Reference Manual
00809-0200-4801, Rev FA
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Rosemount™ 3051S Series Pressure Transmitter

with FOUNDATION™ Fieldbus Protocol

ROSEMOUNT™

EMERSON™

Safety messages

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 this product.

See listed technical assistance contacts.

Customer Central

Technical support, quoting, and order-related questions.

United States - 1-800-999-9307 (7:00 am to 7:00 pm CST)

Asia Pacific- 65 777 211

Europe/ Middle East/Africa - 49 (8153) 9390

North American Response Center

Equipment service needs.

1-800-654-7768 (24 hours—includes Canada)

Outside of these areas, contact your local Emerson representative.

⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Emerson Sales Representative.

⚠ WARNING

Explosions can result in death or serious injury.

Do not remove the transmitter covers in explosive environments when the circuit is live.

Fully engage both transmitter covers to meet explosion-proof requirements.

Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Verify the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Electrical shock could cause death or serious injury.

Avoid contact with the leads and terminals.

Process leaks could result in death or serious injury.

Install and tighten all four flange bolts before applying pressure.

Do not attempt to loosen or remove flange bolts while the transmitter is in service.

Replacement equipment or spare parts not approved by Emerson or use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

Use only bolts supplied or sold by Emerson as spare parts.

Improper assembly of manifolds to traditional flange can damage SuperModule™ Platform.

For safe assembly of manifold to traditional flange, bolts must break back plane of flange web (i.e., bolt hole) but must not contact sensor module housing.

⚠ WARNING

SuperModule and electronics housing must have equivalent approval labeling in order to maintain hazardous location approvals.

When upgrading, verify SuperModule and electronics housing certifications are equivalent. Differences in temperature class ratings may exist, in which case the complete assembly takes the lowest of the individual component temperature classes (for example, a T4/T5 rated electronics housing assembled to a T4 rated SuperModule is a T4 rated transmitter.)

Severe changes in the electrical loop may inhibit HART® Communication or the ability to reach alarm values. Therefore, Emerson cannot absolutely warrant or guarantee that the correct failure alarm level (HIGH or LOW) can be read by the host system at the time of annunciation.

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

Contents

1 Introduction

1.1 Using this manual

The sections in this manual provide information on configuring, troubleshooting, operating, and maintaining Rosemount 3051S Series Pressure Transmitters specifically for FOUNDATION™ Fieldbus Protocol.

The sections in this manual are organized as follows:

- Configuration provides instruction on configuration of the tranmitter, information on software functions, configuration parameters, and other variables are also included.
- Installation contains mechanical and electrical installation instructions, and field upgrade options.
- Operation and maintenance contains techniques to maintain the transmitter.
- Troubleshooting provides troubleshooting techniques for the most common operating issues.
- Advanced Pressure Diagnostics for FOUNDATION Fieldbus contains procedures for installation, configuration, and operation of the FOUNDATION Fieldbus Diagnostics option.
- Reference data supplies links to updated specifications, ordering information, intrinsic safety approval information, European ATEX directive information, and approval drawings.
- FOUNDATION™ Fieldbus Block Information supplies reference block information such as parameter tables.

For transmitter with HART®, see Rosemount 3051S Reference Manual.

1.2 Models covered

The following transmitters and the Rosemount 300S Housing Kit are covered in this manual.

The Rosemount 3051S provides a wide range of applications, and many of these different applications have their own reference manuals. This manual covers the Rosemount 3051S FOUNDATION™ Fieldbus Transmitter.

Table 1-1: Rosemount 3051S Coplanar™ Pressure Transmitter

Performance class	Measurement type		
	Differential	Gauge	Absolute
Ultra	X	X	X
Ultra for Flow	X	N/A	N/A
Classic	X	X	X

Table 1-2: Rosemount 3051S In-Line Pressure Transmitter

Performance class	Measurement type		
	Differential	Gauge	Absolute
Ultra	N/A	X	X
Classic	N/A	X	X

Table 1-3: Rosemount 3051S Liquid Level Pressure Transmitter

Performance class	Measurement type		
	Differential	Gauge	Absolute
Classic	X	X	X

Table 1-4: Rosemount 3051S Transmitter with FOUNDATION Fieldbus Diagnostics Transmitter

Performance class	Measurement type		
	Differential	Gauge	Absolute
Ultra	X	X	X
Ultra for Flow	X	N/A	N/A
Classic	X	X	X

For information on other Rosemount 3051S transmitters, refer to the following reference manuals:

- Rosemount 3051S HART® Reference Manual
- Rosemount 3051S Wireless Reference Manual
- Rosemount 3051S Electronic Remote Sensor (ERS™) System Reference Manual
- Rosemount 3051S MultiVariable™ Reference Manual

Rosemount 300S Scalable Housing Kits

Kits are available for all models of Rosemount 3051S Pressure Transmitters.

1.3 Device driver information

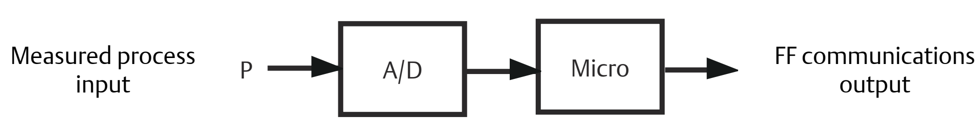
Release date	Device identification			Device driver identification		Review instructions	Review functionality
	NAMUR hardware revision(1)	NAMUR software revision(1)	FOUNDATION™ Fieldbus software revision	FOUNDATION Fieldbus universal revision	Device revision(2)(3)	Manual document number	Change description
July-17	1.0.xx	1.0.xx	3.00.01	6.1.2	24	00809-0200-4801	Updated field diagnostics, mass flow removed
Dec-08	N/A	N/A	1.11.9, 2.1.2	5.0.1	23		Multi-bit alert reporting, block instantiation, common software download
Sep-01	N/A	N/A	1/0/3	4.01	20		Initial product release

(1) *NAMUR Revision is located on the hardware tag of the device. Differences in level 3 changes, signified above by xx, represent minor product changes as defined per NE53. Compatibility and functionality are preserved and product can be used interchangeably.*

(2) *FOUNDATION Fieldbus device revision can be read using a FOUNDATION Fieldbus-capable configuration tool. Value shown is minimum revision that could correspond to NAMUR Revisions.*

(3) *Device driver file names use device and DD revision. To access new functionality, the new device driver must be downloaded. It is recommended to download new device driver files to ensure full functionality.*

1.4 Transmitter data flow



1.5 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation/regulations.

2 Configuration

2.1 Overview

This section covers basic operation, software functionality, and basic configuration of the transmitter. This section is organized by block information. For detailed information about the function blocks used in the Rosemount 3051S Pressure Transmitter, refer to FOUNDATION™ Fieldbus Block Information.

2.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Refer to the following safety messages before performing operations in this section.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Review the approvals section of this manual for any restrictions associated with a safe installation.

Before connecting a communicator in an explosive atmosphere, ensure the instruments in the segment are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In an explosion-proof/flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks

Process leaks may cause harm or result in death.

Install and tighten process connectors before applying pressure.

Electrical shocks

Electrical shock could cause death or serious injury.

Avoid contact with the leads and terminals.High voltage that my be present on leads can cause electrical shock.

Replacement equipment or spare parts not approved by Emerson for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

Use only bolts supplied or sold by Emerson as spare parts.

⚠ WARNING

Improper assembly of manifolds

Improper assembly of manifolds to traditional flange can damage the SuperModule™ Platform.

For safe assembly of manifold to traditional flange, bolts must break black plane of flange web (i.e., bolt hole) but must not contact module housing.

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

2.3 Device description

Before configuring the device, ensure the host has the appropriate Device Description file revision for this device. The device descriptor can be found on FieldCommGroup.org. The initial release of the Rosemount 3051S with FOUNDATION™ Fieldbus Protocol is device revision 20. This manual is for revision 24.

2.4 Device capabilities

2.4.1 Link Active Scheduler (LAS)

Rosemount 3051S Transmitter can be designated to act as the backup LAS in the event that the LAS is disconnected from the segment. As the backup LAS, the transmitter will take over the management of communications until the host is restored.

The host system may provide a configuration tool specifically designed to designate a particular device as a backup LAS. Otherwise, this can be configured manually as follows:

Procedure

1. Access the Management Information Base (MIB) for the Rosemount 3051S.
    - To activate the LAS capability, write 0x02 to the BOOT_OPERAT_FUNCTIONAL_CLASS object (Index 605).
    - To deactivate, write 0x01.
2. Restart the processor.

2.4.2 Capabilities

Virtual Communication Relationship (VCRs)

There are a total of 20 VCRs. One is permanent and 19 are fully configurable by the host system. Twenty-five link objects are available.

Network parameter	Value
Slot Time	6
Maximum Response Delay	4
Maximum Inactivity to Claim LAS Delay	5
Minimum Inter DLPDU Delay	7
Time Sync class	4 (1ms)
Maximum Scheduling Overhead	10
Per CLPDU PhL Overhead	4
Maximum Inter-channel Signal Skew	0
Required Number of Post-transmission-gab-ext Units	0
Required Number of Preamble-extension Units	1

Host timer recommendations

T1 = 96000

T2 = 9600000

T3 = 480000

Block execution times

Analog input	20 ms
PID	25 ms
Arithmetic	20 ms
Input selection	20 ms
Signal characterizer	20 ms
Integrator	20 ms
Output splitter	20 ms
Control selector	20 ms

2.5 General block information

2.5.1 Modes

The Resource, Transducer, and all function blocks in the device have modes of operation. These modes govern the operation of the block. Every block supports both automatic (AUTO) and out of service (OOS) modes. Other modes may also be supported.

Changing modes

To change the operating mode, set the MODE_BLK.TARGET to the desired mode. After a short delay, the parameter MODE_BLOCK.ACTUAL should reflect the mode change if the block is operating properly.

Permitted modes

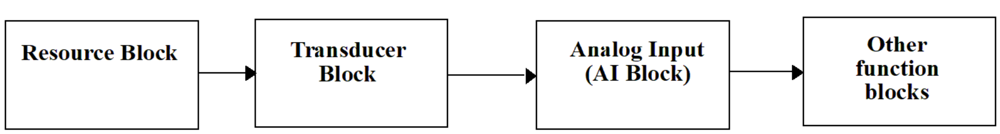
It is possible to prevent unauthorized changes to the operating mode of a block. To do this, configure MODE_BLOCK.PERMITTED to allow only the desired operating modes. It is recommended to always select OOS as one of the permitted modes.

Types of modes

For the procedures described in this manual, it will be helpful to understand the following modes:

AUTO	The functions performed by the block will execute. If the block has any outputs, these will continue to update. This is typically the normal operating mode.
Out of Service (OOS)	The functions performed by the block will not execute. If the block has any outputs, these will typically not update and the status of any values passed to downstream blocks will be BAD. To make some changes to the configuration of the block, change the mode of the block to OOS. When the changes are complete, change the mode back to AUTO.
MAN	In this mode, variables that are passed out of the block can be manually set for testing or override purposes.
Other types of modes	Other types of modes are Cas, RCas, ROut, IMan and LO. Some of these may be supported by different function blocks in the transmitter.

Note
When an upstream block is set to OOS, this will impact the output status of all downstream blocks. The figure below depicts the hierarchy of blocks:



2.5.2 Block instantiation

The transmitter supports the use of Function Block instantiation. When a device supports block instantiation, the number of blocks and block types can be defined to match specific application needs.The number of blocks that can be instantiated is only limited by the amount of memory within the device and the block types that are supported by the device. Instantiation does not apply to standard device blocks like the Resource, Sensor Transducer, LCD display Transducer, and Advanced Diagnostics.

By reading the parameter FREE_SPACE in the Resource block you can determine how many blocks you can instantiate. Each block instantiated takes up 4.5573 percent of the FREE_SPACE.

Block instantiation is done by the host control system or configuration tool, but not all hosts are required to implement this functionality. Refer to the specific host or configuration tool manual for more information.

2.5.3 Simulation

Simulation is the functionality of the AI Block. To support testing, either change the mode of the block to manual and adjust the output value or enable simulation through the configuration tool and manually enter a value for the measurement value and its status (this single value will apply to all outputs). If electing to change the mode of the block to manual, first set the ENABLE jumper on the field device.

With simulation enabled, the actual measurement value has no impact on the OUT value or the status. The OUT values will all have the same value as determined by the simulate value.

2.6 Resource block

2.6.1 FEATURES and FEATURES_SEL

The FEATURES parameter is read only and defines which host accessible features are supported by the transmitter. See the Specifications section of the Rosemount 3051S Product Data Sheet for the complete list.

Use FEATURES_SEL to turn on any of the supported features that are found in the FEATURES parameter.

UNICODE

All configurable string variables in the transmitter, except tag names, are octet strings. You may use either ASCII or Unicode. If the configuration device is generating Unicode octet strings, you must set the Unicode option bit.

REPORTS

The transmitter supports alert reports. You must set the Reports option bit in the features bit string to use this feature. If it is not set, the host must poll for alerts. If this bit is set, the transmitter will actively report alerts.

SOFT W LOCK and HARD W LOCK

Inputs to the security and write lock functions include the hardware security switch, the hardware and software write lock bits of the FEATURE_SEL parameter, and the WRITE_LOCK parameter.

The WRITE_LOCK parameter prevents modification of parameters within the device except to clear the WRITE_LOCK parameter. During this time, the block will function normally, updating inputs and outputs and executing algorithms. When the condition is cleared, an alert is generated with a priority that corresponds to the WRITE_PRI parameter.

The FEATURE_SEL parameter enables you to select any one of the following: a hardware write lock, a software write lock, or no write lock capability. To enable the hardware security function, enable the HARD W LOCK bit in the parameter. When this bit has been enabled, the WRITE_LOCK parameter becomes read only and reflects the state of the hardware switch. In order to enable the software write lock, place the hardware write lock switch in the unlocked position. Then set the SOFT W LOCK bit in the FEATURE_SEL parameter. Once this bit is set, you may set the WRITE_LOCK parameter to Locked or Not Locked. Once you have set the WRITE_LOCK parameter to Locked with either the software or the hardware lock, all user requested writes will be rejected.

2.6.2 MAX_NOTIFY

The MAX_NOTIFY parameter value of seven is the maximum number of alert reports the resource can have sent without getting a confirmation from the host, corresponding to the amount of buffer space available for alert messages. You can set the number lower, to control alert flooding, by adjusting the LIM_NOTIFY parameter value. If LIM_NOTIFY is set to zero, then no alerts are reported.

2.6.3 Alerts/alarms

The transmitter annunciates alerts as either Plantweb™ or NE107 Status Signals. All alerts are configured, masked, and mapped as NE 107 Status Signals. If the control host is DeltaV™ version 11.5 or older, alerts are automatically annunciated as Plantweb Alerts. No user configuration is needed for this conversion.

The alerts and recommended actions should be used in conjunction with Troubleshooting. See FOUNDATION™ Fieldbus Block Information for more information on resource block parameters.

The resource block acts as a coordinator for alerts. Depending on user configuration, each device will have either three or four alert parameters. If Plantweb alerts are annunciated, the three alert parameters will be: FAILED_ALARM, MAINT_ALARM, and ADVISE_ALARM. If NE107 alerts are annunciated, the four alert parameters called status signals will be: FD_FAIL_ACTIVE, FD_OFFSPEC_ACTIVE, FD_MAINT_ACTIVE, and FD_CHECK_ACTIVE.

Note
NE107 alerts and Plantweb alerts annunciate the same diagnostics and display the same recommended actions. The only difference in the alerts reported is the parameters or status signals used to annunciate the alert conditions. The default factory configuration has NE107 alerts enabled.

Alerts processing within the device

Procedure

1. Diagnostics perform comprehensive checks and update status within the device. These status conditions allow you to troubleshoot probable causes and take corrective actions.
2. The status conditions are then mapped into four status signals that can be used for annunciation on the segment to the host.
3. Before annunciation, a check is made to determine if you have masked any alert parameters. Any masked parameters will not be annunciated to the host, but will be visible using the device DD or DTM.
4. Unmasked alert conditions are annunciated by the appropriate status signal to the host.

Plantweb™ Alerts and NE107 Alerts are both processed using the steps described above and annunciate the same consolidated status parameters.

Figure 2-1: NE107 Alert Processing Diagram

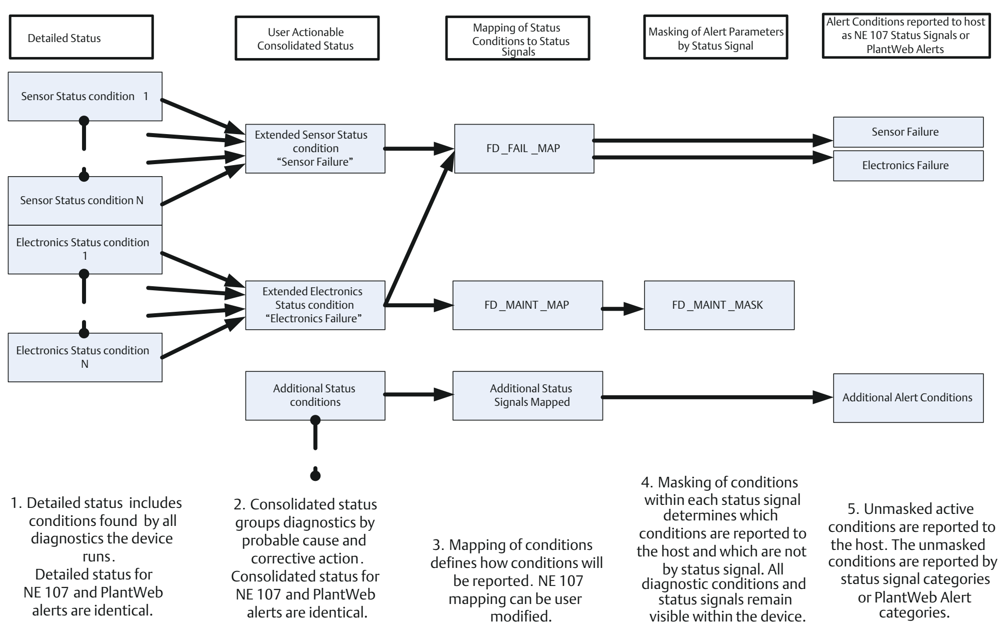
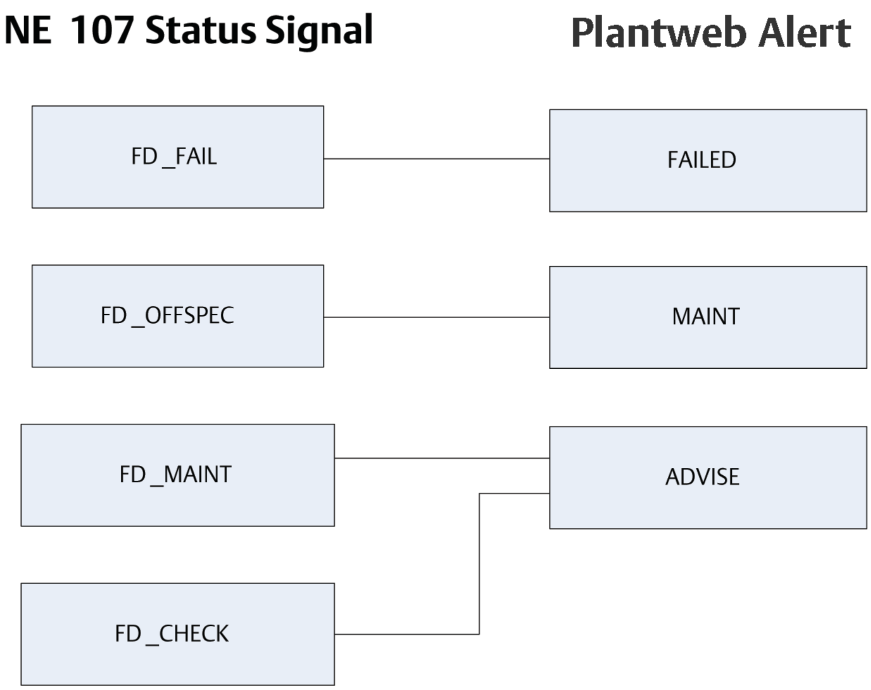


Figure 2-2: NE 107 Status Signal to Plantweb Alert Mapping



The alert priority enumeration value

Alerts have priorities that determine if they occur and where and how they are annunciated.

NE107 status signals and Plantweb™ alerts use the same priorities and annunciate the same ways.

0 Alerts will not occur. If there is an existing alert and the priority is changed from a number greater than zero to zero, it will clear. Active device diagnostics are still shown within the Device Description even if the alert has been cleared.

1 The associated alert is not sent as a notification. If the priority is above 1, then the alert must be reported.

2 Reserved for alerts that do not require the attention of a plant operator, e.g. diagnostic and system alerts. Block alert, error alert, and update event have a fixed priority of 2.

3-7 Increasing higher priorities - advisory alerts.

8–15 Increasing higher priority - critical alerts.

Configure Plantweb Alert priorities with DeltaV™.

NE107 alerts overview

NE107 alert parameters

NE107 has four alert status signals. They are in order from highest to lowest priority:

1. FD_FAIL_ACTIVE
2. FD_OFFSPEC_ACTIVE
3. FD_MAINT_ACTIVE
4. FD_CHECK_ACTIVE

You can configure any of the eight alert conditions to annunciate as any of the four status signals. You can also map individual alert conditions into multiple status signals.

Alert parameter definitions and factory defaults

Note
All eight alert conditions are factory assigned to appropriate status signals. Change the parameter assignment of individual alert conditions only if needed.

Devices are shipped from the factory with all applicable alerts enabled. The factory default alert conditions reported in each status signal are:

1. FD_FAIL_ACTIVE
    a. Incompatible module
    b. Sensor failure
    c. Electronics failure

    A FD_FAIL_ACTIVE status signal indicates a failure within a device that will make the device or some part of the device non-operational. This implies that the process variable may no longer be available and the device is in need of immediate repair.

2. FD_OFFSPEC_ACTIVE
    a. Pressure out of limits
    b. Sensor temperature out of limits

    A FD_OFFSPEC_ACTIVE status signal indicates that the device is experiencing pressure or temperature conditions that are outside the device operating range. This implies that the process variable may no longer be accurate. It also implies that if the condition is ignored the device will eventually fail.

3. FD_MAINT_ACTIVE
    a. Display update failure
    b. Variation change detected

    A FD_MAINT_ACTIVE status signal indicates the device is still functioning but an abnormal process or device condition exists. The device should be checked to determine the type of abnormal condition and recommended actions to resolve it.

4. FD_CHECK_ACTIVE
    a. Function check

    A FD_CHECK_ACTIVE status signal indicates a transducer block is not in “Auto” mode. This may be due to configuration or maintenance activities.

Mapping alert conditions

You can map any of the alert conditions into any of the NE107 status signals using the following parameters.

1. FD_FAIL_MAP assigns a condition to FD_FAIL_ACTIVE.
2. FD_OFFSPEC_MAP assigns a condition to FD_OFFSPEC_ACTIVE.
3. FD_MAINT_MAP assigns a condition to FD_MAINT_ACTIVE.
4. FD_CHECK_MAP assigns a condition to FD_CHECK_ACTIVE.

Masking alert conditions

You can mask any combination of status signals. When a status signal is masked, it will not be annunciated to the host system but will still be active in the device and viewable in the device DD or DTM. The recommended action, FD_RECOMMEN_ACT will continue to show the recommended action for the most severe condition or conditions detected as determined by the status signal priority. This allows maintenance personnel to view and correct device conditions without annunciating the conditions to operational staff. They are masked using the following parameters:

1. FD_FAIL_MASK to mask FD_FAIL_ACTIVE status signals
2. FD_OFFSPEC_MASK to mask FD_OFFSPEC_ACTIVE status signals
3. FD_MAINT_MASK to mask FD_MAINT_ACTIVE status signals
4. FD_CHECK_MASK to mask FD_CHECK_ACTIVE status signals

If you configure a consolidated diagnostic condition to annunciate in multiple status signal categories, it can be masked in one or several status signal categories, but left active and annunciate in others. This provides significant flexibility but can lead to confusion when responding to alerts. Generally alert conditions are assigned to only a single status signal.

Alert priorities

NE107 alerts can have any of 16 different condition priorities ranging from the lowest priority of 0 to the highest priority of 15. This is done using the following parameters.

1. FD_FAIL_PRI to specify the priority of FD_FAIL_ACTIVE status signals
2. FD_OFFSPEC_PRI to specify the priority FD_OFFSPEC_ACTIVE status signals
3. FD_MAINT_PRI to specify the priority FD_MAINT_ACTIVE status signals
4. FD_CHECK_PRI to specify the priority FD_CHECK_ACTIVE status signals

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Note

FOUNDATION™ Fieldbus standards require that NE 107 alert priority is set to zero for all status signals at manufacturing. Zero priority behavior shows any active device diagnostics in the DD or DTM, but alerts are not generated based on the diagnostic conditions or published on the bus. An alert priority of two or higher is required for every status signal category where status signals are to be published on the bus. Check with your host provider to determine the alarm priorities assigned to each status signal category by your host. Manual configuration may be required. DeltaV assigns a priority of two or higher. The priority is based on status signal category. The status signal priority determines the behavior of both real and simulated alerts.

2.6.4 Plantweb alerts overview

Alerts are generated, mapped, and masked as NE 107 Status Signals. If Plantweb™ alerts are required the NE 107 Status Signals are automatically converted to Plantweb alerts for annunciation and display. Plantweb alerts have three alert parameters. They are in order from highest to lowest priority:

1. FAILED_ALM
2. MAINT_ALM
3. ADVISE_ALM

The eight alert conditions are factory configured to annunciate as one of the three specific alert parameters.

Plantweb alert parameter conditions and factory defaults

Emerson ships devices from the factory with all applicable Plantweb™ alerts enabled. The alert conditions reported in each parameter are:

1. FAILED_ALM
    a. Incompatible module
    b. Sensor failure
    c. Electronics failure

    A FAILED_ALM indicates a failure within a device that will make the device or some part of the device non-operational. This implies that the process variable may no longer be available and the device is in need of immediate repair.

2. MAINT_ALM
    a. Pressure out of limits
    b. Sensor temperature out of limits

    A MAINT_ALM indicates that the device is experiencing pressure or temperature conditions that are outside the device operating range. This implies that the process variable may no longer be accurate. It also implies that if the condition is ignored the device will eventually fail. The device should be checked to determine the type of abnormal condition and recommended actions to resolve it.

3. ADVISE_ALM
    a. Function check
    b. Display update failure
    c. Variation change detected

An ADVISE_ALM indicates a transducer block is not in Auto mode. This may be due to configuration or maintenance activities. It can also indicate an abnormal process or device condition exists. Check the device to determine the type of abnormal condition and recommended actions to resolve it.

Plantweb alert priorities

Configure Plantweb™ alert priorities in DeltaV™. Plantweb alerts can have any of 16 different condition prioritiesl, ranging from the lowest priority of 0 to the highest priority of 15. This is done using the following parameters.

1. FAILED_PRI to specify the priority of FAILED_ALM
2. MAINT_PRI to specify the priority of MAINT_ALM
3. ADVISE_PRI to specify the priority of ADVISE_ALM

Plantweb alert priority is configured using DeltaV and is not part of the DD functionality.

2.7 Analog input (AI) function block

2.7.1 Configure the AI block

Note
Always check and reconcile function block configuration (with the exception of resource and transducer blocks) after commissioning the transmitter to the control host. You may not save function block configuration, including AI blocks, made prior to device commissioning in the control host to the control host database during the commissioning process. In addition, the control host may download configuration changes to the transmitter as part of the commissioning process.

Note
Typically, you make changes to the AI block configuration after the transmitter is commissioned using the control host configuraiton software. Consult your host system documentation to see if the AI block guided configuration method provided in the DD or DTM should be used after the device has been commissioned.

Note
DeltaV™ users should only make final AI block configuration and AI block configuration changes using the DeltaV Explorer.

A minimum of four parameters are required to configure the AI block. The parameters are described below with example configurations shown at the end of this section.

AI block configuration edits

Note
Always check and reconcile function block configuration (with the exception of resource and transducer blocks) after commissioning the transmitter to the control host. You may not save function block configuration, including AI blocks, made prior to device commissioning to the control host to the database during the commissioning process. In addition, the control host may download configuration changes to the transmitter as part of the commissioning process.

Note
Typically, make changes to AI block configuration after the transmitter is commissioned using the control host configuration software. Consult your host system documentation

to see if the AI Block guided configuration method provided in the DD or DTM should be used after the device has been commissioned.

Note
For DeltaV users, only make final AI block configuration and AI block configuration changes using the DeltaV Explorer.

A minimum of four parameters are required to configure the AI Block. The parameters are described below with example configurations shown at the end of this section.

CHANNEL

Select the channel that corresponds to the desired sensor measurement. The transmitter measures both pressure (channel 1) and sensor temperature (channel 2).

Table 2-1: I/O Channel Definitions

Channel number	Channel description
1	Pressure in AI.XD_SCALE units
2	Sensor temperature in AI.XD_SCALE units
12	Mean
13	Standard deviation

Note
Channels 12-13 are only available when you order the Advanced Diagnostic Block is licensed.

L_TYPE

The L_TYPE parameter defines the relationship of the sensor measurement (pressure or sensor temperature) to the desired output of the AI Block (e.g. pressure, level, flow, etc.). The relationship can be direct, indirect, or indirect square root.

Direct

Select direct when the desired output will be the same as the sensor measurement (pressure or sensor temperature).

Indirect

Select indirect when the desired output is a calculated measurement based on the sensor measurement (e.g. a pressure measurement is made to determine level in a tank). The relationship between the sensor measurement and the calculated measurement will be linear.

Indirect square root

Select indirect square root when the desired output is an inferred measurement based on the sensor measurement and the relationship between the sensor measurement and the inferred measurement is square root (e.g. flow).

XD_SCALE and OUT_SCALE

The XD_SCALE and OUT_SCALE each include three parameters: 0%, 100%, and engineering units. Set these based on the L_TYPE:

L_TYPE is direct

When the desired output is the measured variable, set the XD_SCALE to the Primary_Value_Range. This is found in the Sensor Transducer Block. Set OUT_SCALE to match XD_SCALE.

L_TYPE is indirect

When an inferred measurement is made based on the sensor measurement, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

L_TYPE is indirect square root

When an inferred measurement is made based on the sensor measurement AND the relationship between the inferred measurement and sensor measurement is square root, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE:

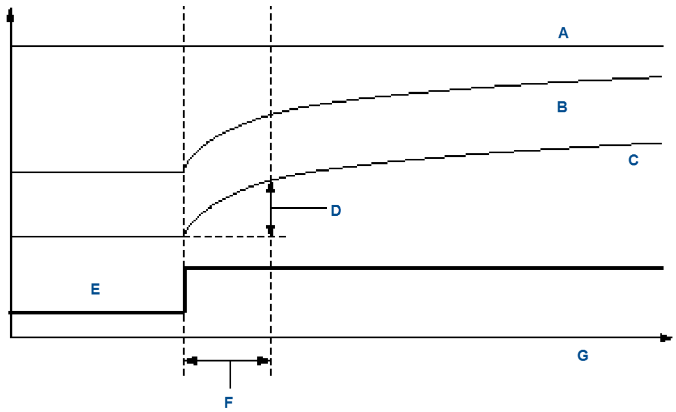
<table>
<tr><th>Parameters</th><th colspan="5">Enter data</th></tr>
<tr><td>Channel</td><td colspan="5">1=Pressure, 2=Sensor Temp, 12=Mean, 13=Standard deviation</td></tr>
<tr><td>L-Type</td><td colspan="5">Direct, Indirect, or Square Root</td></tr>
<tr><td>XD_Scale</td><td colspan="5">Scale and Engineering Units</td></tr>
<tr><td rowspan="6">Note
Select only the units that are supported by the device.</td><td>Pa</td><td>bar</td><td>torr at 0 °C</td><td>ft H_2O at 4°C</td><td>m H_2O at 4 °C</td></tr>
<tr><td>kPa</td><td>mbar</td><td>kg/cm^2</td><td>ft H_2O at 60 °F</td><td>mm Hg at 0 °C</td></tr>
<tr><td>mPa</td><td>psf</td><td>kg/m^2</td><td>ft H_2O at 68 °F</td><td>cm Hg at 0 °C</td></tr>
<tr><td>hPa</td><td>Atm</td><td>in H_2Oat 4 °C</td><td>mm H_2O at 4 °C</td><td>in Hg at 0 °C</td></tr>
<tr><td>Deg C</td><td>psi</td><td>in H_2O at 60 °F</td><td>mm H_2O at 68 °C</td><td>m Hg at 0 °C</td></tr>
<tr><td>Deg F</td><td>g/cm^2</td><td>in H_2O at 68 °F</td><td>cm H_2O at 4 °C</td><td></td></tr>
<tr><td>Out_Scale</td><td colspan="5">Scale and engineering units</td></tr>
</table>

Note
When the engineering units of the XD_SCALE are selected, this causes the engineering units of the PRIMARY_VALUE_RANGE in the Transducer Block to change to the same units. This is the only way to change the engineering units in the sensor transducer block PRIMARY_VALUE_RANGE parameter.

Filtering

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

Figure 2-3: Analog Input PV_FTIME Filtering Diagram



A. *OUT (mode in man)*
B. *OUT (mode in auto)*
C. *PV*
D. *63% of change*
E. *FIELD_VAL*
F. *PV_FTIME*
G. *Time (seconds)*

Low cutoff

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. Set the I/O option in manual or out of service mode only.

Process alarms

Process alarms are part of the process loop control strategy. They are configured in the control host. Process alarm configuration is not included in the configuration menu tree. See your control host documentation for information on configuration of process alarms. Process Alarm detection is based on the OUT value. 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

Alarm priority

Alarms are grouped into five levels of priority:

Priority number	Priority description
0	The alarm condition is not used.
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.
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 options

Status Options (STATUS_OPTS) supported by the AI block are shown below.

Propagate fault forward If the status from the sensor is Bad, Device failure or Bad, Sensor failure, propagate it to OUT without generating an alarm. The use of these sub-status in OUT is determined by this option. Through this option, the user may determine whether alarming (sending of an alert) will be done by the block or propagated downstream for alarming.

Uncertain if limited Set the output status of the Analog Input block to Uncertain if the measured or calculated value is limited.

BAD if limited Set the output status to Bad if the sensor is violating a high or low limit.

Uncertain if Man mode Set the output status of the Analog Input block to Uncertain if the actual mode of the block is Man.

Note
The instrument must be in Out of Service mode to set the status option.

Advanced features

The AI function block provides added capability through the addition of the following parameters:

ALARM_TYPE

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

OUT_D is the 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.

2.8 LCD display transducer block

The LCD display meter connects directly to the FOUNDATION™ Fieldbus output board. The meter indicates output and abbreviated diagnostic messages.

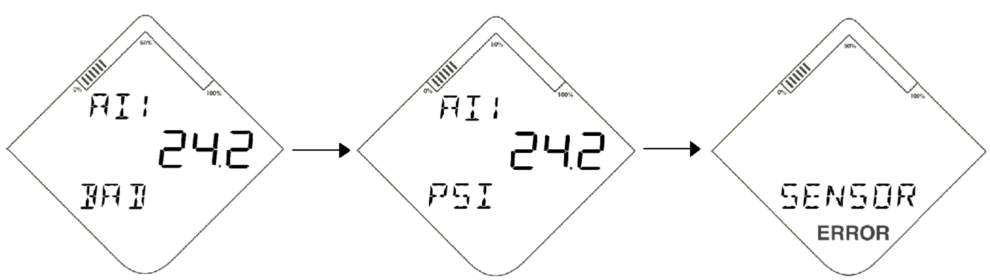
The meter features a four-line display and a 0-100 percent scaled bar graph.

- First line of five characters displays output description
- Second line of seven digits displays actual value
- Third line of six characters displays engineering units
- Fourth line displays Error when transmitter is in alarm

The LCD display meter can also display diagnostic messages.

Each parameter configured for display will appear on the LCD display for a brief period before the next parameter is displayed. If the status of the parameter goes bad, the LCD display will also cycle diagnostics following the displayed variable.

Figure 2-4: LCD Display Messaging



2.8.1 Custom meter configuration

Shipped from the factory, Parameter #1 is configured to display the Primary Variable (pressure) from the LCD display transducer block. Parameters 2–4 are not configured. To change the configuration of Parameter #1 or to configure additional parameters 2–4, use the configuration parameters below.

The LCD display transducer block can be configured to sequence four different process variables as long as the parameters are sourced from a function block that is scheduled to execute within the transmitter. If a function block is scheduled in the transmitter that links a process variable from another device on the segment, that process variable can be shown on the LCD display.

DISPLAY_PARAM_SEL

The DISPLAY_PARAM_SEL parameter specifies how many process variables will be displayed. Select up to eight display parameters.

BLK_TAG_# [(1)]

Enter the Block Tag of the function block that contains the parameter to be displayed.

BLK_TYPE_# [(1)]

Enter the Block Type of the function block that contains the parameter to be displayed. This parameter is generally selected via a drop-down menu with a list of possible function block types. (e.g., Transducer, PID, AI, etc.)

PARAM_INDEX_# [(1)]

The PARAM_INDEX_# parameter is generally selected via a drop-down menu with a list of possible parameter names based upon what is available in the function block type selected. Choose the parameter to be displayed.

CUSTOM_TAG_# [(1)]

The CUSTOM_TAG_# is an optional user-specified tag identifier that can be configured to be displayed with the parameter in place of the block tag. Enter a tag of up to five characters.

UNITS_TYPE_# [(1)]

The UNITS_TYPE_# parameter is generally selected via a drop-down menu with three options: AUTO, CUSTOM, or NONE. Select AUTO only when the parameter to be displayed is pressure, temperature, or percent. For other parameters, select CUSTOM and be sure to configure the CUSTOM_UNITS_# parameter. Select NONE if the parameter is to be displayed without associated units.

CUSTOM_UNITS_# [(1)]

Specify custom units to be displayed with the parameter. Enter up to six characters. To display Custom Units the UNITS_TYPE_# must be set to CUSTOM.

Displaying a variable from another device on the segment (example)

Any variable from a device on the network can be displayed on the LCD display but the variable must be on a regularly scheduled communications cycle and the variable must be linked to a block within the transmitter. A typical configuration to do this is to link the output of the function block of the variable to one of the unused inputs of the Input Selector Block.

(1) _# represents the specified parameter number.

2.8.2 Display bar graph

The LCD display is equipped with a bar graph along the top portion of the display screen. The bar graph will display the percent of range of AI.OUT of the AI block configured for Channel 1 (pressure) of the Sensor Transducer Block.

The bar graph on the LCD display can be enabled from the DISPLAY_PARAM_SEL parameter in the LCD Block.

If no AI Block is found to be configured for Channel 1 the bar graph (including annunciators) will remain blank. If more than one AI Block is found to be configured for the Channel 1 the AI Block with the lowest OD index will be used to calculate the bar graph value.

The following equation is used to calculate the percent of range of AI.OUT:

$$\text{Bar Graph Value} = 100 * \frac{(\text{AI.OUT} - \text{AI.OUT\_SCALE @ 0\%})}{(\text{AI.OUT\_SCALE @ 100\%} - \text{AI.OUT\_SCALE @ 0\%})}$$

If the bar graph value calculation returns a value less than 0%, the LCD display will show a bar graph value of 0 percent.

If the bar graph value calculation returns a value greater than 100 percent, then the LCD display will show a bar graph value of 100 percent.

3 Installation

3.1 Overview

The information in this section covers installation considerations. The Rosemount 3051S with FOUNDATION™ Fieldbus Protocol Quick Start Guide is shipped with every transmitter to describe basic installation, wiring, and startup procedures. Dimensional drawings for each transmitter 's variation and mounting configuration are included.

3.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Refer to the following safety messages before performing operations in this section.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Review the approvals section of this manual for any restrictions associated with a safe installation.

Before connecting a communicator in an explosive atmosphere, ensure the instruments in the segment are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In an explosion-proof/flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks

Process leaks may cause harm or result in death.

Install and tighten process connectors before applying pressure.

Electrical shocks

Electrical shock could cause death or serious injury.

Avoid contact with the leads and terminals.High voltage that my be present on leads can cause electrical shock.

Replacement equipment or spare parts not approved by Emerson for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

Use only bolts supplied or sold by Emerson as spare parts.

⚠ WARNING

Improper assembly of manifolds

Improper assembly of manifolds to traditional flange can damage the SuperModule™ Platform.

For safe assembly of manifold to traditional flange, bolts must break black plane of flange web (i.e., bolt hole) but must not contact module housing.

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

3.3 Considerations

3.3.1 Node address

The transmitter is shipped at a temporary (248) address. This will enable FOUNDATION™ Fieldbus host systems to automatically recognize the device and move it to a permanent address.

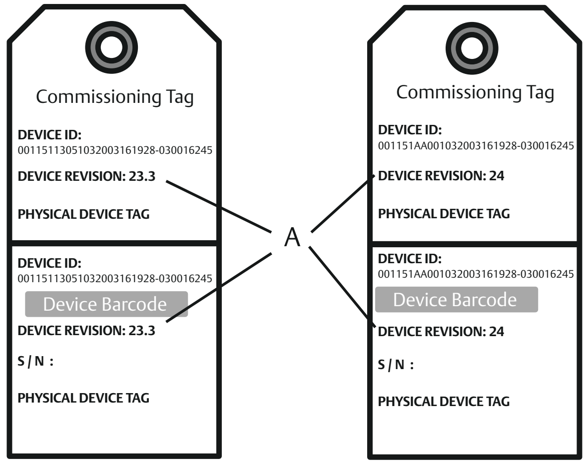
3.3.2 Tagging

Commissioning tag

The transmitter has been supplied with a removable commissioning tag that contains both the Device ID (the unique code that identifies a particular device in the absence of a device tag) and a space to record the device tag (PD_TAG) (the operational identification for the device as 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 to its physical location. The installer should note the physical location of the transmitter on both the upper and lower location of the commissioning tag. The bottom portion should be torn off for each device on the segment and used for commissioning the segment in the control system.

Figure 3-1: Commissioning Tag



A. Device revision

Transmitter tag

If permanent tag is ordered:

- Transmitter is tagged in accordance with customer requirements
- Tag is permanently attached to the transmitter

Software (PD_TAG)

- If permanent tag is ordered, the PD Tag contains the permanent tag information up to 30 characters
- If permanent tag is NOT ordered, the PD Tag contains the transmitter serial number

3.3.3 Installation considerations

Measurement performance depends upon proper installation of the transmitter and impulse piping. Mount the transmitter close to the process and use minimum piping to achieve best performance. Also, consider the need for easy access, personnel safety, practical field calibration, and a suitable transmitter environment. Install the transmitter to minimize vibration, shock, and temperature fluctuation.

Important
Install the enclosed pipe plug (found in the box) in the unused conduit opening. For straight threads, a minimum of six threads must be engaged. For tapered threads, install the plug wrench-tight. For material compatibility considerations, see Rosemount Material Selection Technical Note.

3.3.4 Environmental considerations

Best practice is to mount the transmitter in an environment that has minimal ambient temperature change. The transmitter electronics temperature operating limits are –40 to 185 °F (–40 to 85 °C). Refer to Rosemount 3051S Series of Instrumentation Product Data Sheet, which lists the sensing element operating limits. Mount the transmitter so that it is not susceptible to vibration and mechanical shock and does not have external contact with corrosive materials.

3.3.5 Mechanical considerations

Access requirements and cover installation can help optimize transmitter performance. See the Rosemount 3051S Series of Instrumentation Product Data Sheet for temperature operating limits.

Be sure the transmitter is securely mounted. Tilting of the transmitter may cause a zero shift in the transmitter output.

Side mounted

When the transmitter is mounted on its side, position the coplanar flange to ensure proper venting or draining. Mount the flange as shown in Figure 3-2, and Figure 3-3 keeping drain/vent connections on the bottom for gas service and on the top for liquid service.

Figure 3-2: Coplanar Installation Examples

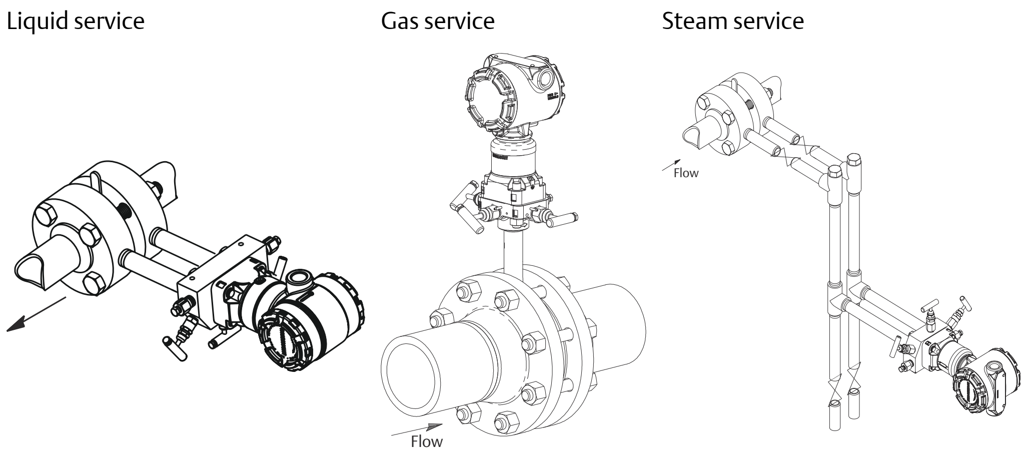
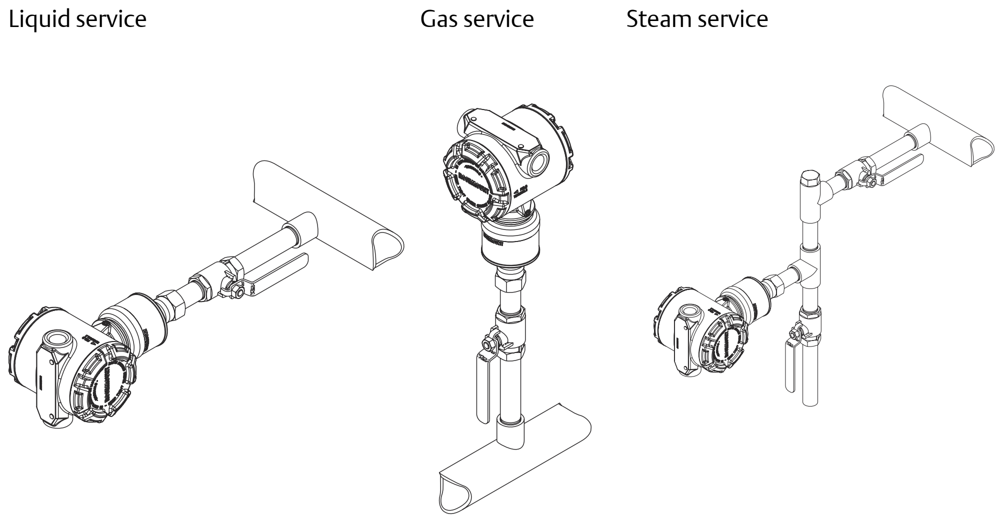


Figure 3-3: In-line Installation Examples



3.3.6 Draft range

Installation

For the Rosemount 3051S_CD0 Draft Range Pressure Transmitter, it is best to mount the transmitter with the isolators parallel to the ground. Installing the transmitter in this way reduces oil mounting effect and provides for optimal temperature performance.

Reducing process noise

There are two recommended methods of reducing process noise:

- Output damping
- Reference side filtering (in gage applications)

Reference side filtering

In gage applications it is important to minimize fluctuations in atmospheric pressure to which the low side isolator is exposed. One method of reducing fluctuations in atmospheric pressure is to attach a length of tubing to the reference side of the transmitter to act as a pressure buffer.

Another method is to plumb the reference side to a chamber that has a small vent to atmosphere. If multiple draft transmitters are being used in an application, the reference side of each device can be plumbed to a chamber to achieve a common gage reference.

3.4 Installation procedures

3.4.1 Process flange orientation

Mount the process flanges with sufficient clearance for process connections. For safety reasons, place the drain/vent valves so the process fluid is directed away from possible human contact when the vents are used. In addition, consider the need for a testing or calibration input.

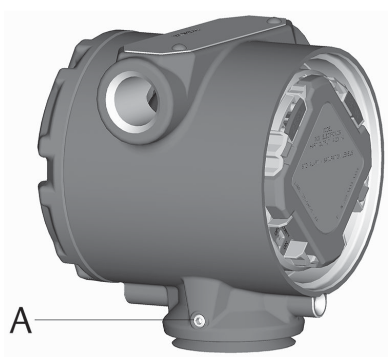
3.4.2 Mount the transmitter

Housing rotation

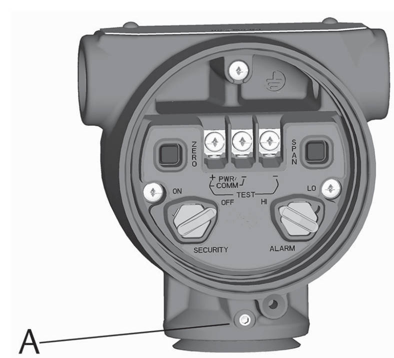
To improve field access to wiring or to better view the optional LCD display:

1. Loosen the housing rotation set screw.
2. First rotate the housing clockwise to the desired location. If the desired location cannot be achieved due to thread limit, rotate the housing counter clockwise to the desired location (up to 360° from thread limit).
3. Re-tighten the housing rotation set screw.

Plantweb housing



Junction box housing



A. Set screw

LCD display

In addition to housing rotation, the optional display can be rotated in 90-degree increments by squeezing the two tabs, pulling out, rotating and snapping back into place. If the LCD display pins are inadvertently removed from the interface board when the display is pulled from the housing, carefully remove the pins from the back of the display, and then re-insert the pins into the interface board. Once the pins are back in place, snap the display into place. Transmitters ordered with the LCD display will be shipped with the display installed.

Replace a display

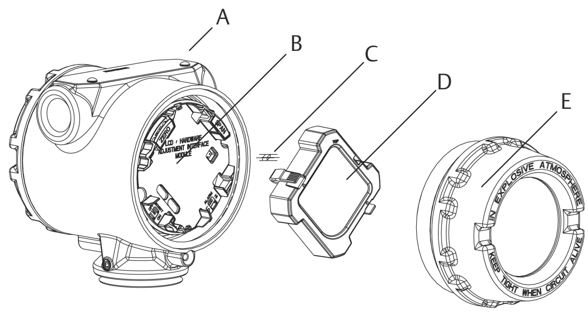
Prerequisites

Installing a display on an existing transmitter requires a small instrument screwdriver and the display kit.

Procedure

1. If the transmitter is installed in a loop, secure the loop and disconnect power.
2. Remove the transmitter cover opposite the field terminal side. Do not remove the instrument covers in explosive environments when the circuit is live.
3. Remove the hardware adjustment module if installed. Engage the four-pin connector into the LCD display and snap into place.
4. Install the meter cover and tighten to ensure metal-to-metal contact.

Figure 3-4: Optional LCD Display



A. Housing
B. Interface board
C. Connector pins
D. LCD display
E. Meter cover

Setting units

Units for both the Sensor Transducer Block and the AI Block are set in the AI Block.

Procedure

1. Set the AI Block to **OOS** mode.
2. Select **XD_Scale.units_index**.
3. Select only one of the engineering units listed on XD_SCALE and OUT_SCALE.
4. Return AI Block to **Auto** mode.

Electronics housing clearance

Mount the transmitter so the terminal side and the LCD display are accessible. Clearance of 0.75-in. (19 mm) is required for cover removal on the terminal side. Three inches of clearance is required for cover removal if a LCD display is installed.

Process connections

Transmitter flange process connection size is ¼–18 NPT. Flange adapters with ½–14 NPT connections are available as the D2 option. Use your plant-approved lubricant or sealant when making the process connections. The process connections on the transmitter flange are on 2⅛-in. (54 mm) centers to allow direct mounting to a three- or five-valve manifold. Rotate one or both of the flange adapters to attain connection centers of 2, 2⅛, or 2¼ inches (51 mm, 54 mm, or 57 mm).

Coplanar process connection

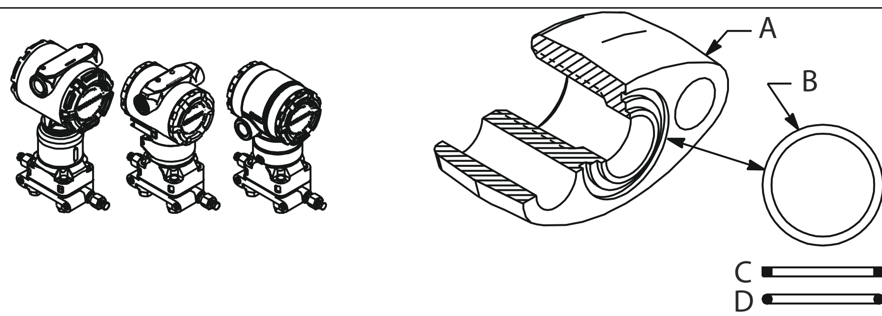
Install and tighten all four flange bolts before applying pressure, or process leakage will result. When properly installed, the flange bolts will protrude through the top of the sensor module housing. Do not attempt to loosen or remove the flange bolts while the transmitter is in service.

Procedure

1. Remove the flange bolts.
2. Leaving the flange in place, move the adapters into position with the O-ring installed.
3. Clamp the adapters and the coplanar flange to the transmitter module using the longer of the bolts supplied.
4. Tighten the bolts. Refer to Table 3-1 for torque specifications.

⚠ WARNING

Failure to install proper flange adapter O-rings may cause process leaks, which can result in death or serious injury. The two flange adapters are distinguished by unique O-ring grooves. Only use the O-ring that is designed for its specific flange adapter, as shown below.



Rosemount 3051S/3051/2051

A. Flange adapter
B. O-ring
C. PTFE
D. Elastomer

Whenever you remove flanges or adapters, visually inspect the PTFE O-rings. Replace them if there are any signs of damage, such as nicks or cuts. If you replace the O-rings, re-torque the flange bolts after installation to compensate for cold flow. Refer to the process sensor body reassembly procedure in Reassembly procedures.

In-line process connection

In-line gage transmitter orientation

⚠ CAUTION

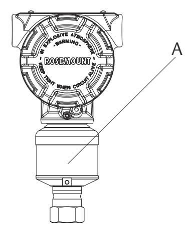
Equipment damage

Interfering or blocking the atmospheric reference port will cause the transmitter to output erroneous pressure values.

The low side pressure port (atmospheric reference) on the in-line gage transmitter is located under the sensor module neck label. See Figure 3-5 .

Keep the vent path free of any obstruction, such as paint, dust, and lubrication by mounting the transmitter so that any contaminants can drain away.

Figure 3-5: In-line Gage Low Side Pressure Port



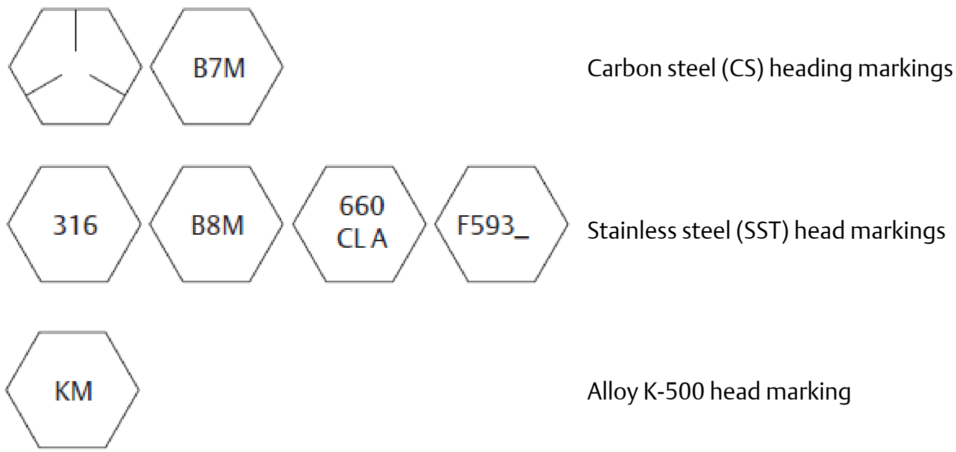
A. Low side pressure port (under neck label)

Flange bolt installation

If the transmitter installation requires assembly of the process flanges, manifolds, or flange adapters, follow these assembly guidelines to ensure a tight seal for optimal performance characteristics of the transmitters. Use only bolts supplied with the transmitter or sold by Emerson as spare parts. Figure 3-6 illustrates common transmitter assemblies with the bolt length required for proper transmitter assembly.

The transmitter can be shipped with a coplanar flange or a traditional flange installed with four 1.75-in. flange bolts. Stainless steel bolts supplied by Emerson are coated with a lubricant to ease installation. Carbon steel bolts do not require lubrication. No additional lubricant should be applied when installing either type of bolt. Bolts supplied by Emerson are identified by their head markings:

Figure 3-6: Flange Bolt Head Markings



The last digit in the F593_head marking may be any letter between A and M.

Bolt installation

Only use bolts supplied with the or sold by Emerson as parts for the transmitter. The use of non approved bolts could reduce pressure. Use the following bolt installation procedure:

1. Finger-tighten the bolts.
2. Torque the bolts to the initial torque value using a crossing pattern.
3. Torque the bolts to the final torque value using the same crossing pattern.

Initial and final torque values for the flange and manifold adapter bolts are as follows:

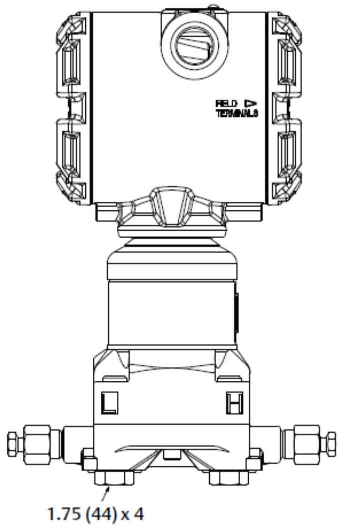
Table 3-1: Torque Values

Bolt material	Initial torque value	Final torque value
CS-ASTM-A449 Standard	300 in-lb (34 N-m)	650 in-lb (73 N-m)
316 SST—Option L4	150 in-lb (17 N-m)	300 in-lb (34 N-m)
ASTM-A-193-B7M—Option L5	300 in-lb (34 N-m)	650 in-lb (73 N-m)
Alloy K-500 —Option L6	300 in-lb (34 N-m)	650 in-lb (73 N-m)
ASTM-A-453-660—Option L7	150 in-lb (17 N-m)	300 in-lb (34 N-m)
ASTM-A-193-B8M—Option L8	150 in-lb (17 N-m)	300 in-lb (34 N-m)

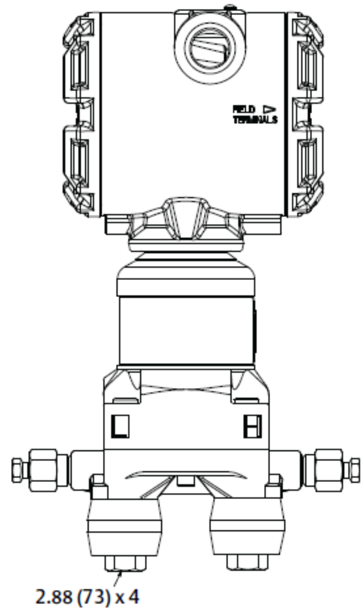
When installing the transmitter to one of the optional mounting brackets, torque the mounting bolts to 125 in-lb (14.1 N-m).

Figure 3-7: Flange Bolts and Adapters

Transmitter with flange bolts



Transmitters with flange adapters and bolts



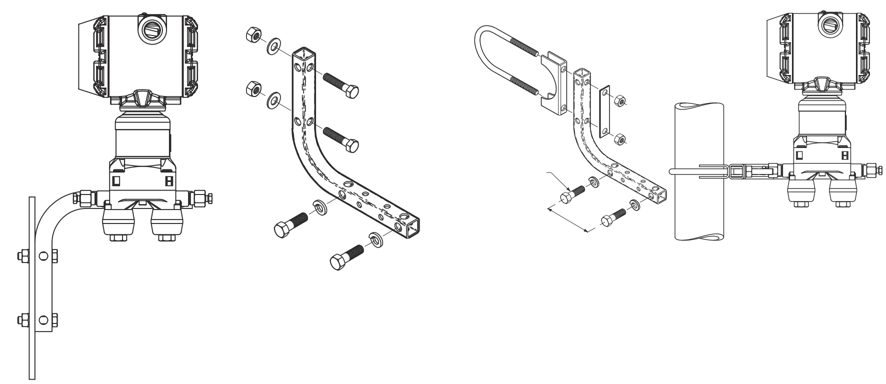
Dimensions are in inches (millimeters)

Mounting brackets

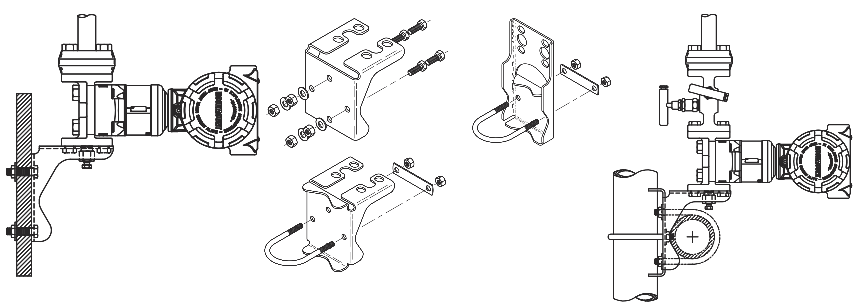
Facilitate mounting transmitter to a 2-in. pipe, or to a panel. The B4 Bracket (SST) option is standard for use with the coplanar and in-line process connections. See Rosemount 3051S Series of Instrumentation Product Data Sheet for bracket dimensions and mounting configurations for the B4 option.

Options B1–B3 and B7–B9 are sturdy, epoxy/polyester-painted brackets designed for use with the traditional flange. The B1–B3 brackets have carbon steel bolts, while the B7–B9 brackets have stainless steel bolts. The BA and BC brackets and bolts are stainless steel. The B1/B7/BA and B3/B9/BC style brackets support 2-in. pipe-mount installations, and the B2/B8 style brackets support panel mounting.

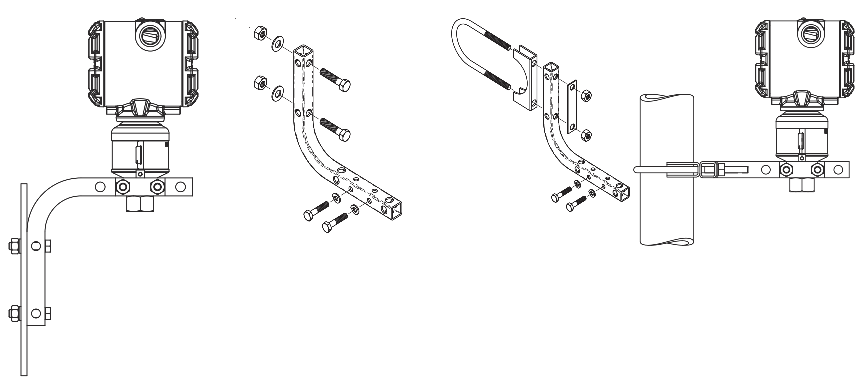
Panel mount *Coplanar flange* *Pipe mount*



Traditional flange



In-line



3.4.3 Impulse piping

Systems that will use impulse piping should follow the guidance in the following section. Not all Rosemount 3051S measurement systems will use impulse piping, especially systems with remote seals, and Rosemount Annubar, compact orifice plates, or an integral orifice plate. Each of these systems has their own manual to assist with installation.

Mounting requirements

Impulse piping configurations depend on specific measurement conditions. Refer to Figure 3-2 and Figure 3-3 for examples of the following mounting configurations:

Liquid measurement

1. Place taps to the side of the line to prevent sediment deposits on the transmitter's process isolators.
2. Mount the transmitter beside or below the taps so gases can vent into the process line.
3. Mount drain/vent valve upward to allow gases to vent.

Gas measurement

1. Place taps in the top or side of the line.
2. Mount the transmitter beside or above the taps so liquid will drain into the process line.

Steam measurement

1. Place taps to the side of the line.
2. Mount the transmitter below the taps to ensure that the impulse piping will stay filled with condensate.
3. In steam service above 250 °F (121 °C), fill impulse lines with water to prevent steam from contacting the transmitter directly and to ensure accurate measurement start-up.

Steam service

For steam service or for applications with process temperatures greater than the limits of the transmitter, do not blow down impulse piping through the transmitter. Flush lines with the blocking valves closed and refill lines with water before resuming measurement. Refer to Figure 3-2 for correct mounting orientation.

Note
For steam or other elevated temperature services, it is important that temperatures at the process connection do not exceed the transmitter's process temperature limits.

Best practices

The piping between the process and the transmitter must accurately transfer the pressure to obtain accurate measurements. These are some possible sources of error: pressure transfer, leaks, friction loss (particularly if purging is used), trapped gas in a liquid line, liquid in a gas line, density variations between the legs, and plugged impulse piping.

The best location for the transmitter in relation to the process pipe is dependent on the process. Use the following guidelines to determine transmitter location and placement of impulse piping:

- Keep impulse piping as short as possible.

- For liquid service, slope the impulse piping at least 1 in./ft (8 cm/m) upward from the transmitter toward the process connection.
- For gas service, slope the impulse piping at least 1 in./ft (8 cm/m) downward from the transmitter toward the process connection.
- Avoid high points in liquid lines and low points in gas lines.
- Make sure both impulse legs are the same temperature.
- Use impulse piping large enough to avoid friction effects and blockage.
- Vent all gas from liquid piping legs.
- When using a sealing fluid, fill both piping legs to the same level.
- When purging, make the purge connection close to the process taps and purge through equal lengths of the same size pipe. Avoid purging through the transmitter.
- Keep corrosive or hot (above 250 °F [121 °C]) process material out of direct contact with the sensor module and flanges.
- Prevent sediment deposits in the impulse piping.
- Maintain equal leg of head pressure on both legs of the impulse piping.
- Avoid conditions that might allow process fluid to freeze within the process flange.

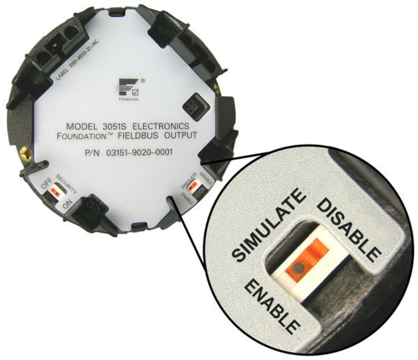
3.4.4 Configure security

The transmitter has a hierarchy of security. If the HW_SEL bit is enabled in the FEATURE_SEL Resource Block parameter, the SECURITY switch located on the electronics can be used to control the security of the device. In the ON position, all writes to the transmitter are disabled. See FEATURES and FEATURES_SEL for more information.

3.4.5 Simulate

The SIMULATE switch is located on the electronics. It is used in conjunction with the transmitter simulate software to simulate process variables and/or alerts and alarms.

- To simulate variables and/or alerts and alarms, the SIMULATE switch must be moved to the ENABLE position and the software enabled through the host.
- To disable simulation, the switch must be in the DISABLE position.



Note

It is important to know that simulate is enabled only when the hardware senses the switch changing from DISABLE to ENABLE. If the power is removed with the switch in ENABLE, simulate is not enabled. The switch must be moved from ENABLE to DISABLE and then back to ENABLE to enable the simulate software.

3.5 Wiring

3.5.1 Transmitter wiring

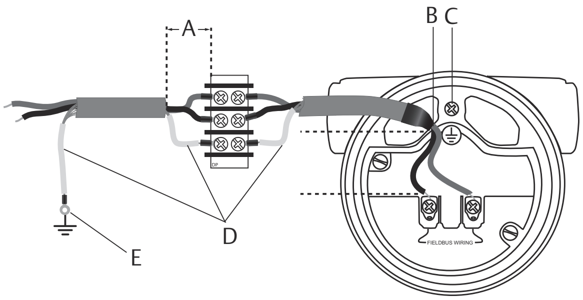
Wiring and power supply requirements can be dependent upon the approval certification. As with all FOUNDATION Fieldbus requirements, a conditioned power supply and terminators are required for proper operation. The standard terminal block is pictured below. The terminals are not polarity sensitive. The transmitter requires 9-32 Vdc to operate. Type A FOUNDATION Fieldbus wiring 18 awg twisted shielded pair is recommended.

Note

Avoid running instrument cable next to power cables in cable trays or near heavy electrical equipment. It is important that the instrument cable shield be:

- trimmed close and insulated from touching the transmitter housing
- continuously connected throughout the segment
- connected to a good earth ground at the power supply end

Figure 3-8: Transmitter Wiring



A. *Minimize distance*
B. *Trim shield and insulate*
C. *Ground for transient protection*
D. *Insulate shield*
E. *Connect shield back to power supply ground*

3.5.2 Transmitter grounding

Always ground the transmitter case in accordance with national and local electrical codes. A ground can be connected to the transmitter either by an external ground lug or the internal ground lug.

Figure 3-9: Grounding Options

SuperModule™ external ground connection

Internal ground connection

The most effective transmitter case grounding method is a direct connection to earth ground with minimal (< 1 Ω) impedance.

Note

Grounding the transmitter case using the threaded conduit connection may not provide a sufficient ground. The transient protection terminal block (Option Code T1) will not provide transient protection unless the transmitter case is properly grounded. Use the above guidelines to ground the transmitter case. Do not run transient protection ground wire with signal wiring; the ground wire may carry excessive current if a lightning strike occurs.

3.5.3 Cover installation

Always ensure a proper seal by installing the electronics housing cover(s) so that metal contacts metal. Use Rosemount O-rings.

3.5.4 Cover jam screw

For transmitter housings shipped with a cover jam screw, as shown in Figure 3-10, the screw should be properly installed once the transmitter has been wired and powered up. The cover jam screw is intended to disallow the removal of the transmitter cover in flameproof environments without the use of tooling.

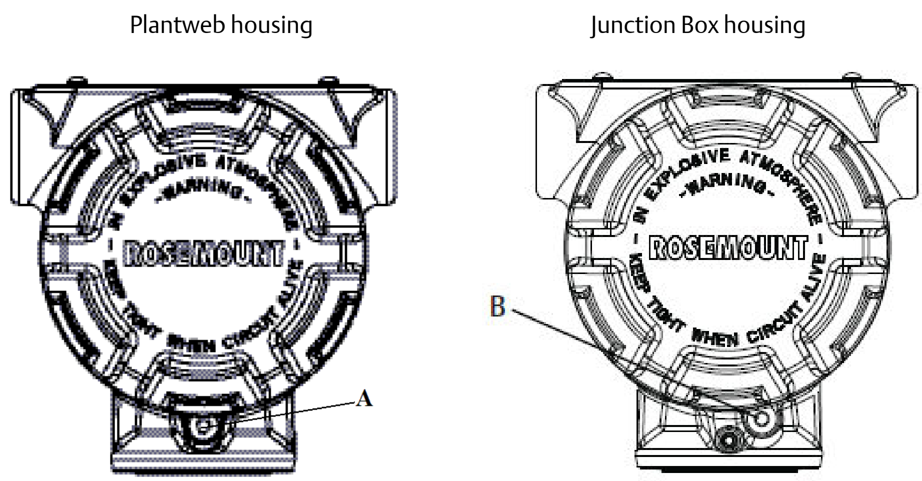
Procedure

1. Verify the cover jam screw is completely threaded into the housing.
2. Install the transmitter housing cover and verify that the cover is tight against the housing.
3. Using an M4 hex wrench, loosen the jam screw until it contacts the transmitter cover.
4. Turn the jam screw an additional ½ turn counterclockwise to secure the cover.

Note
Application of excessive torque may strip the threads.

5. Verify the cover cannot be removed.

Figure 3-10: Cover Jam Screw



A. 2x cover jam screw (1 per side)
B. Cover jam screw

3.6 Zeroing transmitter

Before operating the transmitter, perform a Zero Trim and set the Damping. Refer to Zero trim method for zeroing procedures.

Damping

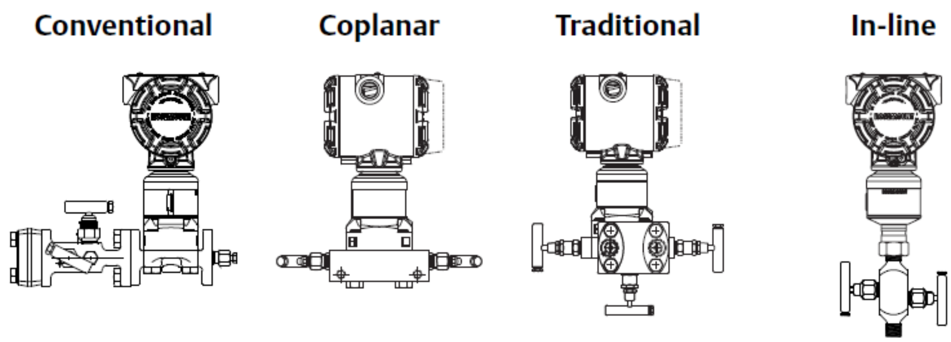
The damping parameter in the Transducer Block may be used to filter measurement noise. By increasing the damping time, the transmitter will have a slower response time, but will decrease the amount of process noise that is translated to the Transducer Block Primary Value. Because both the LCD display and AI Block get input from the Transducer Block, adjusting the damping parameter will affect both blocks.

Note
The AI Block has it's own filtering parameter called PV_FTIME. For simplicity, it is better to do filtering in the Transducer Block as damping will be applied to primary value on every sensor update. If filtering is done in AI block, damping will be applied to output every macrocycle.

3.7 Rosemount 305, 306, and 304 Manifolds

- The Rosemount 305 Integral Manifold mounts directly to the transmitter and is available in two styles: traditional and coplanar.
- The Rosemount 306 Integral Manifold is used with in-line transmitters to provide block-and-bleed valve capabilities of up to 10000 psi (690 bar).
- The Rosemount 304 conventional manifold combines a traditional flange and manifold that can be mounted to most primary elements.

Figure 3-11: Integral Manifold Designs



3.7.1 Rosemount 305 Integral Manifold installation procedure

Prerequisites

Inspect the PTFE sensor module O-rings.

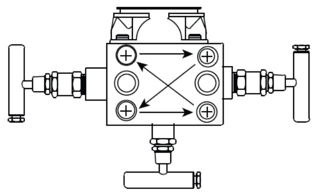
- If the O-rings are undamaged, reusing them is recommended.

- If the O-rings are damaged (if they have nicks or cuts, for example), replace them with new O-rings designed for Rosemount transmitters.

Important
If replacing the O-rings, be careful not to scratch or deface the O-ring grooves or the surface of the isolating diaphragm when removing the damaged O-rings.

Procedure

1. Install the integral manifold on the sensor module.
    a) Finger tighten the bolts.
    b) Tighten the bolts incrementally in a cross pattern to final torque value.



   See Table 3-1 for complete bolt installation information and for torque values.

   When fully tightened, the bolts should extend through the top of the module housing plane of the flange web (i.e., bolt hole) but must not contact the module housing.
2. If the PTFE sensor module O-rings have been replaced, the flange bolts should be re-tightened after installation to compensate for cold flow of the O-rings.

3.7.2 Rosemount 306 Integral Manifold installation procedure

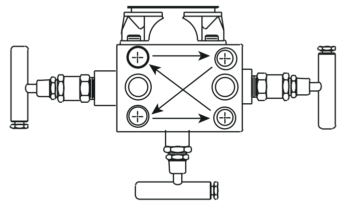
The Rosemount 306 is for use only with a Rosemount 3051S In-line Transmitter.

Assemble the Rosemount 306 to the Rosemount 3051S with a thread sealant. The proper installation torque v alue for a Rosemount 306 Manifold is 425 in-lb.

3.7.3 Rosemount 304 Conventional Manifold installation procedure

Procedure

1. Align the conventional manifold with the transmitter flange.
   Use the four manifold bolts for alignment.
    a) Finger tighten the bolts.
    b) Tighten the bolts incrementally in a cross pattern to final torque value.



See Table 3-1 for complete bolt installation information and for torque values.

When fully tightened, the bolts should extend through the top of the module housing plane of the flange web (i.e., bolt hole) but must not contact the module housing.

2. If applicable, install flange adapters on the process end of the manifold using the 1.75-in. flange bolts supplied with the transmitter.

3.7.4 Manifold operation

⚠ WARNING

Process Leaks

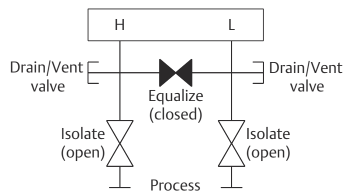
Improper installation or operation of manifolds may result in process leaks, which may cause death or serious injury.

Always perform a zero trim on the transmitter/manifold assembly after installation to eliminate any shift due to mounting effects.

Coplanar transmitters

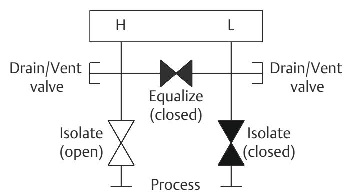
Performing zero trim at static line pressure with 3-valve and 5-valve manifolds

In normal operation the two isolate (block) valves between the process ports and transmitter will be open and the equalize valve will be closed.

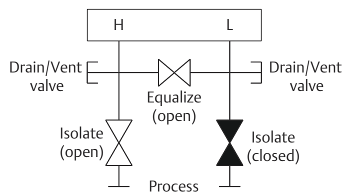


Procedure

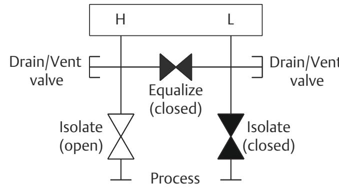
1. To zero trim the transmitter, close the isolate valve on the low side (downstream) side of the transmitter.



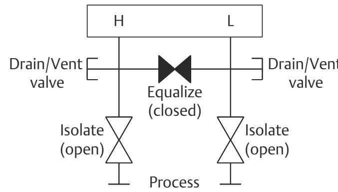
2. Open the equalize valve to equalize the pressure on both sides of the transmitter. The manifold is now in the proper configuration for performing a zero trim on the transmitter.



3. After performing a zero trim on the transmitter, close the equalize valve.



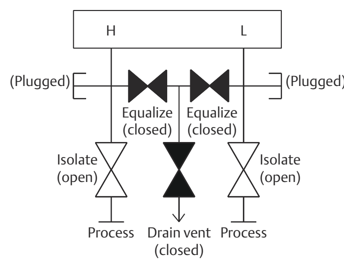
4. Finally, to return the transmitter to service, open the low side isolate valve.



Performing zero trim at static line pressure with 5-valve natural gas manifold

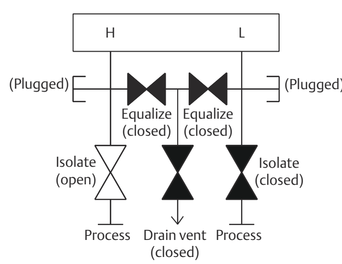
5-valve natural gas configurations shown:

In normal operation, the two isolate (block) valves between the process ports and transmitter will be open, and the equalize valves will be closed. Vent valves may be opened or closed.

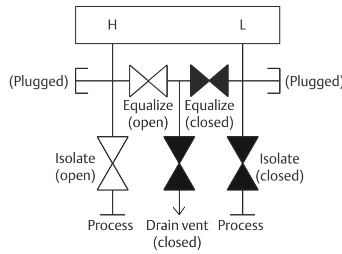


Procedure

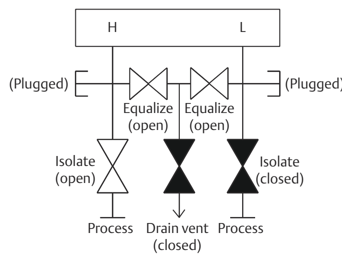
1. To zero trim the transmitter, first close the isolate valve on the low pressure (downstream) side of the transmitter and the vent valve.



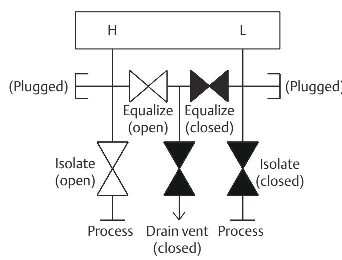
2. Open the equalize valve on the high pressure (upstream) side of the transmitter.



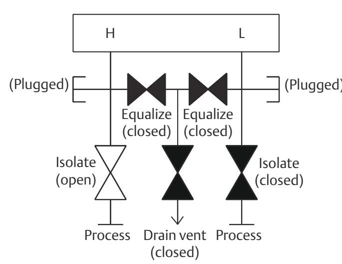
3. Open the equalize valve on the low pressure (downstream) side of the transmitter. The manifold is now in the proper configuration for performing a zero trim on the transmitter.



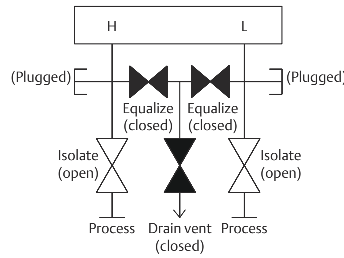
4. After performing a zero trim on the transmitter, close the equalize valve on the low pressure (downstream) side of the transmitter.



5. Close the equalize valve on the high pressure (upstream) side.



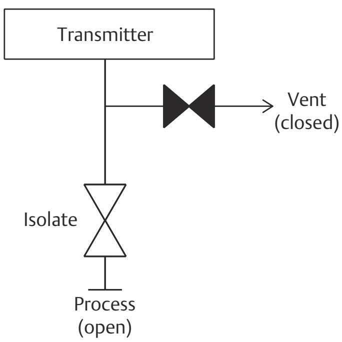
6. Finally, to return the transmitter to service, open the low side isolate valve and vent valve. The vent valve can remain open or closed during operation.



In-line transmitter

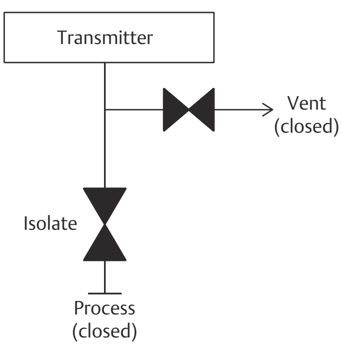
Isolating the transmitter with 2-valve and block and bleed style manifolds

In normal operation the isolate (block) valve between the process port and transmitter will be open and the test/vent valve will be closed. On a block and bleed style manifold, a single block valve provides transmitter isolation and a bleed screw provides drain/vent capabilities.



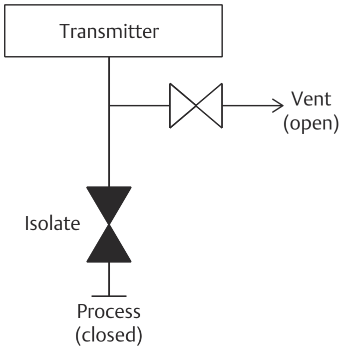
Procedure

1. To isolate the transmitter, close the isolate valve.

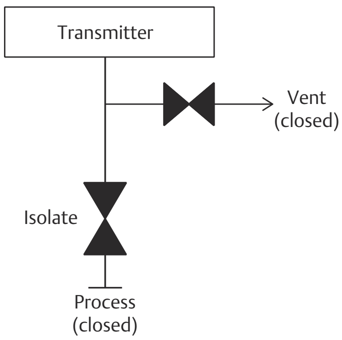


2. To bring the transmitter to atmospheric pressure, open the vent valve or bleed screw.

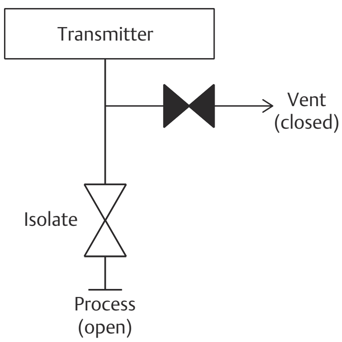
Note
Always use caution when venting directly to atmosphere. A ¼-in. male NPT pipe plug may be installed in the test/vent port and will need to be removed with a wrench in order to vent the manifold properly.



3. After venting to atmosphere, perform any required calibration and then close the test/vent valve or replace the bleed screw.



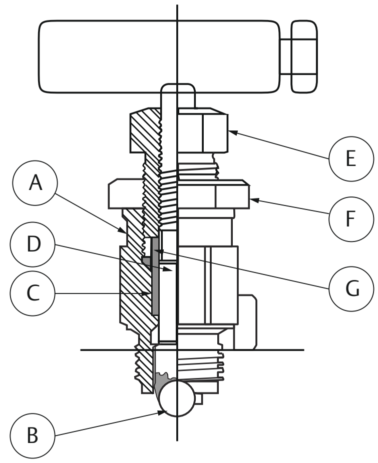
4. Open the Isolate (block) valve to return the transmitter to service.



Adjusting valve packing

Over time, the packing material inside a Rosemount manifold may require adjustment in order to continue to provide proper pressure retention. Not all manifolds have this adjustment capability. The manifold model number will indicate what type of stem seal or packing material has been used.

Figure 3-12: Adjusting Valve Packing



A. *Bonnet*
B. *Ball seat*
C. *Packing*
D. *Stem*
E. *Packing adjuster*
F. *Jam nut*
G. *Packing follower*

Procedure

1. Remove all pressure from the device.
2. Loosen manifold valve jam nut.
3. Tighten manifold valve packing adjuster nut 1/4 turn.
4. Tighten manifold valve jam nut.
5. Re-apply pressure and check for leaks.
6. Above steps can be repeated, if necessary.

   If the above procedure does not result in proper pressure retention, the complete manifold should be replaced.

4 Operation and maintenance

4.1 Overview

This section contains information on operation and maintenance procedures.

Each FOUNDATION™ Fieldbus host or configuration tool has different ways of displaying and performing operations. Some hosts will use Device Descriptions (DD) and DD Methods to complete device configuration and will display data consistently across platforms. The DD can found at FieldCommGroup.org. There is no requirement that a host or configuration tool support these features.

For DeltaV™ users, the DD can be found at Emerson.com/Software-Downloads-Drivers. The information in this section describes how to generally use methods. In addition, if host or configuration tool does not support methods, this section covers manually configuring parameters involved with each method operation. For more detailed information on the use of methods, see the host or configuration tool manual.

4.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Refer to the following safety messages before performing operations in this section.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Review the approvals section of this manual for any restrictions associated with a safe installation.

Before connecting a communicator in an explosive atmosphere, ensure the instruments in the segment are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In an explosion-proof/flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks

Process leaks may cause harm or result in death.

Install and tighten process connectors before applying pressure.

Electrical shocks

Electrical shock could cause death or serious injury.

Avoid contact with the leads and terminals.High voltage that my be present on leads can cause electrical shock.

⚠ WARNING

Replacement equipment or spare parts not approved by Emerson for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

Use only bolts supplied or sold by Emerson as spare parts.

Improper assembly of manifolds

Improper assembly of manifolds to traditional flange can damage the SuperModule™ Platform.

For safe assembly of manifold to traditional flange, bolts must break black plane of flange web (i.e., bolt hole) but must not contact module housing.

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

4.3 Status

Along with the measured or calculated PV value, every Foundation Fieldbus block passes an additional parameter called STATUS. The PV and STATUS are passed from the Transducer Block to the Analog Input Block. The STATUS can be one of the following: GOOD, BAD, or UNCERTAIN.

When there are no problems detected by the self-diagnostics of the block, the status will be GOOD. If a problem occurs with the hardware in the device, or, the quality of the process variable is compromised for some reason, the status will become either BAD or UNCERTAIN depending upon the nature of the problem.

It is important the control strategy that makes use of the Analog Input Block is configured to monitor the status and take action where appropriate when the status is no longer good.

4.4 Master reset method

Resource Block

To perform a master reset, run the Master Reset Method. If your system does not support methods, manually configure the Resource Block parameters listed below. Set the RESTART to one of the options below:

- Run - default state
- Resource - not used

- Defaults - sets all device parameters to Foundation Fieldbus default values
- Processor - does a software reset of the CPU

4.5 Simulation

Simulate replaces the channel value coming from the Sensor Transducer Block. For testing purposes, it is possible to manually drive the output of the Analog Input Block to a desired value. There are two ways to do this: Manual Mode and Simulate Mode.

4.5.1 Manual mode

To change only the OUT_VALUE and not the OUT_STATUS of the AI Block:

Procedure

1. Place the *TARGET MODE* of the block to **MANUAL**.
2. Change the *OUT_VALUE* to the desired value.

4.5.2 Simulate mode

Procedure

1. If the *SIMULATE* switch is in the OFF position, move it to the **ON** position.
2. To change both the OUT_VALUE and OUT_STATUS of the AI Block, set the *TARGET MODE* to **AUTO**.
3. Set *SIMULATE_ENABLE_DISABLE* to **Active**.
4. Enter the desired *SIMULATE_VALUE* to change the OUT_VALUE and *SIMULATE_STATUS_QUALITY* to change the OUT_STATUS.
5. If errors occur when performing these steps, be sure the *SIMULATE* jumper has been reset after powering up the device.

4.6 Calibration

4.6.1 Upper and lower trim methods

To calibrate the transmitter, run the Upper and Lower Trim Methods. If your system does not support methods, manually configure the Transducer Block parameters listed below.

Procedure

1. Set *MODE_BLK.TARGET* to **OOS**.
2. Set *CAL_UNIT* to supported engineering units in the Transducer Block.
3. Apply physical pressure that corresponds to the lower calibration point and allow the pressure to stabilize. The pressure must be between the range limits defined in *PRIMRY_VALUE_RANGE*.
4. Set values of *CAL_POINT_LO* to correspond to the pressure applied to the sensor.

5. Apply pressure, upper cal point.
6. Set *CAL_POINT_HI*.

Note
CAL_POINT_HI must be within PRIMARY_VALUE_RANGE and greater than CAL_POINT_LO + CAL_MIN_SPAN

7. Set *SENSOR_CAL_DATE* to the current date.
8. Set *SENSOR_CAL_WHO* to the person responsible for the calibration.
9. Set *SENSOR _CAL_LOC* to the calibration location.
10. Set *SENSOR_CAL_METHOD* to **User Trim**.
11. Set *MODE_BLK.TARGET* to **AUTO**.

4.6.2 Zero trim method

In order to zero the transmitter, run the Zero Trim Method. If your system does not support methods, manually configure the Transducer Block parameters listed below.

Procedure

1. Set MODE_BLK.TARGET to OOS.
2. Apply zero pressure to the sensor and allow the to reading stabilize.
3. Set values CAL_POINT_LO to 0.
4. Set SENSOR_CAL_DATE to the current date.
5. Set SENSOR_CAL_WHO to the person responsible for the calibration.
6. Set SENSOR _CAL_LOC to the calibration location.
7. Set SENSOR_CAL_METHOD to User Trim.
8. Set MODE_BLK.TARGET to AUTO.

4.6.3 Factory trim recall method

To perform a factory trim on the transmitter, run the Factory Trim Method. If your system does not support methods, manually configure the Transducer Block parameters listed below.

Procedure

1. Set MODE_BLK.TARGET to OOS.
2. Set FACTORY_CAL_RECALL to Recall.
3. Set SENSOR_CAL_DATE to the current date.
4. Set SENSOR_CAL_WHO to the person responsible for the calibration.
5. Set SENSOR _CAL_LOC to the calibration location.
6. Set SENSOR_CAL_METHOD to Factory Trim.
7. Set MODE_BLK.TARGET to AUTO.

5 Troubleshooting

5.1 Overview

This section provides summarized troubleshooting suggestions for the most common operating problems. This section contains Rosemount 3051S FOUNDATION™ Fieldbus troubleshooting information only. Disassembly and reassembly procedures can be found in the Rosemount 3051S Reference Manual.

Follow the procedures described here to verify that transmitter hardware and process connections are in good working order. Always deal with the most likely causes first.

5.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Refer to the following safety messages before performing operations in this section.

⚠ WARNING

Explosions

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Before connecting a communicator in an explosive atmosphere, ensure the instruments in the segment are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In an explosion-proof/flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks

Process leaks may cause harm or result in death.

Install and tighten process connectors before applying pressure.

Electrical shocks

Electrical shock could cause death or serious injury.

Avoid contact with the leads and terminals.High voltage that my be present on leads can cause electrical shock.

Replacement equipment or spare parts not approved by Emerson for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

Use only bolts supplied or sold by Emerson as spare parts.

⚠ WARNING

Improper assembly of manifolds

Improper assembly of manifolds to traditional flange can damage the SuperModule™ Platform.

For safe assembly of manifold to traditional flange, bolts must break black plane of flange web (i.e., bolt hole) but must not contact module housing.

Physical access

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Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

5.3 Service support

To expedite the return process outside of the United States, contact the nearest Emerson representative.

Within the United States, call the Emerson National Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the process material to which the product was last exposed.

⚠ CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Safety Data Sheet (SDS) for each hazardous substance identified must be included with the returned goods.

Rosemount National Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

5.4 Communication problems

The recommended actions should be done with consultation of your system integrator.

5.4.1 Device does not appear on segment

Potential cause

Unknown

Recommended action

1. Check wiring.
2. Recycle power to the device.

Potential cause

No power to device

Recommended actions

1. Ensure the device is connected to the segment.
2. Check voltage at terminals. It should be 9 - 32 Vdc.
3. Check to ensure the device is drawing current. It should be approximately 17 mA.

Potential cause

Segment problems: Electronics failing

Recommended action

Replace loose electronics board in housing.

Potential cause

Segment problems: Incompatible network settings

1. Change host network parameters.
2. Refer to host documentation for procedure.
3. See Device capabilities for device network parameter values.
4. If the problem persists, contact your local Emerson representative.

5.4.2 Device does not stay on segment

Wiring and installation 31.25 kbit/s, voltage mode, wire medium application guide AG-140 available from the FieldComm Group™.

Potential cause

Incorrect signal levels.

Note
Reference host documentation for procedure.

Recommended actions

1. Check for two terminators.
2. Check for excess cable length.

3. Verify power supply or conditioner is good.
4. If the problem persists, contact your local Emerson representative.

Potential cause

Excess noise on segment

Note
Reference host documentation for procedure.

Recommended actions

1. Check for incorrect grounding.
2. Check for correct shielded wire.
3. Tighten wire connections.
4. Check for corrosion or moisture on terminals.
5. Verify power supply is good.
6. If the problem persists, contact your local Emerson representative.

Potential cause

Electronics failure

Recommended actions

1. Tighten electronics board.
2. Replace electronics.
3. If the problem persists, contact your local Emerson representative.

Potential cause

Other

Recommended actions

1. Check for water in terminal housing.
2. If the problem persists, contact your local Emerson representative.

5.5 Analog input (AI) function block

This section describes error conditions that are supported by the AI Block.

Reference the sections below to determine the appropriate corrective action.

Table 5-1: AI 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.

Table 5-1: AI BLOCK_ERR Conditions *(continued)*

Condition number	Condition name and description
3	Simulate Active: Simulation is enabled, and the block is using a simulated value in its execution.
7	Input Failure/Process Variable has Bad Status: The hardware is bad, or a bad status is being simulated.
14	Power up
15	Out of Service: The actual mode is out of service.

5.5.1 Bad or no pressure readings

Read the AI BLOCK_ERR parameter.

BLOCK-ERR reads OUT OF SERVICE (OOS)

Recommended actions

1. AI Block target mode set to **OOS**.
2. Resource block OUT OF SERVICE.

BLOCK_ERR reads CONFIGURATION ERROR

Recommended actions

1. Check CHANNEL parameter.
2. Check L_TYPE parameter.
3. Check XD_SCALE engineering units.

BLOCK_ERR reads BAD INPUT

Recommended actions

1. Check the interface cable between the sensor module and the Fieldbus electronics board.
2. Replace the sensor module.

No BLOCK_ERR but readings are not correct

If using Indirect mode, scaling could be wrong.

Recommended actions

1. Check XD_SCALE parameter.
2. Check OUT_SCALE parameter.

No BLOCK_ERR

Sensor needs to be calibrated or zero trimmed.

Recommended action

See Calibration to determine the appropriate trimming or calibration procedure.

5.5.2 OUT parameter status reads UNCERTAIN, and substatus reads EngUnitRangViolation

Out_ScaleEU_0 and EU_100 settings are incorrect

Recommended action

See the Analog Input (AI) function block section in the Rosemount 3051S Product Data Sheet.

5.6 LCD Transducer Block

This section describes error conditions found in the LCD Transducer Block. Read Table 5-2 and Recommended actions to determine the appropriate corrective action.

Table 5-2: BLOCK_ERR Messages

Condition name and description
Other
Out of Service: The actual mode is out of service.

5.6.1 Recommended actions

LCD display shows DSPLY#INVLID

Potential Cause

One or more of the display parameters are not configured properly.

Recommended actions

1. Read BLOCK_ERR.
2. if its “BLOCK CONFIGURATION”, see LCD display transducer block

Bar Graph and AI.OUT readings do not match

Potential cause

The OUT_SCALE of the AI Block is not configured properly.

Recommended actions

See Analog input (AI) function block and Display bar graph.

Not all values are displayed

Potential cause

The LCD display block parameter DISPLAY_PARAMETER_SELECT is not properly configured.

Recommended actions

See LCD display transducer block.

Display reads “OOS”

Potential cause

The resource and/or LCD Transducer Block are OOS.

Recommended action

Verify both blocks are in AUTO.

The display is hard to read

Potential cause

Some LCD display segments have gone bad

Recommended actions

If some of the segment is bad, replace the LCD display.

Potential cause

Device exceeds temperature limit for the LCD display. -4 to 176 °F (-20 to 80 °C).

Recommended actions

Check ambient temperature of the device.

5.7 Advanced Diagnostics Transducer Block (ADB)

This section describes error conditions found in the Advanced Diagnostics Transducer Block. Reference Table 5-3 to determine the appropriate corrective action (reference Advanced Pressure Diagnostics for FOUNDATION Fieldbus for complete information).

Table 5-3: Advanced Diagnostic Block BLOCK_ERR Messages

Condition name and description
Other
Out of Service: The actual mode is out of service.

5.7.1 Plugged Impulse Line or Process Intelligence will not go to Learning

Potential cause

ADB Block is not licensed. The algorithm status will indicate “Not Licensed.”

Recommended actions

Check DEV_OPTIONS in the Resource Block. Plugged Impulse Line/Process Intelligence or a hex value of 0x00000020 should be shown. See Advanced Diagnostics Transducer Block (ADB).

Potential cause

Resource Block actual mode is OOS

Recommended actions

1. Determine why Resource Block is in OOS.
2. Correct problem then put Resource Block in Auto mode.

Potential cause

ADB Block actual mode is OOS

Recommended actions

Put ADB block into Auto mode.

Potential cause

Algorithms were not activated or configured properly

Recommended actions

1. To activate and configure Process Intelligence see Process Intelligence configuration and operation.
2. To activate and configure Plugged Impulse Line, see Plugged Impulse Line detection technology.

5.7.2 Plugged Impulse Line status reads “Insufficient Dynamics”

Potential cause

Not enough process noise or there is no flow in the line

Recommended actions

1. Check to see if the process is flowing.
2. Your process may have low process dynamics. You can turn off this check. This should only be done after considering the possible results, see Configuration of Plugged Impulse Line detection.

5.7.3 Process Intelligence or Plugged Impulse Line status stays in Verifying

Potential cause

Process dynamics are unstable

Recommended action

Ensure the process flow is stable.

Potential cause

Learning period is too short

Recommended actions

Ensure the Process Intelligence Monitoring Cycle or Plugged Impulse Line Learning Length is at least as long as any dominant cycling or oscillation in the process. See Process Intelligence configuration and operation.

Potential cause

(Plugged Impulse Line only) Plugged Impulse Line Learning Sensitivity not properly configured.

Recommended action

The process may be varying by more than algorithm is configured for. Adjust learning sensitivity to compensate, see Advanced Plugged Impulse Line configuration.

5.7.4 Plugged Impulse Line status reads Bad PV Status

Potential cause

Problem in Sensor Transducer Block

Recommended actions

See Communication problems.

5.8 Troubleshooting and diagnostic messages

Detailed descriptions of the possible messages that will appear on either the LCD display, a Handheld Communicator, or a PC-based configuration and maintenance system are listed in the sections below. Use the sections below to diagnose particular status messages.

5.8.1 Incompatible module

NE107 and Plantweb™ alert: Failure

The pressure sensor is incompatible with the attached electronics.

Recommended actions

- Replace electronics board or sensor module with compatible hardware.

Default configuration

Enabled

LCD display message

^^^^XMTR MSMTCH

Associated status bits

0x08000000

5.8.2 Sensor failure

NE107 and Plantweb™ alert: Failure

An error has been detected in the pressure sensor.

Recommended actions

- Check the interface cable between the sensor module and the electronics board.
- Replace the sensor module.

Default configuration

Enabled

LCD display message

^^^^FAIL SENSOR

Associated status bits

0x20000000

5.8.3 Electronics failure

NE107 and Plantweb™ alert: Failure

A failure has occurred in the electronics board.

Recommended action

- Replace electronics board.

Default configuration

Enabled

LCD display message

^^^^FAIL^BOARD

Associated status bits

0x40000000

5.8.4 Pressure out of limits

NE107 alert: Offspec; Plantweb™ alert: Maintenance

The process pressure is outside the transmitter's measurement range.

Recommended actions

- Verify the applied pressure is within the range of the pressure sensor.

- Verify the manifold valves are in the proper position.
- Check the transmitter pressure connection to verify it is not plugged and the isolating diaphragms are not damaged.
- Replace the sensor module.

Default configuration

Enabled

LCD display message

PRES^OUT LIMITS

Associated status bits

0x00200000

5.8.5 Sensor temperature out of limits

NE107 alert: Offspec; Plantweb™ alert: Maintenance

The sensor temperature is outside the transmitter's operating range.

Recommended actions

- Check the process and ambient temperature conditions are within -85 to 194 °F (-65 to 90 °C).
- Replace the sensor module.

Default configuration

Enabled

LCD display message

TEMP^OUT LIMITS

Associated status bits

0x00008000

5.8.6 Display update failure

NE107 and Plantweb™ alert: Maintenance

The display is not receiving updates from the electronics board.

Recommended actions

- Check the connection between the display and the electronics board.
- Replace the display.
- Replace the electronics board.

Default configuration

Enabled

LCD display message

N/A

Associated status bits

0x00000020

5.8.7 Variation change detected

NE107 and Plantweb™ alert: Maintenance

The statistical process monitor has detected either a mean variation or high or low dynamics in the process.

Recommended actions

- Check the statistical process monitor status in the diagnostics transducer block.
- Check for plugged impulse lines.

Default configuration

Enabled

LCD display message

^^^^^SPM^ALERT

Associated status bits

0x00000080

5.8.8 Alert simulation enabled

NE107 and Plantweb™ alert: Maintenance

Alert simulation is enabled. The active alerts are simulated, and any real alerts are suppressed.

Recommended action

- To view real alerts, disable the alerts simulation.

Default configuration

Enabled

LCD display message

N/A

Associated status bits

FD_SIMULATE.ENABLE 0x02

5.8.9 Function check

NE107 alert: Function Check; Plantweb™ alert: Advisory

The sensor transducer block mode is not in Auto.

Recommended actions

- Check if any transducer block is currently under maintenance.
- If no transducer block is under maintenance, the follow site procedures to change the affected transducer block's Actual Mode to Auto.

Default configuration

Enabled

LCD display message

N/A

Associated status bits

0x00000001

5.8.10 Failure - fix now

Electronic circuit board failure

A failure has been detected in the electronic circuit board.

Recommended action

Replace the electronic circuit board.

LCD display message

Electronic Board

Associated status bits

0x40000000

Sensor module failure

A failure has been detected in the sensor module

Recommended action

Replace the sensor module.

LCD display message

Sensor Module

Associated status bits

0x20000000

Sensor module communication failure

The electronic circuit board has stopped receiving updates from the sensor module.

Recommended action

1. Verify that the device is receiving adequate supply voltage.
2. Remove the front housing cover (considering hazardous location requirements) and check the cable and cable connection between the sensor module and electronic circuit board.
3. Replace the sensor module.
4. Replace the electronic circuit board.

LCD display message

Module Comm

Associated status bits

0x10000000

Sensor module incompatibility

The sensor module is not compatible with the electronic circuit board.

Recommended action

Replace the sensor with a compatible single variable sensor module.

LCD display message

Module Incompat.

Associated status bits

0x08000000

5.8.11 Out of specification - fix soon

Pressure out of limits

The pressure has exceeded the transmitter's maximum measurement range.

Recommended action

1. Verify the conditions of the process where the transmitter is installed.
2. Check the transmitter pressure connection to make sure it is not plugged and isolating diaphragms are not damaged.
3. Replace the sensor module.

LCD display message

Pressure Limit

Associated status bits

0x00200000

Module temperature out of limits

The module temperature sensor has exceeded its normal range.

Recommended action

1. Check the process and ambient temperatures where the transmitter is installed to ensure they are within specifications.
2. Replace the sensor module.

LCD display message

Snsr Temp Limit

Associated status bits

0x00008000

5.8.12 Maintenance required

Plugged impulse line detected

A plugged impulse line has been detected by the Advanced Diagnostic Block.

Recommended action

1. Verify there is a plugged line.
2. If this is a false trip, reconsider the trip values and restart the diagnostic.

LCD display message

Plugged Line

Associated status bits

0x00000200

Statistical process monitor trip

The statistical process monitor has detected either a mean variation or high or low dynamics in the process.

Recommended action

1. Verify the condition of the process being monitored by the SPM.
2. If this is a false trip, reconsider the SPM configuration.

LCD display message

SPM Trip

Associated status bits

0x00000080

Display update error

The electronic circuit board has lost communication with the display.

Recommended action

1. Remove the front housing cover (considering hazardous location requirements) and check the 4-pin connector between the display and the electronic circuit board.
2. Check the cable and cable connection between the sensor module and electronic circuit board.
3. Replace the display.
4. Replace the electronic circuit board.

LCD display message

LCD Update Error

Associated status bits

0x00000020

5.8.13 Function check

Check function

The transducer block mode is not in auto.

Recommended action

1. Check if any transducer block is currently under maintenance.
2. If no transducer block is under maintenance, then follow site procedures to change the affected transducer block's actual mode to auto.

LCD display message

-

Associated status bits

0x00000001

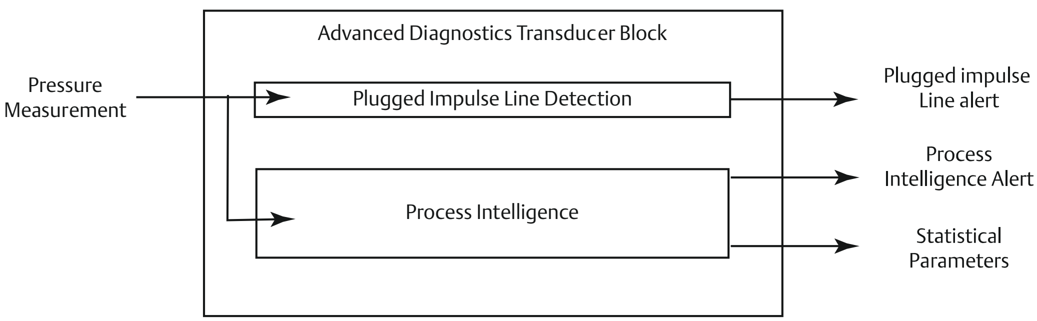
6 Advanced Pressure Diagnostics for FOUNDATION Fieldbus

6.1 Overview

The Rosemount 3051S FOUNDATION™ Fieldbus Pressure Transmitter with Advanced Diagnostics Suite is an extension of the Rosemount 3051S Scalable™ Pressure Transmitter and takes full advantage of the architecture. The Rosemount 3051S SuperModule™ Platform generates the pressure measurement. The FOUNDATION Fieldbus Feature Board is mounted in the Plantweb™ housing and plugs into the top of the SuperModule. The Advanced Diagnostics Suite is a licensable option on the FOUNDATION Fieldbus feature board, and designated by the option code “D01” in the model number.

The Advanced Diagnostics Suite has two distinct diagnostic functions, Process Intelligence and Plugged Impulse Line Detection (PIL), which can be used separately or in conjunction with each other to detect and alert users to conditions that were previously undetectable, or provide powerful troubleshooting tools. Figure 6-1 illustrates an overview of these two functions within the Fieldbus Advanced Diagnostics Transducer Block.

Figure 6-1: Advanced Diagnostics Transducer Block Overview



6.2 Process Intelligence

The Advanced Diagnostics Suite features Process Intelligence technology to detect changes in the process, process equipment or installation conditions of the transmitter. This is done by modeling the process noise signature (using the statistical values of mean and standard deviation) under normal conditions and then comparing the baseline values to current values over time. If a significant change in the current values is detected, the transmitter can generate an alert. Process Intelligence performs its statistical processing on the pressure measurement of the field device. The statistical values are also available as secondary variables from the transmitter via AI Function Blocks if a user is interested in their own analysis or generating their own alarms.

6.3 Plugged Impulse Line diagnostics

The Advanced Diagnostics Suite also implements a Plugged Impulse Line detection algorithm. Plugged Impulse Line diagnostics leverages Process Intelligence technology and adds some additional features that apply Process Intelligence to directly detect plugging in pressure measurement impulse lines. In addition to detecting a change in the process noise signature, the Plugged Impulse Line diagnostics also provide the ability to automatically relearn new baseline values if the process condition changes. When Plugged Impulse Line diagnostics detect a plug, a “Plugged Impulse Line Detected” Plantweb™ alert is generated. Optionally, the user can configure the Plugged Impulse Line diagnostics to, when a plugged impulse line is detected, change the pressure measurement status quality to “Uncertain” to alert an operator that the pressure reading may not be reliable.

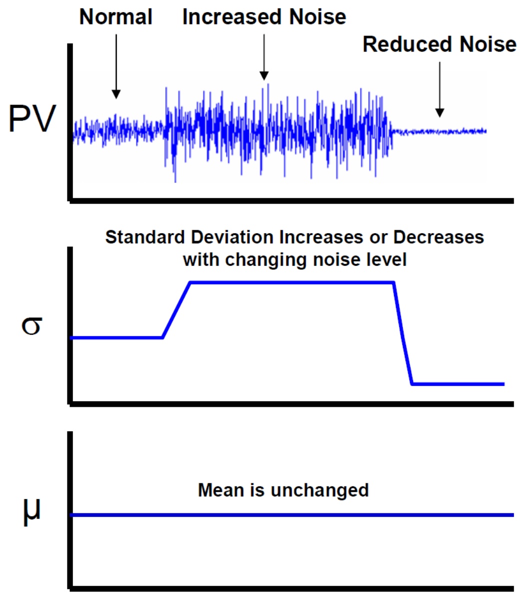
Important
Running the Advanced Diagnostics Block could affect other block execution times. We recommend the device be configured as a basic device versus a Link Master device if this is a concern.

6.4 Process Intelligence technology

Process Intelligence is a unique technology developed by Emerson that provides a means for early detection of abnormal situations in a process environment. The technology is based on the premise that virtually all dynamic processes have a unique noise or variation signature when operating normally. Changes in these signatures may signal that a significant change will occur or has occurred in the process, process equipment, or transmitter installation. For example, the noise source may be equipment in the process such as a pump or agitator, the natural variation in the DP value caused by turbulent flow, or a combination of both.

The sensing of the unique signature begins with the combination of a high speed sensing device with software resident in a FOUNDATION™ Fieldbus Feature Board to compute statistical parameters that characterize and quantify the noise or variation. These statistical parameters are the mean and standard deviation of the input pressure. Filtering capability is provided to separate slow changes in the process due to setpoint changes from the process noise or variation of interest. Figure 6-2 shows an example of how the standard deviation value (σ) is affected by changes in noise level while the mean or average value (μ) remains constant. The calculation of the statistical parameters within the device is accomplished on a parallel software path to the path used to filter and compute the primary output signal (e.g., the pressure measurement used for control and operations). The primary output is not affected in any way by this additional capability.

Figure 6-2: Effects of Process Noise or Variability



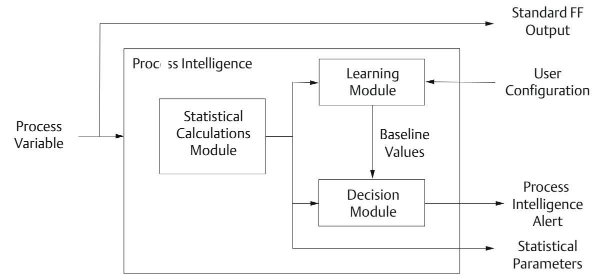
The device can provide the statistical information to the user in two ways. First, the statistical parameters can be made available to the host system directly via FOUNDATION Fieldbus communication protocol or FF to other protocol converters. Once available, the system may make use of these statistical parameters to indicate or detect a change in process conditions. In the simplest example, the statistical values may be stored in the DCS historian. If a process upset or equipment problem occurs, these values can be examined to determine if changes in the values foreshadowed or indicated the process upset. The statistical values can then be made available to the operator directly, or made available to alarm or alert software.

Second, the device has internal software that can be used to baseline the process noise or signature via a learning process. Once the learning process is completed, the device itself can detect significant changes in the noise or variation, and communicate an alarm via Plantweb Insight alert. Typical applications are change in fluid composition or equipment related problems.

6.5 Process Intelligence functionality

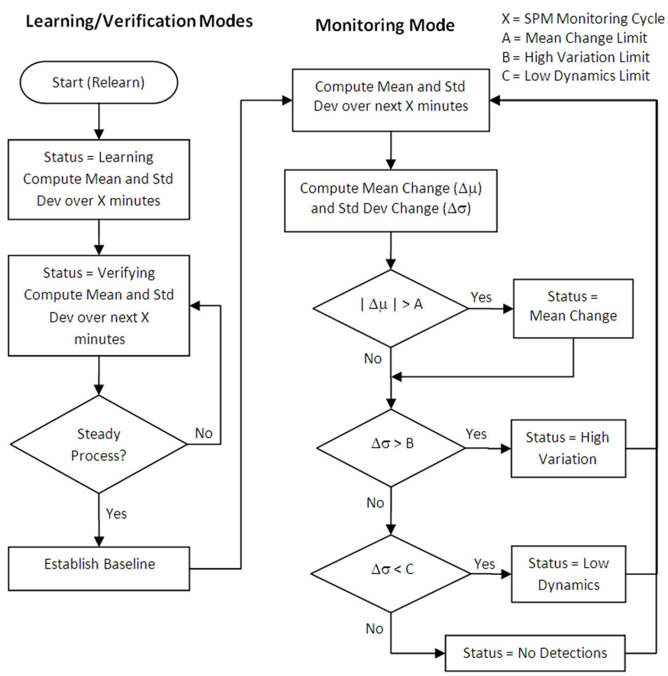
A block diagram of the Process Intelligence diagnostic is shown in Figure 6-3. The process variable (the measured pressure) is input to a Statistical Calculations Module where basic high pass filtering is performed on the pressure signal. The mean (or average) is calculated on the unfiltered pressure signal, the standard deviation calculated from the filtered pressure signal. These statistical values are available via handheld communication devices like the field communicator, asset management software, or distributed control systems with FOUNDATION™ Fieldbus.

Figure 6-3: Transmitter Process Intelligence



Process Intelligence also contains a learning module that establishes the baseline values for the process. Baseline values are established under user control at conditions considered normal for the process and installation. These baseline values are made available to a decision module that compares the baseline values to the most current values of the mean and standard deviation. Based on sensitivity settings and actions selected by the user via the control input, the diagnostic generates a device alert when a significant change is detected in either mean or standard deviation.

Figure 6-4: Process Monitoring Flow



Further detail of the operation of the Process Intelligence diagnostic is shown in the Figure 6-4 flowchart. This is a simplified version showing operation using the default values. After configuration, Process Intelligence calculates mean and standard deviation, used in both the learning and the monitoring modes. Once enabled, Process Intelligence enters the learning/verification mode. The baseline mean and standard deviation are calculated over a period of time controlled by the user (Process Intelligence Monitoring Cycle; default is 15 minutes). The status will be Learning. A second set of values is calculated and compared to the original set to verify that the measured process is stable and repeatable. During this period, the status will change to Verifying. If the process is stable, the diagnostic will use the last set of values as baseline values and move to "Monitoring" status. If the process is unstable, the diagnostic will continue to verify until stability is achieved.

In the "Monitoring" mode, new mean and standard deviation values are continuously calculated, with new values available every few seconds. The mean value is compared to the baseline mean value, and the standard deviation is compared to the baseline standard deviation value. If either the mean or the standard deviation has changed more than user-defined sensitivity settings, an alert is generated via FOUNDATION Fieldbus. The alert may indicate a change in the process, equipment, or transmitter installation.

Note

The Process Intelligence diagnostic capability in the transmitter calculates and detects significant changes in statistical parameters derived from the input process variable. These statistical parameters relate to the variability of and the noise signals present in the process variable. It is difficult to predict specifically which noise sources may be present in a given measurement or control application, the specific influence of those noise sources on the statistical parameters, and the expected changes in the noise sources at any time. Therefore, Emerson cannot absolutely warrant or guarantee that Process Intelligence will accurately detect each specific condition under all circumstances.

6.6 Process Intelligence configuration and operation

The following section describes the process of configuring and using the Process Intelligence diagnostic.

(optional) SPM_MONITORING_CYCLE = [1 – 1440] minutes (see Other Process Intelligence settings)

(optional) SPM_BYPASS_VERIFICATION = [Yes/No] (see SPM_BYPASS_VERIFICATION)

Apply all of these above changes to the device. Finally, set

SPM_ACTIVE = Enabled

After Process Intelligence is enabled and SPM_USER_COMMAND is set to Learn, it will spend the first five (or whatever the SPM_MONITORING_CYCLE is set to) minutes in the learning phase, and then another five minutes in the verification phase. If a steady process is detected at the end of the verification phase, Process Intelligence will move into the monitoring phase. After five minutes in the monitoring phase, Process Intelligence will have the current statistical values (e.g. current mean and standard deviation), and will begin comparing them against the baseline values to determine if a Process Intelligence Alert is detected.

6.6.1 Other Process Intelligence settings

Additional information on other Process Intelligence settings is shown below:

SPM_BYPASS_VERIFICATION

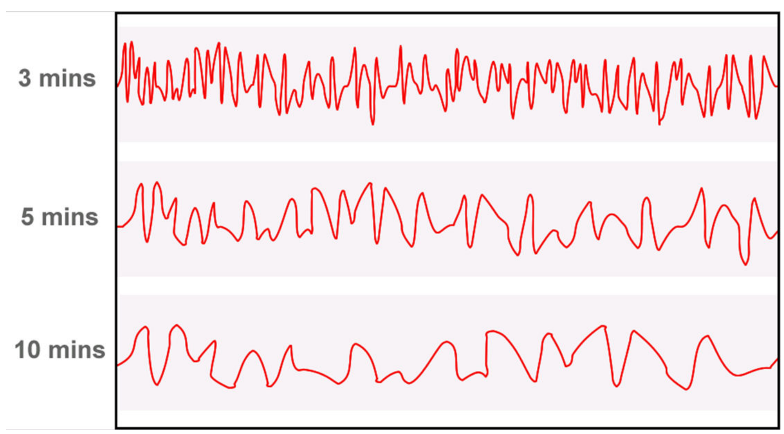
If this is set to "Yes", Process Intelligence will skip the verification process, and the first mean and standard deviation from the learning phase will be taken as the baseline mean and standard deviation. By skipping the verification, Process Intelligence can move into the monitoring phase more quickly. This parameter should only be set to "Yes" if you are certain that the process is at a steady-state at the time you start the Learning. The default (and recommended) setting is "No".

SPM_MONITORING_CYCLE

This is the length of the sample window over which mean and standard deviation are computed. A shorter sample window means that the statistical values will respond faster when there are process changes, but there is also a greater chance of generating false detections. A longer sample window means that mean and standard deviation will take longer to respond when there is a process change. The default value is 15 minutes. For most applications, a monitoring cycle ranging from 1 to 10 minutes is appropriate. The allowable range is one to 1440 minutes (for software revisions 2.0.x or earlier, the minimum SPM Monitoring Cycle is 5 minutes).

Figure 6-5 illustrates the effect of the Process Intelligence Monitoring Cycle on the Statistical Calculations. Notice how with a shorter sampling window there is more variation (e.g., the plot looks noisier) in the trend. With the longer sampling window the trend looks smoother because the Process Intelligence uses process data averaged over a longer period of time.

Figure 6-5: Process Intelligence Monitoring Cycle Effect on Statistical Values



SPM#_USER_COMMAND

Select Learn after all parameters have been configured to begin the Learning Phase. The monitoring phase will start automatically after the learning process is complete. Select Quit to stop Process Intelligence. "Detect" may be selected to return to the monitoring phase.

SPM_ACTIVE

The SPM_ACTIVE parameter starts Process Intelligence when "Enabled". "Disabled" (default) turns the diagnostic monitoring off. Must be set to "Disabled" for configuration. Only set to "Enabled" after fully configuring Process Intelligence.

Enabling Process Intelligence applies a high-pass filter to the pressure measurement prior to calculating standard deviation. This removes the effect of slow or gradual process changes from the standard deviation calculation while preserving the higher-frequency process fluctuations. Using the high-pass filter reduces the likelihood of generating a false detection if there is a normal process or setpoint change.

6.6.2 Alert configuration

To have Process Intelligence generate a Plantweb Insight alert, the alert limits must be configured on the mean and/or standard deviation. The three alert limits available are:

SPM#_MEAN_LIM

Upper and lower limits for detecting a Mean Change

SPM#_HIGH_VARIATION_LIM

Upper limit on standard deviation for detecting a High Variation condition

SPM#_LOW_DYNAMICS_LIM

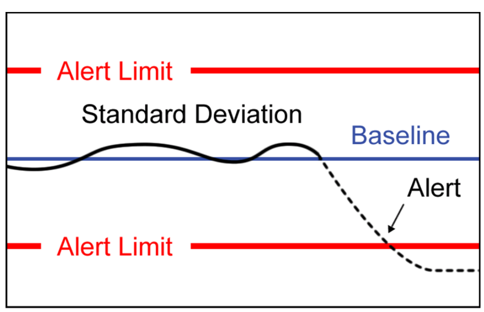
Lower limit on standard deviation for detecting a Low Dynamics condition (must be specified as a negative number)

All limits are specified as a percent change in the statistical value from its baseline. If a limit is set to 0 (the default setting) then the corresponding diagnostic is disabled. For example, if SPM#_High_Variation_Limit is 0, then Process Intelligence does not detect an increase in standard deviation.

Figure 6-6 illustrates an example of the standard deviation, with its baseline value and alert limits. During the monitoring phase, Process Intelligence will continuously evaluate the standard deviation and compare it against the baseline value. An alert will be detected if the standard deviation either goes above the upper alert limit, or below the lower alert limit.

In general, a higher value in any of these limits leads to the Process Intelligence diagnostic being less sensitive, because a greater change in mean or standard deviation is needed to exceed the limit. A lower value makes the diagnostic more sensitive, and could potentially lead to false detections.

Figure 6-6: Example Alerts for Standard Deviation



6.6.3 Process Intelligence operations

During operation, the following values are updated for each ADB Block

SPM#_BASELINE_MEAN

Baseline mean (calculated average) of the process variable, determined during the Learning/Verification process, and representing the normal operating condition

SPM#_MEAN

Current Mean of the process variable

SPM#_MEAN_CHANGE

Percent change between the baseline mean and the current mean

SPM#_BASELINE_STDEV

Baseline standard deviation of the process variable, determined during the Learning/ Verification process, and representing the normal operating condition

SPM#_STDEV

Current Standard Deviation of the process variable

SPM#_STDEV_CHANGE

Percent change between the baseline standard deviation and the current standard deviation

SPM#_TIMESTAMP

Time stamp of the last values and status for Process Intelligence

SPM#_STATUS

Current state of the Process Intelligence diagnostic. Possible values for Process Intelligence status are as shown below:

Status value	Description
Inactive	User Command in "Idle", Process Intelligence not Enabled, or the function block is not scheduled.
Learning	Learning has been set in the User Command, and the initial baseline values are being calculated
Verifying	Current baseline values and previous baseline values or being compared to verify the process is stable.
Monitoring	Monitoring the process and no detections are currently active.
Mean Change Detected	Alert resulting from the Mean Change exceeding the Threshold Mean Limit. Can be caused by a set point change, a load change in the flow, or an obstruction or the removal of an obstruction in the process.
High Variation Detected	Alert resulting from the Stdev Change exceeding the Threshold High Variation value. This is an indicator of increased dynamics in the process, and could be caused by increased liquid or gas in the flow, control or rotational problems, or unstable pressure fluctuations.
Low Dynamics Detected	Alert resulting from the Stdev Change exceeding the Threshold Low Dynamics value. This is an indicator for a lower flow, or other change resulting in less turbulence in the flow.

Note
In most cases, only one of the above Process Intelligence status bits will be active at one time. However, it is possible for “Mean Change Detected” to be active at the same time as either “High Variation Detected” or “Low Dynamics Detected” is active.

6.6.4 Plantweb alert

When any of the Process Intelligence detections (Mean Change, High Variation, or Low Dynamics) is active, a FOUNDATION™ Fieldbus Plantweb™ Insight alert in the device “Process Anomaly Detected (SPM)” will be generated and sent to the host system.

6.6.5 Trending statistical values in control system

Process Intelligence mean and standard deviation values may be viewed and/or trended in a FOUNDATION™ Fieldbus host system through the Analog Input (AI) function blocks.

An AI block may be used to read either the mean or the standard deviation from any one of the ADB blocks. To use the AI block to trend Process Intelligence data, set the CHANNEL parameter to one of the following values:

Table 6-1: Valid SPM Channels for the AI Block

Channel	SPM variable
12	Mean
13	Standard deviation

The Process Intelligence Mean and Standard Deviation can be changed in the AI function blocks.

6.6.6 Process Intelligence configuration with EDDL

For host systems that support Electronic Device Description Language (EDDL), using Process Intelligence is made easier with step-by-step configuration guidance and graphical displays. This section of the manual uses AMS Device Manager version 10.5 for illustrations, although other EDDL hosts could be used as well. In the asset management interface, the Process Intelligence diagnostic is referred to as "Statistical Process Monitoring".

The Process Intelligence Wizard can be launched by selecting **Statistical Process Monitoring** from the **Configure** → **Guided Setup page**.

This wizard will take you step-by-step through the parameters that need to configure Process Intelligence.

6.6.7 EDDL trending of mean and standard deviation

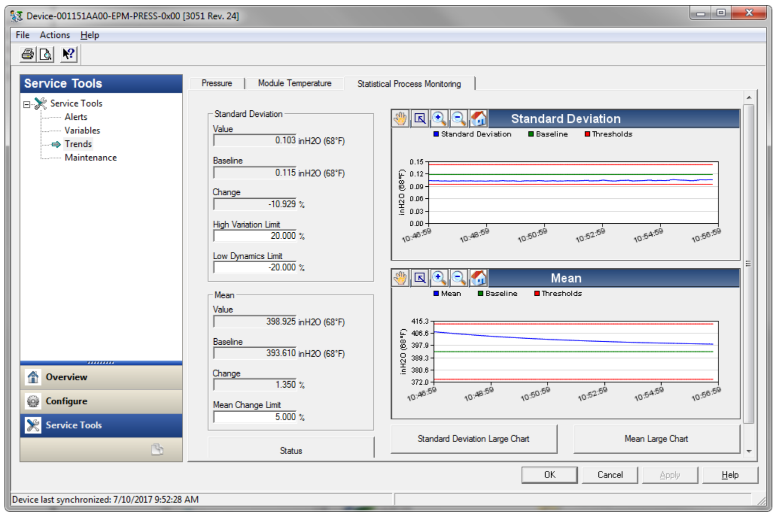
After Process Intelligence has been enabled, the EDDL user interface allows for easy viewing and trending of mean and standard deviation.

Procedure

To open up the trending screen, select **Service Tools** → **Trends** → **Statistical Process Monitoring**.

The EDDL Screen will show an online trend of mean and standard deviation, along with the baseline values, percent change, and detection limits (Figure 6-7).

Figure 6-7: EDDL Trend of Mean and Standard Deviation



Note

Data shown on the EDDL trends are not stored in a process historian or other database. When this screen is closed, all past data in the trends plots are lost. See Trending Process Intelligence data in DeltaV for configuring Process Intelligence data to be stored in a historian.

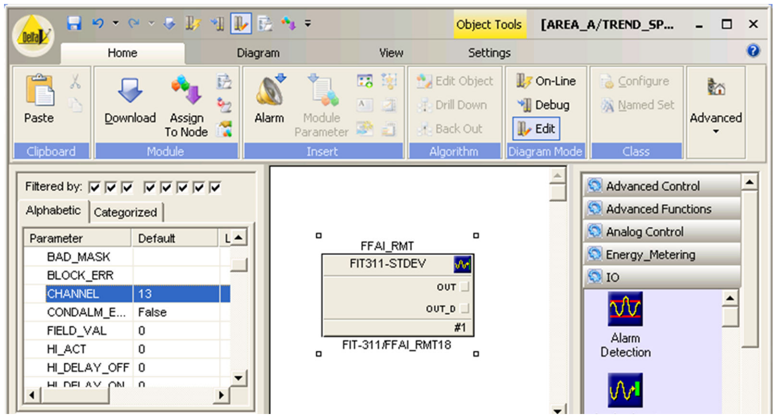
6.6.8 Trending Process Intelligence data in DeltaV

Refer to Trending statistical values in control system for general information about accessing the Process Intelligence data through the AI function blocks. This section shows a specific example of how Process Intelligence data can be accessed within the DeltaV™ host system, saved into the process historian, and used to generate a process alert.

Procedure

1. In DeltaV Control Studio, add an AI function block.
2. Assign the new block to one of the AI function blocks in the Rosemount 3051S Device.
3. Set the CHANNEL to one of the valid Process Intelligence channel values from (e.g., set the CHANNEL to 13 for Standard Deviation, as shown in Figure 6-8).

Figure 6-8: Example AI Function Block for Trending Standard Deviation in DeltaV



4. Set the units and scaling for the function block as follows:

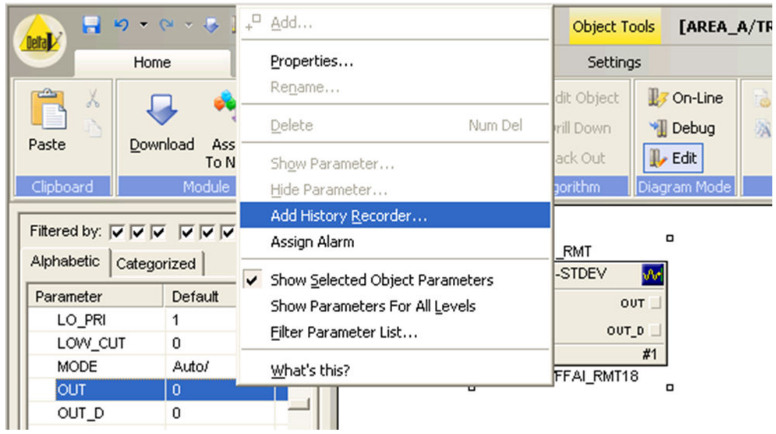
XD_SCALE	0 to 1 in H_2O (68 °F)
OUT_SCALE	0 to 1 in H_2O (68 °F)
L_TYPE	Indirect

The range set in the OUT_SCALE parameter will be the range shown by default when the variable is trended in the DeltaV Process History View. Standard deviation typically has a range much narrower than the process measurement, so the scaling should be set accordingly.

The units for XD_SCALE must be set to in H_2O (68 °F), but the units for OUT_SCALE can be set to any desired engineering unit. If the standard deviation

5. If the standard deviation is to be logged to DeltaV Continuous Historian, the appropriate parameter must be added to the historian.
   a) Right click on the OUT parameter of the AI Block, and select Add History Recorder ... (Figure 6-9).

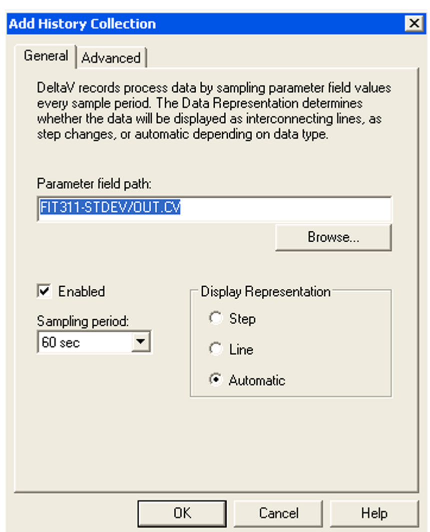
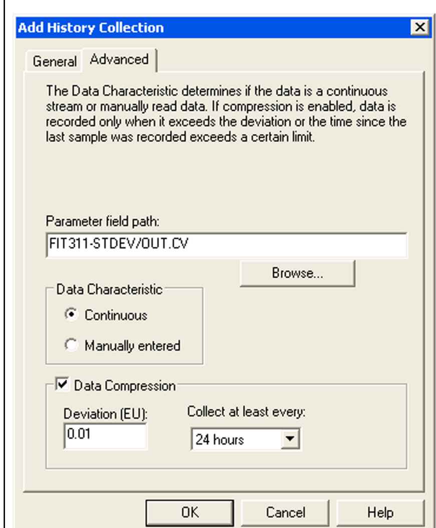
Figure 6-9: Adding History Recorder from DeltaV Control Studio



b) Follow through the Add History Collection dialog (Figure 6-10), to add the parameter to the DeltaV Historian with the desired sampling period, compression, etc.

By default the sampling period is 60 seconds, as shown in Figure 6-10. However, there are many diagnostics applications where one may want to look at changes in the standard deviation much faster than this. In that case, you will want to set the sampling period to a shorter duration.

Figure 6-10: DeltaV Add History Collection

General configuration	Advanced configuration
	

6. If logging the standard deviation, change the default data compression settings.
    - Disable the Data Compression by deselecting the appropriate box.

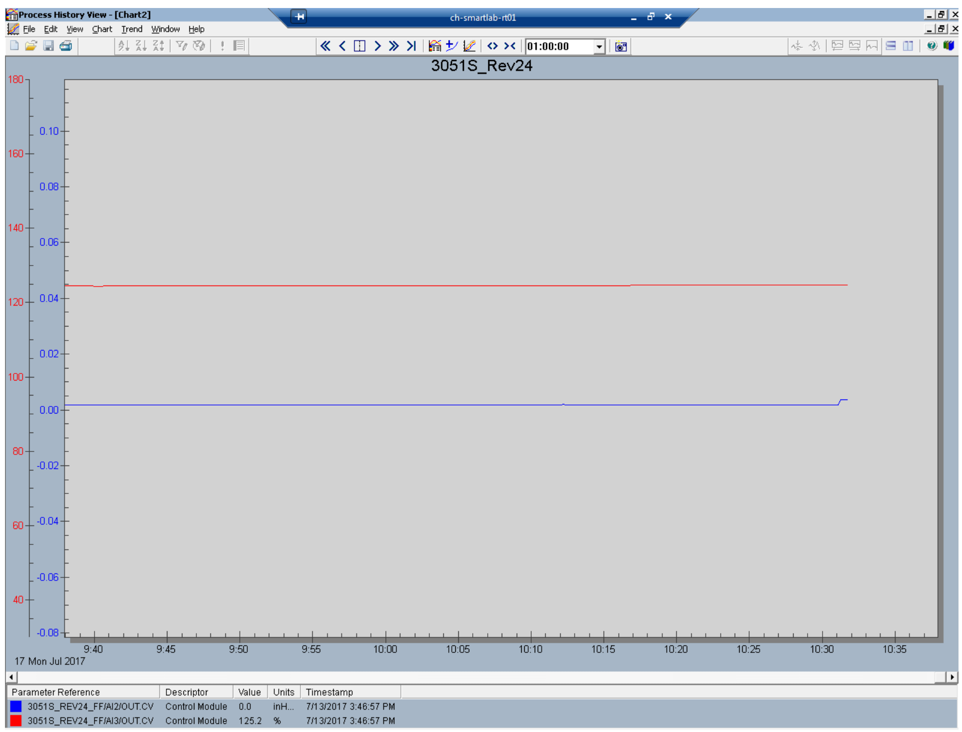
- Set the Deviation (EU)to a much lower value, for example, 0.001 or 0.0001

When adding a standard deviation for history collection in DeltaV, it is recommended that you not use the default data compression settings. By default, the DeltaV Historian will log a new data point only when the process value deviates by 0.01 or more. There are many diagnostics applications where it is useful to look at changes in the standard deviation that are smaller than this.

Refer to the DeltaV books online for more details on the DeltaV Continuous Historian.

7. After the Process Intelligence value has been saved to the historian, when the DeltaV Process History View is opened for the selected parameter, the graph will be populated with the historical data currently in the database (See Figure 6-11).

Figure 6-11: Trend of Standard Deviation in DeltaV Process History View



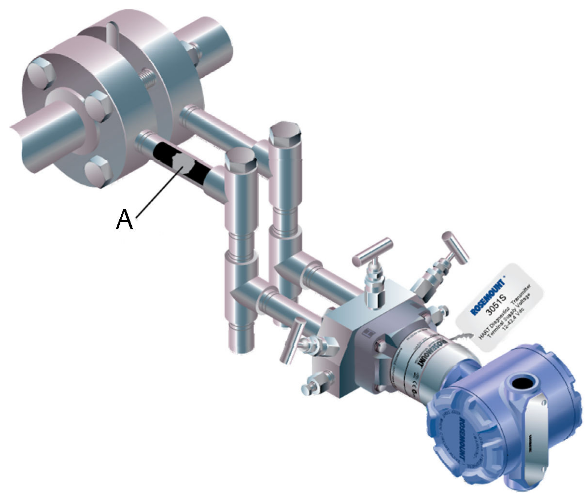
8. After the Process Intelligence data is trended in DeltaV, it is possible to configure HI and/or LO alarms on the mean or standard deviation via the AI Block.
   a) Right-click on the AI Function Block in Control Studio.
   b) Select Assign Alarm.

The Block Alarm configuration window will let you set up desired alarm limits. Refer to the DeltaV books online for detailed information on configuring alarms.

6.7 Plugged Impulse Line detection technology

Pressure transmitters are used in pressure, level, and flow measurement applications. Regardless of application, the transmitter is rarely connected directly to the pipe or vessel. Small diameter tubes or pipes commonly called impulse lines are used to transmit the pressure signal from the process to the transmitter. In some applications, these impulse lines can become plugged with solids or frozen fluid in cold environments, effectively blocking the pressure signals (Figure 6-12). The user typically does not know that the blockage has occurred. Because the pressure at the time of the plug is trapped, the transmitter may continue to provide the same signal as before the plug. Only after the actual process changes and the pressure transmitter's output remains the same may someone recognize that plugging has occurred. This is a typical problem for pressure measurement, and users recognize the need for a plugged impulse line diagnostic for this condition.

Figure 6-12: Plugged Impulse Line Basics



A. Clog

Testing at Emerson and other sites indicates Process Intelligence technology can detect plugged impulse lines. Plugging effectively disconnects the transmitter from the process, changing the noise pattern received by the transmitter. As the diagnostic detects changes in noise patterns, and there are multiple sources of noise in a given process, many factors can come into play. These factors play a large role in determining the success of diagnosing a plugged impulse line. This section of the product manual will acquaint users with the basics of the plugged impulse lines and the Plugged Impulse Line diagnostic, the positive and negative factors for successful plugged line detection, and the do's and don'ts of installing pressure transmitters and configuring and operating the Plugged Impulse Line diagnostic.

6.7.1 Plugged Impulse Line physics

The physics of Plugged Impulse Line detection begins with the fluctuations or noise present in most pressure and Differential Pressure (DP) signals. In the case of DP flow measurements, these fluctuations are produced by the flowing fluid and are a function of the geometric and physical properties of the system. The noise can also be produced by the pump or control system. This is also true for pressure measurements in flow applications, though the noise produced by the flow is generally less in relation to the average pressure value. Pressure level measurements may have noise if the tank or vessel has a source of agitation. The noise signatures do not change as long as the system is unchanged. In addition, these noise signatures are not affected significantly by small changes in the average value of the flow rate or pressure. These signatures provide the opportunity to identify a plugged impulse line.

When the lines between the process and the transmitter start to plug through fouling and build-up on the inner surfaces of the impulse tubing or loose particles in the main flow getting trapped in the impulse lines, the time and frequency domain signatures of the noise start to change from their normal states. In the simpler case of a pressure measurement, the plug effectively disconnects the pressure transmitter from the process. While the average value may remain the same, the transmitter no longer receives the noise signal from the process and the noise signal decreases significantly. The same is true for a DP transmitter when both impulse lines are plugged.

The case of the Differential Pressure measurement in a flow application with a single line plugged is more complicated, and the behavior of the transmitter may vary depending on a number of factors. First the basics: a differential pressure transmitter in a flow application is equipped with two impulse lines, one on the high pressure side (HP) and one on the low pressure side (LP) of the primary element. Understanding the results of a single plugged line requires understanding of what happens to the individual pressure signals on the HP and LP sides of the primary element. Common mode noise is generated by the primary element and the pumping system as depicted in Figure 6-13. When both lines are open, the differential pressure sensor subtracts the LP from the HP. When one of the lines are plugged (either LP or HP), the common mode cancellation no longer occurs. Therefore there is an increase in the noise of the DP signal. See Figure 6-14.

Figure 6-13: Differential Pressure Signals under Different Plugging Conditions

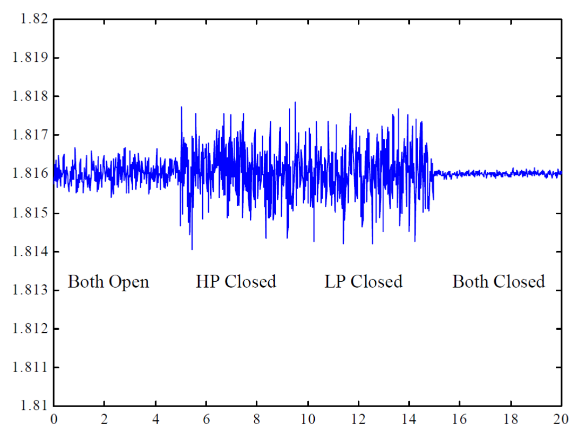
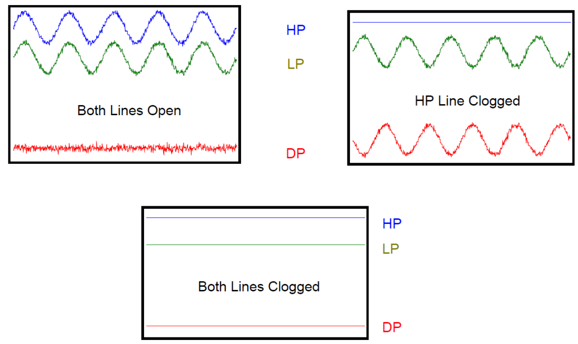


Figure 6-14: Differential Pressure (DP) Signals under Different Plugged Conditions



However, there is a combination of factors that may affect the output of the DP transmitter under single plugged line conditions. If the impulse line is filled with an incompressible fluid, no air is present in the impulse line or the transmitter body, and the plug is formed by rigid material, the noise or fluctuation will decrease. This is because the combination of the above effectively "stiffens" the hydraulic system formed by the DP sensor and the plugged impulse line. The Plugged Impulse Line diagnostic can detect these changes in the noise levels through the operation described previously.

6.7.2 Plugged Impulse Line detection factors

The factors that may play a significant role in a successful or unsuccessful detection of a plugged impulse line can be separated into positive factors and negative factors, with the former increasing the chances of success and the latter decreasing the chances of success. Within each list, some factors are more important than others as indicated by the relative position on the list. If an application has some negative factors that does not mean that it is not a good candidate for the diagnostic. The diagnostic may require more time and effort to set up and test and the chances of success may be reduced. Each factor pair will be discussed.

Ability to test installed transmitter

The single most important positive factor is the ability to test the diagnostic after the transmitter is installed, and while the process is operating. Virtually all DP flow and most pressure measurement installations include a root or manifold valve for maintenance purposes. By closing the valve, preferable the one(s) closest to the process to most accurately replicate a plug, the user can note the response of the diagnostic and the change in the standard deviation value and adjust the sensitivity or operation accordingly.

Stable, in-control process

A process that is not stable or in no or poor control may be a poor candidate for the Plugged Impulse Line diagnostic. The diagnostic baselines the process under conditions considered to be normal. If the process is unstable, the diagnostic will be unable to develop a representative baseline value. The diagnostic may remain in the learning/verifying mode. If the process is stable long enough to establish a baseline, an unstable process may result in frequent relearning/verifications and/or false trips of the diagnostic.

Well vented installation

This is an issue for liquid applications. Testing indicates that even small amounts of air trapped in the impulse line of the pressure transmitter can have a significant effect on the operation of the diagnostic. The small amount of air can dampen the pressure noise signal as received by the transmitter. This is particularly true for DP devices in single line plugging situations and GP/AP devices in high pressure/low noise applications. See DP Flow and low GP/AP vs. high GP/AP measurements and Impulse line length for further explanation. Liquid DP flow applications require elimination of all the air to ensure the most accurate measurement.

DP Flow and low GP/AP vs. high GP/AP measurements

This is best described as a noise to signal ratio issue and is primarily an issue for detection of plugged lines for high GP/AP measurements. Regardless of the line pressure, flow generated noise tends to be about the same level. This is particularly true for liquid flows. If the line pressure is high and the flow noise is very low by comparison, there may not be enough noise in the measurement to detect the decrease brought on by a plugged impulse line. The low noise condition is further enhanced by the presence of air in the impulse lines and transmitter if a liquid application. The Plugged Impulse Line diagnostic will alert the user to this condition during the learning mode by indicating “Insufficient Dynamics” status.

Flow vs. level applications

As previously described, flow applications naturally generate noise. Level applications without a source of agitation have very little or no noise, therefore making it difficult or impossible to detect a reduction in noise from the plugged impulse line. Noise sources include agitators, constant flow in and out of the tank maintaining a fairly consistent level, or bubblers.

Impulse line length

Long impulse lines potentially create problems in two areas. First, they are more likely to generate resonances that can create competing pressure noise signals with the process generated noise. When plugging occurs, the resonant generated noise is still present, and the transmitter does not detect a significant change in noise level, and the plugged condition is undetected. The formula that describes the resonant frequency is:

$fn = (2n-1)*C/4L$ (2)

where:

resonant frequency = fn

mode number = n

speed of sound in the fluid = C

impulse length (in meters) = L

A 10 meter impulse line filled with water could generate resonant noise at 37 Hz, above the frequency response range of a typical Rosemount Pressure Transmitter. This same impulse line filled with air will have a resonance of 8.7 Hz, within the range. Proper support of the impulse line effectively reduces the length, increasing the resonant frequency.

Second, long impulse lines can create a mechanical low pass filter that dampens the noise signal received by the transmitter. The response time of an impulse line can be modeled as a simple RC circuit with a cutoff frequency defined by:

$= RC$ and $^{\tau} = {}^{\pi}\ 1/2\ f_c$

$R = 8\ ^{\nu}\ L /\ ^{\pi}\ r^4$

$C =\ ^{\Delta}$ Volume / $^{\Delta}$ Pressure

where:

Cut-off frequency = fc

Viscosity in centipoises = $^{\nu}$

Impulse line length in meters = L

Radius of the impulse line = r

The "C" formula shows the strong influence of air trapped in a liquid filled impulse line, or an impulse line with air only. Both potential issues indicate the value of short impulse lines. One installation best practice for DP flow measurements is the use of the Rosemount 405 Series of Integrated Compact Orifice Meters with the Rosemount 3051S Pressure Transmitter. These integrated DP flow measurement systems provide perhaps the shortest practical impulse line length possible while significantly reducing overall installation cost and improved performance. They can be specified as a complete DP flow meter.

Note
The Plugged Impulse Line diagnostic capability in the Rosemount 3051S FOUNDATION™ Fieldbus Pressure Transmitter calculates and detects significant changes in statistical parameters derived from the input process variable. These statistical parameters relate to the variability of the noise signals present in the process variable. It is difficult to predict specifically which noise sources may be present in a given measurement or control application, the specific influence of those noise sources on the statistical parameters, and the expected changes in the noise sources at any time. Therefore, it is not absolutely warranted or guaranteed the Plugged Impulse Line diagnostic will accurately detect each specific plugged impulse line condition under all circumstances.

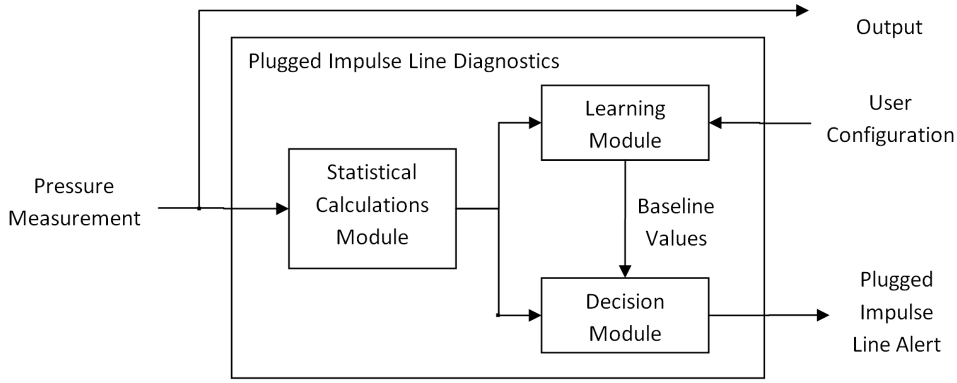
6.7.3 Plugged Impulse Line diagnostic functionality

The Advanced Diagnostics Suite provides the Plugged Impulse Line diagnostic, as an easy way to apply Process Intelligence technology specifically for detecting plugging in pressure measurement impulse lines. Similar to Process Intelligence, Plugged Impulse Line diagnostic also calculates the mean and standard deviation of the pressure measurement and generates an alert when the standard deviation exceeds an upper or lower limit.

Figure 6-15 illustrates a block diagram of the plugged impulse line diagnostic. Notice it is very similar to the diagram for Process Intelligence shown in Figure 6-3. However, there are a couple of notable differences with Plugged Impulse Line diagnostics:

- Statistical values (mean and standard deviation) are not available as outputs
- The Plantweb™ alert generated specifically indicates "Plugged Impulse Line Detected"

Figure 6-15: Overview of Plugged Impulse Line Diagnostics



Plugged Impulse Line diagnostics also includes some additional features to make it especially suitable for detecting plugging in pressure measurement impulse lines. It has the ability to:

- Automatically relearn new baseline values if the pressure measurement changes significantly
- Set the status quality of the pressure measurement to “Uncertain” if a plugged impulse line is detected
- Check for a minimum process dynamics during the learning process
- Adjust the verification settings
- Set separate learning and detection periods

Figure 6-16 shows a flow chart of the Plugged Impulse Line algorithm. Note that this diagram shows the sequence of Plugged Impulse Line steps using the default configuration settings. Information for adjusting these settings is found in Configuration of Plugged Impulse Line detection. The specific steps that Plugged Impulse Line goes through are as follows:

1. Learning phase

Plugged Impulse Line diagnostics begins the learning process when it is Enabled, when the User Command is set to “Relearn”, or when a mean change is detected during the Detection Phase. The diagnostic collects the pressure values for five minutes and computes the mean and the standard deviation.

Note
The length of the learning period is user-adjustable, with five minutes as the default value. During the learning phase, the status is “Learning”.

2. Sufficient variation?

During the Learning and the Verify modes, the Plugged Impulse Line diagnostics checks that the noise level (e.g. the standard deviation) is high enough for reliable detection of plugged impulse lines. If the noise level is too low, the status goes to “Insufficient Dynamics”, and it stops. It will not resume learning again until a “Relearn” command is given.

3. Verification phase

Plugged Impulse Line diagnostics collects the pressure values for an additional five minutes (or same length as learning period) and computes a second mean and standard deviation. During this phase, the Plugged Impulse Line status is "Verifying".

4. Steady process?

At the end of the verification phase, the Plugged Impulse Line diagnostics compares the last mean and standard deviation against the previous mean and standard deviation to determine if the process is at a steady state. If the process is at a steady-state, then it moves into detection phase. If not, then it repeats the verification phase

5. Establish baseline

At the end of the verification phase, if the process has been determined to be at a steady state, the last mean and standard deviation are taken to be the "Baseline" values, representative of the normal process operating condition.

6. Detection phase

During the detection phase, the Plugged Impulse Line diagnostics collects pressure data for one minute and computes the mean and the standard deviation.

Note
The length of this detection period is user-adjustable, with one minute as the default value.

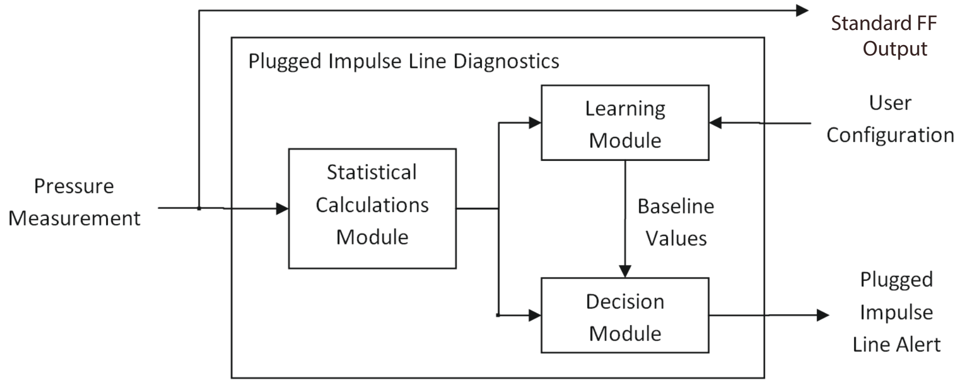
7. Relearn required?

At the end of the detection phase, Plugged Impulse Line diagnostics first compares the current mean with the baseline mean. If the two differ significantly, then it goes back into the learning phase, because the process conditions have changed too much for a reliable detection of a plugged impulse line.

8. Compare standard deviations

If no relearn is required, the Plugged Impulse Line diagnostics compares the current standard deviation against the baseline standard deviation to determine if a plugged impulse line is detected. For all sensor types, it checks if the standard deviation has decreased below a lower limit. For DP sensors, it also checks if the standard deviation has increased above an upper limit. If either of these limits is exceeded, the status changes to *Plugged Impulse Line* and it stops, and will not resume again until a *Relearn* command is given. If a plugged impulse line is not detected, the status is *OK* and the detection phase is repeated.

Figure 6-16: Plugged Impulse Line Diagnostics Flow



6.8 Configuration of Plugged Impulse Line detection

This section describes the configuration of the Plugged Impulse Line diagnostic.

6.8.1 Basic configuration

For some impulse line plugging applications there will be a very significant (> 80 percent) decrease in standard deviation. Examples of this would include a plug in the impulse line of a GP/AP measurement in a noisy process, or a plug in both impulse lines of a DP measurement. In these applications, configuring plugged impulse line detection requires nothing more than turning it on.

Procedure

1. To configure Plugged Impulse Line detection, set *PLINE_ON* to **Enabled**.

   Once the Plugged Impulse Line is enabled, it will automatically start the learning process, and move to the detection phase if there is sufficient variation and the process is stable.

2. Optionally, if, when a plugged impulse line is detected, you want to automatically have the status quality of the pressure measurement go to *Uncertain*, set the PLINE_AFFECT_PV_STATUS parameter to **Yes**.

   By default, the value of PLINE_AFFECT_PV_STATUS is *No*, meaning the quality of the pressure measurement will not be changed if Plugged Impulse Line detects a plugged impulse line. Setting this parameter to *Yes* will cause the status quality to change to *Uncertain* when a plugged impulse line is detected. Depending on the DCS configuration, the *Uncertain* quality could be visible to the operator, or it could affect the control logic.

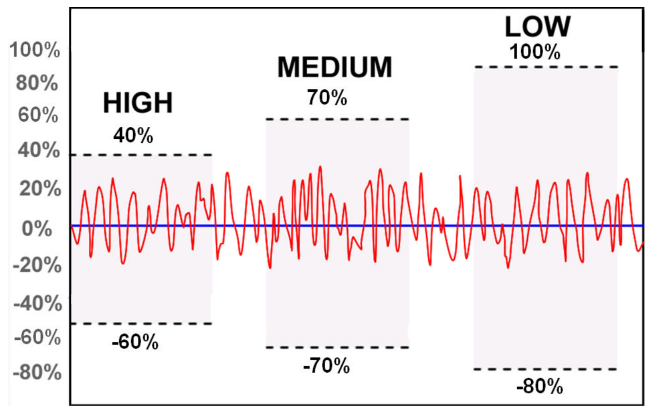
3. To re-start the Plugged Impulse Line diagnostics learning process, set the parameter **PLINE_RELEARN** = **Relearn**.

6.8.2 Configuration of detection sensitivity

Although a few impulse line applications can be configured just by enabling the Plugged Impulse Line diagnostics, the majority of applications will require configuring the detection sensitivity (that is, the upper and/or lower limit on the standard deviation at which an impulse line plug will be detected).

Figure 6-17 illustrates the basic detection sensitivity setting for Plugged Impulse Line diagnostics. In general, a higher sensitivity means that the Plugged Impulse Line diagnostics is more sensitive to changes in the process dynamics, while a lower sensitivity means that the Plugged Impulse Line is less sensitive to process dynamics changes.

Figure 6-17: Plugged Impulse Line Basic Detection Sensitivities



Detection sensitivities are specified as a percent change in the standard deviation from the baseline value.

Note
Figure 6-17 shows a higher detection limit (% change) actually corresponds to a lower sensitivity, because a greater change in the process dynamics is required to trigger a plugged impulse line alert. Likewise, a lower detection limit corresponds to a higher sensitivity.

In the Plugged Impulse Line diagnostic, the Detection Sensitivity is determined by three parameters: PLINE_SENSITIVITY, PLINE_DETECT_SENSITIVITY, and PLINE_SINGLE_DETECT_SENSITIVITY.

The PLINE_SENSITIVITY parameter provides the means to set a basic detection sensitivity (Figure 6-17).

It can be set to the values:

- High
- Medium (default)
- Low

Each value has a corresponding upper and lower limit shown in the table Table 6-2.

Note
Setting the basic sensitivity affects both the upper and the lower detection limits.

Table 6-2: Basic Plugged Impulse Line Detection Sensitivities

PLINE_SENSITIVITY value	Upper standard deviation limit	Lower standard deviation limit
High	40%	-60%
Medium	70%	-70%
Low	100%	-80%

So, for example, if the PLINE_SENSITIVITY is set to *High*, then a plugged impulse line will be detected if the standard deviation either increases by more than 40 percent above its baseline value, or decreases more than 60 percent below its baseline value.

Note

For GP/AP sensors, the Plugged Impulse Line diagnostic does not check for an increase in standard deviation, and a plugged impulse line is detected only if the standard deviation goes below the lower limit. For DP sensors, it checks for both an increase and a decrease in standard deviation.

The upper and lower detection limits can be set to custom values, using the following parameters.

PLINE_DETECT_SENSITIVITY

Adjusts the Lower detection limit. If this value is 0 (default), the Lower limit is determined by PLINE_SENSITIVITY. If this value is greater than 0, then it overrides the basic sensitivity value. This value can be set in the range 0 – 100%.

PLINE_SINGLE_DETECT_SENSITIVITY

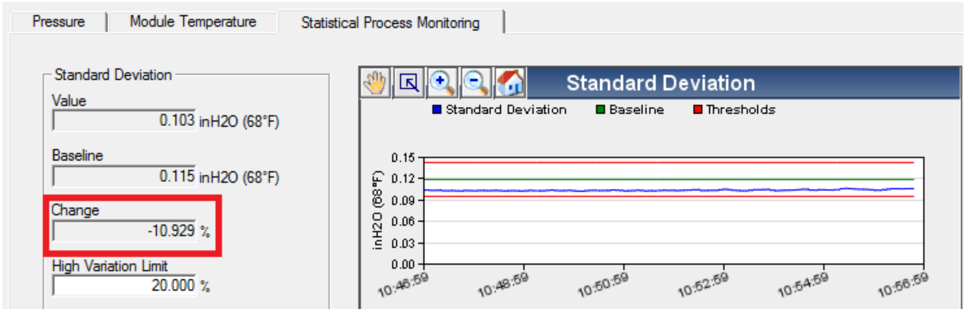
Adjusts the Upper detection limit. If this value is 0 (default), the Upper limit is determined by PLINE_SENSITIVITY. If this value is greater than 0, then it overrides the basic sensitivity value. This value can be set in the range 0 – 10,000%.

6.8.3 Determining detection sensitivity

Determining what values to configure for the upper and lower detection limits can be done by configuring Plugged Impulse Line to monitor and trend the standard deviation, and then looking at how the standard deviation changes when impulse line plug is simulated, by closing the transmitter root valves or manifold valves.

First, Plugged Impulse Line needs to be configured to monitor the pressure as described in Process Intelligence configuration and operation. The Plugged Impulse Line diagnostic uses the same interface as Process Intelligence. After configuration, the standard deviation needs to be trended, either in an EDDL-supported host (such as AMS Device Manager, shown in Figure 6-18), or in the DCS as described in Trending statistical values in control system.

Figure 6-18: Trend of Standard Deviation in AMS Device Manager



After configuring, wait long enough for the Plugged Impulse Line diagnostic to begin updating the percent change in standard deviation. This will be at least two to three times the monitoring cycle.

While the standard deviation is being trended, the impulse line valve (e.g. manifold or root) must be manually closed. After the impulse line is closed off, note in the trend how much the standard deviation has changed. In the example in the standard deviation has decreased by 10.9 percent.

This process needs to be repeated for each impulse line plugging condition that needs to be detected. For DP measurements, this should be done for both the high side and the low side impulse line. Optionally, you may also wish to do this for both sides plugged. For GP/AP measurements, this process would be done only for the single impulse line.

Upper and lower detection limits are chosen based on the degree of standard deviation change that was observed when the impulse lines were plugged. These limits should be less than the observed change in standard deviation, but more than changes in standard deviation that happen under normal process conditions. A lower detection limit will result in a plug being detected earlier and more often, but could also lead to false detections. A higher detection limit will reduce the likelihood of false detections, but also increase the probability that an impulse line plug will not be detected.

A good guideline is to set the detection limit to half of the observed change in standard deviation, but no less than 20 percent.

6.8.4 Advanced Plugged Impulse Line configuration

Plugged Impulse Line diagnostics provides the ability for advanced users to fine-tune some of the algorithm settings.

PLINE_RELEARN_THRESHOLD

This adjusts the limit at which the Plugged Impulse Line diagnostics will automatically relearn new baseline values if the process mean changes. By default, this threshold is:

- Two inches of water for DP Range 1 (-25 to 25 inH_2O) sensors
- Five inches of water for DP Range 2 (-250 to 250 inH_2O) sensors
- 1 percent of Primary Value Range for all other sensors

When PLINE_RELEARN_THRESHOLD is at 0 (default) the above values are used for the relearn threshold. When a positive number is entered here, this value (in % of Primary

Value range) overrides the default relearn threshold values. For example, if the sensor is type DP Range 3 (-1000 to 1000 inH_2O), and PLINE_RELEARN_THRESHOLD is set to 1%, then Plugged Impulse Line will relearn if the mean changes by more than 10 inH_2O.

PLINE_AUTO_RELEARN

This can be used to turn off the automatic relearning. If set to ***Disabled***, the Plugged Impulse Line diagnostic will not go back into learning mode, even if there is a large mean change. In most cases, this parameter should be kept at ***Enabled*** because without this check, a large change in a flow rate could also cause a change in the standard deviation, triggering a false detection.

PLINE_LEARN_LENGTH

The length of time over which mean and standard deviation are calculated during the learning and verification phases. Default is five minutes. Allowable range is 1-60 minutes. If the process has a periodic change in the mean over time (e.g. a slow oscillation), a longer learning cycle may provide a better baseline.

PLINE_DETECT_LENGTH

The length of time over which mean and standard deviation are calculated during the detection phase. Default is one minute. Allowable range is 1-60 minutes. This value should not be longer than the PLINE learning cycle. A shorter value will in general allow a plugged impulse line to be detected more quickly. However, if the process has a dominant cycling or oscillation, this parameter should be set to longer than the period of oscillation.

PLINE_LEARN_SENSITIVITY

The PLINE_LEARN_SENSITIVITY parameters provide very specific adjustments to the sensitivity during the learning phase. Most of the time, it is sufficient to use these default values:

- Insufficient Dynamics Check: Ignores the insufficient dynamic check if not selected. Use only when there is very low process noise. This could result in a plugged impulse line not being detected.
- 10%, 20%, and 30% Stdev. Change Check: Allows for 10, 20, or 30 percent change in standard deviation while in the learning state. If this value is exceeded, the algorithm will stay in the verifying state until the value is not exceeded.
- Three or Six Sigma Mean Change Check: Allows for a three or six standard deviations change in the mean while in the learning state. If this value is exceeded, algorithm will stay in the verifying state until the value is not exceeded.
- 2% Mean Change Check: The mean value of the baseline calculation cannot vary more than 2 percent during the learning or verifying states. If this value is exceeded, algorithm will stay in the verifying state until the value is not exceeded.

You may want to increase or disable one or more of these learning sensitivity settings, if you find that the Plugged Impulse Line continues to stay in the verification phase.

6.8.5 Plugged Impulse Line operation

During operation the PIL_STATUS indicates the current status of the algorithm. The valid values are:

Value	Description
OK	The diagnostic is operating and has not detected a plugged impulse line.
Inactive	The diagnostic is not currently operating.
Learning	The diagnostic is in the learning phase, establishing a baseline mean and standard deviation.
Verifying	The diagnostic is verifying the values established in the learning phase.
Insufficient Dynamics	The diagnostic did not measure enough process noise to establish a baseline value during the learning phase.
Bad PV Status	The sensor transducer status is Bad, therefore the algorithm is paused. Algorithm will resume when a good or uncertain status returns.
Plugged Impulse Line	The diagnostic is operating and has detected a plugged impulse line.

Plugged Impulse Line also indicates the timestamp of the last detection of a plugged impulse line via these parameters:

PLINE_HISTORY_TIMESTAMP Time stamp when the last plugged impulse line was detected.

PLINE_HISTORY_STATUS Indicates whether a plugged impulse line has ever been detected.

6.8.6 Plugged Impulse Line configuration in EDDL

Host systems that support EDDL may use labels for the Plugged Impulse Line configuration parameters that are slightly different from the Fieldbus parameter names described previously in this section. Table 6-3 shows the correspondence between the FOUNDATION™ Fieldbus parameter names used in this document, and the labels used in EDDL hosts, such as AMS Device Manager.

Table 6-3: Corresponding EDDL Labels

FOUNDATION Fieldbus parameter name	EDDL label(s)
PLINE_ON	Plugged Line
PLINE_LEARN_LENGTH	Learning Cycle
PLINE_SENSITIVITY	Detection Limit
PLINE_AFFECT_PV_STATUS	Affect PV Status
PLINE_RELEARN	User Command
PLINE_AUTO_RELEARN	Auto Relearn
PLINE_RELEARN_THRESHOLD	Relearn Threshold
PLINE_LEARNING_SENSITIVITY	Learning Sensitivity
PLINE_DETECT_LENGTH	Detecting Cycle
PLINE_DETECT_SENSITIVITY	Custom Lower Limit
PLINE_SINGLE_DETECT_SENSITIVITY	Custom Upper Limit
PLINE_STATUS	Status

Table 6-3: Corresponding EDDL Labels *(continued)*

FOUNDATION Fieldbus parameter name	EDDL label(s)
PLINE_HISTORY_STATUS	Plugged Impulse Line History - Status
PLINE_HISTORY_TIMESTAMP	Plugged Impulse Line History - Time Stamp

6.8.7 Viewing the indication of a Plugged Impulse Line

When a plugged impulse line is detected, a Plantweb™ alert is generated, and this alert can be seen in AMS Alert Monitor. Also (optionally), using the "Affect PV Status" parameter, the status of the pressure measurement can be made to change from ***Good*** to ***Uncertain*** when a plugged impulse line is detected. Dependent upon the DCS configuration, the uncertain status of the measurement may be indicated within the operator interface.

A Reference data

A.1 Product certification

To view current Rosemount 3051S Pressure Transmitter Product Certifications, follow these steps:

Procedure

1. Go to Emerson.com/Rosemount/Rosemount-3051S.
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. Click **Manuals & Guides**.
4. Select the appropriate Quick Start Guide.

A.2 Ordering information, specification, and drawings

To view current Rosemount 3051S Pressure Transmitter ordering information, specifications, and drawings, follow these steps:

Procedure

1. Go to Emerson.com/Rosemount/Rosemount-3051S.
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. For installation drawings, click **Drawings & Schematics**.
4. Select the appropriate document.
5. For ordering information, specifications, and dimensional drawings, click **Data Sheets & Bulletins**
6. Select the appropriate Product Data Sheet.

B FOUNDATION™ Fieldbus Block Information

B.1 Resource Block

This section contains information on the Rosemount 3051S Resource Block. Descriptions of all Resource Block Parameters, errors, and diagnostics are included. Also the modes, alarm detection, status handling, and troubleshooting are discussed.

Definition

This block defines the physical resources of the device. The resource block also handles functionality that is common across multiple blocks. The block has no linkable inputs or outputs.

Table B-1: Resource Block Parameters

Index	Parameter	Units	Writable mode	Description
1	ST_REV	None	Read only	Revision level of the static data associated with the function block
2	TAG_DESC	None	O/S, Auto	User description of the intended application of the block
3	STRATEGY	None	O/S, Auto	Strategy field can be used to identify grouping of blocks
4	ALERT_KEY	None	O/S, Auto	Identification number of the plant unit
5	MODE_BLK	N/A	N/A	Actual, target, permitted, and normal modes of the block
	MODE_BLK.TARGET	Enumeration	O/S, Auto	Mode requested by the operator, limited to the values allowed by the PERMITTED sub-parameter
	MODE_BLK.ACTUAL	Enumeration	Read only	Current block mode, which may differ from the target based on operating conditions; value is calculated as part of block execution
	MODE_BLK.PERMITTED	Enumeration	O/S, Auto	Defines the modes allowed for a block instance; permitted mode is configured based on application requirement. Any mode change request will be checked by the device to ensure the requested target is defined as a permitted mode.
	MODE_BLK.NORMAL	Enumeration	O/S, Auto	Mode the block should be set to during normal operating conditions; limited to values allowed by the PERMITTED subparameter

Table B-1: Resource Block Parameters *(continued)*

Index	Parameter	Units	Writable mode	Description
6	BLOCK_ERR	Enumeration	Read only	Reflects error status associated with hardware or software components associated with a block; a bit string so that multiple errors may be shown
7	RS_STATE	Enumeration	Read only	State of the function block application state machine
8	TEST_RW	N/A	N/A	Read/write test parameter - used only for conformance testing
9	DD_ RESOURCE	None	Read only	String identifying the tag of the resource containing the Device Description for the resource
10	MANUFAC_ID	Enumeration	Read only	Manufacturer identification number - used by interface device to locate DD file for the resource
11	DEV_TYPE	Enumeration	Read only	Manufacturer's model number associated with the resource - used by interface devices to locate the DD file for the resource.
12	DEV_REV	None	Read only	Manufacturer revision number associated with the resource - used by interface device to locate DD file for the resource
13	DD_REV	None	Read only	Revision of the DD associated with the resource - used by interface device to locate DD file for the resource
14	GRANT_DENY	N/A	N/A	Options for controlling access of host computer and local control panels for operating, tuning, and alarm parameters of the block
15	HARD_TYPES	Enumeration	Read only	Types of hardware available as channel numbers; scalar input is the only supported hardware type
16	RESTART	Enumeration	O/S, Auto	Allows manual restart to be initiated or allows values to be defaulted
17	FEATURES	Enumeration	Read only	Shows supported resource block options
18	FEATURE_SEL	Enumeration	O/S, Auto	Allows selection of resource block options
19	CYCLE_TYPE	Enumeration	Read only	Identifies the block execution methods available for this resource
20	CYCLE_SEL	Enumeration	O/S, Auto	Allows selection of block execution method for this resource
21	MIN_CYCLE_T	1/32 msec	Read only	Smallest macrocycle time of which the device is capable
22	MEMORY_ SIZE	Kilobytes	Read only	Available configuration memory in the empty resource; to be checked before attempting a download

Table B-1: Resource Block Parameters *(continued)*

Index	Parameter	Units	Writable mode	Description
23	NV_CYCLE_T	1/32 msec	Read only	Minimum time interval specified by manufacturer for writing copies of NV parameters to non-volatile memory
24	FREE_SPACE	Percent	Read only	Percent of memory available for further configuration
25	FREE_TIME	Percent	Read only	Percent of block processing time that is free to process additional blocks; this parameter is not used and is set to a constant 0
26	SHED_RCAS	1/32 msec	O/S, Auto	Sets time limit for loss of communication from a remote device; these constants are used by each function block
27	SHED_ROUT	1/32 msec		Sets time limit for loss of communication from a remote device; these constants are used by each function block
28	FAULT_STATE	Enumeration	Read only	Unused
29	SET_FSTATE	Enumeration	O/S, Auto	Unused
30	CLR_FSTATE	Enumeration	O/S, Auto	Unused
31	MAX_NOTIFY	None	Read only	Maximum number of possible unconfirmed alert notify messages
32	LIM_NOTIFY	None	O/S, Auto	Maximum number of allowed unconfirmed alert notify messages
33	CONFIRM_ TIME	1/32 msec	O/S, Auto	Minimum time between retries of alert reports
34	WRITE_LOCK	Enumeration	O/S, Auto	If set to *Locked*, no writes from anywhere are allowed, except to clear WRITE_LOCK.
35	UPDATE_EVT	N/A	N/A	Alert generated by any change to the static data; not generated when block is O/S
36	BLOCK_ALM	N/A	N/A	Used for all configuration, hardware, connection failure, or system problems in the block
37	ALARM_SUM	N/A	N/A	Current alert status, unacknowledged states, unreported states, and disabled states of alarms associated with the function block
38	ACK_OPTION	Enumeration	O/S, Auto	Allows selection of which alarms associated with the resource block will be automatically acknowledged
39	WRITE_PRI	None	O/S, Auto	Priority of alarm generated by clearing the write lock
40	WRITE_ALM	N/A	N/A	Alert generated if write lock parameter is cleared

Table B-1: Resource Block Parameters *(continued)*

Index	Parameter	Units	Writable mode	Description
41	ITK_VER	None	Read only	Major revision number of the interoperability test case used in certifying this device as interoperable
42	FD_VER	None	Read only	Reflects value of major version of Field Diagnostics specification To which the device was designed; allows hosts to distinguish between changes that may be necessary in such a recent specification
43	FD_FAIL_ACTIVE	Enumeration	Read only	Reflects error conditions being detected as active as selected for this category; bit string so multiple conditions may be shown
44	FD_OFFSPEC_ACTIVE	Enumeration	Read only	Reflects error conditions being detected as active as selected for this category; bit string so multiple conditions may be shown
45	FD_MAINT_ACTIVE	Enumeration	Read only	Reflects error conditions being detected as active as selected for this category; bit string so multiple conditions may be shown
46	FD_CHECK_ACTIVE	Enumeration	Read only	Reflects error conditions being detected as active as selected for this category; bit string so multiple conditions may be shown
47	FD_FAIL_MAP	Enumeration	O/S, Auto	Maps conditions to be detected as active for the FAIL alarm category; each detected condition has a corresponding bit defined in this map. If the bit is set, it indicates the condition is in the FAIL category (sets the same bit in FD_FAIL_ACTIVE if condition occurs); multiple bits can be set at the same time.
48	FD_OFFSPEC_MAP	Enumeration	O/S, Auto	Maps conditions to be detected as active for the OFFSPEC alarm category; each detected condition has a corresponding bit defined in this map. If the bit is set, it indicates the condition is in the OFFSPEC category (sets the same bit in FD_OFFSPEC_ACTIVE if condition occurs); multiple bits can be set at the same time.
49	FD_MAINT_MAP	Enumeration	O/S, Auto	Maps conditions to be detected as active for the MAINT alarm category; each detected condition has a corresponding bit defined in this map. If the bit is set, it indicates the condition is in the MAINT category (sets the same bit in FD_MAINT_ACTIVE if condition occurs); multiple bits can be set at the same time.

Table B-1: Resource Block Parameters *(continued)*

Index	Parameter	Units	Writable mode	Description
50	FD_CHECK_MAP	Enumeration	O/S, Auto	Maps conditions to be detected as active for the CHECK alarm category; each detected condition has a corresponding bit defined in this map. If the bit is set, it indicates the condition is in the CHECK category (sets the same bit in FD_CHECK_ACTIVE if condition occurs); multiple bits can be set at the same time.
51	FD_FAIL_MASK	Enumeration	O/S, Auto	Allows user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through alarm parameter. A bit equal to '1' masks (i.e. inhibit) broadcast of a condition, and a bit equal to '0' unmasks (i.e. allow) broadcast of a condition.
52	FD_OFFSPEC_MASK	Enumeration	O/S, Auto	Allows user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through alarm parameter. A bit equal to '1' masks (i.e. inhibit) broadcast of a condition, and a bit equal to '0' unmasks (i.e. allow) broadcast of a condition.
53	FD_MAINT_MASK	Enumeration	O/S, Auto	Allows user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through alarm parameter. A bit equal to '1' masks (i.e. inhibit) broadcast of a condition, and a bit equal to '0' unmasks (i.e. allow) broadcast of a condition.
54	FD_CHECK_MASK	Enumeration	O/S, Auto	Allows user to suppress any single or multiple conditions that are active, in this category, from being broadcast to the host through alarm parameter. A bit equal to '1' masks (i.e. inhibit) broadcast of a condition, and a bit equal to '0' unmasks (i.e. allow) broadcast of a condition.
55	FD_FAIL_ALM	N/A	N/A	Used primarily to broadcast a change in associated active conditions, which are not masked, for this alarm category to a Host System
56	FD_OFFSPEC_ALM	N/A	N/A	Used primarily to broadcast a change in associated active conditions, which are not masked, for this alarm category to a Host System
57	FD_MAINT_ALM	N/A	N/A	Used primarily to broadcast a change in associated active conditions, which are not masked, for this alarm category to a Host System

Table B-1: Resource Block Parameters *(continued)*

Index	Parameter	Units	Writable mode	Description
58	FD_CHECK_ALM	N/A	N/A	Used primarily to broadcast a change in associated active conditions, which are not masked, for this alarm category to a Host System
59	FD_FAIL_PRI	None	O/S, Auto	Allows host system to specify priority of this alarm category
60	FD_OFFSPEC_PRI	None	O/S, Auto	Allows host system to specify priority of this alarm category
61	FD_MAINT_PRI	None	O/S, Auto	Allows host system to specify priority of this alarm category
62	FD_CHECK_PRI	None	O/S, Auto	Allows host system to specify priority of this alarm category
63	FD_SIMULATE	N/A	N/A	Allows conditions to be manually supplied when simulation is enabled; physical simulate switch needs to be enabled to allow simulation to be activated in software. When simulation is enabled, the DIAGNOSTIC_SIMULATE_VALUE can be used to simulate the *_ACTIVE parameters; however, FD_EXTENDED_ACTIVE_1 is unaffected. While simulation is enabled, the recommended action will show that simulation is active.
64	FD_RECOMMEN_ACT	Enumeration	Read only	Device-enumerated summary of the most severe condition or conditions detected; DD help should describe by enumerated action, what should be done to alleviate the condition or conditions
65	FD_EXTENDED_ACTIVE_1	Enumeration	Read only	Displays all possible active conditions so there will always be one parameter that will display active conditions even if they are not mapped to the categories
66	FD_EXTENDED_MAP_1	Enumeration	O/S, Auto	Any bit values are allowed to be written, but they will be discarded; the parameter will always return and use the initial value.
67	COMPATIBILITY_REV	None	Read only	Indicates oldest version of DD that can be used with this device (DD must contain a device revision number equal to or greater than this parameter); also see DD_REV for other limitations on which DDs can be used
68	HARDWARE_ REVISION	None	Read only	Revision of hardware used in device
69	SOFTWARE_REV	None	Read only	Software revision of device code
70	PD_TAG	None	Read only	PD tag description of device
71	DEV_STRING	N/A	N/A	Factory use only

Table B-1: Resource Block Parameters *(continued)*

Index	Parameter	Units	Writable mode	Description
72	DEV_OPTIONS	Enumeration	Read only	Indicates which device options are enabled
73	OUTPUT_ BOARD_SN	None	Read only	Output board serial number
74	FINAL_ASSY_ NUM	None	O/S, Auto	Final assembly number of the device
75	DOWNLOAD_ MODE	Enumeration	O/S, Auto	Factory use only
76	HEALTH_ INDEX	None	Read only	Represents the overall health of the device, 100 being perfect. The value will be set based on highest severity FD_EXTENDED_ACTIVE_1 bit when simulation is not active, otherwise FD_SIMULATE.DIAGNOSTIC_SIMULATE_VALUE is used. Disabling or masking a device condition will not have an effect on the health index.
77	FAILED_PRI	None	O/S, Auto	Designates alarming priority of the FAILED_ALM; also used to switch between Plantweb alerts and Field Diagnostics functionality: 0 = Field Diagnostics enabled, Plantweb Alerts disabled 1-15 = Plantweb Alerts enabled, Field Diagnostics disabled
78	RECOMMENDED_ACTION	Enumeration	Read only	This parameter is a copy of FD_RECOMMEN_ACT.
79	FAILED_ALM	N/A	N/A	Alarm indicating a failure within a device that makes the device non-operational
80	MAINT_ALM	N/A	N/A	Alarm indicating device needs maintenance soon
81	ADVISE_ALM	N/A	N/A	Alarm indicating advisory alarms; conditions do not have a direct impact on process or device integrity
82	FAILED_ ENABLE	Enumeration	Read only	This parameter is the read only copy of FD_FAIL_MAP; needed for backward compatibility with Plantweb Alerts
83	FAILED_MASK	Enumeration	Read only	This parameter is the read only copy of FD_FAIL_MASK; needed for backward compatibility with Plantweb Alerts
84	FAILED_ ACTIVE	Enumeration	Read only	This parameter is the read only copy of FD_FAIL_ACTIVE; needed for backward compatibility with Plantweb Alerts
85	MAINT_PRI	None	O/S, Auto	Designates alarming priority of the MAINT_ALM
86	MAINT_ ENABLE	Enumeration	Read only	This parameter is the read only copy of FD_OFFSPEC_MAP; needed for backward compatibility with Plantweb Alerts

Table B-1: Resource Block Parameters *(continued)*

Index	Parameter	Units	Writable mode	Description
87	MAINT_MASK	Enumeration	Read only	This parameter is the read only copy of FD_OFFSPEC_MASK; needed for backward compatibility with Plantweb Alerts
88	MAINT_ ACTIVE	Enumeration	Read only	This parameter is the read only copy of FD_OFFSPEC_ACTIVE; needed for backward compatibility with Plantweb Alerts
89	ADVISE_PRI	None	O/S, Auto	Designates alarming priority of the ADVISE_ALM
90	ADVISE_ ENABLE	Enumeration	Read only	This parameter is the read only copy of both FD_MAINT_MAP and FD_CHECK_MAP parameters combined; needed for backward compatibility with Plantweb Alerts
91	ADVISE_MASK	Enumeration	Read only	This parameter is the read only copy of both FD_MAINT_MASK and FD_CHECK_MASK parameters combined; needed for backward compatibility with Plantweb Alerts
92	ADVISE_ ACTIVE	Enumeration	Read only	This parameter is the read only copy of both FD_MAINT_ACTIVE and FD_CHECK_ACTIVE parameters combined; needed for backward compatibility with Plantweb Alerts
93	DEVICE_INFO	N/A	N/A	Used to group device specific informational parameters
94	SWITCHES_STATE	N/A	N/A	Shows group of device specific informational parameters related to the state of security and simulate switches
95	MODEL_STRING_1	None	Read only	Model string matching transmitter configuration (string entered when transmitter was ordered); can be used to order an identical unit
96	MODEL_STRING_2	None	Read only	Model string matching transmitter configuration (string entered when transmitter was ordered); can be used to order an identical unit
97	MODEL_STRING_3	None	Read only	Model string matching transmitter configuration (string entered when transmitter was ordered); can be used to order an identical unit
98	MODEL_STRING_4	None	Read only	Model string matching transmitter configuration (string entered when transmitter was ordered); can be used to order an identical unit

B.2 Sensor Transducer Block

This block contains the actual measurement data, including a pressure and temperature reading. The transducer block includes information about sensor type, engineering units, linearization, reranging, temperature compensation, and diagnostics.

Table B-2: Sensor Transducer Block Parameters

Index	Parameter	Writable mode	Description
1	ST_REV	Read only	Revision level of static data associated with the block
2	TAG_DESC	O/S, Man, Auto	User description of intended application of the block
3	STRATEGY	O/S, Man, Auto	Can be used to identify grouping of blocks
4	ALERT_KEY	O/S, Man, Auto	Identification number of plant unit
5	MODE_BLK	N/A	Actual, target, permitted, and normal modes of the block
6	BLOCK_ERR	Read only	Reflects error status associated with hardware or software components associated with a block; bit string so multiple errors may be shown
7	UPDATE_EVT	N/A	Alert generated by any change to the static data; not generated when the block is O/S
8	BLOCK_ALM	N/A	Alarm used for all configuration, hardware, connection failure, or system problems in the block
9	TRANSDUCER_DIRECTORY	Read only	Directory that specifies number and starting indices of transducers in the transducer block
10	TRANSDUCER_TYPE	Read only	Identifies transducer that follows
11	TRANSDUCER_TYPE_VER	Read only	Transducer version identified by TRANSDUCER_TYPE in the form 0xAABB where AA = major revision of transducer specification on which the transducer is based and BB = revision number assigned and controlled by device manufacturer
12	XD_ERROR	Read only	Provides additional error codes related to transducer blocks
13	COLLECTION_ DIRECTORY	Read only	Specifies the number, starting indices, and DD item IDs of data collections in each transducer block; has value of zero if only a single data collection exists (for this device, this parameter will always be zero)
14	PRIMARY_ VALUE_TYPE	Read only	Type of measurement represented by the primary value
15	PRIMARY_ VALUE	N/A	Measured value and status available to the function block

Table B-2: Sensor Transducer Block Parameters *(continued)*

Index	Parameter	Writable mode	Description
16	PRIMARY_ VALUE_ RANGE	N/A	Structure to report sensor limits and units index
	PRIMARY_ VALUE_ RANGE.EU_100	Read only	At startup, this is read from the SuperModule™ analog input class, pressure instance, attribute 6 *Upper Sensor Limit*
	PRIMARY_ VALUE_ RANGE.EU_0	Read only	At startup, this is read from the SuperModule analog input class, pressure instance, attribute 7 *Lower Sensor Limit*
	PRIMARY_VALUE_RANGE.UNITS_INDEX	Read only	Engineering units used for primary value and range; unit values are changed in the pressure channel AI block XD_SCALE.UNITS_INDEX.
	PRIMARY_VALUE_RANGE.DECIMAL	Read only	Position of decimal for values for display purposes
17	CAL_POINT_ HI	O/S, Man	High calibration value
18	CAL_POINT_ LO	O/S, Man	Low calibration value
19	CAL_MIN_SPAN	Read only	Minimum calibration span value allowed; this information is necessary to ensure that when calibration is done, the two calibrated points are not too close together
20	CAL-VALUE	N/A	Pressure value used for calibration
21	CAL_UNIT	O/S, Man	Engineering units code index for the calibration values
22	XD_OPTS	O/S	Options the user may select to alter transducer status behavior while in manual mode; a write to any unused bits will be discarded (if both bits are set, BIT 0 takes precedence over BIT 1)
23	SENSOR_TYPE	Read only	Indicates type of sensor module
24	SENSOR_ RANGE	N/A	High and low range limit values, engineering units code, and number of digits to the right of the decimal point for the sensor
25	SENSOR_SN	Read only	Sensor serial number
26	SENSOR_CAL_METHOD	O/S, Man, Auto	Method of last sensor calibration; could be one of several standard calibration methods defined by ISO or some other method
27	SENSOR_CAL_ LOC	O/S, Man, Auto	Location of last sensor calibration; describes physical location where the calibration was performed
28	SENSOR_CAL_DATE	O/S, Man, Auto	Date of last sensor calibration; intended to reflect calibration of that sensor part usually wetted by the process

Table B-2: Sensor Transducer Block Parameters *(continued)*

Index	Parameter	Writable mode	Description
29	SENSOR_CAL_WHO	O/S, Man, Auto	Name of person responsible for the last sensor calibration
30	SENSOR_ ISOLATOR_ MTL	Read only	Defines construction material for isolating diaphragms; enumeration values are defined in the DD independent of device code
31	SENSOR_FILL_ FLUID	Read only	Defines fill fluid type used in the sensor; enumeration values are defined in the DD independent of device code
32	SECONDARY_ VALUE	N/A	Sensor temperature parameter; a secondary value
	SECONDARY_VALUE.STATUS	Read only	Status for this variable; values indicated in the valid range column are all the possible statuses the software can report for this variable
	SECONDARY_VALUE.VALUE	Read only	Sensor temperature value received from the SuperModule
33	SECONDARY_ VALUE_UNIT	Read only	Engineering units code index for sensor temperature value; unit values are changed in sensor temperature channel AI block XD_SCALE.UNITS_INDEX
34	DAMPING	O/S, Man, Auto	Time constant of a single exponential filter for PRIMARY_VALUE, in seconds
35	FACTORY_CAL_RECALL	O/S, Man	Recalls sensor calibration set at the factory; always read as *1: No Recall*.
36	MODULE_ CONFIG_TYPE	Read only	Indicates configuration type of the sensor module
37	MODULE_RANGE	Read only	Number describing the range code of the module for pressure
38	FLANGE_TYPE	O/S, Man, Auto	Indicates flange type attached to the device; enumeration values are defined in the DD independent of device code
39	FLANGE_MATERIAL	O/S, Man, Auto	Indicates material type of which the flange is made; enumeration values are defined in the DD independent of device code
40	REMOTE_SEAL_ NUMBER	O/S, Man, Auto	Indicates number of remote seals attached to the device; enumeration values are defined in the DD independent of device code
41	REMOTE_SEAL_ TYPE	O/S, Man, Auto	Indicates remote seal type attached to the device; enumeration values are defined in the DD independent of device code
42	REMOTE_SEAL_ISOLATOR_MATERIAL	O/S, Man, Auto	Indicates material type with which the remote seal isolators are made; enumeration values are defined in the DD independent of device code

Table B-2: Sensor Transducer Block Parameters *(continued)*

Index	Parameter	Writable mode	Description
43	REMOTE_SEAL_ FILL_FLUID	O/S, Man, Auto	Indicates fill fluid type used in the remote seals; enumeration values are defined in the DD independent of device code
44	O_RING_MATERIAL	O/S, Man, Auto	Indicates material type with which the flange O-rings are made; enumeration values are defined in the DD independent of device code
45	DRAIN_VENT_ MATERIAL	O/S, Man, Auto	Indicates material type with which the drain vents on the flange are made; enumeration values are defined in the DD independent of device code

B.3 Analog Input (AI) Function Block

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. The internal components of the AI function block are shown below, and Table B-3 lists the AI block parameters and their units of measure, descriptions, and index numbers.

Table B-3: Definitions of AI Block System Parameters

Inde x	Parameter	Valid range	Initial value	Units	Writable mode	Description
10	XD_SCALE	Any sensor range	N/A	N/A	N/A	Used to define range and units expected from the transducer

Table B-3: Definitions of AI Block System Parameters *(continued)*

Inde x	Parameter	Valid range	Initial value	Units	Writable mode	Description
	XD_SCALE.UNITS_INDEX	Depends on what variable the AI block channel is hooked up to; only units valid for that variable can be written. Example: if pressure channel is '1', valid range for this parameter is the same as the valid range for PRIMARY_VALUE_RANGE.UNITS_INDEX.	Set at factory	Enumeration	O/S	Engineering units used for the specified channel
15	CHANNEL	1: Pressure 2: Module temperature Only valid if ADB is enabled (reference SMVFF268) 12: Mean 13: Standard deviation	Set at factory	Enumeration	O/S	Channel number of measurement the AI block is providing
16	L_TYPE	1: Direct 2: Indirect 3: Indirect square root	Set at factory	Enumeration	O/S, Man	Determines if values passed by transducer block to AI block may be used directly (Direct) or if value is in different units and must be converted linearly (Indirect), or with square root (Ind Sqr Root), using the input range defined by transducer and associated output range

B.4 LCD Display Transducer Block

Table B-4: LCD Display Transducer Block Parameters

Index	Parameter	Writable mode	Description
1	ST_REV	Read only	Revision level of static data associated with the function block

Table B-4: LCD Display Transducer Block Parameters *(continued)*

Index	Parameter	Writable mode	Description
2	TAG_DESC	O/S, Auto	User description of intended application of the block
3	STRATEGY	O/S, Auto	Can be used to identify grouping of blocks
4	ALERT_KEY	O/S, Auto	Identification number of the plant unit
5	MODE_BLK	N/A	Actual, target, permitted, and normal block modes
	MODE_BLK.TARGET	O/S, Auto	Mode requested by operator; limited to values allowed by the PERMITTED subparameter
	MODE_BLK.ACTUAL	Read only	Current block mode; may differ from target based on operating conditions (value is calculated as part of block execution)
	MODE_BLK.PERMITTED	O/S, Auto	Defines modes allowed for a block instance; permitted mode configured is based on application requirement (any mode change request will be checked by device to ensure the requested target is defined as permitted mode)
	MODE_BLK.NORMAL	O/S, Auto	Mode to which the block should be set during normal operating conditions; limited to values allowed by the PERMITTED subparameter
6	BLOCK_ERR	Read only	Reflects error status associated with hardware or software components associated with a block; a bit string so multiple errors may be shown
7	UPDATE_EVT	N/A	Alert generated by any change to the static data; not generated when block is O/S
8	BLOCK_ALM	N/A	Used for all configuration, hardware, connection failure, or system problems in the block
9	TRANSDUCER_DIRCTORY	Read only	Directory that specifies number and starting indices of transducers in the transducer block
10	TRANSDUCER_TYPE	Read only	Identifies transducer that follows
11	TRANSDUCER_TYPE_VER	Read only	Transducer version identified by TRANSDUCER_TYPE in the form 0xAABB where AA = major revision of transducer specification and BB = revision number assigned and controlled by device manufacturer
12	XD_ERROR	Read only	Provides additional error codes related to transducer blocks
13	COLLECTION_ DIRECTORY	Read only	Specifies number, starting indices, and DD Item IDs of data collections in each transducer block; has zero value if only a single data collection exists (for this device, this parameter will always be zero)
14	DISPLAY_ PARAM_SEL	O/S, Auto	"Advanced" configuration; involves specifying parameters from function blocks for display
15	BLK_TYPE_1	O/S, Auto	Enumerated block type for this advanced config display parameter from which to read the display value

Table B-4: LCD Display Transducer Block Parameters *(continued)*

Index	Parameter	Writable mode	Description
16	BLK_TAG_1	O/S, Auto	Block tag containing this advanced config display parameter; a string of 1-32 characters that uniquely identifies each block (value should match an existing transducer block or function block tag in the device and any other values will cause a configuration error)
17	PARAM_INDEX_1	O/S, Auto	Parameter index for this advanced config display parameter; each value corresponds to a displayable parameter in the block specified by the block tag
18	CUSTOM_TAG_1	O/S, Auto	Block description displayed for this advanced config display parameter
19	UNITS_TYPE_1	O/S, Auto	Determines where display parameter units come from
20	CUSTOM_ UNITS_1	O/S, Auto	User-entered units that are displayed when UNITS_TYPE is set to *Custom*
21	BLK_TYPE_2	O/S, Auto	Enumerated block type for this advanced config display parameter from which to read the display value
22	BLK_TAG_2	O/S, Auto	Block tag containing this advanced config display parameter; a string of 1-32 characters that uniquely identifies each block (value should match an existing transducer block or function block tag in the device and any other values will cause a configuration error)
23	PARAM_INDEX_2	O/S, Auto	Parameter index for this advanced config display parameter; each value corresponds to a displayable parameter in the block specified by the block tag
24	CUSTOM_TAG _2	O/S, Auto	Block description displayed for this advanced config display parameter
25	UNITS_TYPE_2	O/S, Auto	Determines where display parameter units come from
26	CUSTOM_ UNITS _2	O/S, Auto	User-entered units that are displayed when UNITS_TYPE is set to *Custom*
27	BLK_TYPE_3	O/S, Auto	Enumerated block type for this advanced config display parameter from which to read the display value
28	BLK_TAG_3	O/S, Auto	Block tag containing this advanced config display parameter; a string of 1-32 characters that uniquely identifies each block (value should match an existing transducer block or function block tag in the device and any other values will cause a configuration error)
29	PARAM_INDEX_3	O/S, Auto	Parameter index for this advanced config display parameter; each value corresponds to a displayable parameter in the block specified by the block tag
30	CUSTOM_TAG _3	O/S, Auto	Block description displayed for this advanced config display parameter

Table B-4: LCD Display Transducer Block Parameters *(continued)*

Index	Parameter	Writable mode	Description
31	UNITS_TYPE_3	O/S, Auto	Determines where display parameter units come from
32	CUSTOM_ UNITS _3	O/S, Auto	User-entered units that are displayed when UNITS_TYPE is set to *Custom*
33	BLK_TYPE_4	O/S, Auto	Enumerated block type for this advanced config display parameter from which to read the display value
34	BLK_TAG_4	O/S, Auto	Block tag containing this advanced config display parameter; a string of 1-32 characters that uniquely identifies each block (value should match an existing transducer block or function block tag in the device and any other values will cause a configuration error)
35	PARAM_INDEX_4	O/S, Auto	Parameter index for this advanced config display parameter; each value corresponds to a displayable parameter in the block specified by the block tag
36	CUSTOM_TAG _4	O/S, Auto	Block description displayed for this advanced config display parameter
37	UNITS_TYPE_4	O/S, Auto	Determines where display parameter units come from
38	CUSTOM_ UNITS _4	O/S, Auto	User-entered units that are displayed when UNITS_TYPE is set to *Custom*
39	SCALED_OUTPUT_UNIT	O/S, Auto	User-entered units displayed when *Scaled Output* basic parameter screen is selected

B.5 Advanced Diagnostics Transducer Block (ADB)

Table B-5: ADB Parameters

Index	Parameter	Valid range	Initial value	Units	Writable mode	Description
1	ST_REV	N/A	0	None	Read only	Revision level of static data associated with the block
2	TAG_DESC	All	32_spaces	None	O/S, Auto	User description of intended block application
3	STRATEGY	All	0	None	O/S, Auto	Can be used to identify block grouping
4	ALERT_KEY	1 to 255	0	None	O/S, Auto	Identification number of plant unit
5	MODE_BLK	N/A	N/A	N/A	N/A	Actual, target, permitted, and normal block modes

Table B-5: ADB Parameters *(continued)*

Index	Parameter	Valid range	Initial value	Units	Writable mode	Description
6	BLOCK_ERR	BIT 15: Out-of-Service	0x0000	Enumeration	Read only	Reflects error status associated with hardware or software components associated with a block; a bit string so multiple errors may be shown
7	UPDATE_EVT	N/A	N/A	N/A	N/A	Alert generated by any change to the static data; not generated when block is O/S
8	BLOCK_ALM	N/A	N/A	N/A	N/A	Used for all configuration, hardware, connection failure, or system problems in the block
9	TRANSDUCER_DIRECTORY	0, no directories present	0	None	Read only	Specifies number and starting indices of transducers in the transducer block
10	TRANSDUCER_TYPE	65535: Transducer Other	65535	Enumeration	Read only	Identifies transducer that follows
11	TRANSDUCER_TYPE_VER	0x0001, where: 00 represents major revision of the FOUNDATION™ Fieldbus spec governing the block (this block is custom so there is no relevant spec). 01 represents the Rosemount revision.	0x0001	None	Read only	Version of transducer identified by TRANSDUCER_TYPE in the form 0xAABB where AA = major revision of the transducer specification on which the transducer is based and BB = revision number assigned and controlled by manufacturer of device
12	XD_ERROR	0: No Error	0	Enumeration	Read only	Provides additional error codes related to transducer blocks
13	COLLECTION_ DIRECTORY	0	0	None	Read only	Specifies the number, starting indices, and DD item IDs of data collections in each transducer block; has a zero value if only a single data collection exists (for this device, this parameter will always be zero)
14	SPM_ACTIVE	0x00 = Disabled 0xFF = Enabled	Set at factory	None	O/S, Auto	Enables/disables Statistical Process Monitoring algorithm
15	SPM_MONITORING_CYCLE	1 to 1440 minutes (1440 minutes = 24 hours)	5	Minutes	O/S, Auto	Length of standard deviation and mean monitoring cycle

Table B-5: ADB Parameters *(continued)*

Index	Parameter	Valid range	Initial value	Units	Writable mode	Description
16	SPM_BYPASS_VERIFICATION	0x00 = No 0xFF = Yes	0	None	O/S, Auto	Enables/disables Bypass of Process Stability Checks during Learning
17	SPM_STATUS	BIT 0: Inactive BIT 1: Learning BIT 2: Verifying BIT 3: Monitoring BIT 4 Mean Change Detected BIT 5: High Variation Detected BIT 6: Low Dynamics Detected	0x01	None	Read only	Status of the SPM1 Statistical Process Monitoring
18	SPM_TIMESTAMP	N/A	0	Time value	Read only	Time stamp of last SPM_STATUS
19	SPM_USER_COMMAND	1: Detect 2: Learn 3: Quit 4: Idle	4	Enumeration	O/S, Auto	User control for Statistical Process Monitoring session; only ***Detect***, ***Learn***, and ***Quit*** values can be written as user commands
20	SPM_MEAN	N/A	N/A	SPM_VALUE_UNIT	Read only	Mean calculation of SPM input
21	SPM_MEAN_CHANGE	N/A	N/A	Percent	Read only	Percent change in SPM mean with respect to baseline mean
22	SPM_STDEV	N/A	N/A	SPM_VALUE_UNIT	Read only	Standard deviation calculation of SPM input
23	SPM_STDEV_CHANGE	N/A	N/A	Percent	Read only	Change in SPM standard deviation with respect to baseline standard deviation
24	SPM_BASELINE_MEAN	N/A	N/A	SPM_VALUE_UNIT	Read only	Baseline mean for SPM
25	SPM_BASELINE_STDEV	N/A	N/A	SPM_VALUE_UNIT	Read only	Baseline standard deviation for SPM
26	SPM_MEAN_LIM	0.0 to 3.402823E38	0.0	Percent	O/S, Auto	Percent change in mean allowed before triggering a variation change alert; value of zero disables the check

Table B-5: ADB Parameters *(continued)*

Index	Parameter	Valid range	Initial value	Units	Writable mode	Description
27	SPM_HIGH_VARIATION_LIM	0.0 to 3.402823E38	0.0	Percent	O/S, Auto	Percent increase in standard deviation allowed before triggering a variation change alert; value of zero disables the check
28	SPM_LOW_DYNAMICS_LIM	-99 to 0	0.0	Percent	O/S, Auto	Percent decrease in standard deviation allowed before triggering a variation change alert; value of zero disables the check

Table B-5: ADB Parameters *(continued)*

Index	Parameter	Valid range	Initial value	Units	Writable mode	Description
29	SPM_VALUE_ UNIT	1130: Pascals 1132: Megapascals 1133: Kilopascals 1136: Hectopascals 1137: Bars 1138: Millibars 1139: Torr 1140: Atmospheres 1141: Pounds per square inch 1144: Grams per square centimeter 1145: Kilograms per square centimeter 1146: Inches of water at 68 degrees F 1147: Inches of water at 4 degrees C 1148: Inches of water at 68 degrees F 1150: Millimeters of water at 4 degrees C 1151: Millimeters of water at 68 degrees F 1152: Feet of water at 68 degrees F 1153: Feet of water at 4 degrees C 1154: Feet of water at 68 degrees F 1156: Inches of mercury at 0 degrees C 1158: Millimeters of mercury at 0 degrees C 1724: Inches of water at 60 degrees F 1735: Centimeters of water at 4 degrees C 1736: Meters of water at 4 degrees C 1737: Centimeters of mercury at 0 degrees C 1738: Pounds per square foot 1739: Meters of mercury at 0 degrees C	Set at factory	Enumeration	Read only	Engineering units used for SPM calculation output value; unit values are set in the Mean or Stdev channel AI block XD_SCALE.UNITS_INDEX

Table B-5: ADB Parameters *(continued)*

Index	Parameter	Valid range	Initial value	Units	Writable mode	Description
		1750: Feet of water at 60 degrees F 1751: Kilograms per square meter				
30	PLINE_STATUS	BIT 0: Inactive BIT 1: Learning BIT 2: Verifying BIT 3: Plugged Impulse Line BIT 4: OK BIT 5: Insufficient Dynamics BIT 6: BAD PV Status	0x01	None	Read only	Most recent impulse line status
31	PLINE_ TIMESTAMP	N/A	0	Time value	Read only	Time stamp of last PLINE_STATUS
32	PLINE_ON	FALSE: 0x00: Disabled TRUE: 0xFF: Enabled	0	None	O/S, Auto	Turns plugged line detection algorithm on/off
33	PLINE_ RELEARN	1: Run 2: Relearn	1	Enumeration	O/S, Auto	Resets the PIL algorithm and re-initiates learning
34	PLINE_ SENSITIVITY	1: Low 2: Medium 3: High	2	Enumeration	O/S, Auto	Sensitivity of PIL detection
35	PLINE_AFFECT_PV_STATUS	FALSE: 0x00 TRUE: 0xFF	0	None	O/S, Auto	Determines whether the quality of pressure measurement will be affected by PIL status
36	PLINE_ HISTORY_ STATUS	1: Plugged impulse line 2: No history	2	Enumeration	Read only	Previous plugged line determination status
37	PLINE_ HISTORY_ TIMESTAMP	N/A	0	Time value	Read only	Previous plugged line determination time stamp
38	PLINE_LEARN_ LENGTH	1 to 60 minutes	5	minutes	O/S, Auto	Length of learning and verification cycles in minutes
39	PLINE_DETECT_LENGTH	1 to 60 minutes	1	minute	O/S, Auto	Length of detection cycle status update in minutes
40	PLINE_AUTO_ RELEARN	FALSE: 0x00: Disabled TRUE: 0xFF: Enabled	0xFF	None	O/S, Auto	Enables/disables auto relearn on process mean changes
41	PLINE_ RELEARN_ THRESHOLD	0.0 to 50.0 percent of URL	0.0	Percent of URL	O/S, Auto	Threshold for relearning in percent of URL of sensor range; when set to 0.0, threshold is based on internally defined values determined by sensor range

Table B-5: ADB Parameters *(continued)*

Index	Parameter	Valid range	Initial value	Units	Writable mode	Description
42	PLINE_ LEARNING_ SENSITIVITY	BIT 0: Insufficient dynamics check BIT 1: 10% Stdev change check BIT 2: 20% Stdev change check BIT 3: 30% Stdev change check BIT 4: 3*Stdev mean change check BIT 5: 6*Stdev mean change check BIT 6: 2% mean change check	0x55	None	O/S, Auto	Learning sensitivity check options; only one of bits 1-3 is allowed and only one of bits 4-5 is allowed
43	PLINE_DETECT_SENSITIVITY	0.0 to 100 percent	0.0	Percent	O/S, Auto	Overrides PIL sensitivity if a non-zero value is entered; value corresponds to a percentage decrease in standard deviation
	PLINE_SINGLE_DETECT_ SENSITIVITY	0.0 to 10,000 percent	0+H67:I72	Percent	O/S, Auto	Overrides PIL sensitivity if a non-zero value is entered; value corresponds to a percentage increase in standard deviation

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