The **Uncertain** - EU range violation status is always set, and the PV status is set high- or low-limited if the sensor limits for conversion are exceeded.

In the STATUS_OPTS parameter, you can select from the following options to control the status handling:

BAD if Limited – sets the OUT status quality to *Bad* when the value is higher or lower than the sensor limits.

Uncertain if Limited – sets the OUT status quality to *Uncertain* when the value is higher or lower than the sensor limits.

Uncertain if in Manual mode – The status of the Output is set to *Uncertain* when the mode is set to Manual

NOTES

1. The instrument must be in Manual or Out of Service mode to set the status option.
2. The AI block only supports the BAD if Limited option. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

Advanced Features

The AI function block provided with Fisher-Rosemount fieldbus devices provides added capability through the addition of the following parameters:

ALARM_TYPE – Allows one or more of the process alarm conditions detected by the AI function block to be used in setting its OUT_D parameter.

OUT_D – Discrete output of the AI function block based on the detection of process alarm condition(s). This parameter may be linked to other function blocks that require a discrete input based on the detected alarm condition.

STD_DEV and **CAP_STDDEV** are diagnostic parameters that can be used to determine the variability of the process.

Application Information

The configuration of the AI function block and its associated output channels depends on the specific application. A typical configuration for the AI block involves the following parameters:

- **CHANNEL:** If the device supports more than one measurement, verify that the selected channel contains the appropriate measurement or derived value.
- **L_TYPE:** Select **Direct** when the measurement is already in the engineering units that you want for the block output. Select **Indirect** when you want to convert the measured variable into another, for example, pressure into level or flow into energy. Select **Indirect Square Root** when the block I/O parameter value represents a flow measurement made using differential pressure, and when square root extraction is not performed by the transducer.
- **SCALING:** XD_SCALE provides the range and units of the measurement and OUT_SCALE provides the range and engineering units of the output.

Application Example: Temperature Transmitter

Situation

A temperature transmitter with a range of –200 to 450 °C.

Solution

Table B-3 lists the appropriate configuration settings, and Figure B-3 illustrates the correct function block configuration.

TABLE B-3. Analog Input Function Block Configuration for a Typical Temperature Transmitter

Parameter	Configured Values
L_TYPE	Direct
XD_SCALE	Not Used
OUT_SCALE	Not Used

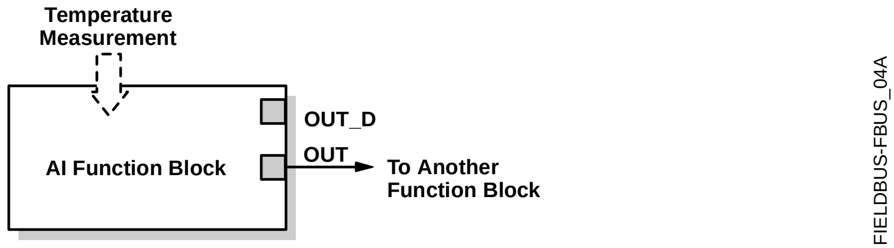


Figure B-3. Analog Input Function Block Diagram for a Typical Temperature Transmitter

Application Example: Pressure Transmitter used to Measure Level in an Open Tank

Situation #1

The level of an open tank is to be measured using a pressure tap at the bottom of the tank. The level measurement will be used to control the level of liquid in the tank. The maximum level at the tank is 16 ft. The liquid in the tank has a density that makes the level correspond to a pressure of 7.0 psi at the pressure tap (see Figure B-4).

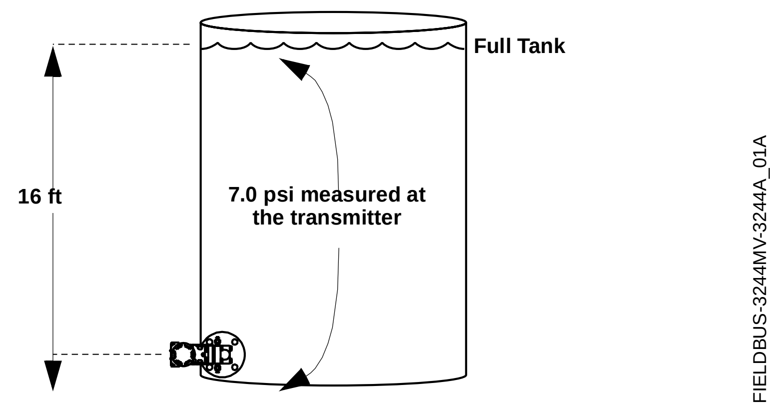


Figure B-4. Situation #1 Diagram

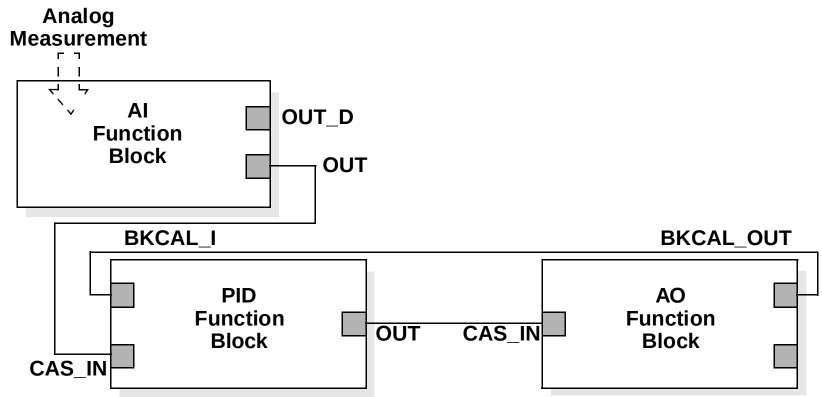
Solution # 1

Table B-4 lists the appropriate configuration settings, and Figure B-5 illustrates the correct function block configuration.

TABLE B-4. Analog Input Function Block Configuration for a Pressure Transmitter used in Level Measurement (situation #1)

Parameter	Configured Values
L_TYPE	Indirect
XD_SCALE	0 to 7 psi
OUT_SCALE	0 to 16 ft

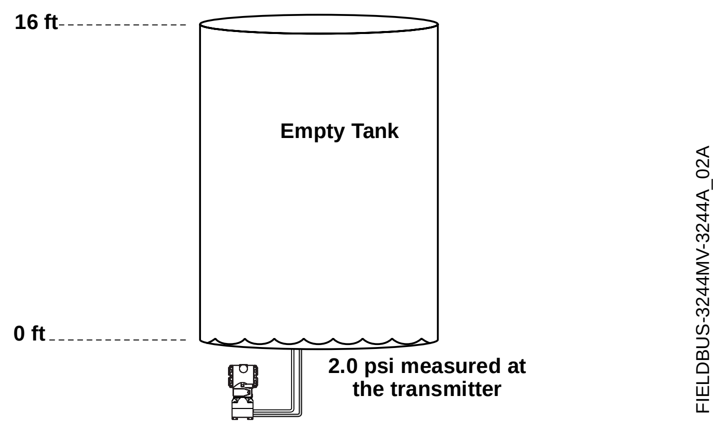
Figure B-5. Function Block Diagram for a Pressure Transmitter used in Level Measurement



Situation #2

The transmitter in situation #1 is installed below the tank in a position where the liquid column in the impulse line, when the tank is empty, is equivalent to 2.0 psi (see Figure B-6).

Figure B-6. Situation #2 Diagram



Solution # 2

Section : Analog Input Function Block Configuration for a Pressure Transmitter used in Level Measurement (Situation #2) lists the appropriate configuration settings.

TABLE B-5. Analog Input Function Block Configuration for a Pressure Transmitter used in Level Measurement (Situation #2)

Parameter	Configured Values
L_TYPE	Indirect
XD_SCALE	2 to 9 psi
OUT_SCALE	0 to 16 ft

Application Example: Differential Pressure Transmitter to Measure Flow

Situation

The liquid flow in a line is to be measured using the differential pressure across an orifice plate in the line, and the flow measurement will be used in a flow control loop. Based on the orifice specification sheet, the differential pressure transmitter was calibrated for 0 to 20 in H_20 for a flow of 0 to 800 gal/min, and the transducer was not configured to take the square root of the differential pressure.

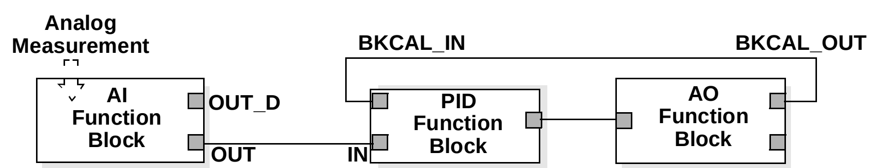
Solution

Table B-6 lists the appropriate configuration settings, and Figure B-7 illustrates the correct function block configuration.

TABLE B-6. Analog Input Function Block Configuration for a Differential Pressure Transmitter

Parameter	Configured Values
L_TYPE	Indirect Square Root
XD_SCALE	0 to 20 in.
OUT_SCALE	0 to 800 gal/min.

Figure B-7. Function Block Diagram for a Differential Pressure Transmitter Used in a Flow Measurement



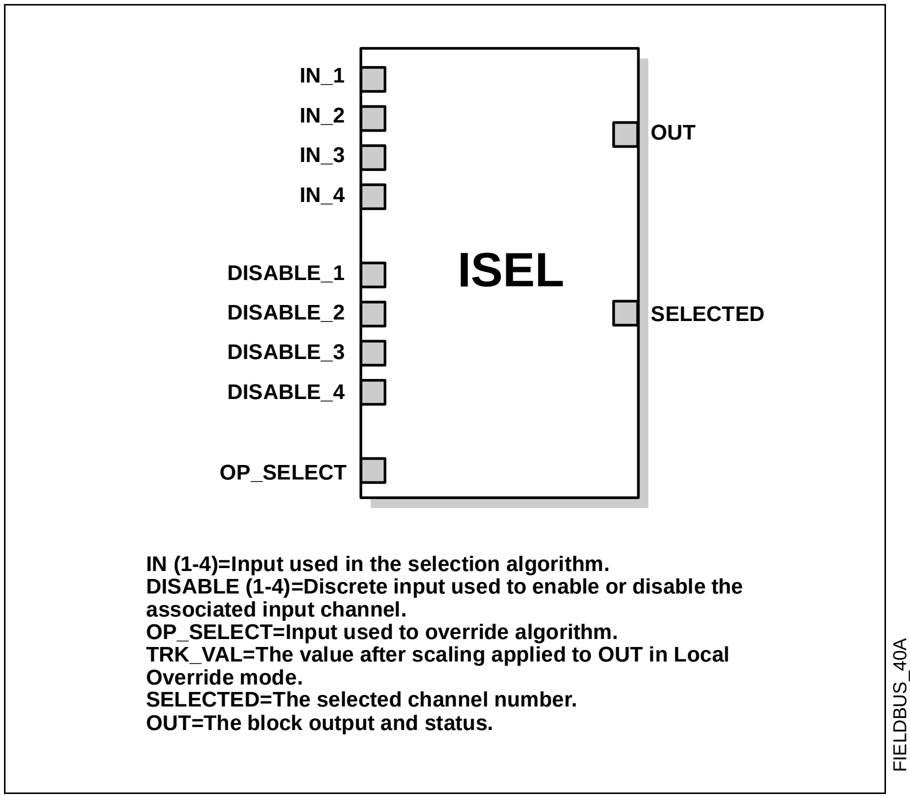
TROUBLESHOOTING

Refer to Table B-7 to troubleshoot any problems that you encounter.

TABLE B-7. Troubleshooting

Symptom	Possible Causes	Corrective Action
Mode will not leave OOS	Target mode not set.	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. The following are parameters that must be set before the block is allowed out of OOS: • CHANNEL must be set to a valid value and cannot be left at initial value of 0. • XD_SCALE.UNITS_INDX must match the units in the transducer block channel value. • L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at initial value of 0.
	Resource block	The actual mode of the Resource block is OOS. See Resource Block Diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Typically, BLOCK_ERR will show “Power-Up” for all blocks that are not scheduled. Schedule the block to execute.
Process and/or block alarms will not work.	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.
Value of output does not make sense	Linearization Type	L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at initial value of 0.
	Scaling	Scaling parameters are set incorrectly: • XD_SCALE.EU0 and EU100 should match that of the transducer block channel value. • OUT_SCALE.EU0 and EU100 are not set properly.
Cannot set HI_LIMIT, HI_HI_LIMIT, LO_LIMIT, or LO_LO_LIMIT Values	Scaling	Limit values are outside the OUT_SCALE.EU0 and OUT_SCALE.EU100 values. Change OUT_SCALE or set values within range.

Appendix C Input Selector Function Block

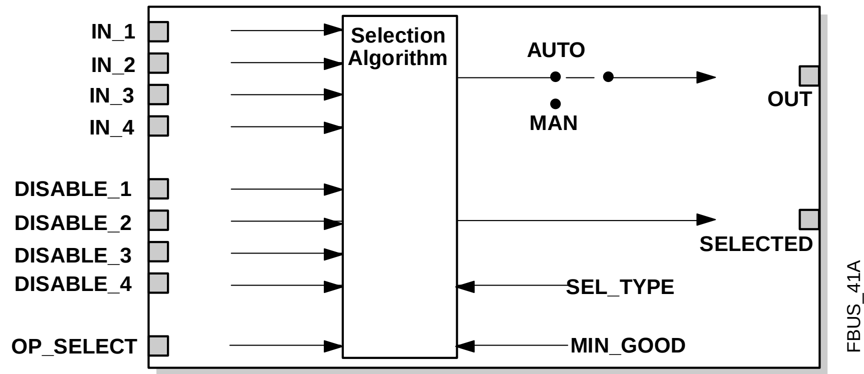


The Input Selector (ISEL) function block can be used to select the first good, Hot Backup, maximum, minimum, or average of as many as four input values and place it at the output. The block supports signal status propagation. There is no process alarm detection in the Input Selector function block. Figure C-3 illustrates the internal components of the ISEL function block. Table C-1 on page -2 lists the ISEL block parameters and their descriptions, units of measure, and index numbers.

TABLE C-1. Input Selector Function
Block System Parameters

Parameter	Index Number	Units	Description
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	24	None	The block alarm is used for all configuration, hardware, connection failure, or system problems 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 parameter. 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.
BLOCK_ERR	06	None	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.
DISABLE_1	15	None	A Connection from another block that disables the associated input from the selection.
DISABLE_2	16	None	A Connection from another block that disables the associated input from the selection.
DISABLE_3	17	None	A Connection from another block that disables the associated input from the selection.
DISABLE_4	18	None	A Connection from another block that disables the associated input from the selection.
GRANT_DENY	09	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
IN_1	11	Determined by source	The connection input from another block. One of the inputs to be selected from.
IN_2	12	Determined by source	The connection input from another block. One of the inputs to be selected from.
IN_3	13	Determined by source	The connection input from another block. One of the inputs to be selected from.
IN_4	14	Determined by source	The connection input from another block. One of the inputs to be selected from.
MIN_GOOD	20	None	The minimum number of good inputs
Mode_Blk	05	None	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
OP_SELECT	22	None	Overrides the algorithm to select 1 of the 4 inputs regardless of the selection type.
OUT	07	EU of IN	The block output value and status.
OUT_Range	08	None	The range of the output. Typically, all inputs have the same units and the value is also the same.
SELECTED	21	None	The selected input number (1–4).
SELECT_TYPE	19	None	Specifies selection method (see Block Execution)
STATUS_OPTS	10	None	Allows you to select options for status handling and processing. The supported status option for the PID block is Target to Manual if Bad IN.
Strategy	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	None	The user description of the intended application of the block.
UPDATE_EVT	23	None	This alert is generated by any change to the static data.

Figure C-1. Input Selector Function Block Schematic



Block Errors

Table C-2 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the ISEL block and are given here only for your reference.

TABLE C-2. BLOCK_ERR Conditions

Condition Number	Condition Name and Description
0	**Other**: The output has a quality of uncertain.
1	***Block Configuration Error:*** Select type is not configured
2	*Link Configuration Error*
3	*Simulate Active*
4	Local Override
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	**Input Failure/Process Variable has Bad Status:** One of the inputs is Bad or not connected.
8	Output Failure
9	Memory Failure
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	**Power Up**: The device was just powered-up.
15	**Out of Service:** The actual mode is out of service.

Modes

The ISEL function block supports three modes of operation as defined by the MODE_BLK parameter:

- **Manual (Man)** The block output (OUT) may be set manually.
- **Automatic (Auto)** OUT reflects the selected value.
- **Out of Service (O/S)** The block is not processed. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

Alarm Detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the ISEL block are defined above.

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Block Execution

The ISEL function block reads the values and statuses of as many as four inputs. To specify which of the six available methods (algorithms) is used to select the output, configure the selector type parameter (SEL_TYPE) as follows:

- **Max** selects the maximum value of the inputs.
- **Min** selects the minimum value of the inputs.
- **Avg** calculates the average value of the inputs.
- **Mid** calculates the middle of three inputs or the average of the middle two inputs if four inputs are defined.
- **1st Good** selects the first available good input.
- **Hot Backup** latches on the selected input and continues to use it until it is bad.

If the DISABLE_N is active, the associated input is not used in the selection algorithm.

If the OP_SELECT is set to a value between 1 and 4, the selection type logic is overridden and the output value and status is set to the value and status of the input selected by OP_SELECT.

SELECTED will have the number of the selected input unless the SEL_TYPE is average, in which case it will have the number of inputs used to calculate its value.

Status Handling

In Auto mode, OUT reflects the value and status quality of the selected input. If the number of inputs with Good status is less than MIN_GOOD, the output status will be Bad.

In Man mode, the OUT status high and low limits are set to indicate that the value is a constant and the OUT status is always Good.

In the STATUS_OPTS parameter, you can select from the following options to control the status handling:

- **Use Uncertain as Good**: sets the OUT status quality to Good when the selected input status is Uncertain.
- **Uncertain if in Manual mode**: The status of the Output is set to Uncertain when the mode is set to manual.

NOTE
The instrument must be in Manual or Out of Service mode to set the status option.

Application Information

You can use the ISEL function block to select the maximum temperature input from four inputs and send it to a PID function block to control a process water chiller (see Figure C-2) or you can use the block to calculate the average temperature of the four inputs (see Figure C-3).

Figure C-2. Input Selector Function Block Application Example (SEL_TYPE = max)

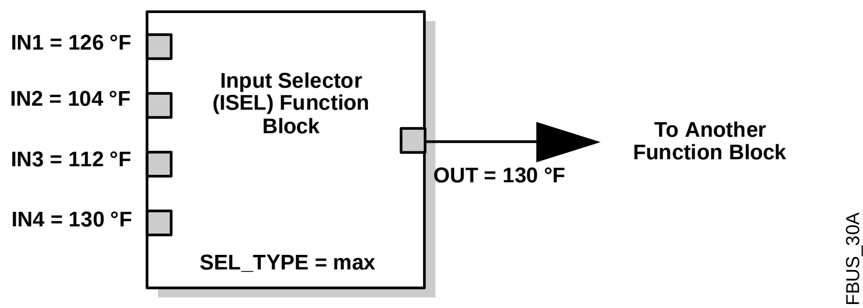


Figure C-3. Input Selector Function Block Application Example (SEL_TYPE = average)

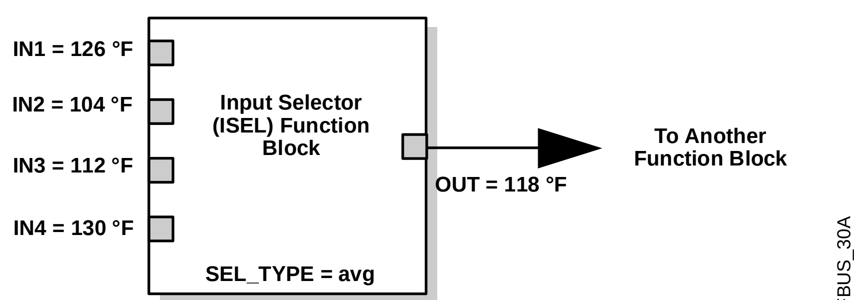
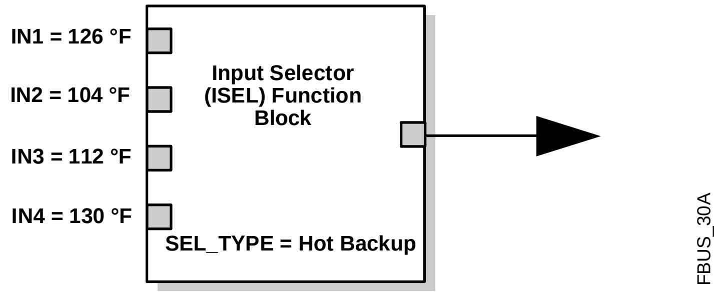


Figure C-4. Input Selector Function Block Application Example (SEL_TYPE = Hot Backup)



	IN1		IN2		Out		Selected	
Time	Value	Status	Value	Status	Value	Status	Value	Status
T_0	Good	20	Good	21	Good	20	Good	1
T_1	Bad	20	Good	21	Good	21	Good	2
T_2	Good	20	Good	21	Good	21	Good	2

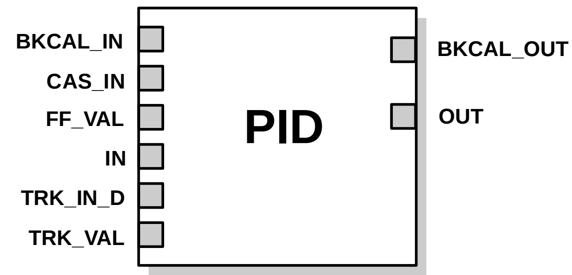
TROUBLESHOOTING

Refer to Table C-3 to troubleshoot any problems that you encounter.

TABLE C-3. Troubleshooting

Symptom	Possible Causes	Corrective Action
Mode will not leave OOS	Target mode not set.	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. SELECT_TYPE must be set to a valid value and cannot be left at 0.
	Resource block	The actual mode of the Resource block is OOS. See Resource Block Diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Typically, BLOCK_ERR will show “Power-Up” for all blocks that are not scheduled. Schedule the block to execute.
Status of output is BAD	Inputs	All inputs have Bad status
	OP selected	OP_SELECT is not set to 0 (or it is linked to an input that is not 0), and it points to an input that is Bad.
	Min good	The number of Good inputs is less than MIN_GOOD.
Block alarms will not work.	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.

Appendix D PID Function Block



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BKCAL_IN	The analog input value and status from another block's BKCAL_OUT output that is used for backward output tracking for bumpless transfer and to pass limit status.
CAS_IN:	The remote setpoint value from another function block.
FF_VAL:	The feedforward control input value and status.
IN:	The connection for the process variable from another function block.
TRK_IN_D:	Initiates the external tracking function.
TRK_VAL:	The value after scaling applied to OUT in Local Override mode.
BKCAL_OUT	The value and status required by the BKCAL_IN input of another function block to prevent reset windup and to provide bumpless transfer to closed loop control.
OUT:	The block output and status

The PID function block combines all of the necessary logic to perform proportional/integral/derivative (PID) control. The block supports mode control, signal scaling and limiting, feedforward control, override tracking, alarm limit detection, and signal status propagation.

The block supports two forms of the PID equation: Standard and Series. You can choose the appropriate equation using the FORM parameter. The Standard ISA PID equation is the default selection

.

$$\text{Standard Out} = \text{GAIN} \times e \times \left(1 + \frac{1}{\tau_r s + 1} + \frac{\tau_d s}{\alpha \times \tau_d s + 1}\right) + F$$

$$\text{Series Out} = \text{GAIN} \times e \times \left[\left(1 + \frac{1}{\tau_r s}\right) + \left(\frac{\tau_d s + 1}{\alpha \times \tau_d s + 1}\right)\right] + F$$

Where	
GAIN	proportional gain value
τ_r	integral action time constant (RESET parameter) in seconds
s	laplace operator
τ_d	derivative action time constant (RATE parameter)
a	fixed smoothing factor of 0.1 applied to RATE
F	feedforward control contribution from the feedforward input (FF_VAL parameter)
e	error between setpoint and process variable

To further customize the block for use in your application, you can configure filtering, feedforward inputs, tracking inputs, setpoint and output limiting, PID equation structures, and block output action.

Table D-1 lists the PID block parameters and their descriptions, units of measure, and index numbers, and Figure D-5 illustrates the internal components of the PID function block.

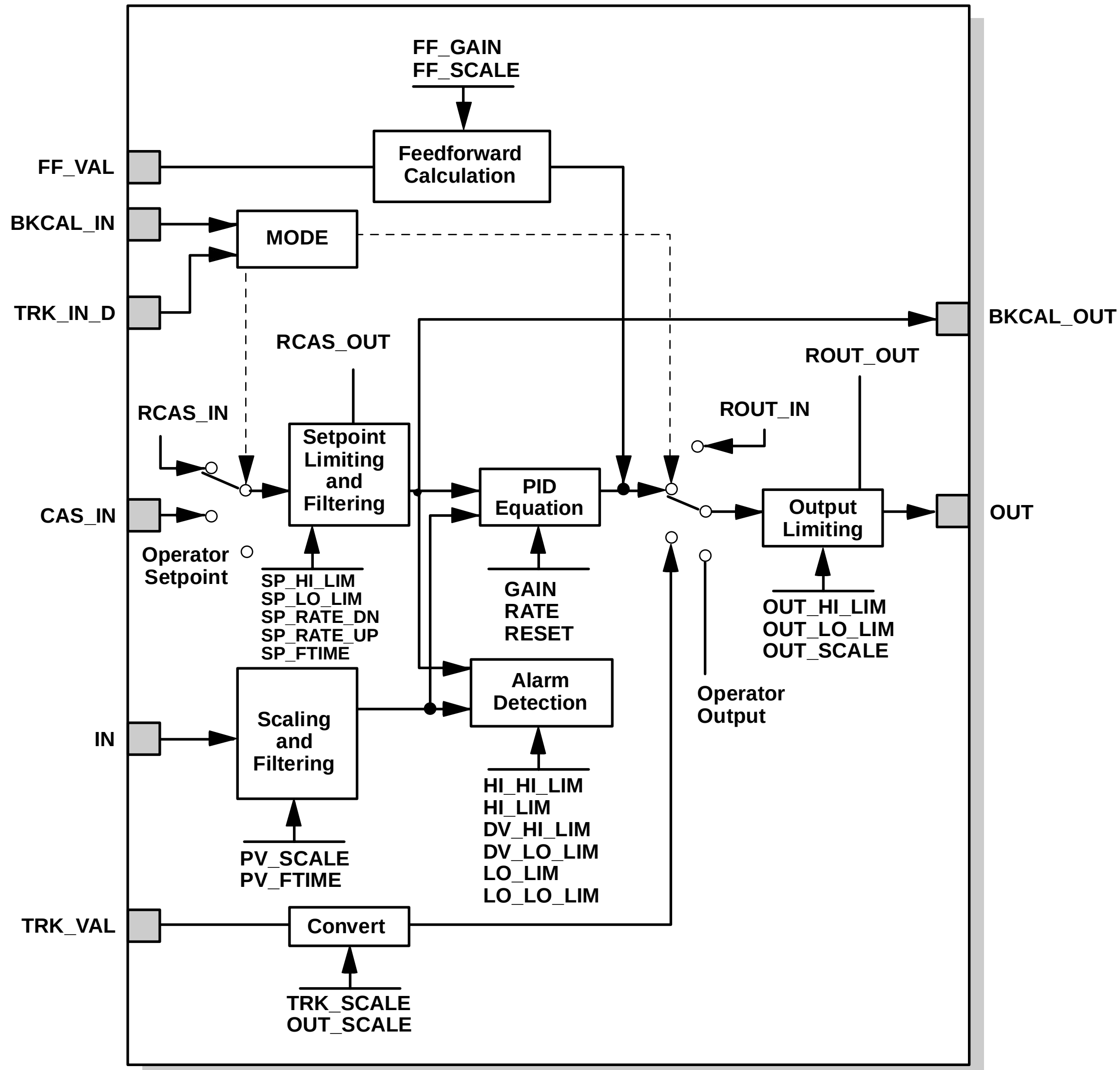
TABLE D-1. PID Function Block System Parameters

Parameter	Index Number	Units	Description
ACK_OPTION	46	None	Used to set auto acknowledgment of alarms.
ALARM_HYS	47	Percent	The amount the alarm value must return to within the alarm limit before the associated active alarm condition clears.
ALARM_SUM	45	None	The summary alarm is used for all process alarms 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 parameter. 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.
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
IDEADBAND	74	None	Deadband that is applied to the integrator term.
BAL_TIME	25	Seconds	The specified time for the internal working value of bias to return to the operator set bias. Also used to specify the time constant at which the integral term will move to obtain balance when the output is limited and the mode is AUTO, CAS, or RCAS.
BETA	73	None	Weighting factor for derivative action when STRUCTURE_CONFIG is 2 Deg. of Freedom.
BIAS	66	EU of OUT_SCALE	The bias value used to calculate output for a PD type controller.
BKCAL_HYS	30	Percent	The amount the output value must change away from the its output limit before limit status is turned off.
BKCAL_IN	27	EU of OUT_SCALE	The analog input value and status from another block's BKCAL_OUT output that is used for backward output tracking for bumpless transfer and to pass limit status.
BKCAL_OUT	31	EU of PV_SCALE	The value and status required by the BKCAL_IN input of another block to prevent reset windup and to provide bumpless transfer of closed loop control.
BLOCK_ALM	44	None	The block alarm is used for all configuration, hardware, connection failure, or system problems 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 parameter. As soon as the Unreported status is cleared by the alert reporting task, and other block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	None	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.
BYPASS	17	None	Used to override the calculation of the block. When enabled, the SP is sent directly to the output.
CAP_STDDEV	76	None	Capability standard deviation, the best deviation that can be achieved.
CAS_IN	18	EU of PV_SCALE	The remote setpoint value from another block.
CONTROL_OPTS	13	None	Allows you to specify control strategy options. The supported control options for the PID block are Track enable, Track in Manual, SP-PV Track in Man, SP-PV Track in LO or IMAN, Use PV for BKCAL_OUT, and Direct Acting
DV_HI_ALM	64	None	The DV HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm.
DV_HI_LIM	57	EU of PV_SCALE	The setting for the alarm limit used to detect the deviation high alarm condition.
DV_HI_PRI	56	None	The priority of the deviation high alarm.
DV_LO_ALM	65	None	The DV LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm.
DV_LO_LIM	59	EU of PV_SCALE	The setting for the alarm limit use to detect the deviation low alarm condition.
DV_LO_PRI	58	None	The priority of the deviation low alarm.

Parameter	Index Number	Units	Description
ERROR	67	EU of PV_SCALE	The error (SP-PV) used to determine the control action.
FF_GAIN	42	None	The feedforward gain value. FF_VAL is multiplied by FF_GAIN before it is added to the calculated control output.
FF_SCALE	41	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the feedforward value (FF_VAL).
FF_VAL	40	EU of FF_SCALE	The feedforward control input value and status.
GAIN	23	None	The proportional gain value. This value cannot = 0.
GAMMA	72	Percent	Weighting factor for proportional action when STRUCTURE_CONFIG is 2 Deg. of Freedom.
GRANT_DENY	12	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by the device.
HI_ALM	61	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm.
HI_HI_ALM	60	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm.
HI_HI-LIM	49	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition.
HI_HI_PRI	48	None	The priority of the HI HI Alarm.
HI_LIM	51	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition.
HI_PRI	50	None	The priority of the HI alarm.
IN	15	EU of PV_SCALE	The connection for the PV input from another block.
LO_ALM	62	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm.
LO_LIM	53	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
LO_LO_ALM	63	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence, and the state of the alarm.
LO_LO_LIM	55	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition.
LO_LO_PRI	54	None	The priority of the LO LO alarm.
LO_PRI	52	None	The priority of the LO alarm.
MATHFORM	70	None	Used to select either Standard or Series form of the PID equations.
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
OUT	09	EU of OUT_SCALE	The block input value and status.
OUT_HI_LIM	28	EU of OUT_SCALE	The maximum output value allowed.
OUT-LO_LIM	29	EU of OUT_SCALE	The minimum output value allowed
OUT_SCALE	11	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
PV	07	EU of PV_SCALE	The process variable used in block execution.
PV_FTIME	16	Seconds	The time constant of the first-order PV filter. It is the time required for a 63 percent change in the IN value.
PV_SCALE	10	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with PV.
RATE	26	Seconds	The derivative action time constant.
RCAS_IN	32	EU of PV_SCALE	Target setpoint and status that is provided by a supervisory host. Used when mode is RCAS.
RCAS_OUT	35	EU of PV_SCALE	Block setpoint and status after ramping, filtering, and limiting that is provided to a supervisory host for back calculation to allow action to be taken under limiting conditions or mode change. Used when mode is RCAS.
RESET	24	Seconds per repeat	The integral action time constant.
ROUT_IN	33	EU of OUT_SCALE	Target output and status that is provided by a supervisory host. Used when mode is ROUT.
ROUT_OUT	36	EU of OUT_SCALE	Block output that is provided to a supervisory host for a back calculation to allow action to be taken under limiting conditions or mode change. Used when mode is RCAS.

Parameter	Index Number	Units	Description
SHED_OPT	34	None	Defines action to be taken on remote control device timeout.
SP	08	EU of PV_SCALE	The target block setpoint value. It is the result of setpoint limiting and setpoint rate of change limiting.
SP_FTIME	69	Seconds	The time constant of the first-order SP filter. It is the time required for a 63 percent change in the IN value.
SP_HI_LIM	21	EU of PV_SCALE	The highest SP value allowed.
SP_LO_LIM	22	EU of PV_SCALE	The lowest SP value allowed.
SP_RATE_DN	19	EU of PV_SCALE per second	Ramp rate for downward SP changes. When the ramp rate is set to zero, the SP is used immediately.
SP-RATE_UP	20	EU of PV_SCALE per second	Ramp rate for upward SP changes. When the ramp rate is set to zero, the SP is used immediately.
SP_WORK	68	EU of PV_SCALE	The working setpoint of the block after limiting and filtering is applied.
STDDEV	75	None	Standard deviation of the measurement.
STATUS_OPTS	14	None	Allows you to select options for status handling and processing. The options supported in the PID block are the following: Initiate fault state if Bad In, Initiate fault state if Bad Cascade In, Use Uncertain as Good, and Target to Maanual if Bad In.
STRATEGY	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
STRUCTURE_ CONFIG	71	Percent	Defines the structure of the PID equations. The eight options are the following: • PID terms on error • PI terms on error, D term on PV • I terms on error, PD term on PV • PD terms on error • P term on error, D term on PV • ID terms on error • I term on error, Dterm on PV • 2 Deg. of Freedom PID
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	None	The user description of the intended application of the block.
TRK_IN_D	38	None	Discrete input that initiates external tracking.
TRK_SCALE	37	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the external tracking value (TRK_VAL).
TRK_VAL	39	EU of TRK_SCALE	The value (after scaling from TRK_SCALE to OUT_SCALE) APPLIED to OUT in LO mode.
UPDATE_EVT	43	None	This alert is generated by any changes to the static data.

Figure D-1. PID Function Block Schematic



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SETPOINT SELECTION AND LIMITING

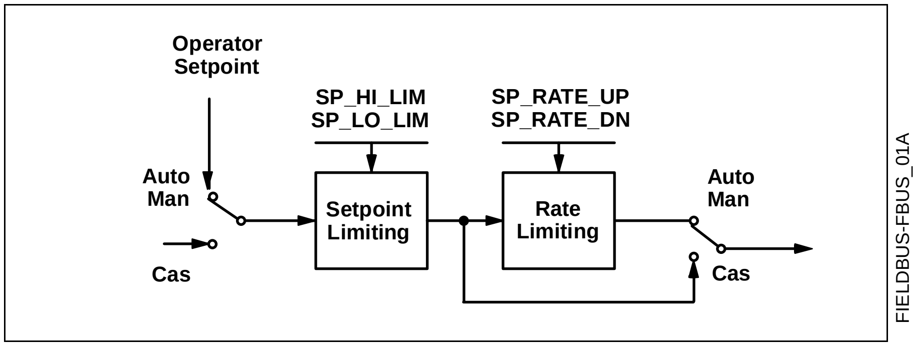
The setpoint of the PID block is determined by the mode. You can configure the SP_HI_LIM and SP_LO_LIM parameters to limit the setpoint. In Cascade or Remote Cascade mode, the setpoint is adjusted by another function block or by a host computer, and the output is computed based on the setpoint.

In Automatic mode, the setpoint is entered manually by the operator, and the output is computed based on the setpoint. In Auto mode, you can also adjust the setpoint limit and the setpoint rate of change using the SP_RATE_UP and SP_RATE_DN parameters.

In Manual mode the output is entered manually by the operator, and is independent of the setpoint. In Remote Output mode, the output is entered by a host computer, and is independent of the setpoint.

Figure D-2 illustrates the method for setpoint selection.

Figure D-2. PID Function Block Setpoint Selection



Filtering

The filtering feature changes the response time of the device to smooth variations in output readings caused by rapid changes in input. You can configure the filtering feature with the FILTER_TYPE parameter, and you can adjust the filter time constant (in seconds) using the PV_FTIME or SP_FTIME parameters. Set the filter time constant to zero to disable the filter feature.

Feedforward Calculation

The feedforward value (FF_VAL) is scaled (FF_SCALE) to a common range for compatibility with the output scale (OUT_SCALE). A gain value (FF_GAIN) is applied to achieve the total feedforward contribution.

Tracking

You enable the use of output tracking through the control options. You can set control options in Manual or Out of Service mode only.

The **Track Enable** control option must be set to *True* for the track function to operate. When the Track in Manual control option is set to *True*, tracking can be activated and maintained only when the block is in Manual mode. When **Track in Manual** is *False*, the operator can override the tracking function when the block is in Manual mode. Activating the track function causes the block's actual mode to revert to Local Override.

The TRK_VAL parameter specifies the value to be converted and tracked into the output when the track function is operating. The TRK_SCALE parameter specifies the range of TRK_VAL.

When the TRK_IN_D parameter is *True* and the **Track Enable** control option is *True*, the TRK_VAL input is converted to the appropriate value and output in units of OUT_SCALE.

Output Selection and Limiting

Output selection is determined by the mode and the setpoint. In Automatic, Cascade, or Remote Cascade mode, the output is computed by the PID control equation. In Manual and Remote Output mode, the output may be entered manually (see also Figure D-5). You can limit the output by configuring the OUT_HI_LIM and OUT_LO_LIM parameters.

Bumpless Transfer and Setpoint Tracking

You can configure the method for tracking the setpoint by configuring the following control options (CONTROL_OPTS):

SP-PV Track in Man — Permits the SP to track the PV when the target mode of the block is Man.

SP-PV Track in LO or IMan — Permits the SP to track the PV when the actual mode of the block is Local Override (LO) or Initialization Manual (IMan).

When one of these options is set, the SP value is set to the PV value while in the specified mode.

You can select the value that a master controller uses for tracking by configuring the **Use PV for BKCAL_OUT** control option. The BKCAL_OUT value tracks the PV value. BKCAL_IN on a master controller connected to BKCAL_OUT on the PID block in an open cascade strategy forces its OUT to match BKCAL_IN, thus tracking the PV from the slave PID block into its cascade input connection (CAS_IN). If the **Use PV for BKCAL_OUT** option is not selected, the working setpoint (SP_WRK) is used for BKCAL_OUT.

You can set control options in Manual or Out of Service mode only. When the mode is set to Auto, the SP will remain at the last value (it will no longer follow the PV.)

PID Equation Structures

Configure the STRUCTURE parameter to select the PID equation structure. You can select one of the following choices:

- PI Action on Error, D Action on PV
- PID Action on Error
- I Action on Error, PD Action on PV

Set RESET to zero to configure the PID block to perform integral only control regardless of the STRUCTURE parameter selection. When RESET equals zero, the equation reduces to an integrator equation with a gain value applied to the error:

$$\frac{GAIN \times e(s)}{s}$$

Where	
GAIN:	proportional gain value
e:	error
s:	laplace operator

Reverse and Direct Action

To configure the block output action, enable the **Direct Acting** control option. This option defines the relationship between a change in PV and the corresponding change in output. With **Direct Acting** enabled (True), an increase in PV results in an increase in the output.

You can set control options in Manual or Out of Service mode only.

NOTE
Track Enable, **Track in Manual**, **SP-PV Track in Man**, **SP-PV Track in LO or IMan**, **Use PV for BKCAL_OUT**, and **Direct Acting** are the only control options supported by the PID function block. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

Reset Limiting

The PID function block provides a modified version of feedback reset limiting that prevents windup when output or input limits are encountered, and provides the proper behavior in selector applications.

Block Errors

Table D-2 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the PID block and are given here only for your reference.

TABLE D-2. BLOCK_ERR Conditions

Condition Number	Condition Name and Description
0	*Other*
1	**Block Configuration Error:** The BY_PASS parameter is not configured and is set to 0, the SP_HI_LIM is less than the SP_LO_LIM, or the OUT_HI_LIM is less than the OUT_LO_LIM.
2	*Link Configuration Error*
3	*Simulate Active*
4	**Local Override**: The actual mode is LO.
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	**Input Failure/Process Variable has Bad Status:** The parameter linked to IN is indicating a Bad status.
8	*Output Failure*
9	*Memory Failure*
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	*Power Up*
15	**Out of Service:** The actual mode is out of service.

Modes

The PID function block supports the following modes:

Manual (Man)—The block output (OUT) may be set manually.

Automatic (Auto)—The SP may be set manually and the block algorithm calculates OUT.

Cascade (Cas)—The SP is calculated in another block and is provided to the PID block through the CAS_IN connection.

Remote Cascade (RCas)—The SP is provided by a host computer that writes to the RCAS_IN parameter.

Remote Output (Rout)—The OUT is provided by a host computer that writes to the ROUT_IN parameter

Local Override (LO)—The track function is active. OUT is set by TRK_VAL. The BLOCK_ERR parameter shows Local override.

Initialization Manual (IMan)—The output path is not complete (for example, the cascade-to-slave path might not be open). In IMan mode, OUT tracks BKCAL_IN.

Out of Service (O/S)—The block is not processed. The OUT status is set to *Bad: Out of Service*. The BLOCK_ERR parameter shows Out of service.

You can configure the Man, Auto, Cas, and O/S modes as permitted modes for operator entry.

Alarm Detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the AI block are defined above.

Process alarm detection is based on the PV value. You can configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

Additional process alarm detection is based on the difference between SP and PV values and can be configured via the following parameters:

- Deviation high (DV_HI_LIM)
- Deviation low (DV_LO_LIM)

In order to avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter. The priority of each alarm is set in the following parameters:

- HI_PRI
- HI_HI_PRI
- LO_PRI
- LO_LO_PRI
- DV_HI_PRI
- DV_LO_PRI

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Status Handling

If the input status on the PID block is *Bad*, the mode of the block reverts to Manual. In addition, you can select the **Target to Manual if Bad IN** status option to direct the target mode to revert to manual. You can set the status option in Manual or Out of Service mode only.

NOTE
Target to Manual if Bad IN is the only status option supported by the PID function block. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

Application Information

The PID function block is a powerful, flexible control algorithm that is designed to work in a variety of control strategies. The PID block is configured differently for different applications. The following examples describe the use of the PID block for closed-loop control (basic PID loop), feedforward control, cascade control with master and slave, and complex cascade control with override.

Closed Loop Control

To implement basic closed loop control, compute the error difference between the process variable (PV) and setpoint (SP) values and calculate a control output signal using a PID (Proportional Integral Derivative) function block.

The proportional control function responds immediately and directly to a change in the PV or SP. The proportional term **GAIN** applies a change in the loop output based on the current magnitude of the error multiplied by a gain value.

The integral control function reduces the process error by moving the output in the appropriate direction. The integral term **RESET** applies a correction based on the magnitude and duration of the error. Set the RESET parameter to zero for integral-only control. To reduce reset action, configure the RESET parameter to be a large value.

The derivative term **RATE** applies a correction based on the anticipated change in error. Derivative control is typically used in temperature control where large measurement lags exist.

The MODE parameter is a switch that indicates the target and actual mode of operation. Mode selection has a large impact on the operation of the PID block:

- **Manual** mode allows the operator to set the value of the loop output signal directly.
- **Automatic** mode allows the operator to select a setpoint for automatic correction of error using the **GAIN**, **RESET**, and **RATE** tuning values.
- **Cascade** and **Remote Cascade** modes use a setpoint from another block in a cascaded configuration.
- **Remote Out** mode is similar to **Manual** mode except that the block output is supplied by an external program rather than by the operator.
- **Initialization Manual** is a non-target mode used with cascade configurations while transitioning from manual operation to automatic operation.
- **Local Override** is a non-target mode that instructs the block to revert to Local Override when the tracking or fail-safe control options are activated.
- **Out of Service** mode disables the block for maintenance.

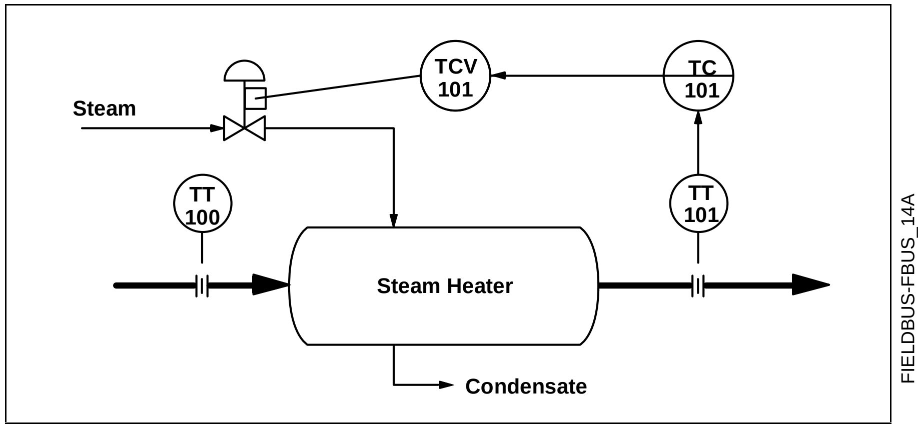
Abrupt changes in the quality of the input signal can result in unexpected loop behavior. To prevent the output from changing abruptly and upsetting the process, select the **SP-PV Track in Man** I/O option. This option automatically sets the loop to Manual if a *Bad* input status is detected. While in manual mode, the operator can manage control manually until a *Good* input status is reestablished.

Application Example: Basic PID Block for Steam Heater Control

Situation

A PID block is used with an AI block and an AO block to control the flow steam used to heat a process fluid in a heat exchanger. Figure D-3 illustrates the process instrumentation diagram.

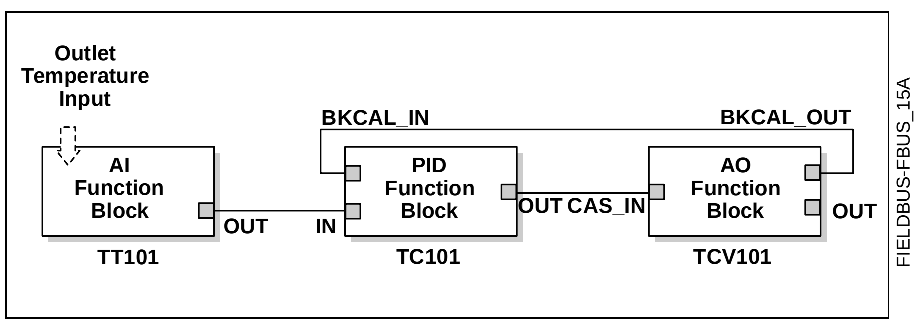
Figure D-3. PID Function Block Steam Heater Control Example



Solution

The PID loop uses TT101 as an input and provides a signal to the analog output TCV101. The BKCAL_OUT of the AO block and the BKCAL_IN of the PID block communicate the status and quality of information being passed between the blocks. The status indication shows that communications is functioning and the I/O is working properly. Figure D-4 illustrates the correct function block configuration.

Figure D-4. PID Function Block Diagram for Steam Heater Control Example



Application Example: Feedforward Control

Situation

In the previous example, control problems can arise because of a time delay caused by thermal inertia between the two flow streams (TT100 and TT101). Variations in the inlet temperature (TT100) take an excessive amount of time to be sensed in the outlet (TT101). This delay causes the product to be out of the desired temperature range.

Solution

Feedforward control is added to improve the response time of the basic PID control. The temperature of the inlet process fluid (TT100) is input to an AI function block and is connected to the FF_VAL connector on the PID block. Feedforward control is then enabled (FF_ENABLE), the feedforward value is scaled (FF_SCALE), and a gain (FF_GAIN) is determined. Figure D-5 illustrates the process instrumentation diagram, and Figure D-6 illustrates the correct function block configuration.

Figure D-5. PID Function Block Feedforward Control Example

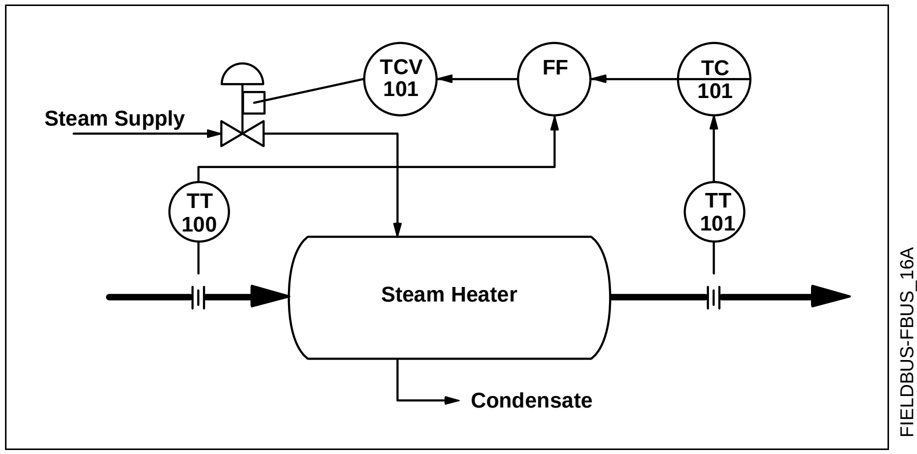
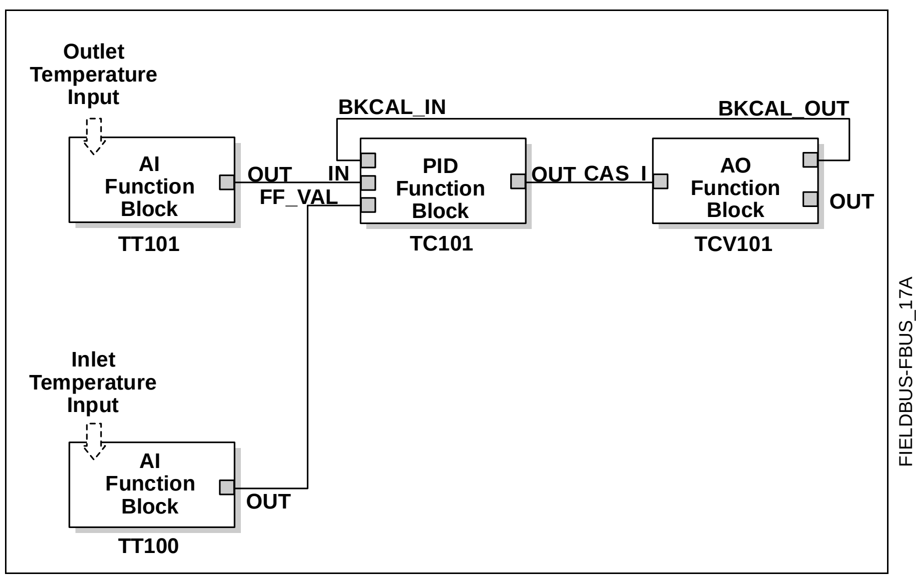


Figure D-6. Function Block Diagram for Feedforward Control

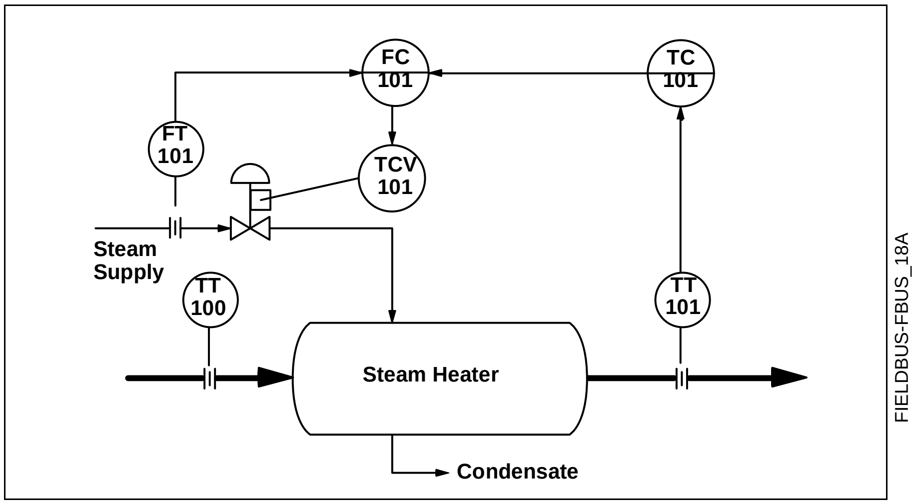


Application Example: Cascade Control with Master and Slave Loops

Situation

A slave loop is added to a basic PID control configuration to measure and control steam flow to the steam heater. Variations in the steam pressure cause the temperature in the heat exchanger to change. The temperature variation will later be sensed by TT101. The temperature controller will modify the valve position to compensate for the steam pressure change. The process is slow and causes variations in the product temperature. Figure D-7 illustrates the process instrumentation diagram.

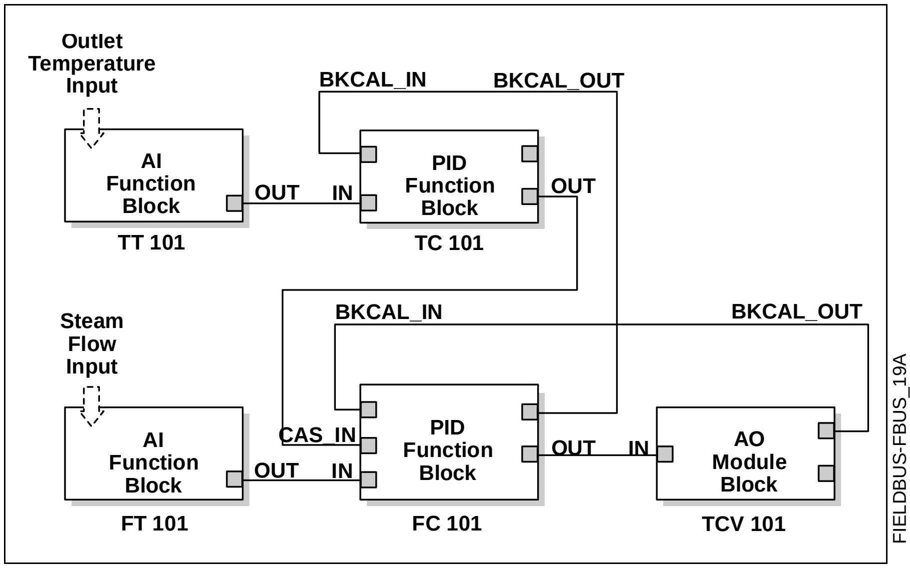
Figure D-7. PID Function Block Cascade Control Example



Solution

If the flow is controlled, steam pressure variations will be compensated before they significantly affect the heat exchanger temperature. The output from the master temperature loop is used as the setpoint for the slave steam flow loop. The BKCAL_IN and BKCAL_OUT connections on the PID blocks are used to prevent controller windup on the master loop when the slave loop is in Manual or Automatic mode, or it has reached an output constraint. Figure D-8 illustrates the correct function block configuration.

Figure D-8. PID Function Block Diagram for Cascade Control Example



Application Example: Cascade Control with Override

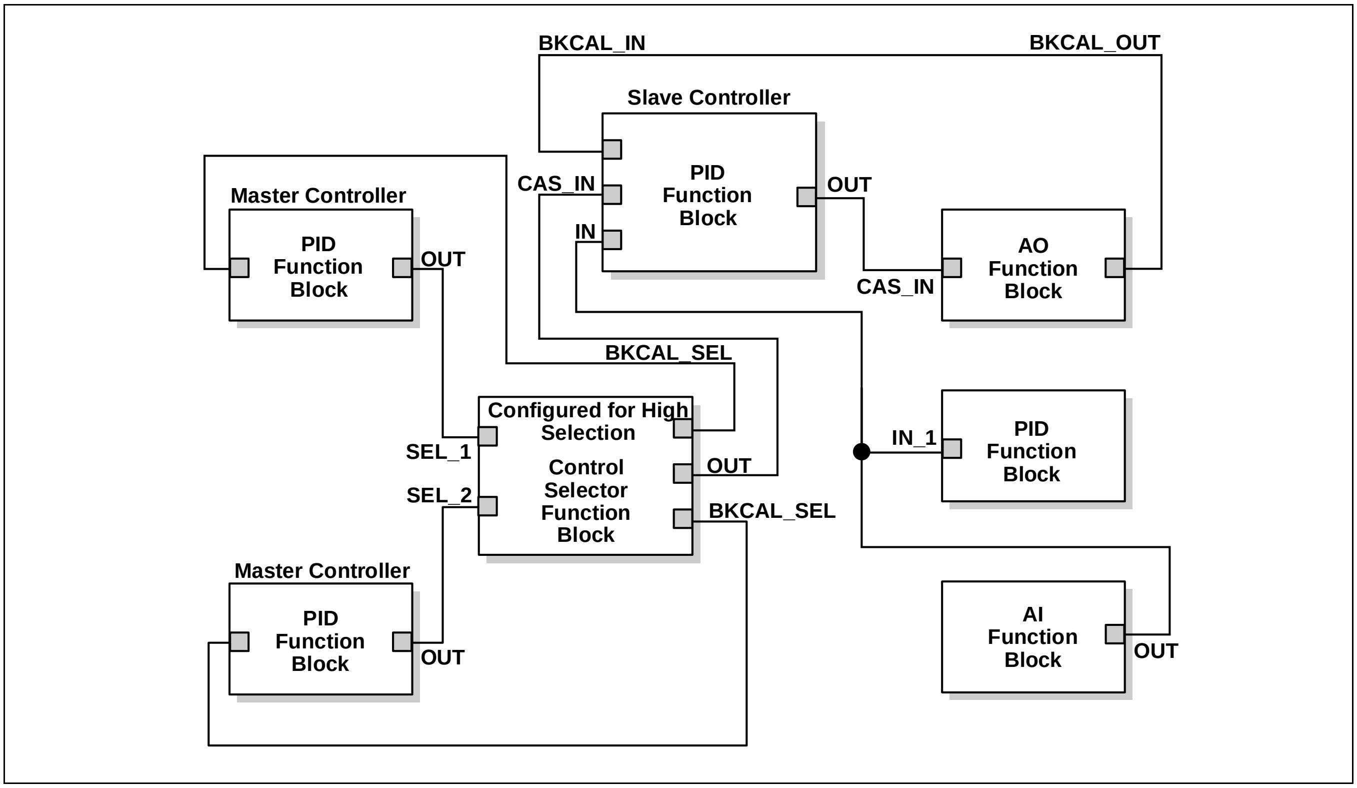
You can use the PID function block with other function blocks for complex control strategies. Figure D-9 illustrates the function block diagram for cascade control with override.

When configured for cascade control with override, if one of the PID function blocks connected to the selector inputs is deselected, that PID block filters the integral value to the selected value (the value at its BKCAL_IN). The selected PID block behaves normally and the deselected controller never winds up. At steady state, the deselected PID block offsets its OUT value from the selected value by the proportional term. When the selected block becomes output-limited, it prevents the integral term from winding further into the limited region.

When the cascade between the slave PID block and the Control Selector block is open, the open cascade status is passed to the Control Selector block and through to the PID blocks supplying input to it. The Control Selector block and the upstream (master) PID blocks have an actual mode of **IMan**.

If the instrument connected to the AI block fails, you can place the AI block in Manual mode and set the output to some nominal value for use in the Integrator function block. In this case, IN at the slave PID block is constant and prevents the integral term from increasing or decreasing.

Figure D-9. Function Block Diagram for
Cascade Control with Override



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TROUBLESHOOTING

Refer to Table D-3 to troubleshoot any problems that you encounter.

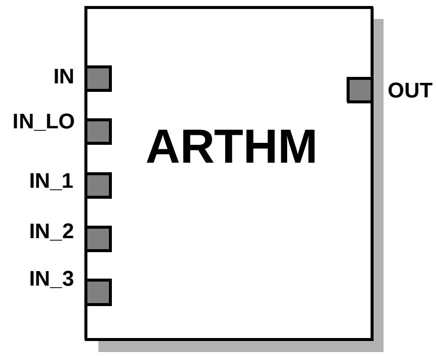
TABLE D-3. Troubleshooting

Symptom	Possible Causes	Corrective Action
Mode will not leave OOS	Target mode not set.	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. The following are parameters that must be set before the block is allowed out of OOS: • BYPASS must be off or on and cannot be left at initial value of 0. • OUT_HI_LIM must be less than or equal to OUT_LO_LIM. • SP_HI_LIM must be less than or equal to SP_LO_LIM.
	Resource block	The actual mode of the Resource block is OOS. See Resource Block Diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Typically, BLOCK_ERR will show “Power-Up” for all blocks that are not scheduled. Schedule the block to execute.
Mode will not leave IMAN	Back Calculation	BKCAL_IN • The link is not configured (the status would show “Not Connected”). Configure the BKCAL_IN link to the downstream block. • The downstream block is sending back a Quality of “Bad” or a Status of “Not Invited”. See the appropriate downstream block diagnostics for corrective action.
Mode will not change to AUTO	Target mode not set.	Set target mode to something other than OOS.
	Input	IN • The link is not configured (the status would show “Not Connected”). Configure the IN link to the block. • The upstream block is sending back a Quality of “Bad” or a Status of “Not Invited”. See the appropriate upstream block diagnostics for corrective action.

Symptom	Possible Causes	Corrective Action
Mode will not change to CAS	Target mode not set.	Set target mode to something other than OOS.
	Cascade input	CAS_IN • The link is not configured (the status would show “Not Connected”). Configure the CAS_IN link to the block. • The upstream block is sending back a Quality of “Bad” or a Status of “Not Invited”. See the appropriate up stream block diagnostics for corrective action.
Mode sheds from RCAS to AUTO	Remote Cascade Value	Host system is not writing RCAS_IN with a quality and status of “good cascade” within shed time (see 2 below).
	Shed Timer	The mode shed timer, SHED_RCAS in the resource block is set too low. Increase the value.
Mode sheds from ROUT to MAN	Remote output value	Host system is not writing ROUT_IN with a quality and status of “good cascade” within shed time (see 2 below).
	Shed timer	The mode shed timer, SHED_RCAS, in the resource block is set too low. Increase the value.
Process and/or block alarms will not work.	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.

Appendix E

Arithmetic Function Block



The Arithmetic function block provides the ability to configure a range extension function for a primary input and applies the nine (9) different arithmetic types as compensation to or augmentation of the range extended input. All operations are selected by parameter and input connection.

The nine (9) arithmetic functions are Flow Compensation Linear, Flow Compensation Square Root, Flow Compensation Approximate, BTU Flow, Traditional Multiply and Divide, Average, Summer, Fourth Order Polynomial, and Simple HTG Compensate Level.

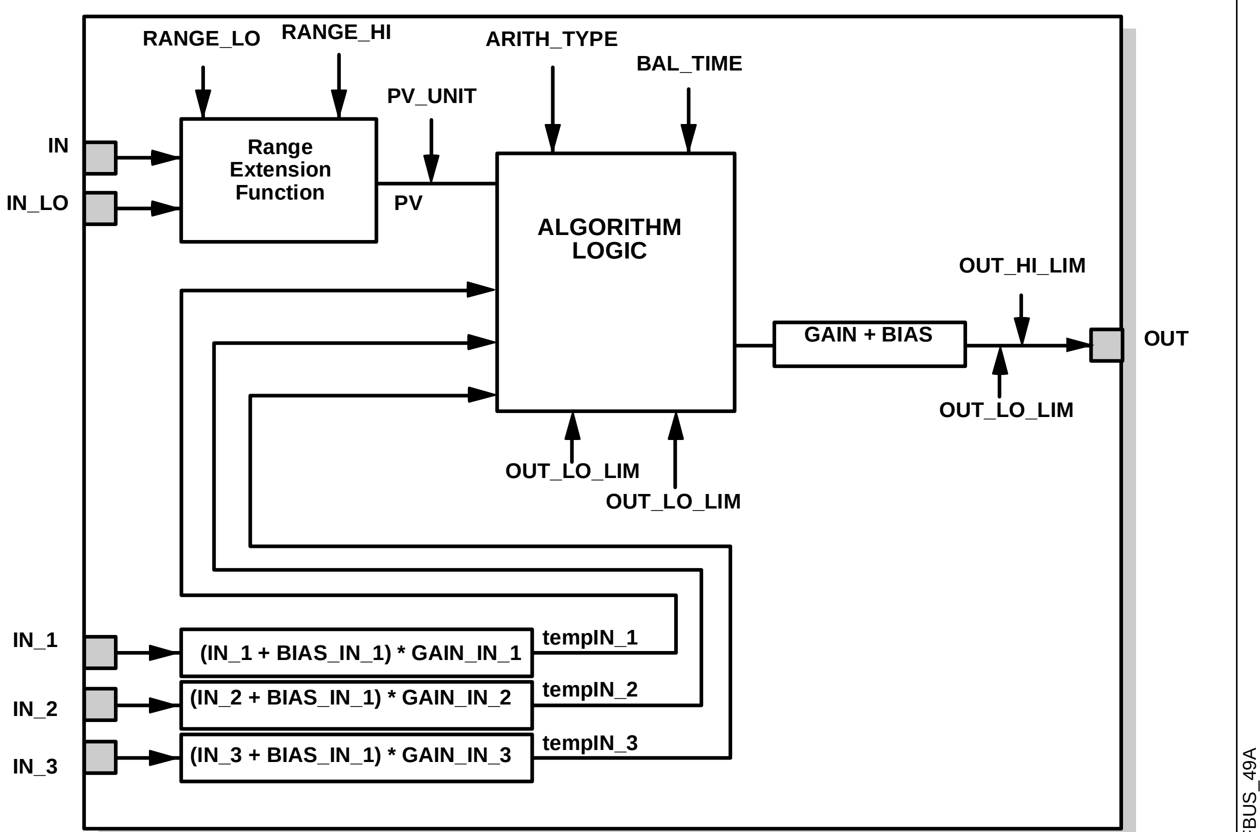
This Arithmetic function block supports mode control (Auto, Manual, Out of Service). There is no standard alarm detection in this block.

TABLE E-1. Arithmetic Block Parameters .

Index Number	Parameter	Units	Description
04	ALERT_KEY	None	The identification number of the plant unit. This information may be used in the host fro sorting alarms, etc.
29	ARITH_TYPE	None	The set of 9 arithmetic functions applied as compensation to or augmentation of the range extended input.
30	BAL_TIME	Seconds	Specifies the time for a block value to match an input, output, or calculated value or the time for dissipation of the internal balancing bias.
31	BIAS	None	The bias value
21	BIAS_IN_1	None	The bias value for IN_1.
23	BIAS_IN_2	None	The bias value for IN_2.
25	BIAS_IN_3	None	The bias value for IN_3.
36	BLOCK_ALM	None	This block alarm is used for all configuration, hardware, connection failure, or system problems 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 parameter. As soon as the Unreported status is cleared by the alert reporting task, and other block alert may be reported without clearing the Active status, if the subcode has changed.
06	BLOCK_ERR	None	The summary of active error conditions associated with the block. The possible block errors are Block configuration error, Simulate active, Local override, Input failure/process variable has Bad status, Output failure, Readback failed, Out of service, and Other. Each function block reports none or a subset of these error conditions.
27	COMP_HI_LIM	EU of PV	Determines the high limit of the compensation input.
28	COMP_LO_LIM	EU of PV	Determines the low limit of the compensation input.
32	GAIN	None	The proportional gain (multiplier) value.
22	GAIN_IN_1	None	The proportional gain (multiplier) value for IN_1
24	GAIN_IN_2	None	The proportional gain (multiplier) value for IN_2
26	GAIN_IN_3	None	The proportional gain (multiplier) value for IN_3
12	GRANT_DENY	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by the device.
14	IN	Determined by source or EU of PV_SCALE	The analog input value and status. The number of inputs is an extensible parameter in some function blocks.
16	IN_1	Determined by supplying block or source.	The first analog input value and status.
17	IN_2	Determined by supplying block or source.	The second analog input value and status.
18	IN_3	Determined by supplying block or source.	The third analog input value and status.
15	IN_LO	None	The value used for the input whenever IN is below range.
13	INPUT_OPTS	None	Sets the options for using IN, IN_LO, IN_1, IN_2 and IN_3 when any are either Bad or Uncertain.
05	MODE_BLK	None	The mode record of the block. MODE contains the actual, target, permitted, and normal modes. In some function blocks, this parameter is used to request and show the source of the setpoint, the source of the output, and/or the block operating state.
08	OUT	EU of OUT_SCALE or Percent or EU of IN	The analog output value and status. The number of outputs is an extensible parameter in some blocks.
33	OUT_HI_LIM	EU of OUT_SCALE or Supplied by IN	The maximum output value allowed.

Index Number	Parameter	Units	Description
34	OUT_LO_LIM	EU of OUT_RANGE or Supplied by IN	The minimum output value allowed.
11	OUT_RANGE	None	Range of the output
09	PRE_OUT	EU of OUT	The pre-trip limit from SP or zero.
07	PV	EU of OUT or EU of PV_SCALE	The process variable used in block execution and alarm limit detection.
10	PV_SCALE	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
19	RANGE_HI	None	The high limit for IN.
20	RANGE_LO	None	The low limit for IN. If IN is less than RANGE_LO, then IN_LO is used.
03	STRATEGY	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
01	ST_REV	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
02	TAG_DESC	None	The user description of the intended application of the block.
35	UPDATE_EVT	None	This alert is generated by any changes to the static data.

Figure E-1. Arithmetic Function Block Schematic



Block Errors

Table E-2 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the ARTHM block and are given here only for your reference.

TABLE E-2. BLOCK_ERR Conditions

Condition Number	Condition Name and Description
0	**Other**: The output has a quality of uncertain.
1	***Block Configuration Error:*** Select type is not configured
2	*Link Configuration Error*
3	*Simulate Active*
4	Local Override
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	**Input Failure/Process Variable has Bad Status:** One of the inputs is Bad or not connected.
8	Output Failure
9	Memory Failure
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	**Power Up**: The device was just powered-up.
15	**Out of Service:** The actual mode is out of service.

Modes

The ARTHM block supports the following modes:

Manual (Man) – The block output (OUT) may be set manually.

Automatic (Auto) – OUT reflects the analog input measurement or the simulated value when simulation is enabled.

Out of Service (O/S) – The block is not processed. FIELD_VAL and PV are not updated and the OUT status is set to Bad: Out of Service. The BLOCK_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.

The target mode of a block bay be restricted to one or more of the supported modes.

Alarm Detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the ISEL block are defined above.

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Block Execution

The Arithmetic function block provides range extension and compensation through nine (9) arithmetic types.

There are two inputs (IN and IN_LO) used in calculating PV. PV is then combined with up to three inputs (IN_1, IN_2, and IN_3) through the user selected compensation function (ARITH_TYPE) to calculate the value of func. A gain is applied to func and then a bias is added to get the value PRE_OUT. In AUTO, PRE_OUT is used for OUT.

Range Extension and Calculation of PV

When both IN and IN_LO are usable, the following formula is applied to calculate range extension for PV:

$$PV = G \bullet IN + (1 - G) \bullet IN\_LO$$

G has a range from 0 to 1, for IN from RANGE_LO to RANGE_HI.

Compensation Input Calculations

For each of the inputs IN_1, IN_3, IN_4 there is a gain and bias. The compensation terms (t) are calculated as follows:

- When IN_(k) is usable:

$$t(k) = GAIN\_IN(k) \bullet (BIAS\_IN(k) + IN\_(k))$$

- When IN_(k) is not usable, then t(k) gets the value of the last t(k) computed with a usable input.

Status Handling

IN_x Use Bad

IN_x Use Uncertain

IN_LO Use Uncertain

IN Use Uncertain

For complete descriptions of supported input options, refer to the Option Bitstring Parameters topic.

Application Information

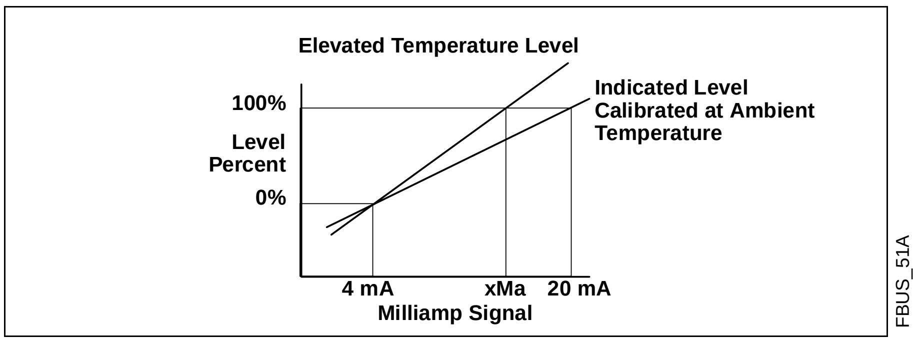
The Arithmetic function block can be used to calculate tank level changes based on greatly changing temperature conditions in devices that depend on the physical properties of the fluid.

For example, a differential pressure cell's analog input can be scaled initially to provide a 4-20 mA signal for 0-100% of level indication. As the temperature of the system rises, the density of the fluid decreases. For a system that requires accurate level indication at widely ranging temperature, changing density proves inconvenient.

The Arithmetic function block allows for the automatic compensation of this change by incorporating gain and bias adjustments to the temperature signal. It then applies both the compensated temperature signal and the level signal to a characteristic system equation. The result is a level that is a true indication of fluid in the vessel.

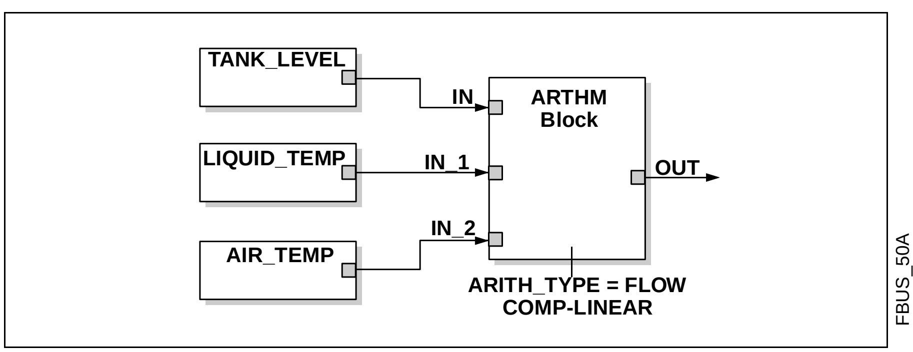
Different fluids over the same temperature range have different effects on level due to their thermal expansion coefficients. Vessel geometry also plays a major role. As the height of the vessel increases, the effect of thermal expansion becomes more apparent. The following figure shows the relative temperature effects on a level signal.

Figure E-2. Relative Temperature Effects on Level



The calculation is done by applying the level signal to the IN connector, the liquid temperature to the IN_1 connector, and the ambient air temperature to the IN_2 connector. Select the Arithmetic type (ARITH_TYPE) of Flow Compensation - Linear. This allows a ratio to be set up that increases the level indication at block output for an increase in the tank temperature relative to ambient temperature.

Figure E-3. Arithmetic Function Block Diagram Example



This application can be applied to very large storage tanks whose contents are subject to thermal expansion and contraction during seasonal changes in temperature.

Advanced Topics

Arithmetic Types

The parameter, ARITH_TYPE, determines how PV and the compensation terms (t) are combined. User may select from nine (9) commonly used math functions, depicted below. COMP_HI and COMP_LO are compensation limits.

Flow Compensation Linear	Flow Compensation Square Root
$func = PV \bullet f$ $f = \frac{t(1)}{t(2)}$ limited between COMP_HI and COMP_LO	$func = PV \bullet f$ $f = \sqrt{\frac{t(1) \bullet t(3)}{t(2)}}$ limited between COMP_HI and COMP_LO

If there is a divide by zero and the numerator is positive, f is set to COMP_HI; if the numerator is negative, then f is set to COMP_LO. The square root of a negative value will equal the negative of the square root of the absolute value. Imaginary roots are not supported.

Flow Compensation Approximate	BTU Flow	Traditional Multiply and Divide
$func = PV \bullet f$ $f = t(1) \bullet t(2) \bullet t(3)^2$ limited between COMP_HI and COMP_LO	$f = PV \bullet f$ $f = t(1) - t(2)$ limited between COMP_HI and COMP_LO	$f = PV \bullet f$ $f = \frac{t(1)}{t(2)} + t(3)$ limited between COMP_HI and COMP_LO

If there is a divide by zero and numerator is positive, f will be limited to COMP_HI; if the numerator is negative, f will be limited to COMP_LO.

Compensation inputs which are not usable are not included in the calculation. PV is always included.

Average
$SUM = PV.VAL; n = 1$ $For k = 1, 3 \{sum = sum + t(k); n = (n+1)\} EndFor$ $func = \frac{sum}{n}$

Summer
$SUM = PV$ $For k = 1, 3 \{sum = sum + t(k); n = (n+1)\} EndFor$ $func = sum$

Compensation inputs which are not configured are not used in the calculation. PV is always used.

Forth Order Polynomial
$$func = PV + t(1)^2 + t(2)^3 + t(3)^4$$
Simple HTG Compensate Level
$$func = \frac{PV - t(1)}{PV - t(2)}$$

If there is a divide by zero and the numerator is positive, func will be limited to COMP_HI; if the numerator is negative, func will be limited to COMP_LO.

TROUBLESHOOTING

Refer to Table E-3 to troubleshoot any problems that you encounter.

TABLE E-3. Troubleshooting

Symptom	Possible Causes	Corrective Action
Model will not leave OOS	Target model not set	Set target mode to something other than OOS
	Configuration error	BLOCK_ERR will show the configuration error set. ARITH_TYPE must be set to a valid value and cannot be left at 0.
	Resource Block	The actual mode of the Resource block is OOS. See Resource block diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to the target mode. Typically, BLOCK_ERR will show “Power-Up” for all blocks that are not scheduled. Schedule the block to execute.
Status of outputs is BAD	Inputs	Input has BAD status.
Block alarms will not work	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alert bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has the Propagate Fault Forward bit set. This must be cleared to cause the alarm to occur.

Appendix F

Signal Characterizer Function Block

IN_1 and IN_2=The input values to the block.
OUT_1=The output associated with IN_1.
OUT_2=The output associated with IN_2.

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The Signal Characterizer (SGCR) function block characterizes or approximates any function that defines an input/output relationship. The function is defined by configuring as many as twenty X,Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates. Two separate analog input signals can be processed simultaneously to give two corresponding separate output values using the same defined curve.

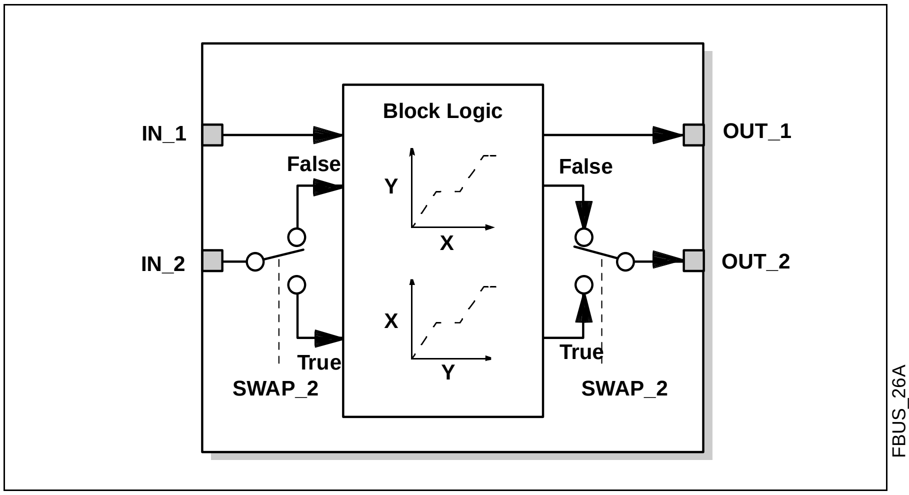
The SGCR block supports signal status propagation. There are no standard alarms in this function block. Custom alarms are supported.

Figure F-1 illustrates the internal components of the SGCR function block, and Table F-1 lists the system parameters. The block correlates the input IN_1 to the output OUT_1 and the input IN_2 to the output OUT_2 according to the configured curve. You can configure the curve by defining as many as twenty pairs of X,Y values in the CURVE_X and CURVE_Y parameters. The CURVE_X array defines the input values (X1 to X20) and the CURVE_Y array defines the output values (Y1 to Y20).

TABLE F-1. Signal Characterizer Function Block System Parameters

Index Number	Attribute	Units	Description
04	ALERT_KEY	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
18	BLOCK_ALM	None	This block alarm is used for all configuration, hardware, connection failure or system problems 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 parameter. As soon as the Unreported status is cleared by the alert reporting task, and other block alert may be reported without clearing the Active status, if the subcode has changed.
06	BLOCK_ERR	None	The summary of active error conditions associated with the block. The block errors for the Signal Characterizer function block are Block configuration error and Out of service.
15	CURVE_X	Determined by source	The array of input curve values (as many as 20 points).
16	CURVE_Y	Determined by source	The array of output curve values (as many as 20 points).
11	GRANT_DENY	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by the device.
12	IN_1	Determined by source	The first analog input value and status.
13	IN_2	Determined by source	The second analog input value and status.
05	MODE_BLK	None	The mode record of the block. Contains the actual, target, permitted, and normal modes.
07	OUT_1	EU of Y_RANGE	The analog output value and status related to IN_1.
08	OUT_2	EU of X_RANGE	The analog output value and status related to IN_2.
03	STRATEGY	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
01	ST_REV	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
14	SWAP_2	None	Swaps the X and Y axes used for OUT_2.
02	TAG_DESC	None	The user description of the intended application of the block.
17	UPDATE_EVT	None	This alert is generated by any changes to the static data
09	X_RANGE	None	Range of the X variable
10	Y_RANGE	None	Range of the Y variable

Figure F-1. Signal Characterizer Function Block Schematic



Block Errors

Table F-2 lists conditions reported in the BLOCK_ERR parameter. Conditions in *italics* are inactive for the ISEL block and are given here only for your reference.

TABLE F-2. BLOCK_ERR Conditions

Condition Number	Condition Name and Description
0	**Other**: The output has a quality of uncertain.
1	***Block Configuration Error:*** Select type is not configured
2	*Link Configuration Error*
3	*Simulate Active*
4	Local Override
5	*Device Fault State Set*
6	*Device Needs Maintenance Soon*
7	**Input Failure/Process Variable has Bad Status:** One of the inputs is Bad or not connected.
8	Output Failure
9	Memory Failure
10	*Lost Static Data*
11	*Lost NV Data*
12	*Readback Check Failed*
13	*Device Needs Maintenance Now*
14	**Power Up**: The device was just powered-up.
15	**Out of Service:** The actual mode is out of service.

Modes

The Signal Characterizer function block supports the following modes:

Automatic (Auto) – The outputs are controlled by the block.

Out of Service (O/S) – The block is not processed. The block is placed in O/S mode when both IN_1 and IN_2 inputs have Bad statuses. The BLOCK_ERR attribute shows Out of service.

The target mode of a block bay be restricted to one or more of the supported modes.

Alarm Detection

A block alarm will be generated whenever the BLOCK_ERR has an error bit set. The types of block error for the ISEL block are defined above.

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Block Execution

For any given input value, the SGCR block determines where the input lies in CURVE_X and calculates the slope of that segment using the point-slope method:

$$y = mx + b$$

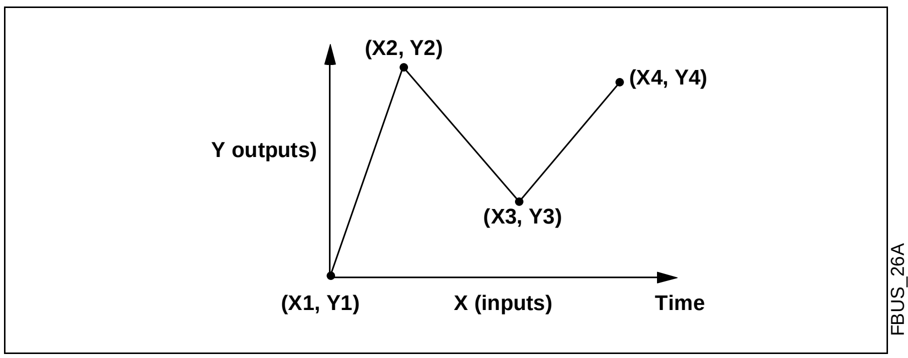
Where	
m:	slope of line
b:	intercept of the line

Using this formula, the block derives an output value that corresponds to the input. When the input lies beyond the range configured in CURVE_X, the output is clamped to the corresponding limit in the CURVE_Y array.

CURVE_X Values

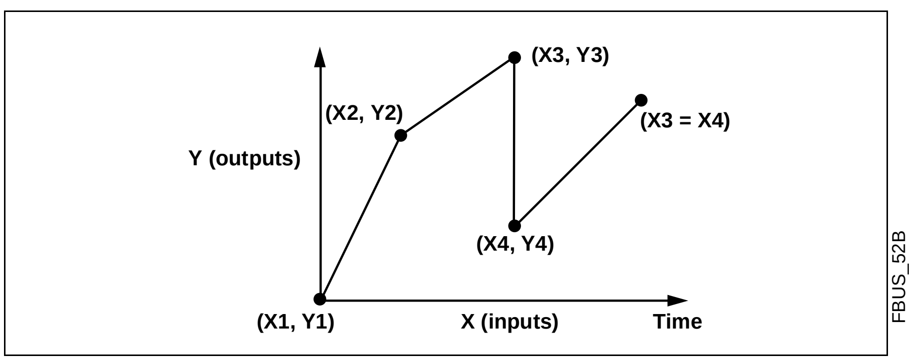
The CURVE_X values must be defined in ascending order. The X1 element must be the smallest value and each following X value must be larger than the previous X value (see Figure F-2). If the X values are not configured in ascending order, a block alarm is set and the last X value that is larger than the previous one is used as the curve endpoint.

Figure F-2. Example of Valid Signal Characterizer Function Block CURVE_X Values



The curve in Figure F-3 has an invalid definition because X3 is greater than X4. Between these points, the Y value is undefined because it can be any value from Y3 to Y4. In this configuration, the X3,Y3 pair becomes the endpoint for the curve definition. To use the X4,Y4 pair, you must designate X4 to be greater than or equal to X3.

Figure F-3. Example of Invalid Signal Characterizer Function Block CURVE_X Values

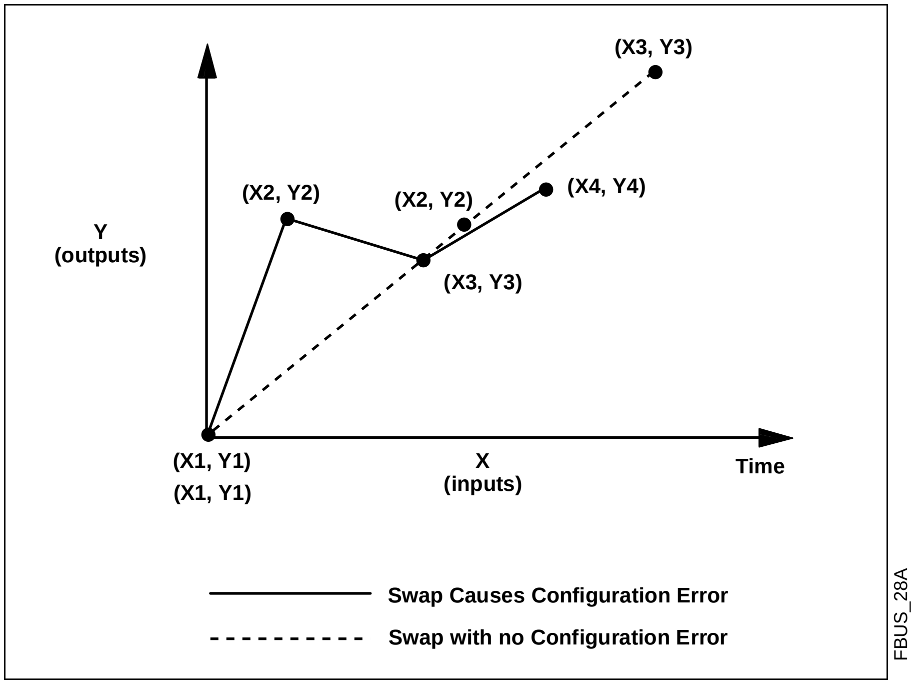


SWAP_2 Parameter

The SWAP_2 parameter swaps the X and Y axes used for OUT_2. When the SWAP_2 parameter is *True*, IN_2 references the CURVE_Y values and OUT_2 references the CURVE_X values. In addition, the IN_2 units change to Y_UNITS and the OUT_2 units change to X_UNITS.

The block sets a configuration error when SWAP_2 is *True* and the CURVE_Y elements are not configured in an increasing manner. Figure F-4 illustrates how the block configuration error (BLOCK_ERR) is set during a SWAP_2 action.

Figure F-4. Example of a Signal Characterizer Function Block SWAP_2 Configuration Error



When swap is in effect, the first curve has an invalid definition because Y3 is less than Y2. In this configuration, the X2,Y2 pair becomes the endpoint for the swapped curve definition when processing IN_2. Note that the X4,Y4 pair is the valid endpoint when processing IN_1.

Block Errors

The following conditions are reported in the BLOCK_ERR attribute:

Block configuration error – The curve definition is truncated (fewer than 20 points are defined) and the X value of the X,Y pairs beyond the valid definition are nonzero. The block still performs the signal characterizer function.

Out of service – The block is in Out of Service (OOS) mode.

Status Handling

The OUT_1 status is set to the IN_1 status and the OUT_2 status is set to the IN_2 status. When one of the curve limits is reached, the appropriate limit is set in the substatus.

Application Information

You can use the SGCR block as a curve fitting function. For example, you can scale a 4 to 20 mA input signal to a 0 to 100% output value using the block. You can also use the block to convert measurements from a split-range or other nonlinear device or from a dual-temperature control device used for both heating and cooling.

You can use the SGCR block to alter the relationship of a PID block output to valve position, and thereby gain more linear control over a critical region.

TROUBLESHOOTING

Refer to Table F-3 to troubleshoot any problems that you encounter.

TABLE F-3. Troubleshooting

Symptom	Possible Causes	Corrective Action
Model will not leave OOS	Target model not set	Set target mode to something other than OOS
	Configuration error	BLOCK_ERR will show the configuration error set. CURVE_X and CURVE_Y are not set correctly. See description of CURVE_X for further details.
	Resource block	The actual mode of the Resource block is OOS. See Resource block diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to the target mode. Typically, BLOCK_ERR will show “Power-Up” for all blocks that are not scheduled. Schedule the block to execute.
Status of outputs is BAD	Inputs	Input has BAD status.
Block alarms will not work	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alert bit.
	Notifications	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has the Propagate Fault Forward bit set. This must be cleared to cause the alarm to occur.

Appendix G

Operation with Fisher-Rosemount® DeltaV™

INTRODUCTION

This appendix provides specific instructions for performing basic configuration operations on the Model 3244MV using the Fisher-Rosemount DeltaV host software. It is not a comprehensive resource, rather a starting point. For more information, refer to the following sources:

- **Section 3: Operation** for complete information about the transmitter operation that does not depend upon the host software.
- **Section 4: Transducer Block** for complete information about the transducer block and its parameters.
- **Section 5: Resource Block** for complete information about the resource block and its parameters.
- **Appendix A: Foundation**™ Fieldbus Technology for general information about FOUNDATION fieldbus.
- **Appendix B: Analog Input Function Block** for complete information about the Analog Input block and its parameters.
- **Appendix C: Input Selector Function Block** for complete information about the Input Selector Block and its parameters.
- **Appendix D: PID Function Block** for complete information about the Proportional/Integral/Derivative block and its parameters.
- **DeltaV (or your host software title) On-line Help or Documentation** for complete information about navigating in the host software that you are using (supplied by the software manufacturer).

About DeltaV Software with AMS*inside*

AMS*inside* DeltaV software allows users to manage their instrumentation, and to perform on-line configurations of their instruments. The ability to communicate with instruments and configure instruments on-line facilitates instrument commissioning and loop validation. With AMS*inside*, users can also access status and diagnostic data from smart devices and monitor their performance. AMS leverages the I/O capabilities of the control system to gather asset management data without interfering with the control system's operations.

SOFTWARE FUNCTIONALITY

The Model 3244MV with FOUNDATION fieldbus software is designed to permit remote testing and configuration using the Fisher-Rosemount DeltaV™ Fieldbus configuration tool, or other FOUNDATION fieldbus host.

Configure the Model 3244MV

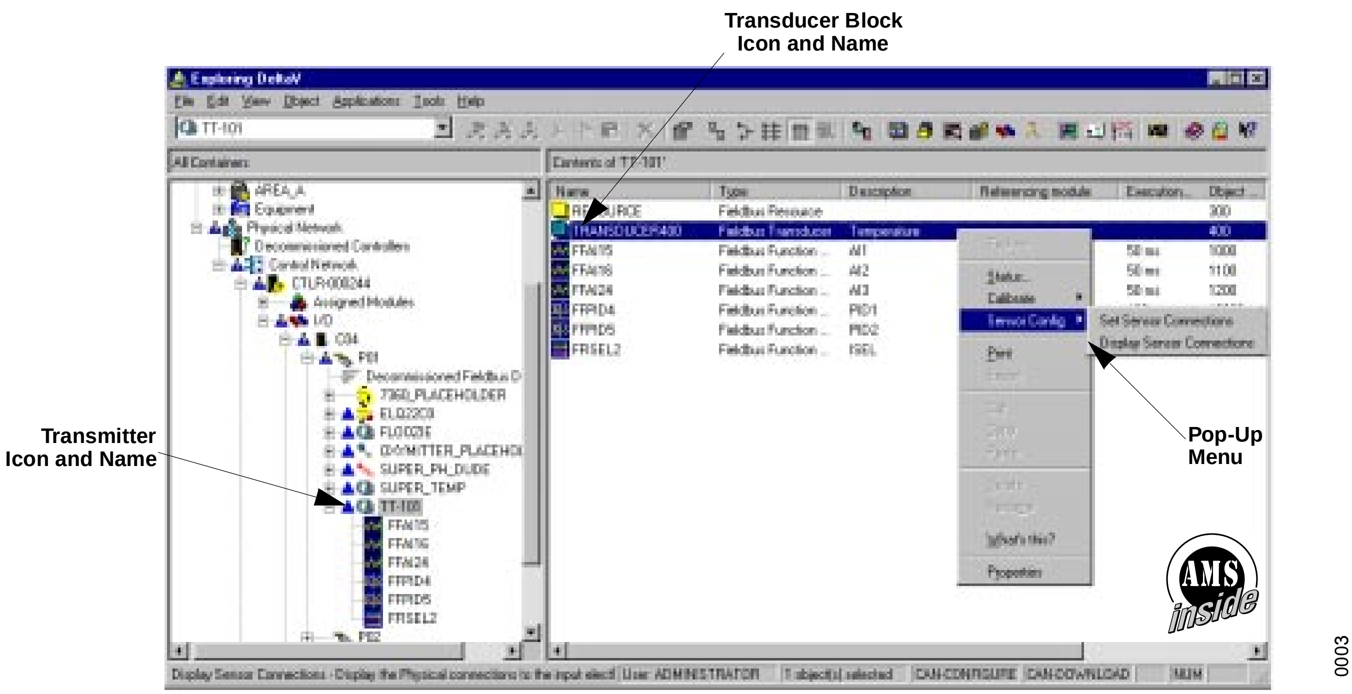
Configuring the Model 3244MV MultiVariable Temperature Transmitter involves first configuring the sensor connections and optionally calibrating the sensor.

Configure the Sensor Connections

Refer to Figure G-1 and the steps below to configure the sensor connections:

1. Locate the transmitter icon in DeltaV Explorer **All Containers** window and left-click once on the transmitter icon or name.
2. Locate the transducer block icon in the **Contents of. . .** window and right-click once on the block icon or name.
3. Select **Sensor Config > Set Sensor Connections** from the pop-up menu.
4. Follow the on-screen instructions through the sensor configuration steps.

Figure G-1. Navigating to Sensor Connections



Display Sensor Connections

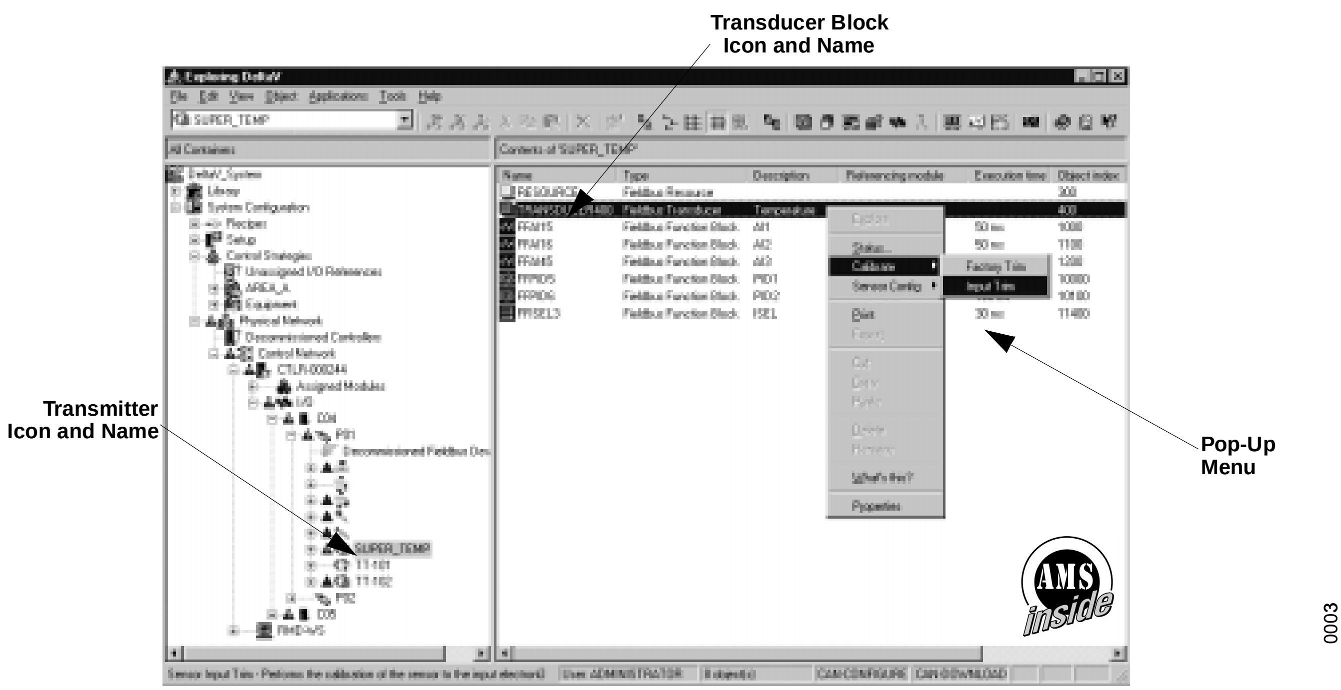
To display the sensor connections, including the special sensor matching coefficients (A, B, C, and R_0) or Callandar-Van Dusen constants (α, β, δ, and R_0), right click on the transducer block icon or name, then select **Sensor Config > Display Sensor Connections** from the pop-up menu. (See Figure G-1.)

Calibrating the Sensor (Input Trim)

To calibrate the sensor to your own (non-factory) specification refer to Figure G-3 and the steps below:

1. Locate the transmitter icon in DeltaV Explorer **All Containers** window and left-click once on the transmitter icon or name.
2. Locate the transducer block icon in the **Contents of. . .** window and right-click once on the block icon or name.
3. Select **Calibrate > Input Trim** from the pop-up menu.
4. Follow the on-screen instructions through the input trim steps.

Figure G-2. Navigating to Input Trim

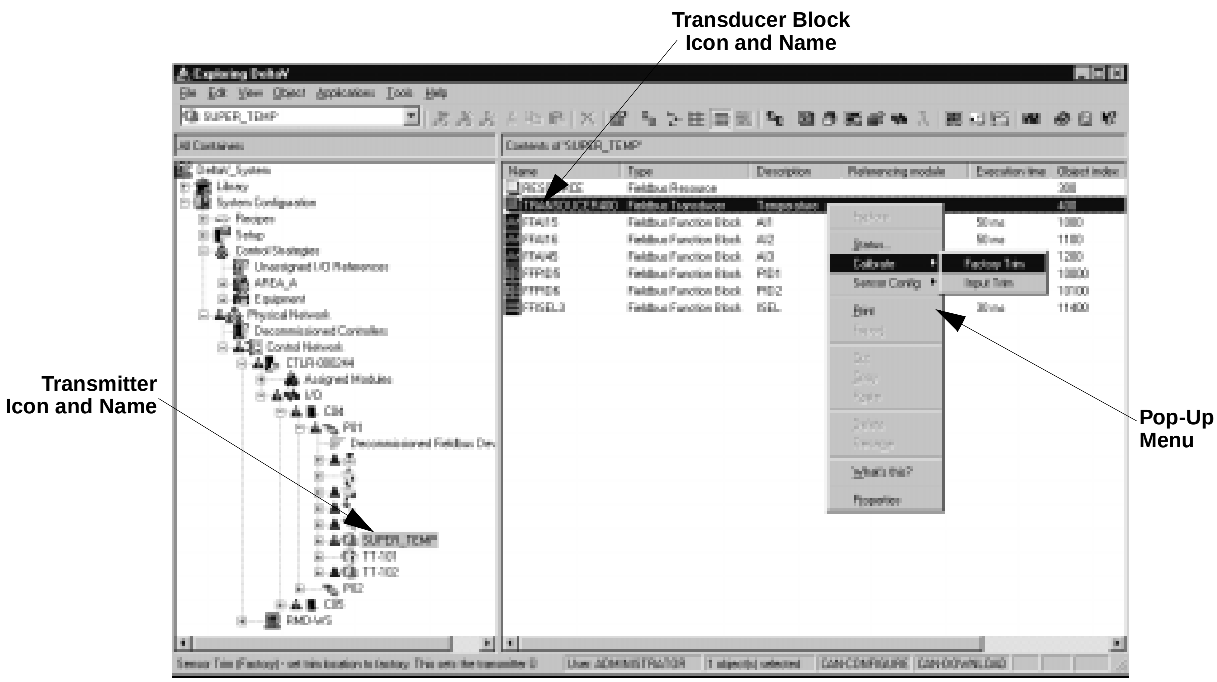


Calibrating the Sensor (Factory Trim)

To calibrate the sensor to factory specifications refer to Figure G-4 and the steps below:

1. Locate the transmitter icon in DeltaV Explorer **All Containers** window and left-click once on the transmitter icon or name.
2. Locate the transducer block icon in the **Contents of. . .** window and right-click once on the block icon or name.
3. Select **Calibrate > Factory Trim** from the pop-up menu.
4. Follow the on-screen instructions through the factory trim steps.

Figure G-3. Navigating to Factory Trim



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CONFIGURE THE LOOP

To completely configure the transmitter for use in a Fieldbus loop, you must perform the following procedures:

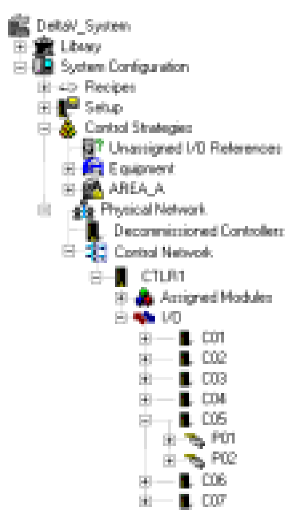
1. **Create a device profile** – A device profile is an electronic representation of the transmitter that exists only in the DeltaV. It is like a place-holder for a certain type of transmitter.
2. **Define a control strategy** – The control strategy is the relationship between all of the function blocks on the Fieldbus segment.
3. **Commission the device** – Commissioning the device involves copying all applicable parameters from the device profile to the physical device.
4. **Set Transmitter Configuration Parameters** – Setting transmitter configuration parameters configures the device for use in your specific application.
5. **Download the control strategy to the device** – Downloading the control strategy to the device transfers the control strategy from the DeltaV to the transmitter, where it governs the relationship and operation of all function blocks.

NOTE
The following procedures assume that the DeltaV and the transmitter are installed and powered.

Create a Device Profile

1. Select **DeltaV > Engineering > DeltaV Explorer** from the start menu.
2. Navigate through the file structure to the listing of Fieldbus ports (see Figure G-4).

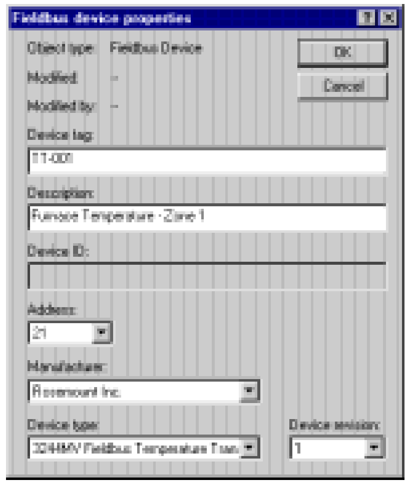
Figure G-4. Location of Fieldbus Ports



3. Right click on the port to which you wish to connect the new Fieldbus device, and select **New Fieldbus Device** from the menu that appears.

The **Fieldbus Device Properties** window appears (see Figure G-5).

Figure G-5. **Fieldbus Device Properties** Window



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4. Enter all appropriate device information in the window.

NOTE
The DeltaV software automatically completes the **Address** field. You can customize these fields, but it usually is not necessary. Select the device revision based upon the transmitters to be used.

5. Select "OK" to add the device to the segment.

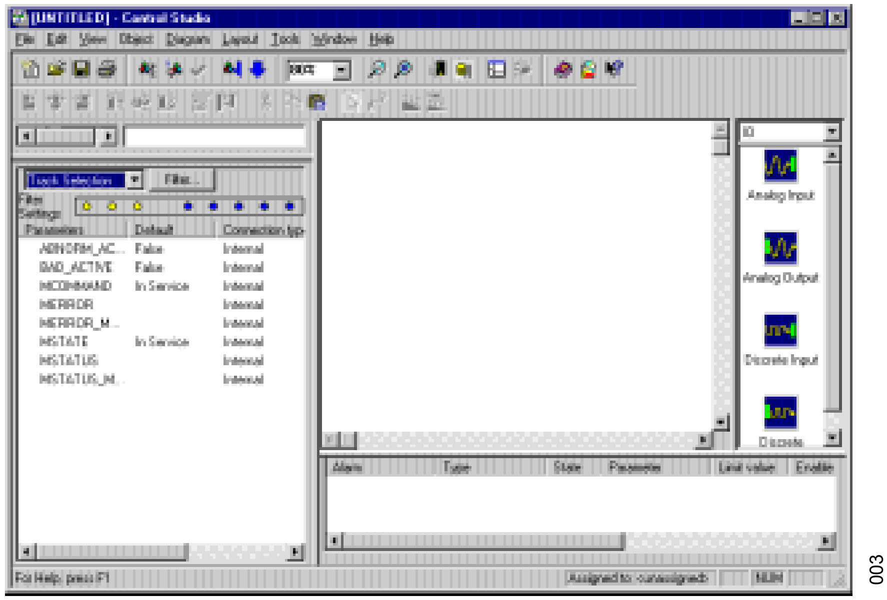
The device appears on the segment as a non-commissioned Fieldbus device (TT-001).

Define the Control Strategy

1. Select **DeltaV > Engineering > Control Studio** from the start menu.

The main control studio screen appears (see Figure G-6).

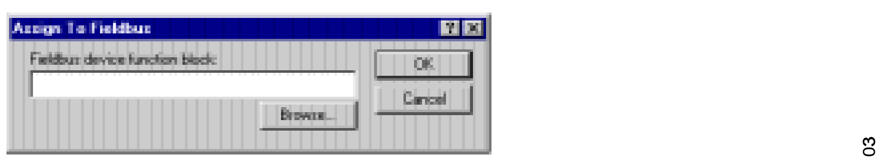
Figure G-6. Main Control Studio Screen



2. Select the function blocks you wish to add from the menu along the right side of the window. For the purpose of this example, we will add an AI, a PID, and an AO block.
3. Right click on each block and select **Rename** from the menu that appears to rename the block with an appropriate tag.
4. Right click on each block and select **Assign I/O > to Fieldbus...** to assign the I/O.

The **Assign to Fieldbus** window appears (see Figure G-7).

Figure G-7. **Assign to Fieldbus** Window



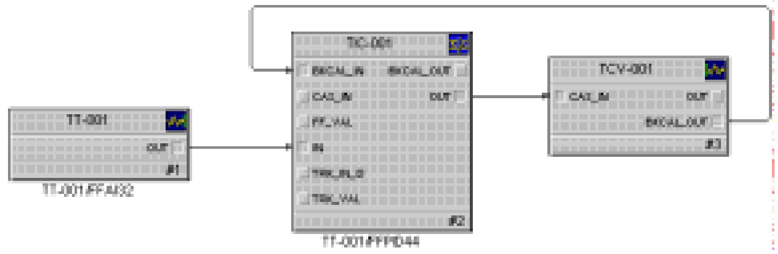
5. Select “Browse” to select the device to which you wish to assign each block.

You will have to navigate through the correct controller, I/O, card, and port to reach the device.

6. Connect the blocks as you want them to execute. For the purpose of this example, we connected the blocks as in Figure G-8.

NOTE
If you are not able to draw connections between the blocks as in Figure G-8), select the “Connect” button ( ) and try again.

Figure G-8. Basic Control Strategy



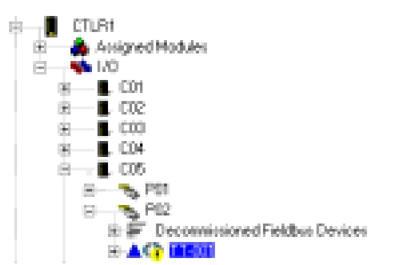
7. Save the control strategy.
8. Select the "Assign to Node" button ( ) to assign the strategy to the correct node in the controller.

Commission the Transmitter

To commission the transmitter you simply need to drag the appropriate device from the **Decommissioned Fieldbus Device** folder to the appropriate device profile.

1. Select **DeltaV > Engineering > DeltaV Explorer** from the start menu.
2. Select the device you wish to commission from the **Decommissioned Fieldbus Devices** folder. The device will be listed under its unique serial number (0011513244DVT900311531O3013).
3. Drag the decommissioned device to the device profile that you created earlier (see Figure G-9).

Figure G-9. Sample Location of a Transmitter Profile in **DeltaV Explorer**



The **Device Commissioning Wizard – Start** window appears (see Figure G-10).

Figure G-10. **Device Commissioning Wizard – Start** window.

4. Select "Next."

The **Device Commissioning Wizard – Reconcile Block** window 1 appears (see Figure G-11).

Figure G-11. **Device Commissioning Wizard – Reconcile Block 1** window

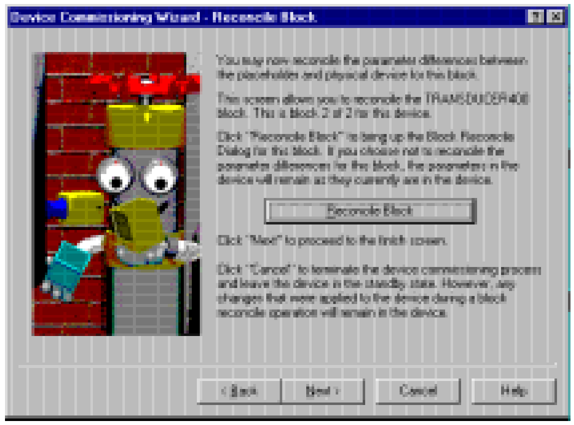
NOTE
If you wish to reconcile differences between the Resource block in the transmitter and the Resource block in the device profile that you created, select "Reconcile Block." If you wish to override the settings in the device profile with the settings in the device, go to Step 5.

---

5. Select "Next."

The **Device Commissioning Wizard – Reconcile Block** window 2 appears (see Figure G-12).

Figure G-12. **Device Commissioning Wizard – Reconcile Block 2** window



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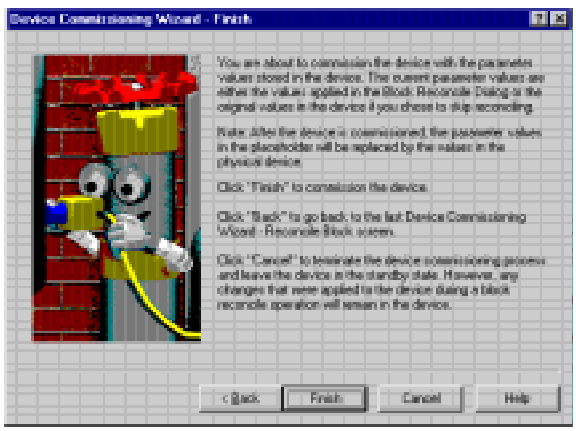
NOTE
If you wish to reconcile differences between the Transducer block in the transmitter and the Transducer block in the device profile that you created, select "Reconcile Block." If you wish to override the settings in the device profile with the settings in the device, go to Step 6.

6. Select "Next."

The **Device Commissioning Wizard – Finish** window appears (see Figure G-13).

Figure G-13. **Device Commissioning Wizard – Finish** window



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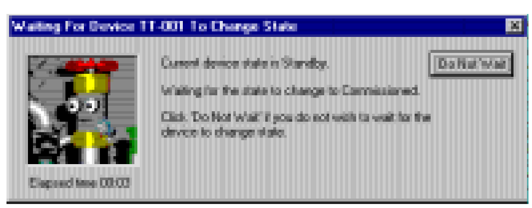
7. Select "Finish."

A window appears informing you that DeltaV is waiting for the device to change from a decommissioned to a commissioned state (see Figure G-14). This process may take several minutes.

Figure G-14. **Device Commissioning Wizard – Finish** window



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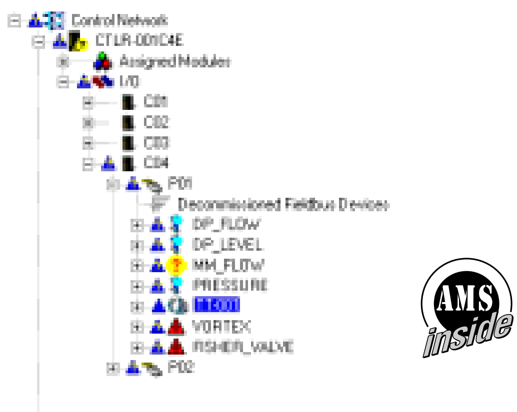
Once the DeltaV finishes commissioning the device, the icon in DeltaV Explorer changes from non-commissioned (TT-001) to commissioned (TT-001).

Set Transmitter Configuration Parameters

1. Select **DeltaV > Engineering > DeltaV Explorer** from the Start menu
2. Navigate through the file structure to find the transmitter you wish to configure (see Figure G-15)

Figure G-15. Sample Location of a Transmitter in **DeltaV Explorer**



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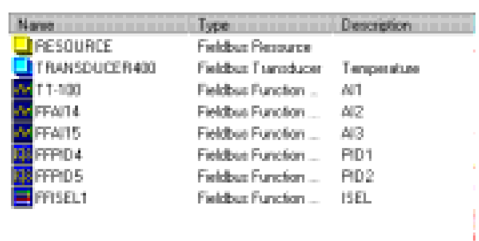
3. Double click the transmitter you wish to configure.

The function blocks within the transmitter appear in the right half of the Delta V Explorer window (see Figure G-16).

Figure G-16. List of Function Blocks in **DeltaV Explorer**



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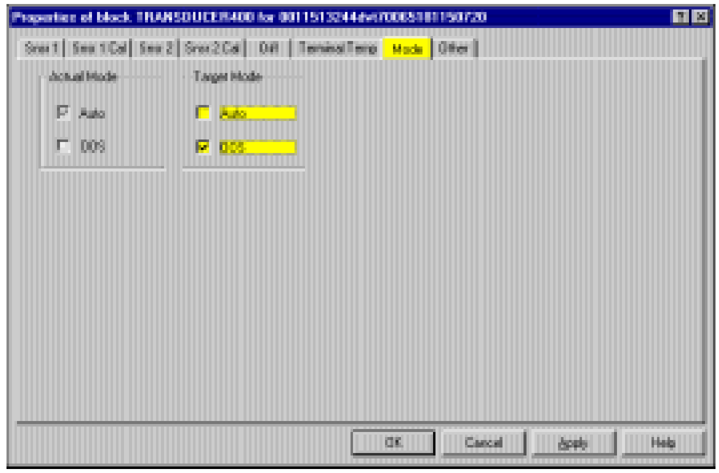
4. Double click on the TRANSDUCER block icon.

The transducer block properties window appears (see Figure G-17).

Figure G-17. Transducer Block Properties Window



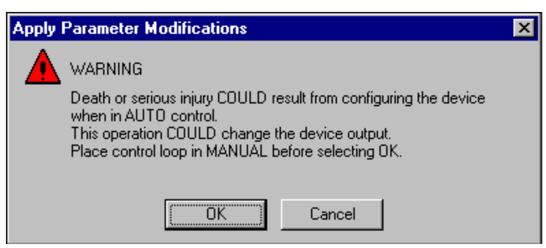
5. Select the **Mode** tab.
6. Select Out of Service (**OOS**) and deselect **Auto** in the **Target Mode** region of the window.

The parameters you change in the properties window remain highlighted (as in Figure G-17) so you can easily track changes.

7. Click the **Apply** button to apply the changes you made.

The software warns you that the changes you made may upset the process and create a dangerous situation in your plant (see Figure G-18). Before you select **OK**, verify that the control loop is in manual control.

Figure G-18. Transducer Block Properties Window



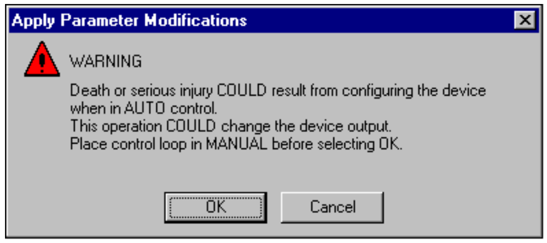
The **Actual Mode** region changes to **OOS**.

8. Click **OK** to return to the Delta V Explorer.
9. Right click on the TRANSDUCER block icon to access the configuration parameters menu.
10. Select the parameter you wish to configure, and follow the on-line instructions to complete the configuration.

NOTE
As you make changes to the configuration parameters, the software warns you that the changes you made may upset the process and create a dangerous situation in your plant (see Figure G-19). Before you select **OK**, verify that the control loop is in manual control.

See **Section 4: Transducer Block** to change the sensor type and to calibrate the sensors.

Figure G-19. Transducer Block Properties Window



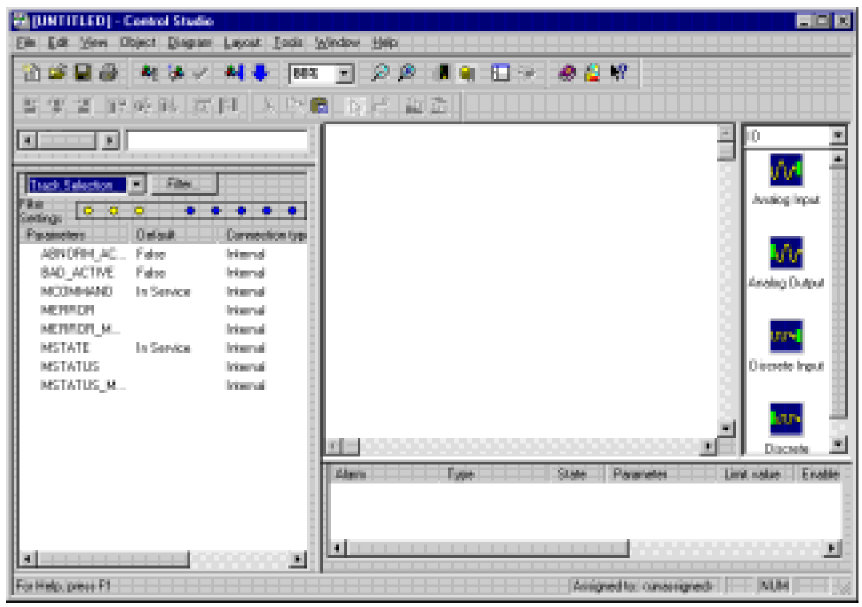
11. Repeat Steps 4 through 8 to return the mode of the transducer block to **Auto**.

Download the Control Strategy to the Device

1. Select **DeltaV > Engineering > Control Studio** from the start menu.

The main control studio screen appears (see Figure G-20).

Figure G-20. Main Control Studio Screen



2. Open the control strategy that you defined on Pages G-7 and G-8.

3. Click the "Download" button ( ), and follow the on-line instructions to download the control strategy to the transmitter.

Updating the DD files

Use the following steps to update the DD files:

1. Open “Exploring Delta V.”
2. Select/Expand “library” (Under DeltaV_System).
3. Select “Fieldbus Device.”
4. Using the right mouse button, click “Fieldbus Device.” This will bring up a list of options.
5. From the list, select “Add Device Definition.” This should give you a “Browser for folder” selection box.
6. Go to the directory that contains the 7 files needed to “register” a new device with DeltaV. These files will consist of 3 *.dll files, *.sym, *.ffl, *.fhx, and *.reg file. These files can be obtained from http:\\www.rosemount.com.
7. After answering “yes” to the first prompt, DeltaV will start the installation.

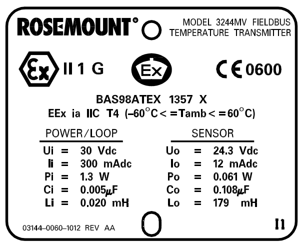
Appendix H

European ATEX Directive Information

CENELEC/BASEEFA

Intrinsic Safety

Model 3244MV MultiVariable Temperature Transmitters with FOUNDATION Fieldbus that have the following label attached have been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19–April–1994.



0060H01A

The following information is provided as part of the labeling of the transmitter:

- Name and address of the manufacturer (may be any of the following):
- Rosemount USA
- Rosemount England
- Rosemount Germany
- Rosemount Singapore

0600

EX

- Complete model number (see **Section 7: Specifications and Reference Data**).
- The serial number of the device
- Year of construction
- Marking for explosion protection: II 1 G
- Required Parameters:
- EEx ia IIC T4 (–60 °C <= T_{amb} <= 60 °C)

ALONE

Power/Loop	Sensor
U_i = 30 V dc	U_o = 24.3 V dc
I_i = 300 mA dc	I_o = 12 mA dc
P_i = 1.3 W	P_o = 0.061 W
C_i = 0.005 μF	C_o = 0.108 μF
L_i = 0.020 mH	L_o = 179 mH

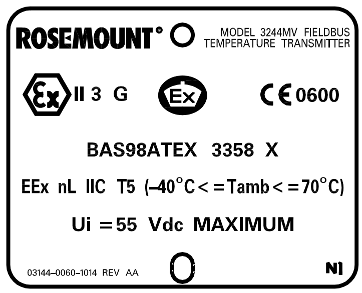
- Cert. No: BAS98ATEX 1357 X

Special conditions for safe use (X):

The transmitter is not capable of withstanding the insulation test required by EN50 020, Clause 5.7 (1977). This condition must be taken into account during installation.

CENELEC/BASEEFA Type N Approval

Rosemount Model 3244MV MultiVariable Temperature Transmitters with FOUNDATION Fieldbus that have the following label attached, have been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on
19–April–1994.



0060G30A

The following information is provided as part of the labeling of the transmitter:

- Name and address of the manufacturer (may be any of the following):
- Rosemount USA
- Rosemount England
- Rosemount Germany
- Rosemount Singapore

CE 0600

ALONE

- Complete model number (see **Section 7: Specifications and Reference Data**).
- The serial number of the device
- Year of construction
- Marking for explosion protection: Ex II 3 G
- Required Parameters:
- EEx nL IIC T5 (–40 °C <= T_{amb} <= 70 °C)
- Cert. No: BAS98ATEX 3358 X

EX

Special conditions for safe use (X):

The transmitter is not capable of withstanding the electrical strength test required by Clause 9.1 of EN 50021: 1998. This condition must be taken into account during installation.

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Product documentation available at...
www.rosemount.com

http://www.rosemount.com

00809-0100-4769 Rev BA 07/00

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