Reference Manual
00809-0100-4774, Rev DB
July 2020

Rosemount™ 3051 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, ensure you thoroughly understand the contents before installing, using, or maintaining this product.
For technical assistance, contacts are listed below:

Customer Central (Technical support, quoting, and order-related questions.)

- United States: 1-800-999-9307 (7:00 am to 7:00 pm Central Time)
- Asia Pacific: 65 777 8211
- 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.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

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

Installation of device in an explosive environment must be in accordance with appropriate local, national, and international standards, codes, and practices. Review the *Product Certifications* section of the Rosemount 3051 Product Data Sheet for any restrictions associated with a safe installation.

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

Process leaks

Process leaks may cause harm or result in death.

Install and tighten process connectors before applying pressure.

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

Electrical shock

Electrical shock can result in death or serious injury.

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

Replacement equipment

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

Improper assembly of manifolds to traditional flange can damage sensor module.

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.

Severe changes in the electrical loop may inhibit HART Communication or the ability to reach alarm values. Therefore, Rosemount absolutely cannot 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.

⚠ CAUTION

Nuclear applications

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.

Contents

1 Introduction

1.1 Using this manual

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

Configuration provides instruction on commissioning and operating the transmitters. It also includes information on software functions, configuration parameters, and online variables.

Hardware installation contains mechanical installation instructions.

Electrical installation contains electrical installation instructions.

Operation and maintenance provides detailed information on calibrating the transmitter.

Troubleshooting provides troubleshooting techniques for the most common operating problems.

Reference data provides information on how to access specifications, ordering information,and dimensional drawings.

Field Communicator menu trees and fast keys provides full menu trees and abbreviated Fast Key sequences for commissioning tasks.

1.2 Models covered

The following Rosemount 3051 Transmitters are covered by this manual:

- Rosemount 3051C Coplanar™ Pressure Transmitter
  - Measures differential and gage pressure up to 2000 psi (137.9 bar).
  - Measures absolute pressure up to 4000 psia (275.8 bar).
- Rosemount 3051T In-Line Pressure Transmitter
  - Measures gage/absolute pressure up to 10000 psi (689.5 bar).
- Rosemount 3051L Liquid Level Transmitter
  - Measures level and specific gravity up to 300 psi (20.7 bar).
- Rosemount 3051CF Series Flowmeter
  - Measures flow in line sizes from ½-in. (15 mm) to 96-in. (2400 mm).

Note
For transmitter with 4-20 mA HART® Revision 5 and 7 Selectable Protocol, see Rosemount 3051 Reference Manual.

For transmitter with PROFIBUS® PA, see Rosemount 3051 Reference Manual.

1.3 Host files

Before configuring the device, ensure the host has the appropriate Device Description (DD) or Device Type Manager (DTM™) file revision for this device. The device descriptor can be found on Fieldbus.org. The DTM can be found at Emerson.com. The current release of the Rosemount 3051 with Foundation Fieldbus protocol is device revision 8. This manual is for revision 8.

1.4 Product recycling/disposal

Consider recycling equipment. Dispose of packaging in accordance with local and national legislations/regulations.

2 Configuration

2.1 Overview

This section contains information on commissioning and tasks that should be performed on the bench prior to installation, as well as tasks performed after installation.

2.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments in the loop 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

Install and tighten process connectors before applying pressure.

Electrical shock

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

Static electricity

Observe safe handling precautions for static-sensitive components.

Conduit/cable entries

Unless marked, the conduit/cable entries in the transmitter housing use a ½–14 NPT thread form. Entries marked “M20” are M20 × 1.5 thread form. On devices with multiple conduit entries, all entries will have the same thread form. Only use plugs, adapters, glands, or conduit with a compatible thread form when closing these entries.

When installing in a hazardous location, use only appropriately listed or Ex certified plugs, glands, or adapters in cable/conduit entries.

⚠ WARNING

Replacement parts

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

Improper assembly of manifolds to traditional flange can damage sensor module.

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.
Severe changes in the electrical loop may inhibit HART® communication or the ability to reach alarm values. Therefore, Rosemount 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.

2.2.1 Device Description (DD) and Device Type Manager (DTM™) based interfaces

The Rosemount 3051Pressure Transmitter Rev 8 has both DD based and DTM based user interfaces available. All device configuration and maintenance tasks can be performed using either technology.

The DD capabilities supported will vary based on host supplier and host revision. Check with your host supplier to determine and obtain the appropriate DD for your situation. The type of DD your host supports may influence navigation between different functions, and the exact steps used to perform different tasks. The device menu tree has multiple ways to navigate between and perform tasks. Not all ways will be usable on all hosts, but at least one way will be usable on every host.

2.2.2 Device menu tree

Device information and device tasks are organized in a menu tree structure. The complete menu tree is shown in Figure 2-9. A partial menu tree covering the most common device tasks is shown in Figure 2-10.

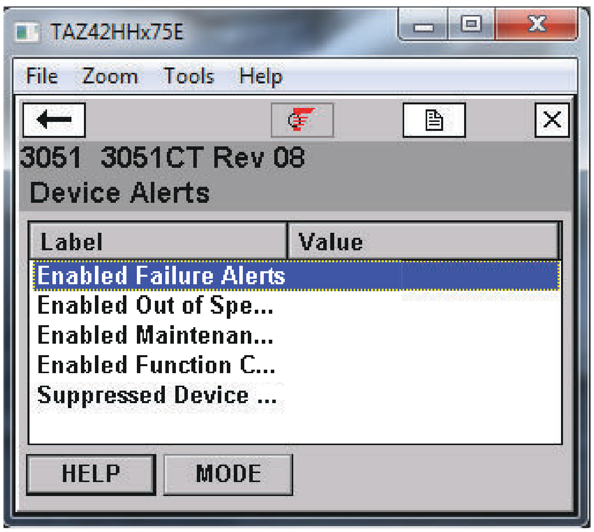
2.2.3 Basic organization

Device information and tasks are organized into three different menu tree branches. They are *Overview*, *Configure*, and *Service Tools*. Information and tasks may be resident in more than a single branch of the menu tree.

The device menu tree is the landing screen for the Handheld user interface. The device menu tree is also permanently displayed on PC-based user interfaces. On PC-based user interfaces, you can expand or collapse the menu tree as needed to facilitate navigation.

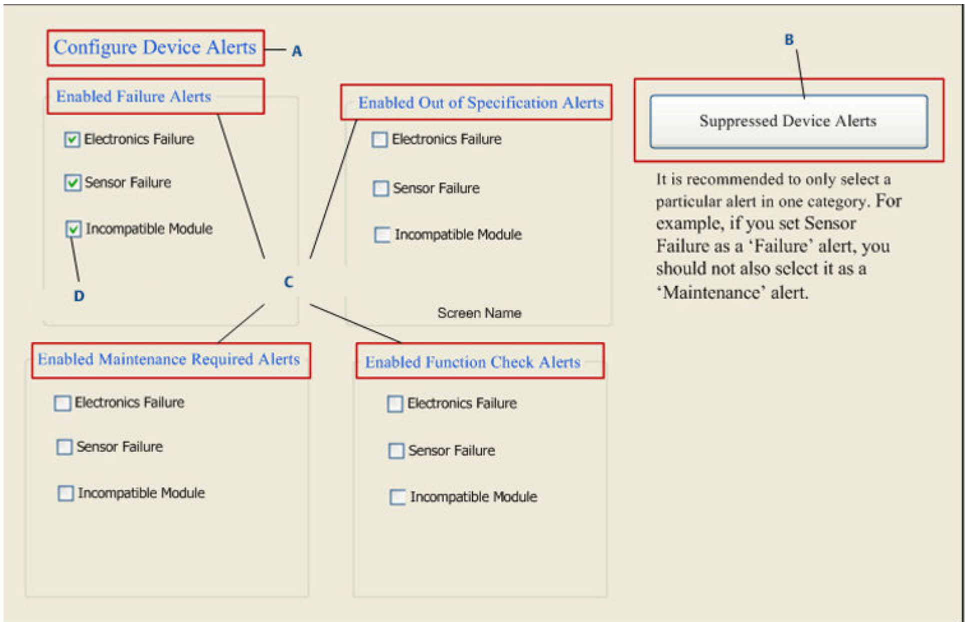
The same device menu tree applies for both handheld and PC-based user interfaces. On the handheld, each menu tree entry has a dedicated screen (see Figure 2-3). On PC-based user interfaces, several menu tree entries may be displayed on a single screen with each menu tree entry used as the heading for a section of that screen (see Figure 2-2). The net result is that you can use the menu tree to navigate all DD's and DTM's; however, you may need to perform actions on one screen or several screens to perform the same task.

Figure 2-1: Configure Device Alerts-Multiple Screens



On devices with smaller screens the information and parameters necessary to complete a task may be divided into several screens. In this figure, each category of alert to be configured has a dedicated screen shown. There are four total screens used for alert configuration.

Figure 2-2: Configure Device Alerts-Single Screen



A. *Screen name*
B. *Configure Suppressed Alerts button*
C. *Status signal categories*
D. *Alert check boxes*

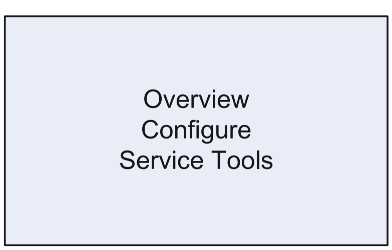
On this PC-based configuration screen, alert configuration for all four alert categories is performed on a single screen.

2.2.4 Home screen

The *Home* screen provides access to the three main branches of the menu tree. These branches are ***Overview***, ***Configure***, and ***Service Tools***. From this screen, select any of the three main branches to access detailed device functionality.

Note
Some tasks can be performed from multiple locations on the menu tree. This is done to allow you to perform related tasks with a minimum of screen changes and keystrokes. The organization of the device menu tree is further described below.

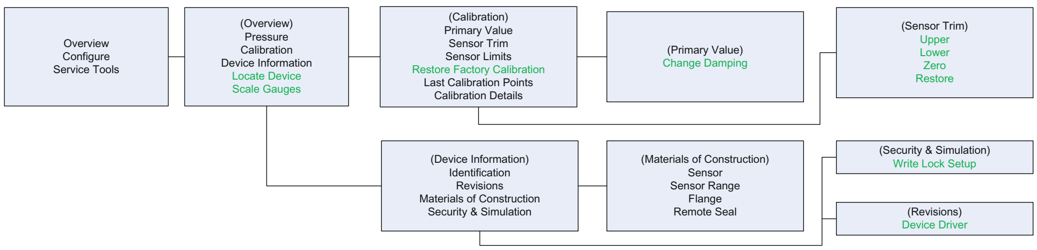
Figure 2-3: Home Screen



2.2.5 Overview

The *Overview* branch of the menu tree provides device information and single keystroke shortcuts to view variables and device status, access device diagnostics, and perform basic calibration functions. The *Overview* screen is the landing screen for PC-based user interfaces.

Figure 2-4: Overview



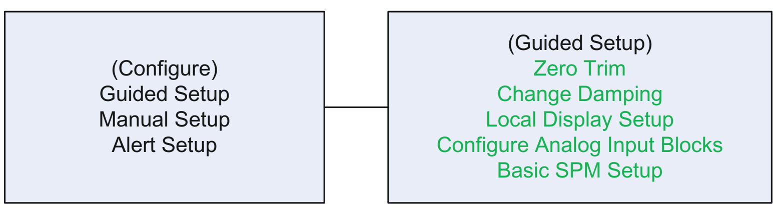
Black text - Navigation selections available

(Text) - Name of selection used on parent menu screen to access this screen

Green text - Automated methods

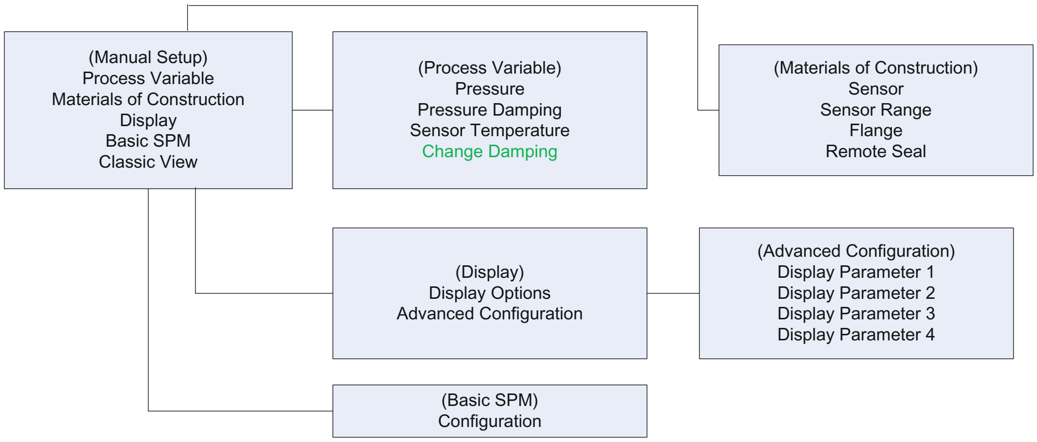
2.2.6 Configure

Figure 2-5: Guided Setup



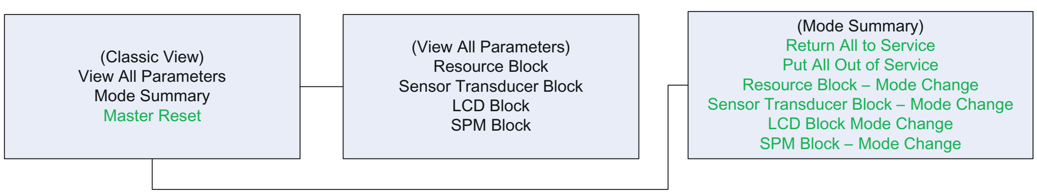
The *Configure* branch of the menu tree provides both guided setup and manual setup. Guided setup provides automated step by step methods for performing device configuration. Manual setup provides user editable screens where you can perform a configuration task by selecting or entering the necessary parameters without step by step guidance.

Figure 2-6: Manual Setup



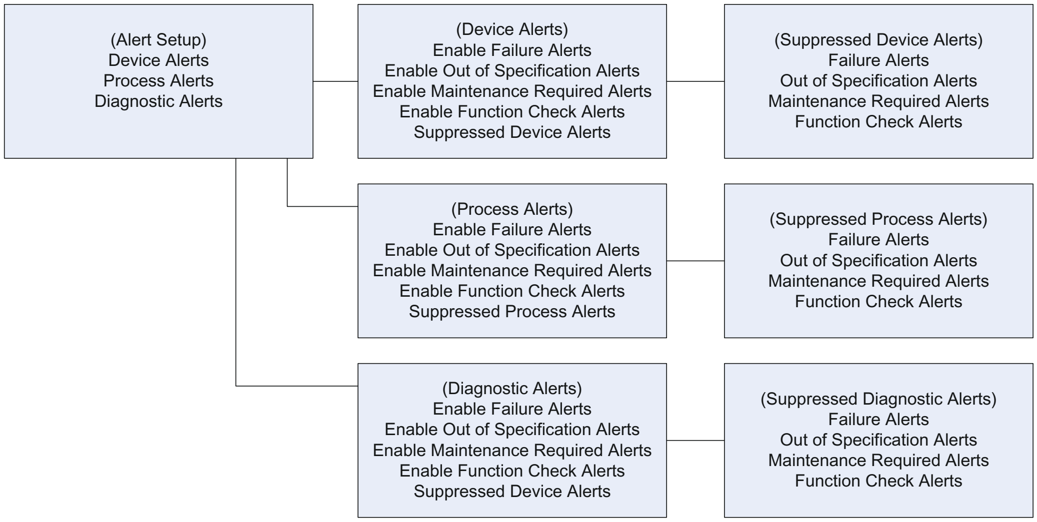
Manual setup can take less time than guided setup if you are familiar with the task to be performed. Manual setup also allows you to edit specific parameters without needing to step through all the setup steps. If you are not familiar with a specific task, Emerson™ recommends guided setup so task steps are done in the correct order and all needed steps are performed.

Figure 2-7: Classic View



The ***Manual Setup*** branch also provides a view called classic view which lists block parameters in a single scroll-down menu. Expert users may prefer this view for configuration, as you can do multiple configuration tasks without leaving the single menu screen.

Figure 2-8: Alert Setup



Black text - Navigation selections available

(Text) Name of selection used on parent menu screen to access this screen

Green text - Automated methods

The final ***Configure*** branch supports alert setup. The same configuration process supports both NE107 alerts (the factory default Device alerts), and PlantWeb® alerts. Note the diagnostics performed and the recommended actions for NE107 alerts and Plantweb alerts are identical. The only difference is that NE107 alerts and Plantweb alerts annunciate the alerts using different categories.

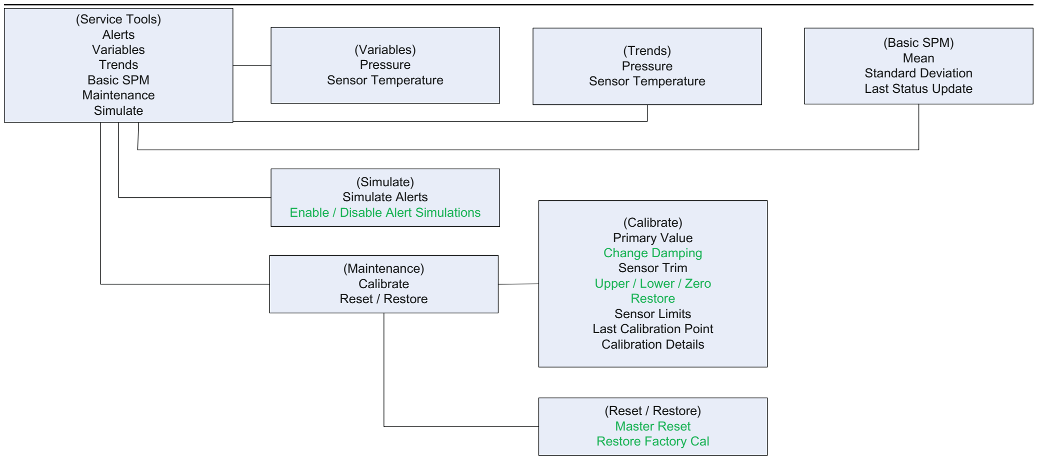
NE107 requires device manufacturers to provide a way for you to enable, suppress, and re-categorize alerts. NE107 alerts can be defined as any of four categories. They are *Failure Alerts*, *Out of Specification Alerts*, *Maintenance Required Alerts*, and *Function Check Alerts*. To minimize configuration tasks and time, the Rosemount 3051 ships from the factory with alerts enabled and pre-categorized. Emerson recommends using factory default categories if the defaults meet plant standards and there is no identified benefit to changing categories.

Note

The NE107 specification allows a single alert to be included in multiple categories. As a general practice, Emerson does not recommend this as alarm management can become needlessly complex.

You can suppress NE107 alerts. If you configure an alert to reside in multiple categories, you can suppress it in some categories, but not others. To completely suppress an alert, you must suppress it in every category where it is configured.

2.2.7 Service tools



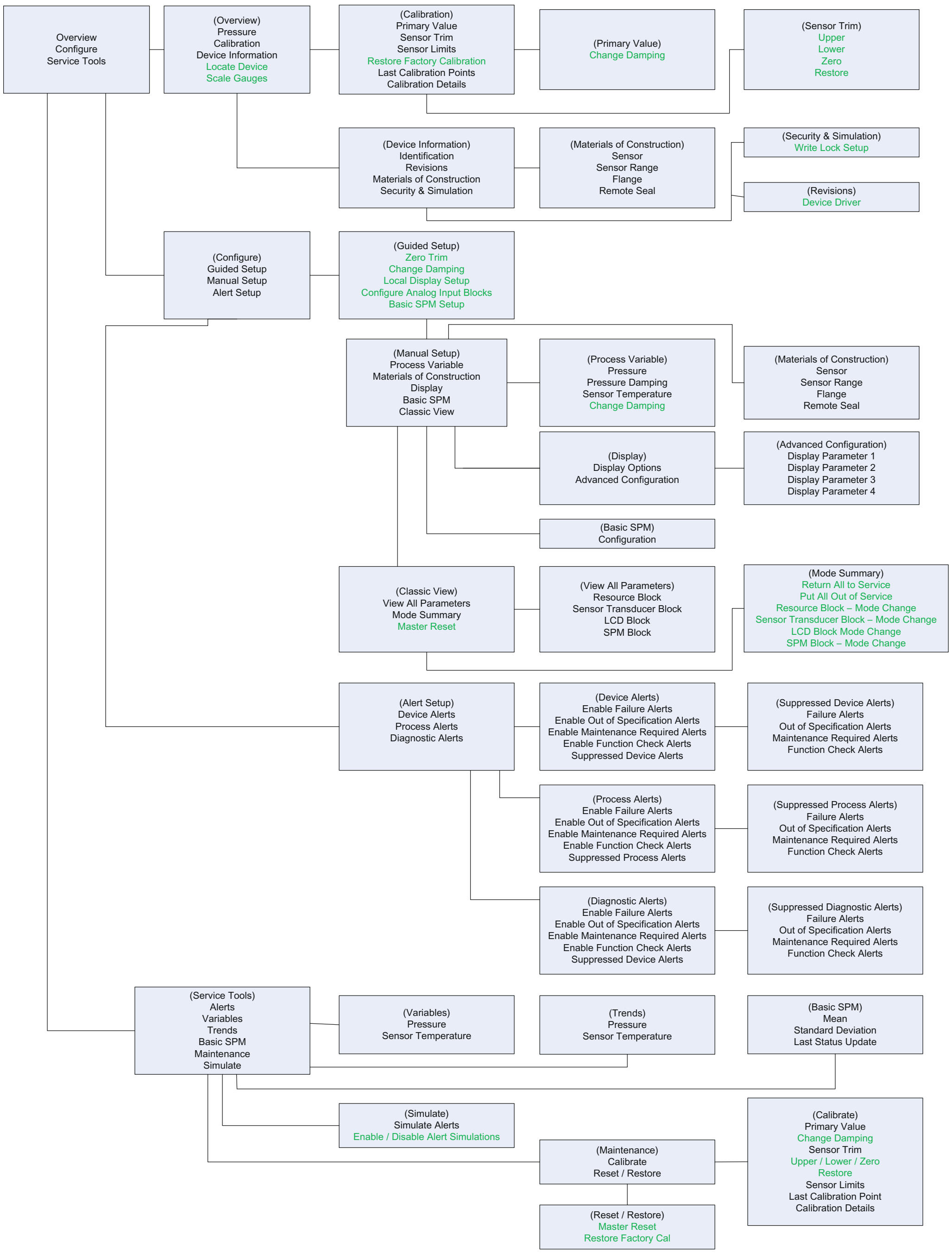
Black text - Navigation selection available

(Text) - Name of selection used on parent menu screen to access this screen

Green text - Automated methods

The *Service Tools* branch of the menu tree allows you to perform typical device maintenance tasks, simulate alerts and parameters, and perform some configuration resets to return devices to as-manufactured settings.

Figure 2-9: Complete Menu Tree

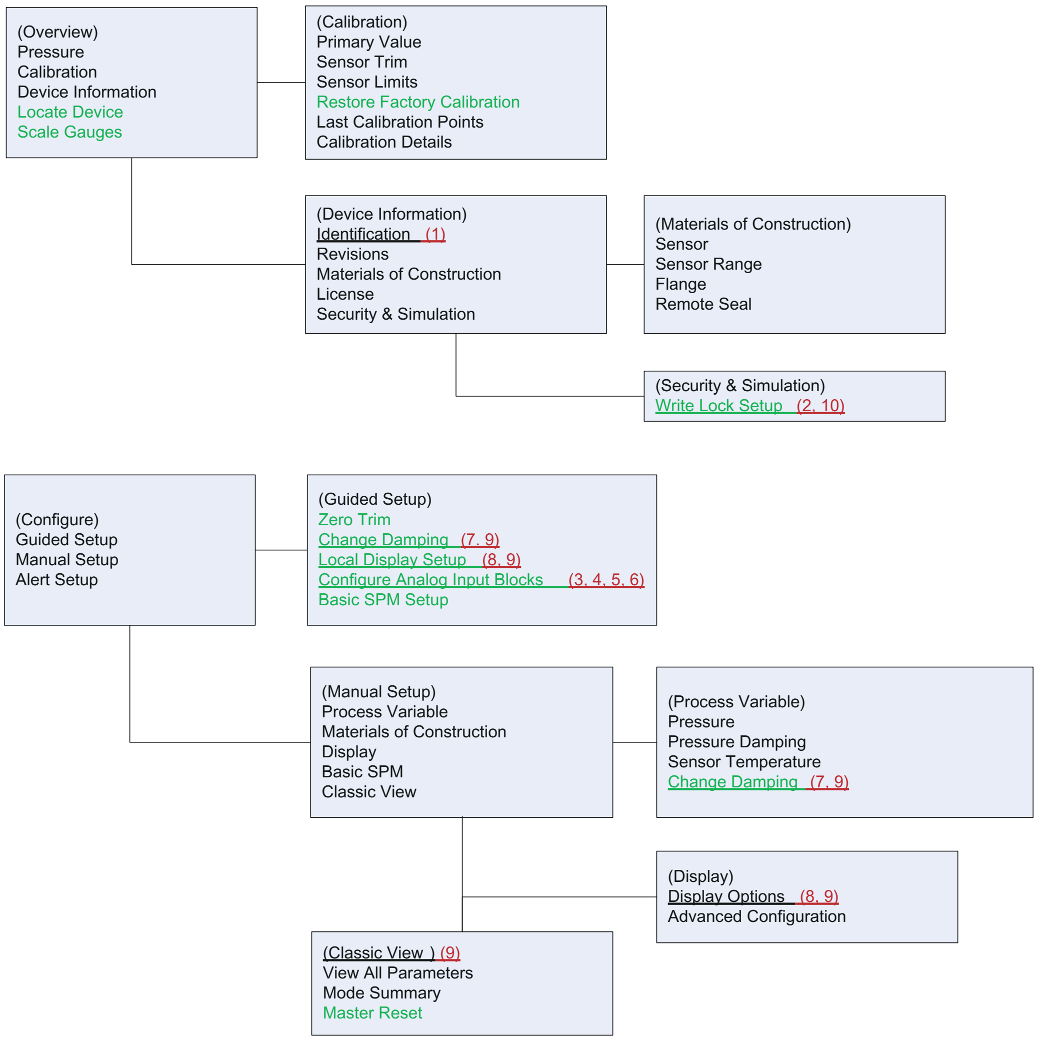


Black text - Navigation selection available

(Text) - Name of selection used on parent menu screen to access this screen

Green text - Automated methods

Figure 2-10: Partial Menu Tree



Black text - Navigation selection available

(Text) - Name of selection used on parent menu screen to access this screen

Green text - Automated methods

Red text - Configuration task numbers from configuration flow chart

2.2.8 Navigation

To navigate, click the navigation button labeled with the task you wish to perform. This takes you to the next navigation screen or the screen where the you can perform the desired function or launches a guided configuration automated procedure.

Note that you can perform some tasks from several different locations in the menu tree. This allows you to perform multiple tasks while minimizing the total navigation required to access and use the desired functions.

Guided setup with automated task procedures (methods)

Guided setup provides automated task procedures for tasks which require multiple steps to perform. Guided setup also provides notification of recommended actions, such as suggesting the device user contact control room personnel to have the process loop placed in manual mode prior to configuration.

Guided setup generally proceeds in three stages. The first is preparation. In this stage, the device gives user notifications and and performs steps neede3d to prepare the device for task setup. The second is task execution where the task is performed in a series of steps. Sometimes the number and sequence of steps is changed based on the values or parameters selected. This eliminates your need to understand and track how each configuration choice may influence what can be done in succeeding steps. The third task is post-setup processing. In this step, the device returns to operation or gracefully cancels a task.

Guided setup handles mode management as part of preparation and post processing. This means blocks that must be placed in manual or out of service mode for configuration will be placed in those modes and upon completion of the configuration task, will return those blocks to the normal operating mode.

Guided setup helps you complete tasks with the highest probability of success and gracefully terminate partially completed tasks by returning device parameters to the values that existed before the terminated task was started. If you are not very familiar with a device, consider using guided configuration.

Manual setup with manual and automated task procedures

If you are familiar with the mode changes and configuration steps needed to complete a task and properly return the device to service, you can use manual setup. You can also use manual setup used when you need to change a single parameter and don't want to execute the full sequence of steps that are part of guided configuration.

You can sometimes complete manual setup in less time than guided setup; however, manual setup doesn’t provide the comprehensive guidance or graceful task termination of guided setup. If you are very familiar with tasks and wish to perform them in the least time, consider using manual setup.

2.2.9 Classic view

Classic view provides an alternate way to view parameters and perform manual setup. In the classic view, the individual screens used for manual setup are replaced by a single scrollable list of parameters. The classic view reduces screen to screen navigation to a minimum, but requires that you know all the parameters which need to be used and the order of those parameters to perform each task. You also need to know how to manage modes, both to perform tasks and to return devices to operation.

Expert users will use classic view to review all block parameters, and to perform some configuration or service tasks. Emerson does not recommend classic view to anyone who is not a device and FOUNDATION™ Fieldbus expert.

Control function block configuration

The Rosemount 3051 uses standard control function blocks.

You can configure these function blocks and link them into control strategies on the control host using the configuration screens and tools specific to that control host. To configure control function blocks and use those in control strategies, consult your control host user documentation.

The device configuration tools support configuration of analog input blocks as needed to select the channel and perform signal conditioning and scaling. The transmitter ships from the factory with Analog Input Block 1 linked to the primary variable of the transducer block and scheduled to run. This is necessary to configure signal conditioning and scaling. Emerson encourages you to use Analog Input Block 1 for the primary variable when configuring control strategies.

2.2.10 Confirm correct device driver

- Verify the latest Device Driver (DD/DTM™) is loaded on your systems to ensure proper communications.
- Download the latest DD at Emerson.com or Fieldbus.org.
- In the **Browse by Member** dropdown menu, select Rosemount business unit of Emerson.
- Select desired product.
- Use the device revision numbers to find the correct Device Driver.

Table 2-1: FOUNDATION Fieldbus Device Revisions and Files

Device revision(1)	Host	Device driver (DD)(2)	DD download web address	Device driver (DTM)
8	All	DD4: DD Rev 1	Fieldbus.org	Emerson.com
	All	DD5: DD Rev 1	Fieldbus.org	
	Emerson	AMS V 10.5 or higher: DD Rev 2	Emerson.com	
	Emerson	AMS V 8 to 10.5: DD Rev 1	Emerson.com	
	Emerson	375/475: DD Rev 2	Easy upgrade utility	
7	All	DD4: DD Rev 3	Fieldbus.org	Emerson.com
	All	DD5: NA	N/A	
	Emerson		Emerson.com	
	Emerson	375/475: DD Rev 6	Easy upgrade utility	

(1) *FOUNDATION Fieldbus device revision can be read using a FOUNDATION Fieldbus capable configuration tool.*
(2) *Device driver file names use device and DD revision. To access functionality, the correct device driver must be installed on your control and asset management hosts and on your configuration tools.*

2.3 Device capabilities

2.3.1 Link active scheduler (LAS)

The 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 Rosemount 3051 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.

2.3.2 Capabilities

Virtual Communication Relationship (VCRs)

There are a total of 20 VCRs. Two are permanent, and 18 are fully configurable by the host system. 25 link objects are available.

Network parameter	Value
Slot time	6
Maximum response delay	4
Maximum inactivity to claim LAS delay	47
Minimum inter DLPDU delay	7
Time sync class	4 (1 ms)
Maximum scheduling overhead	21
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

Table 2-2:

Block	Time (in ms)
Analog input	20
PID	25
Arithmetic	20
Input selection	20
Signal characterizer	20

Table 2-2: ***(continued)***

Block	Time (in ms)
Integrator	20
Output splitter	20
Control selector	20

2.4 Node address

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

2.5 General block information

2.5.1 FOUNDATION™ Fieldbus function blocks

Reference information on the process control function blocks can be found in the Function Block Reference Manual.

Resource block

The resource block contains diagnostic, hardware, and electronics information. There are no linkable inputs or outputs to the resource block.

Sensor transducer block

The sensor transducer block contains sensor information including the sensor diagnostics and the ability to trim the pressure sensor or recall factory calibration.

LCD display transducer block

The LCD display transducer block is used to configure the LCD display meter.

Statistical process monitoring (SPM) block

The SPM block is available on a new transmitter if the D01 option is ordered.

With this block, you can view, configure, and monitor the statistical process monitoring diagnostics used for process monitoring and plugged impulse line detection.

Analog input block

The analog input (AI) function block processes the measurements from the sensor 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 AI block is widely used for scaling functionality.

Note
Typically, instrument personnel configure the channel, Set XD_Scale, Set L_Type, and sometimes Set Out_Scale. The control systems configuration engineer configures other AI block parameters, block links, and schedule.

Input selector block

You can use the input selector (ISEL) function block to select the first good, Hot Backup™, maximum, minimum, or average of as many as eight input values and place it at the output. The block supports signal status propagation.

Integrator block

The integrator (INT) function block integrates one or two variables over time. The block compares the integrated or accumulated value to pre-trip and trip limits and generates discrete output signals when the limits are reached.

The INT block is used as a totalizer. This block will accept up to two inputs and has six options to totalize the inputs and two trip outputs.

Arithmetic block

The arithmetic (ARTH) function block provides the ability to configure a range extension function for a primary input. You can also use it to compute nine different arithmetic functions, including flow with partial density compensation, electronic remote seals, hydrostatic tank gauging, ratio control, and others.

Signal characterizer block

The signal characterizer (SGCR) function block characterizes or approximates any function that defines an input/output relationship. The function is defined by configuring as many as 20 X,Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates. You can process two separate analog input signals simultaneously to give two corresponding separate output values using the same defined curve.

PID block

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

The block supports two forms of the PID equation: standard and series. You can select the appropriate equation using the MATHFORM parameter. The standard ISA PID equation is the default selection.

Control selector block

The control selector (CSEL) function block selects one of two or three inputs to be the output. The inputs are normally connected to the outputs of PID or other function blocks. One of the inputs would be considered normal and the other two overrides.

Output splitter block

The output splitter (OSPL) function block provides the capability to drive two control outputs from a single input. It takes the output of one PID or other control block to control two valves or other actuators.

Index numbers

Table 2-3: Block Index Numbers

Block name	Revision 7	Revision 8
Resource block	1000	1000
Sensor transducer block	1100	1100
Display transducer block	1200	1200
Analog input block	1400, 1500	1400, 1500, 2300, 2400
PID block	1600	1600
Input selector block	1700	1700
Signal characterizer block	1800	1800
Arithmetic block	1900	1900
Integrator block	2000	2000
Control selector block	N/A	2100
Output splitter block	N/A	2200

Function blocks with default block indexes up to 1500 are permanent. Function blocks with default block addresses 1600 and higher are instantiated and can be deleted.

2.5.2 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. The blocks may also support other modes.

Changing modes

To change the operating mode, set the MODE_BLK.TARGET to the desired mode. After a short delay, the parameter MODE_BLK.ACTUAL should reflect the mode change if the block is operating properly. The automated procedures (methods) make appropriate resource, transducer, and analog input block mode changes for most configuration tasks.

Permitted modes

You can prevent unauthorized changes to the operating mode of a block. To do this, configure MODE_BLK.PERMITTED to allow only the desired operating modes. Emerson recommends always selecting OOS as one of the permitted modes.

Types of modes

For procedures described in this manual, it is 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

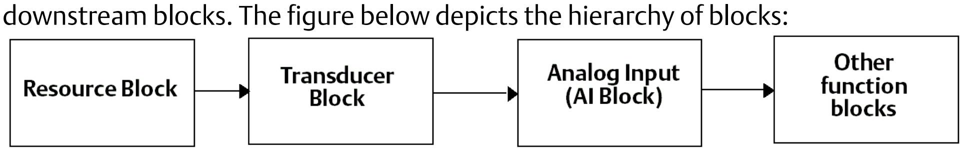
In this mode, you can manually set variables that are passed out of the block for testing or override purposes.

Other types of modes

Other types of modes are Cas, RCas, ROut, IMan, and LO. For more information, see the Function Block Reference Manual.

Mode propagation

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:



2.5.3 Block instantiation

When a device supports block instantiation, you can define the number of blocks and block types 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 SPM blocks.

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

2.5.4 Simulation

Simulation is the functionality of the AI block. There are two ways to simulate values as follows:

Procedure

1. Change the mode of the block to Manual and adjust the output value.
2. 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).

   In both cases, first set the **ENABLE** switch 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

This section contains information on the Resource Block. It includes descriptions of all Resource Block parameters, errors, and diagnostics. It also discusses the modes, alarm detection, status handling, and troubleshooting.

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 Resource Block 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 2-11: NE107 Alert Processing Diagram

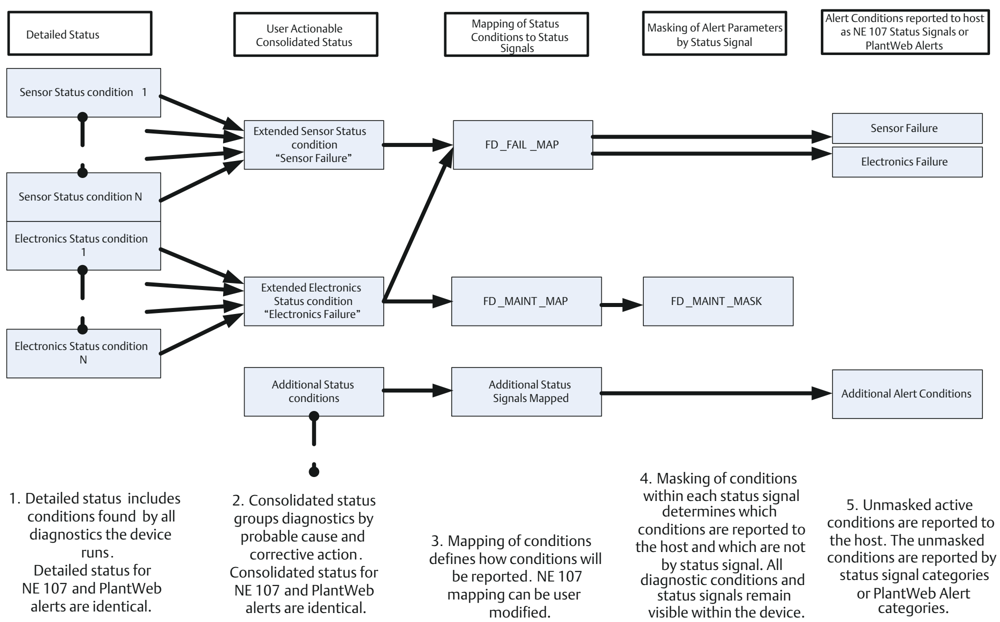
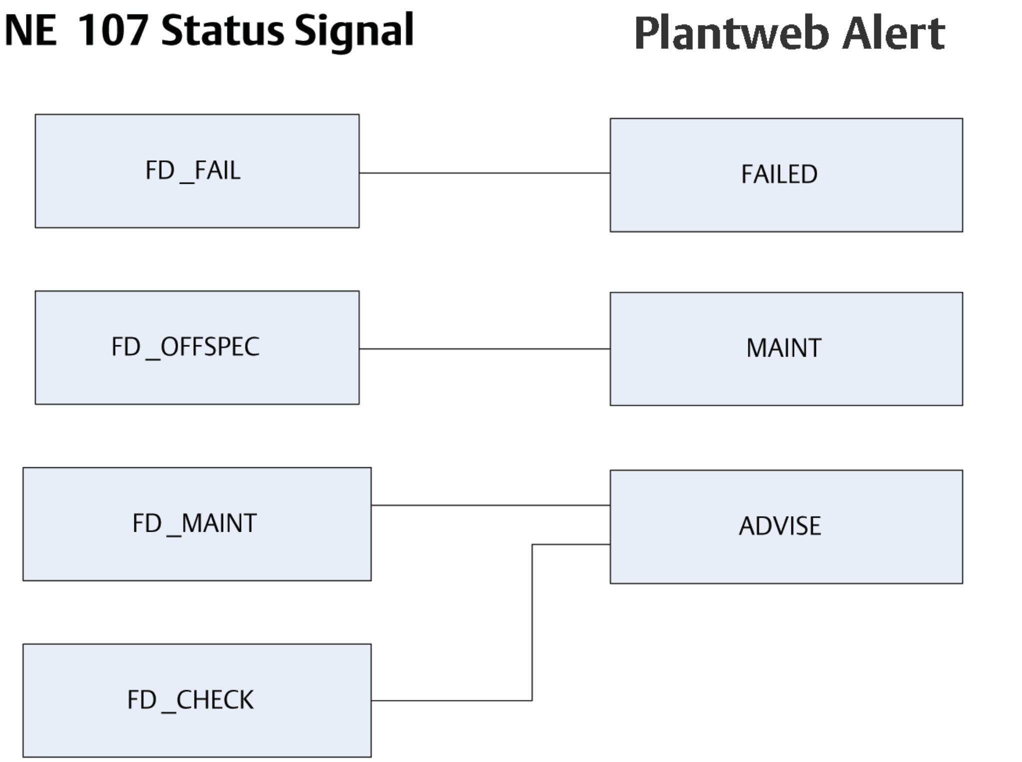


Figure 2-12: NE 107 Status Signal to Plantweb Alert Mapping



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

---

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 Basic device setup

⚠ CAUTION

Set all transmitter hardware adjustments during commissioning to avoid exposing the transmitter electronics to the plant environment after installation.

Note
The information contained within Basic device setup is the same as in the Quick Start Guide. Reference Analog input (AI) function block through Advanced device setup for more detailed configuration information.

2.7.1 Configure

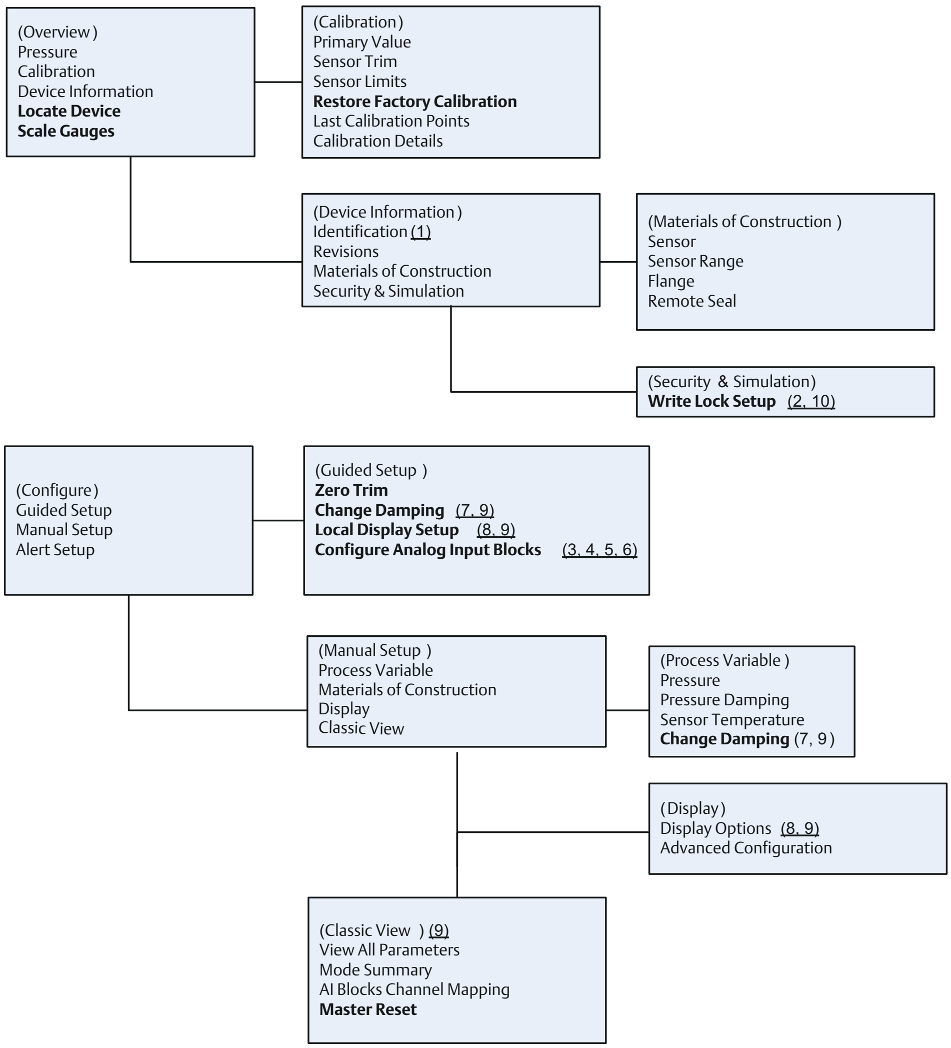
Each FOUNDATION Fieldbus host or configuration tool has a different way of displaying and performing configurations. Some use DD methods for configuration and to display data consistently across platforms. There is no requirement that a host or configuration tool support these features. Use the following block examples to do basic configuration to the transmitter. For more advanced configurations, reference Analog input (AI) function block through Advanced device setup in this manual.

Note
DeltaV™ users should use DeltaV Explorer for the Resource and Transducer blocks and control studio for the Function Blocks.

Configure the AI block

The screens used for each step are shown in Figure 2-13. In addition, step-by-step instructions for each step of AI block configuration are provided in Figure 2-13.

Figure 2-13: Basic Configuration Menu Tree



Standard Text – Navigation selections available
(Text) – Name of selection used on parent menu screen to access this screen
Bold Text – Automated methods
Underlined Text -- Configuration task numbers from configuration flow chart

The steps to configure the AI block are as follows:

1. Verify device tag: PD_TAG.
2. Check switches and software write lock.
3. Set signal conditioning: L_TYPE.
4. Set scaling: XD_SCALE.
5. Set scaling: OUT_SCALE.
6. Set low cutoff: LOW_CUT.

7. Set damping: PRIMARY_VALUE_DAMPING.
8. Set up LCD display.
9. Review transmitter configuration.
10. Set switches and software write lock.

Prerequisites

See Figure 2-13 to graphically view the step by step process for basic device configuration. Before beginning configuration, you may need to verify the device tag or deactivate hardware and software write protection on the transmitter. To do this, follow the steps below. Otherwise continue at Step 1.

1. To verify the device tag:
   a. Navigation: from the *Overview* screen, select **Device Information** to verify the device tag.
2. To check the switches (see Figure 1):
   a. The **Write Lock** switch must be in the unlocked position if the switch has been enabled in software.
   b. To disable the software write lock (devices ship from the factory with the software write lock disabled):
      - From the *Overview* screen, select **Device Information** and then select the **Security and Simulation** tab.
      - Perform **Write Lock Setup** to disable software write lock.

Note
Place the control loop in Manual mode before beginning analog input block configuration.

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 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, make changes to the 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.

Procedure

1. Begin configuring the AI block.

- To use guided setup:
    a. Navigate to **Configure > Guided Setup**.
    b. Select **AI Block Unit Setup**.

  Note
  Guided setup will automatically go through each step in the proper order.

- To use manual setup:
    a. Navigate to **Configure > Manual Setup > Process Variable**.
    b. Select AI Block Unit Setup.
    c. Place the AI block in Out of Service mode.

  Note
  When using manual setup, perform the steps in the order described in Configure the AI block.

Note
For convenience, AI Block 1 is pre-linked to the transmitter primary variable and should be used for this purpose. AI Block 2 is pre-linked to the transmitter sensor temperature. You must select the the channel for AI Blocks 3 and 4. The control host and some asset management hosts can deconfigure the factory assigned links and assign the primary variable and sensor temperature to other AI blocks.

- Channel 1 is the primary variable.
- Channel 2 is the sensor temperature.

If the FOUNDATION Fieldbus Diagnostics Option Code D01 is enabled, these additional channels are available.

- Channel 12 is the SPM mean.
- Channel 13 is the SPM standard deviation.

To configure SPM, refer to Advanced pressure diagnostics.

Note
Step 3 through Step 6 are all performed in a single step by step method under guided setup.

Note
If the L_TYPE selected in Step 2 is **Direct**, Step 3, Step 4 and Step 5 are not needed. If the L_TYPE selected is **Indirect**, Step 5 is not needed. Guided setup automatically skips any unneeded steps.

2. Select the Signal Conditioning **L_TYPE** from the dropdown menu:
    a) Select **L_TYPE**: Direct for pressure measurements using the device default units.
    b) Select **L_TYPE**: Indirect for other pressure or level units.
    c) Select **L_TYPE**: Indirect Square Root for flow units.
3. Set **XD_SCALE** to the 0% and 100% scale points (the transmitter range):

   a) Select the **XD_SCALE_UNITS** from the dropdown menu.
   b) Enter the **XD_SCALE 0%** point.

      This may be elevated or suppressed for level applications.
   c) Enter the **XD_SCALE 100%** point.

      This may be elevated or suppressed for level applications.
   d) If **L_TYPE** is **Direct**, you may place the AI block in **AUTO** mode to return the device to service.

      Guided setup does this automatically.

4. If **L_TYPE** is **Indirect** or **Indirect Square Root**, set **OUT_SCALE** to change engineering units.
   a) Select the **OUT_SCALE UNITS** from the dropdown menu.
   b) Set the **OUT_SCALE** low value.

      This may be elevated or suppressed for level applications.
   c) Set the **OUT_SCALE high** value.

      This may be elevated or suppressed for level applications.
   d) If **L_TYPE** is **Indirect**, you may place the AI Block in **AUTO** mode to return the device to service.

      Guided Setup does this automatically.
5. If **L_TYPE** is **Indirect Square Root**, a **LOW FLOW CUTOFF** function is available.
   a) Enable **LOW FLOW CUTOFF**.
   b) Set the **LOW_CUT VALUE** in **XD_SCALE UNITS**.
   c) You may place the AI Block in **AUTO** mode to return the device to service.

      Guided Setup does this automatically.
6. Change damping.
   - To use guided setup:
     — Navigate to **Configure > Guided Setup**, and select Change Damping.

     Note
     Guided setup automatically goes through each step in the proper order.

     — Enter the desired damping value in seconds. The permitted range of values is 0.4 to 60 seconds.
   - To use manual setup:
     — Navigate to **Configure > Manual Setup > Process Variable**, and select **Change Damping**.

     — Enter the desired damping value in seconds. The permitted range of values is 0.4 to 60 seconds.
7. Configure optional LCD display (if installed).

- To use guided setup:
  — Navigate to **Configure > Guided Setup**, and select Local Display Setup.

  Note
  Guided setup will automatically go through each step in the proper order.

  — Check the box next to each parameter to be displayed to a maximum of four parameters. The LCD display will continuously scroll through the selected parameters.
- To use manual setup:
  — Navigate to **Configure > Manual Setup**, and select Local Display Setup.

  — Check each parameter to be displayed. The LCD display will continuously scroll through the selected parameters.

8. Review transmitter configuration and place in service.
   a) To review the transmitter configuration, navigate using the guided setup navigation sequences for *AI Block Unit Setup*, *Change Damping*, and *Set up LCD Display*.

   b) Change any values as necessary.

   c) Return to the *Overview* screen.

   d) If mode is **Not in Service**, click the **Change** button, and then click **Return All to Service**.

   Note
   If hardware or software write protection is not needed, you can skip Step 9.

9. Set switches and software write lock.
   a) Check switches (see Figure 1).

   Note
   You can leave the **Write Lock** switch in the locked or unlocked position. The **Simulate Enable/Disable** switch may be in either position for normal device operation.

Enable software write lock

Procedure

1. Navigate from the *Overview* screen.
   a) Select **Device Information**.

   b) Select the **Security and Simulation** tab.

2. Perform **Write Lock Setup** to enable software write lock.

2.8 Analog input (AI) function block

2.8.1 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 2-4: 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:

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

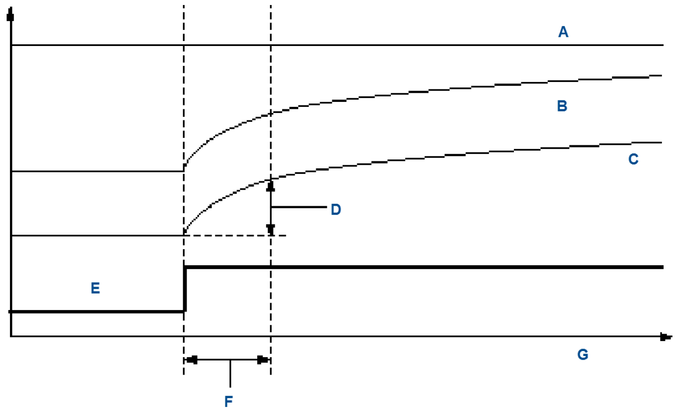
Note
When the engineering units of the XD_SCALE are selected, this causes the engineering units of the PRIMARY_VALUE_RANGE in the Transducer Block to change to the same units. This is the only way to change the engineering units in the sensor transducer block PRIMARY_VALUE_RANGE parameter.

Configuration examples

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 2-14: 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.

2.9 Advanced device setup

2.9.1 Overall configuration

Configuration tasks are listed in alphabetical order. Each task starts with navigation per the menu tree navigation diagram to an appropriate configuration starting screen. Next, individual configuration steps are listed. In many cases, you can use the steps for either guided or manual configuration. Specific parameter names and valid input ranges are located in the *Specifications* section of the Rosemount 3051 Product Data Sheet.

The summary of the sections are as follows:

Note
You can initiate many configuration tasks from more than one appropriate configuration starting screen. This manual describes configuration from one starting screen only. Do not interpret the starting screen used in the manual as the preferred starting screen.

Note
Physical layout of the parameters on the screen may be different for different configuration tools. The parameters, parameter names, and operations performed will be consistent regardless of screen layout.

Note
Before performing any configuration or service task, contact the control room and have the loop placed in Manual mode. When configuration or service tasks are complete, contact the control room so appropriate return to automatic control can take place.

2.9.2 Damping

Note
Perform damping, gauge scaling, calibration, and sensor trims in the Sensor Transducer Block. For block oriented user interfaces, configure Damping in the Sensor Transducer Block.

Menu navigation: **Configure → Manual Setup → Process Variable**

You can change damping with the *Overview*, *Configure*, or *Service Tools* branches of the menu tree. All perform the same function. The *Configure* branch is used here.

Navigate to the *Process Variables* screen and click the **Change Damping** button. An automated task procedure called *Method* will guide you through changing the damping. Alternately, an operator or configuration engineer can change the damping from the control system *Analog Input Block* configuration screens. Consult your control system documentation for more information.

Figure 2-15: Process Variables Screen

The change damping button shown in Figure 2-15 above starts an automated procedure called a *Method* which allows damping to be changed.

Procedure

1. The device is placed out of service.
2. Enter the new damping value in seconds.
3. The device returns to Auto mode.

2.9.3 Gauge scaling

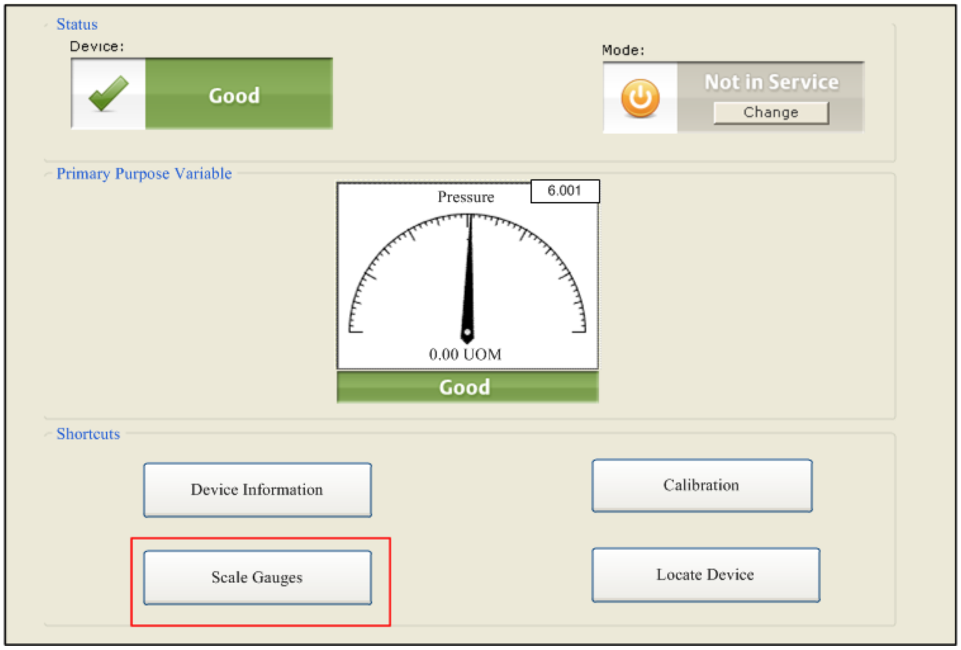
Menu navigation: *Overview*

Use scale gaugesto change the scaling displayed on the gauges used to view variables. From the *Overview* screen, click the **Scale Gauges** button. An automated task procedure called a `Method` guides you through scaling the gauges.

Procedure

1. Enter the desired value for the lower range of the pressure gauge.
2. Enter the desired value for the upper range of the pressure gauge.

Figure 2-16: Overview Screen



The **Scale Gauges** button shown in Figure 2-16 above starts an automated procedure called a method which allows you to change the scaling on the gauge.

2.9.4 Local display (LCD display)

Note
Set up the local display in the LCD display transducer block. For block oriented user interfaces, perform local display configuration in the LCD display transducer block.

Menu navigation: **Configure** → **Manual Setup** → **Display**

The local display can be configured using guided setup or manual setup.

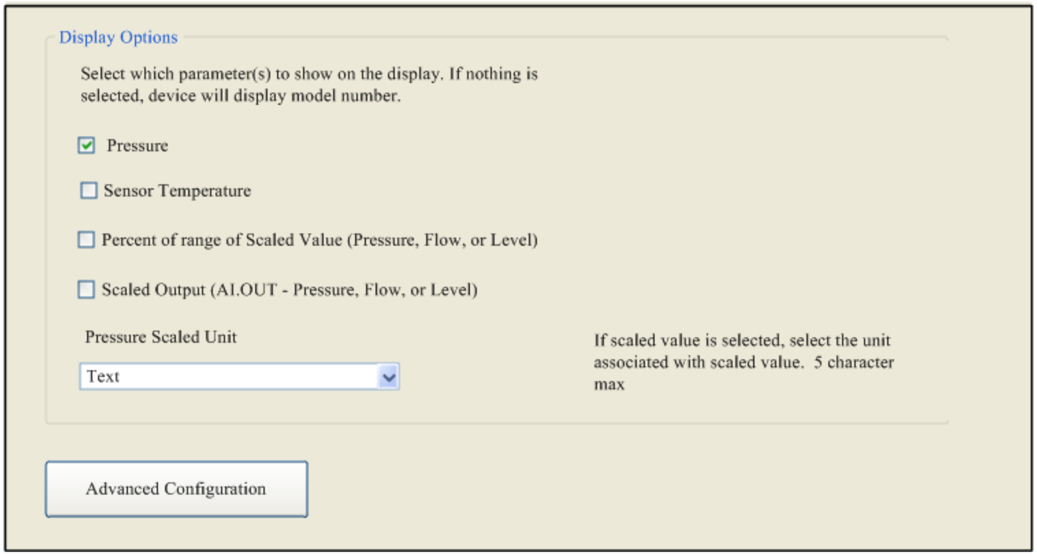
Basic display setup

Basic display setup provides a check - the - box way for the user to configure up to four parameters to display on the LCD display. These parameters are displayed on a rotating basis.

Procedure

1. Check the box next to each parameter the LCD display should display.
2. If you select Scaled Output, use the **Pressure Scaled Unit** dropdown menu to select units.

Figure 2-17: Local Display Basic Configuration Screen



The screen shown in Figure 2-17 above allows you to select parameters to be displayed on the LCD display by checking the box next to each parameter. Select the **Advanced Configuration** button to access more display configuration options.

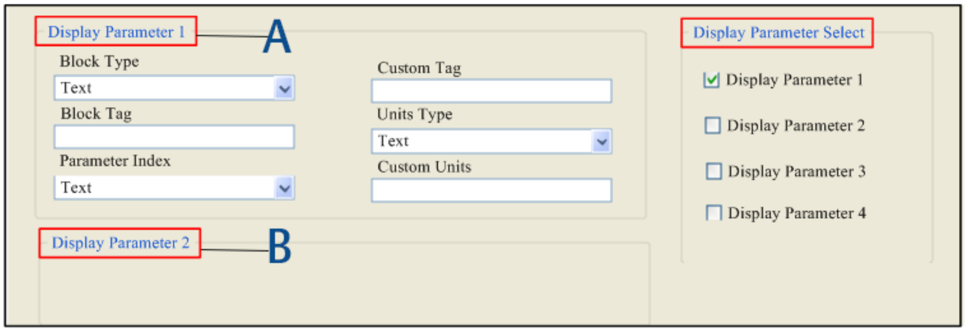
Advanced display setup

Menu navigation: **Configure** → **Manual Setup** → **Display** → **Advanced Configuration**

Advanced display setup provides a fill-in-the-blank screen where you can configure parameters from any function block in the device to be displayed on the LCD display. Setup is a two-step process. First, define each of up to four parameters. To define a parameter, select the Block Type, Parameter Index, and Units Type from dropdown menus. You can enter Block Tag, Custom Tag, and Custom Units.

Once you have defined all desired parameters, select parameters for display by checking the box in the *Display Parameter Select* field.

Figure 2-18: LCD Display Advanced Configuration Screen



A. Parameter 1 definition
B. Parameter 2 definition

The screen shown in Figure 2-18 above provides the capability to define parameters for display beyond those defined in Basic Configuration. Configuration fields for Parameters 2, 3, and 4 are provided but not shown in the image.

Note
You can configure the LCD display to display a mix of basic and advanced parameters.

2.9.5 Mode

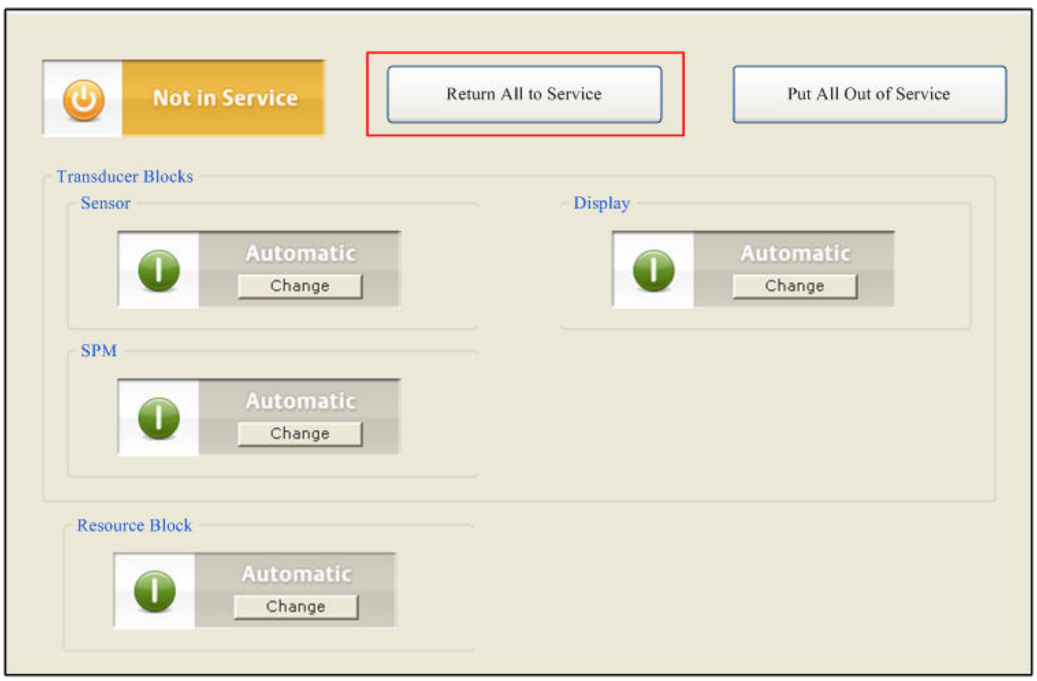
Note
Each block has modes. For block oriented user interfaces, you must manage modes individually in each block.

Menu navigation: **Configure** → **Manual Setup** → **Classic View** → **Mode Summary**

FOUNDATION™ Fieldbus blocks have modes. Modes propagate, so if a block is in out-of-service mode, for example, other blocks linked to it may not function as anticipated. The Rosemount 3051 DD's and DTM's have automated procedures that manage transducer, resource, and analog input block modes, placing them out of service to allow configuration, then returning them to auto mode when the configuration task is completed or canceled. If you complete tasks with manual procedures, you are responsible for managing modes.

The Mode Summary function displays the active mode for all resource and transducer blocks, and allows you to change modes of those blocks individually or collectively. This is most frequently used to return all to service. You can manage analog input modes from the *Analog Input Block Configuration* screens or from the control host.

Figure 2-19: Mode Summary Screen



The screen shown in Figure 2-19 above shows the modes of all resource and transducer blocks and provides a mechanism to individually or collectively take blocks out of service and return them to automatic mode.

2.9.6 Alert configuration NE107 and Plantweb™

The objective of alerts is to inform you of conditions of interest and guide you to effective corrective actions. The detailed diagnostics performed and the consolidated status which is annunciated are the same for both NE107 and Plantweb Alerts.

Note
Alerts are located in the resource block. For block oriented user interfaces, configure NE107 and Plantweb alerts, alert suppression, and alert simulation in the resource block.

Menu navigation: **Configure** → **Alert Setup** → **Device Alerts**OR **Process Alerts** OR **Diagnostic Alerts**

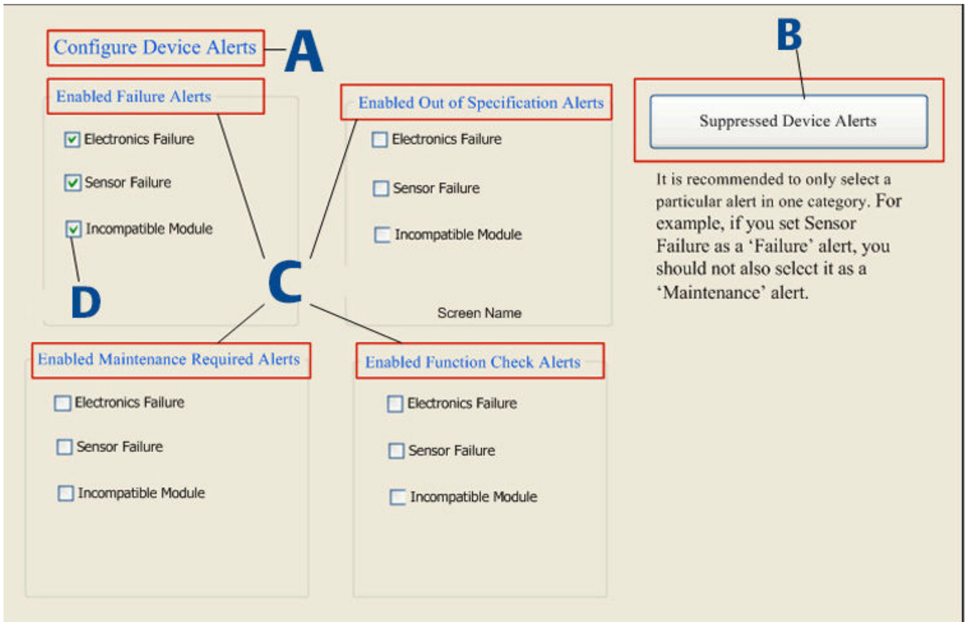
Note
Device Alerts, Process Alerts, and Diagnostic Alerts are configured the same way. One example is shown.

Ne107 alerts category configuration

NE107 alerts are divided into Device alerts, Process alerts, or Diagnostics alerts. Each alert type has a dedicated *Configuration* screen, and a dedicated *Suppress Alerts* screen. The *Configure Device Alerts* screen is used here.

See Alerts/alarms for more information on the conditions of each. The alerts are categorized as Failure alerts, Out of Specification alerts, Maintenance - Required alerts, and Function Check alerts. Each category contains the same list of Device alerts and check boxes. To assign an alert to a category, select the check box next to the alert. This activates the alert in that category. You can assign alerts to more than one category by selecting the same alert check box in multiple categories. Emerson does not recommend this, as alarms can proliferate, increasing the complexity of alarm management and delaying corrective action. Emerson recommends using factory default alert categories..

Figure 2-20: Configure Device Alerts Screen



A. *Screen name*
B. *Configure Suppressed Alerts button*
C. *Status signal categories*
D. *Alert check boxes*

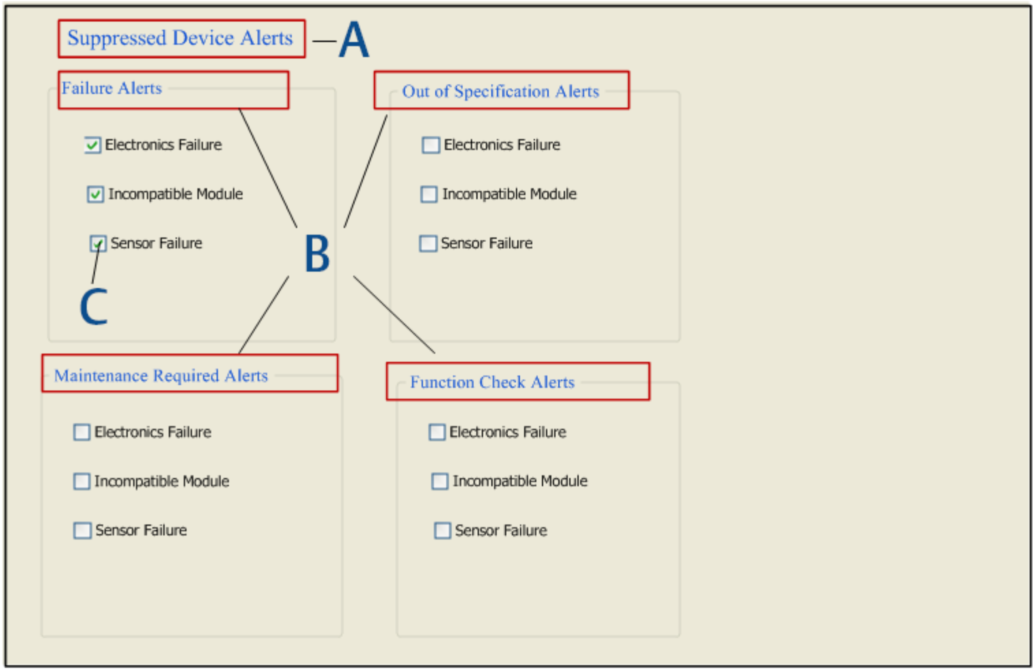
The screen shown in Figure 2-20 is where you can assign alerts by selecting the box next to the desired alert in the desired category.

Alerts suppression

Menu Navigation: **Configure>Alert Setup>Device Alerts** OR **Process Alerts** OR **Diagnostic Alerts**

Once you have configured alerts, you can suppress them. To suppress alerts, click **Suppressed Device Alerts** on the *Configuration* screen. You can suppress alerts by selecting the check box next to the alert. To stop suppressing an alert, deselect the check box suppressing the alert.

Figure 2-21: Suppressed Device Alerts Screen



A. *Screen name*
B. *Status signal categories*
C. *Suppress alert check boxes*

The screen shown in Figure 2-21 is where you can suppress alerts by checking the box next to the alert to be suppressed.

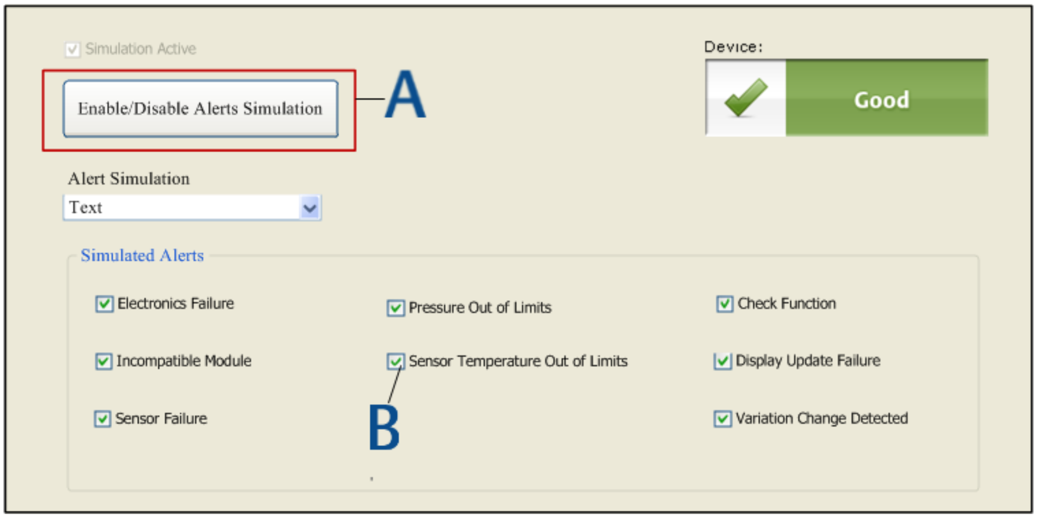
2.9.7 Alert simulation

Alert simulation provides the capability to simulate configured NE107 or Plantweb™ alerts. NE107 alerts and Plantweb alerts show the same consolidated status derived from the same diagnostics so the single alert simulation is used for both. Alert simulation is typically used for training or to verify alert configuration.

Menu navigation: **Service Tools** → **Simulate**

To enable alert simulation, click the **Enable/Disable Alerts Simulation** button. When simulate is active it will display on the screen. Once alerts simulation is active, you can simulate individual alerts by checking the check box next to the desired alert condition. The device status indication located on the upper right corner of the screen changes to show the device status associated with the simulated alert. The simulated status is displayed everywhere device status is displayed. Alert simulation is enabled and disabled using an automated procedure called a `Method`.

Figure 2-22: Enable/Disable Alert Simulation Screen



A. *Enable/Disable Alert suppression button*
B. *Check boxes to activate/deactivate simulation of specific alerts*

The screen shown in Figure 2-22 above enables/disables overall alert simulation capability and allows individual alerts to be selected for simulation.

The sequence of steps to enable alert simulation is:

Procedure

1. A screen displays stating **Alert Simulation is disabled**.
2. The screen presents the question **Do you want to enable alerts simulation?** Below this sentence are two radio buttons labeled Yes and No. Click Yes.

   The sequence of steps to disable alert simulation is:

3. A screen is displayed stating **Alert Simulation is enabled**.
4. The screen presents the question **Do you want to disable alerts simulation?** Below this sentence are two radio buttons labeled Yes and No. Click Yes.

2.9.8 Statistical Process Monitoring (SPM)

Note
Set up SPM in the SPM transducer block. For block oriented user interfaces, configure SPM in the SPM transducer block.

Menu navigation: **Configure>Guided Setup>Basic SPM Setup**

SPM configuration provides the capability to configure SPM for use in plugged line detection or other abnormal process conditions. See Advanced pressure diagnostics for more information on SPM functions and uses.

Note
SPM is a factory only option, option code D01, and can't be licensed/installed in the field.

An automated task procedure called a `Method` guides you through SPM setup. The basic sequence of steps is:

Procedure

1. Enter the monitoring cycle.

   The minimum monitoring time is one minute; three minutes is a typical monitoring cycle.
2. For Bypass Verification, select Yes or No. Emerson™ recommends verification for applications where SPM monitoring has not been done previously, or where process changes may cause significant changes in mean or standard deviation.
3. Enter the thresholds in percent.
   a) The first threshold is the Mean Change that will trigger an alert.
   b) The second threshold is the High Variation Limit that will trigger an alert.

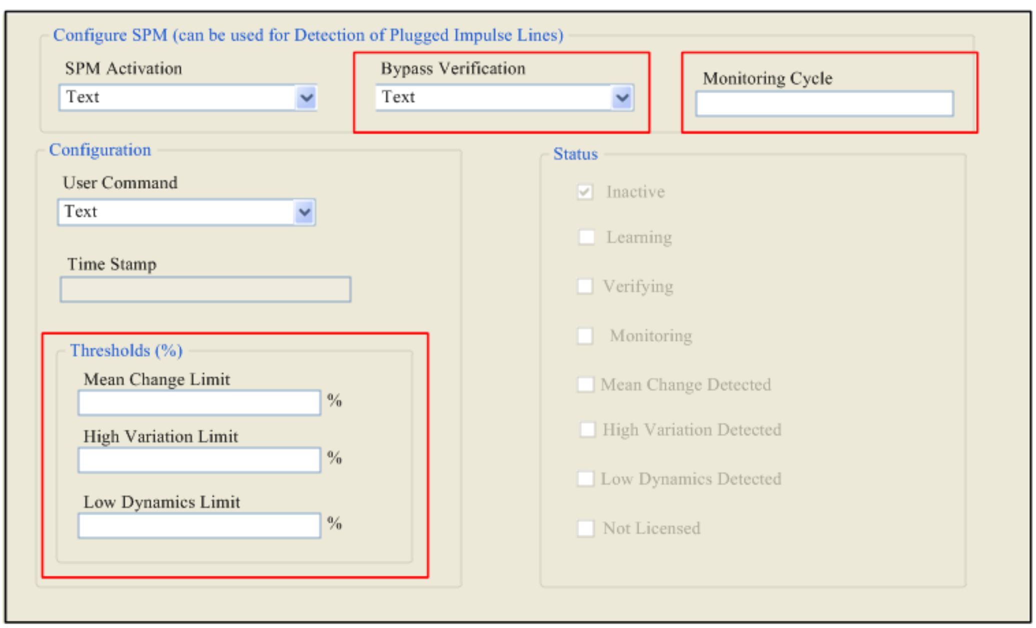
      Typical values are from 40–80 percent.
   c) The third threshold is the Low Dynamics Limit that will trigger an alert.
   d) Filtering is selected or disabled.
4. Enable software write lock.

Example

Note
To enable or disable monitoring or make configuration changes, you may prefer the manual *SPM Configuration* screen.

Menu navigation: **Configure** → **Manual Setup** → **Basic SPM**

Figure 2-23: Configure SPM Display Screen



The screen shown in Figure 2-23 above allows full SPM configuration, configuration edits, enabling and disabling monitoring, and provides an indication of the status of the monitored variable.

2.9.9 Write lock

Note
Perform write lock functions in the Resource Block. For block oriented user interfaces, perform write lock management in the Resource Block.

Menu navigation: **Overview → Device Information → Security and Simulation**

An automated task procedure called a `Method` guides you through write lock setup. Write lock permits you to configure, enable, and disable the various write lock options. You can implement write lock can be implemented as a hardware lock or a software lock. If you implement it as a hardware lock, the position of the hardware lock switch on the transmitter electronics board will determine if device writes are permitted. Hardware write lock is typically used to prevent writes from a remote location. Software write lock is used to prevent local or remote writes unless the write lock is disabled.

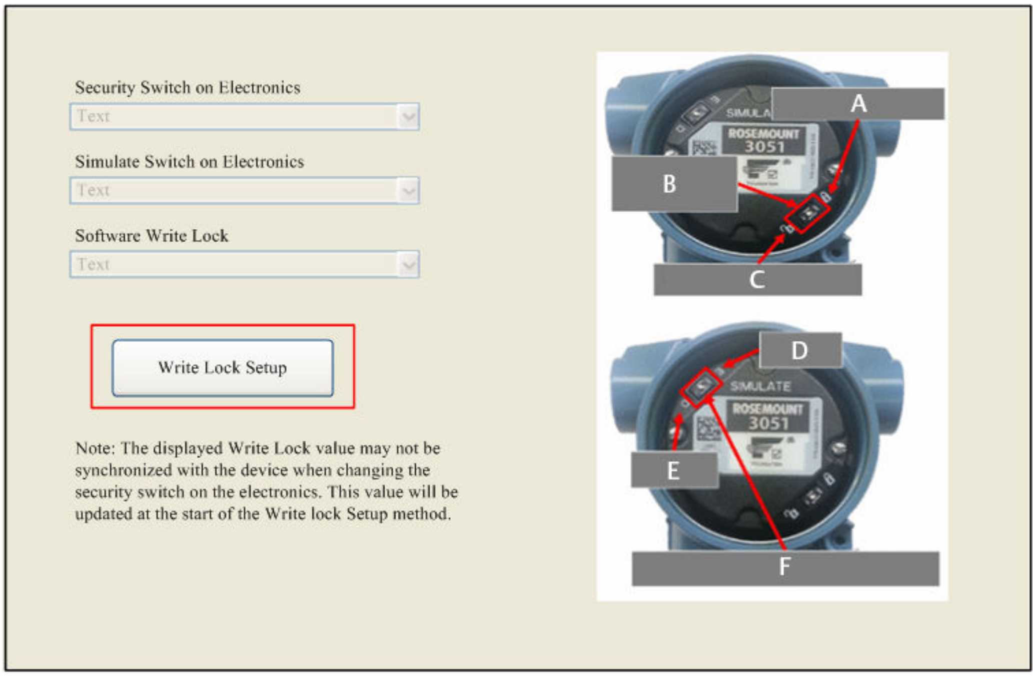
When the write lock procedure is initiated, it first informs you if write lock is currently enabled and if it is configured as hardware or software write lock.

If hardware write lock is enabled, you must set the physical switch on the electronics board in the unlocked position to enable changes, including changes to write lock, to be permitted.

If software write lock is enabled, follow the on-screen instructions to enable changes.

Select hardware or software write lock by clicking the radio button next to the desired option.

Figure 2-24: Security and Simulation Display Screen



A. *Hardware locked*
B. *Hardware lock switch*
C. *Hardware not locked*
D. *Enable*
E. *Disable*
F. *Simulate enable / disable switch*

The screen shown in Figure 2-24 above allows you to see if the device has simulation active, to see if any form of write lock is active, and to configure hardware and software write lock.

3 Hardware installation

3.1 Overview

The information in this section covers installation considerations for the Rosemount 3051 with FOUNDATION™ Fieldbus protocols. Emerson ships a Quick Start Guide with every transmitter to describe the recommended pipe fitting and wiring procedures for initial installation.

Dimensional drawings for each Rosemount 3051 variation and mounting configuration are included in Mounting brackets.

Note
For transmitter disassembly and reassembly, refer to Disassembly procedures and Reassemble.

3.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of personnel performing the operation.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Installation of device in an explosive environment must be in accordance with appropriate local, national, and international standards, codes, and practices.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments in the loop 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.

Install and tighten all four flange bolts before applying pressure.

Electrical shock

Electrical shock can result in death or serious injury.

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

⚠ WARNING

Spare parts

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.

⚠ CAUTION

Improper assembly

Improper assembly of manifolds to traditional flange can damage sensor module.

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.

3.3 Installation considerations

Measurement accuracy depends upon proper installation of the transmitter and impulse piping. Mount the transmitter close to the process and use a minimum of piping to achieve best accuracy. Keep in mind 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 unused housing conduit opening with a minimum of five threads of engagement to comply with explosion-proof requirements. For material compatibility considerations, refer to Material Selection Technical Note.

3.3.1 Mechanical considerations

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 3-10 for correct mounting orientation.

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 3-10, keeping drain/vent connections on the bottom for gas service and on the top for liquid service.

3.3.2 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). Mount the transmitter so that it is not susceptible to vibration and mechanical shock and does not have external contact with corrosive materials.

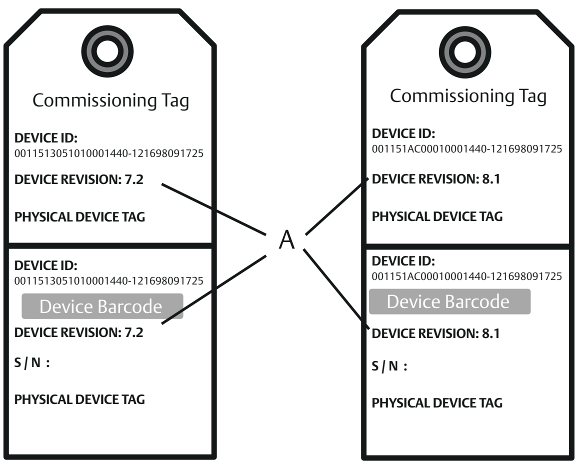
3.4 Tagging

3.4.1 Commissioning tag

The transmitter is 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. Tear off the bottom portion for each device on the segment and use it for commissioning the segment in the control system.

Figure 3-1: Commissioning Tag



A. Device revision

3.4.2 Transmitter tag

If a permanent tag is ordered:

- The transmitter is tagged in accordance with customer requirements.
- The tag is permanently attached to the transmitter.

Software (PD_TAG)

- If a permanent tag is ordered, the PD Tag contains the permanent tag information up to 32 characters.
- If a permanent tag is NOT ordered, the PD Tag contains the transmitter serial number.

3.5 Installation procedures

3.5.1 Mount the transmitter

For dimensional drawing information refer to the *Dimensional Drawings* section of the Rosemount 3051 Product Data Sheet.

Process flange orientation

Complete the following steps to mount the process flanges.

Procedure

1. Mount the process flanges with sufficient clearance for process connections.
2. 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.

   Note
   Most transmitters are calibrated in the horizontal position. Mounting the transmitter in any other position will shift the zero point to the equivalent amount of liquid head pressure caused by the varied mounting position. To reset zero point, refer to Sensor trim overview.

Housing rotation

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

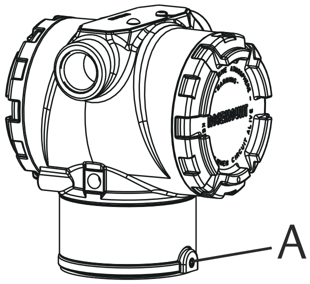
Procedure

1. Loosen the housing rotation set screw using a 5/64-in. hex wrench.
2. Turn the housing left or right up to a maximum of 180 ° from its original position.(1)
3. Re-tighten the housing rotation set screw to a maximum of 7 in-lb when desired location is reached.

   Note
   Over-rotating will damage the transmitter.

(1) *Rosemount 3051C original position aligns with "H" side; Rosemount 3051T original position is the opposite side of the bracket holes.*

Figure 3-2: Housing Rotation



A. *Housing rotation set screw (5/64-in.)*

Electronics housing clearance

Mount the transmitter so the terminal side is accessible. Clearance of 0.75-in. (19 mm) is required for cover removal. Use a conduit plug in the unused conduit opening. Three inches of clearance is required for cover removal if a meter is installed.

Environmental seal for housing

Ensure full contact with terminal block screw and washer. When using a direct wiring method, wrap wire clockwise to ensure it is in place when tightening the terminal block screw.

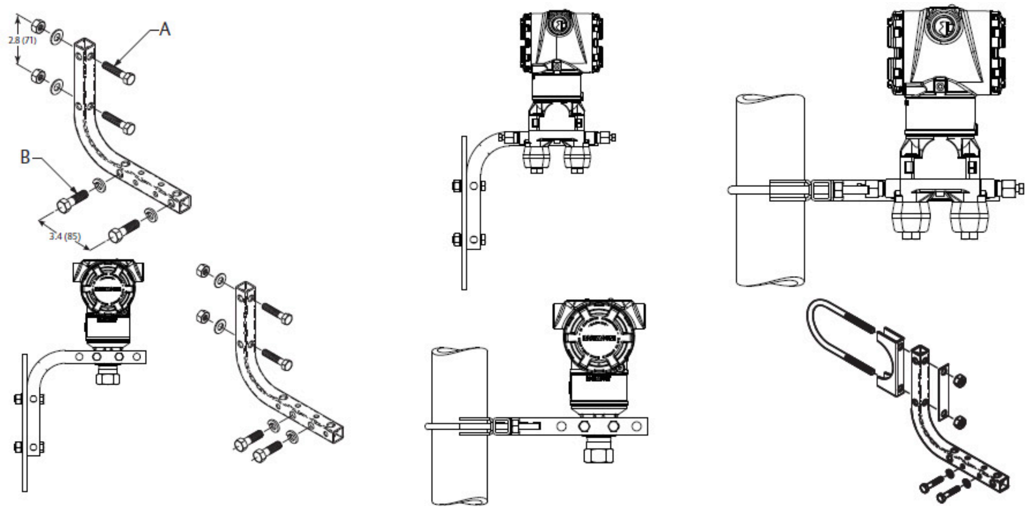
Note
The use of a pin or ferrule wire terminal is not recommended as the connection may be more susceptible to loosening over time or under vibration.

Mounting brackets

Table 3-1: Mounting Brackets

Option code	Process connections			Mounting			Materials			
	Coplanar	In-Line	Traditional	Pipe mount	Panel mount	Flat panel mount	CS bracket	SST bracket	CS bolts	SST bolts
B4	X	X	N/A	X	X	X	N/A	X	N/A	X
B1	N/A	N/A	X	X	N/A	N/A	X	N/A	X	N/A
B2	N/A	N/A	X	N/A	X	N/A	X	N/A	X	N/A
B3	N/A	N/A	X	N/A	N/A	X	X	N/A	X	N/A
B7	N/A	N/A	X	X	N/A	N/A	X	N/A	N/A	X
B8	N/A	N/A	X	N/A	X	N/A	X	N/A	N/A	X
B9	N/A	N/A	X	N/A	N/A	X	X	N/A	N/A	X
BA	N/A	N/A	X	X	N/A	N/A	N/A	X	N/A	X
BC	N/A	N/A	X	N/A	N/A	X	N/A	X	N/A	X

Figure 3-3: Mounting Bracket Option Code B4



A. *5/16 x 1½-in. bolts for panel mounting (not supplied)*
B. *⅜-16 x 1¼-in. bolts for mounting to transmitter*

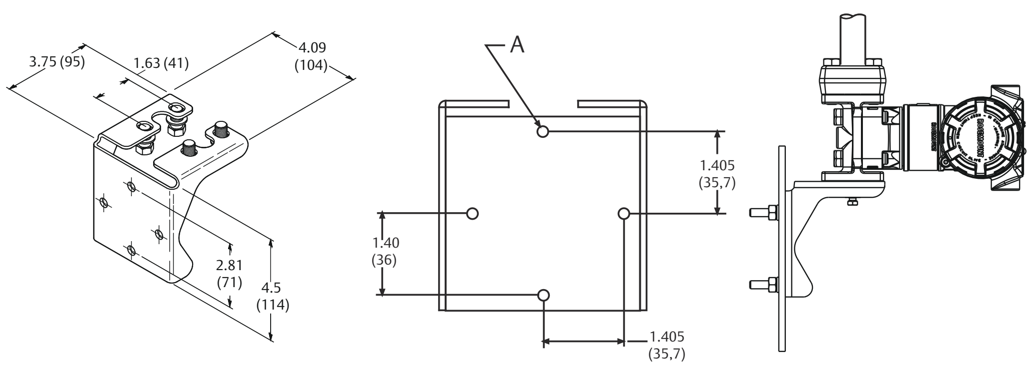
Dimensions are in inches (millimeters).

1. The last digit in the FS93_ head marking may be any letter between A and M.

Figure 3-4: Mounting Bracket Option Codes B1, B7, and BA

Dimensions are in inches (millimeters).

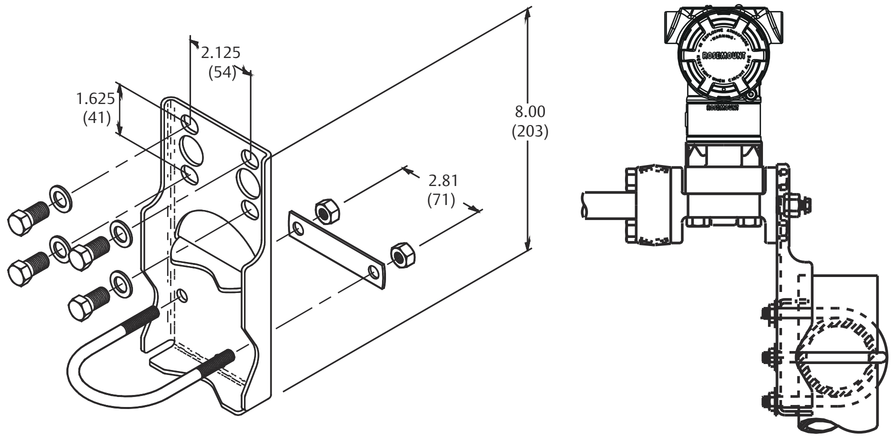
Figure 3-5: Panel Mounting Bracket Option Codes B2 and B8



A. *Mounting holes 0.375-in. diameter (10)*

Dimensions are in inches (millimeters).

Figure 3-6: Flat Mounting Bracket Option Codes B3 and BC



Dimensions are in inches (millimeters).

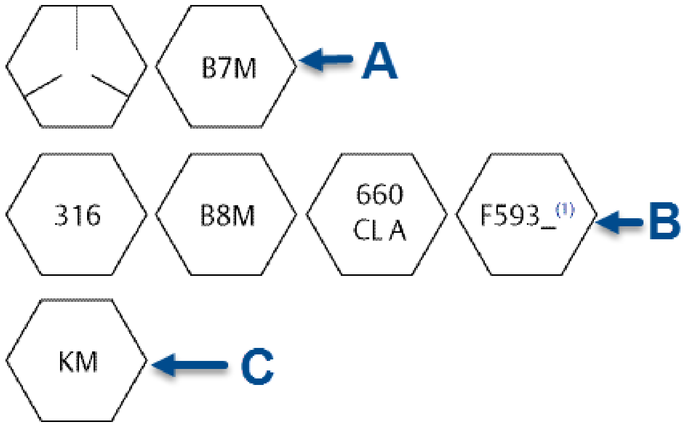
Procedure

1. Finger-tighten the bolts.
2. Torque the bolts to the initial torque value using a crossing pattern (see Table 3-2 for torque values).
3. Torque the bolts to the final torque value using the same crossing pattern.

Flange bolts

Emerson can ship the transmitter with a coplanar flange or a traditional flange installed with four 1.75-in. flange bolts. Mounting bolts and bolting configurations for the coplanar and traditional flanges can be found in Bolt installation. Stainless steel bolts supplied by Emerson are coated with a lubricant to ease installation. Carbon steel bolts do not require lubrication. Do not apply additional lubricant when installing either type of bolt. Bolts supplied by Emerson are identified by their head markings.

Figure 3-7: Head Markings



A. *Carbon steel (CS) head markings*
B. *Stainless steel (SST) head markings*
C. *Alloy K-500 head marking*

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

Bolt installation

Use the following bolt installation procedure:

⚠ WARNING

Spare parts

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.

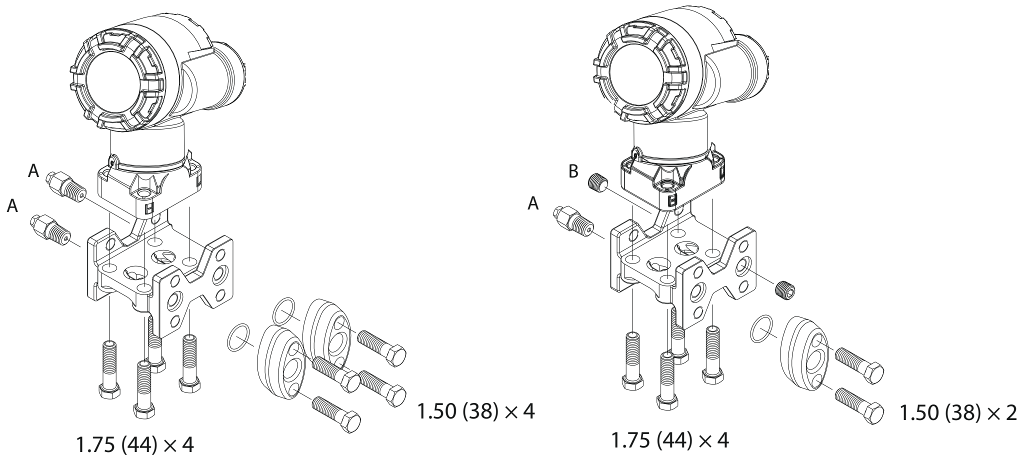
Use only bolts supplied or sold by Emerson as spare parts.

Table 3-2: Bolt Installation Torque Values

Bolt material	Initial torque value	Final torque value
CS-(ASTM-A445) standard	300 in-lb (34 N-m)	650 in-lb (73 N-m)
Austemitic 316 SST—Option L4	150 in-lb (17 N-m)	300 in-lb (34 N-m)
ASTM A193 Grade 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)

Figure 3-8: Traditional Flange Bolt Configurations

Differential transmitter | Gage/absolute transmitter[1]



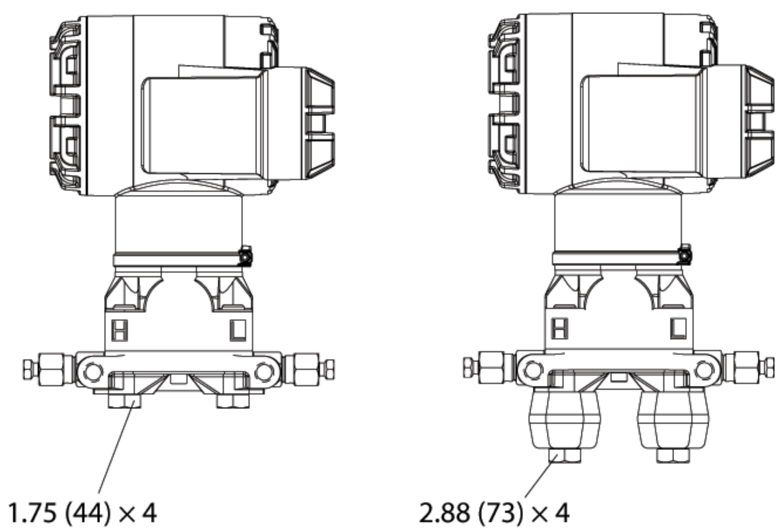
A. *Drain/vent*

Dimensions are in inches (millimeters).

(1) For gage and absolute transmitters: 150 (38) × 2

Figure 3-9: Mounting Bolts and Bolt Configurations for Coplanar Flange

Transmitter with flange bolts	Transmitter with flange adapters and flange/adapter bolts



Dimensions are in inches (millimeters).

Description	Qty	Size in. (mm)
Differential pressure		
Flange bolts	4	1.75 (44)
	4	2.88 (73)
Gage/absolute pressure (1)		
Flange bolts	4	1.75 (44)
Flange/adapter bolts	2	2.88 (73)

(1) Rosemount 3051T Transmitters are direct mount and do not require bolts for process connection.

1. Use the fingers to tighten the bolts.
2. Torque the bolts to the initial torque value using a crossing pattern (see Table 3-2 for torque values).
3. Torque the bolts to the final torque value using the same crossing pattern.

3.5.2 Impulse piping

Mounting requirements

Impulse piping configurations depend on specific measurement conditions. Refer to Figure 3-10 for examples of the following mounting configurations:

Liquid measurement

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

Gas measurement

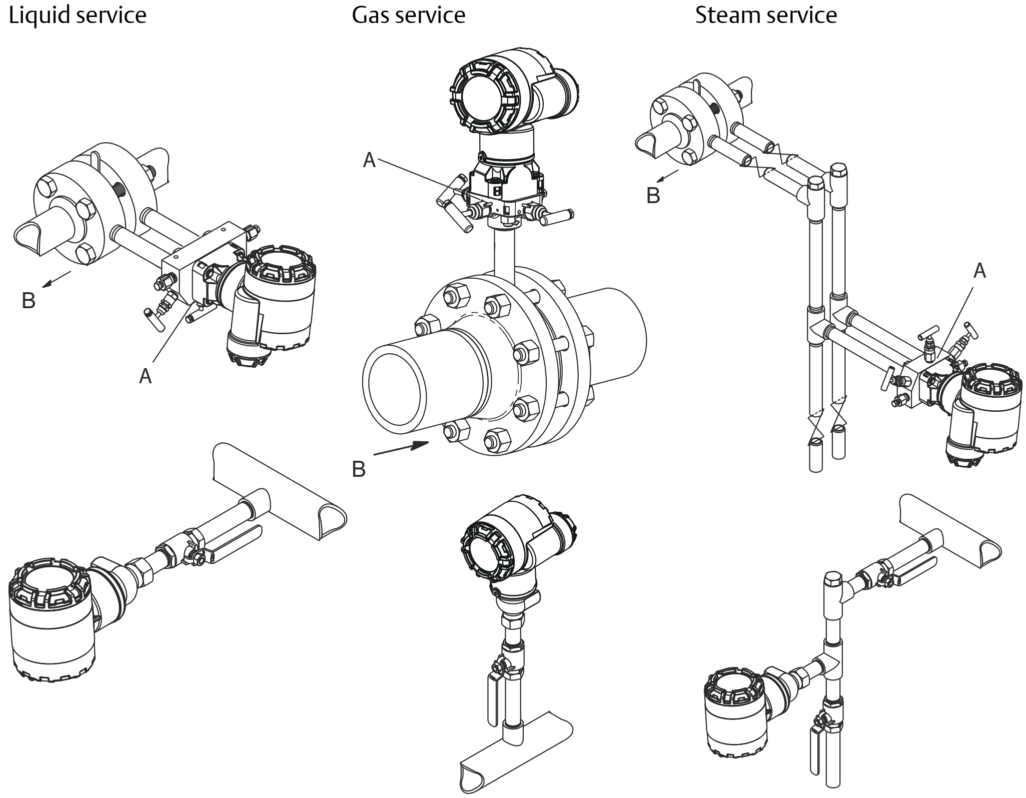
- Place taps in the top or side of the line.
- Mount the transmitter beside or above the taps so liquid will drain into the process line.

Steam measurement

- Place taps to the side of the line.
- Mount the transmitter below the taps to ensure that the impulse piping will stay filled with condensate.
- 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.

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.

Figure 3-10: Installation Examples



A. *Drain/vent valves*
B. *Flow*

Best practices

The piping between the process and the transmitter must accurately transfer the pressure to obtain accurate measurements. There are five 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, and density variations between the legs.

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.

3.5.3 Process connections

Coplanar or traditional process connections

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.

Flange adapters

Rosemount 3051DP and GP process connections on the transmitter flanges are ¼–18 NPT. Flange adapters are available with standard ½ –14 NPT Class 2 connections. The flange adapters allow you to disconnect from the process by removing the flange adapter bolts. Use plant-approved lubricant or sealant when making the process connections. Refer to the *Dimensional drawings* section in the Rosemount 3051 Product Data Sheet to see the distance between pressure connections. This distance may be varied ±¼-in. (6.4 mm) by rotating one or both of the flange adapters.

To install adapters to a coplanar flange, perform the following procedure:

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 sensor module using the larger of the bolts supplied.
4. Tighten the bolts. Refer to Flange bolts for torque specifications.

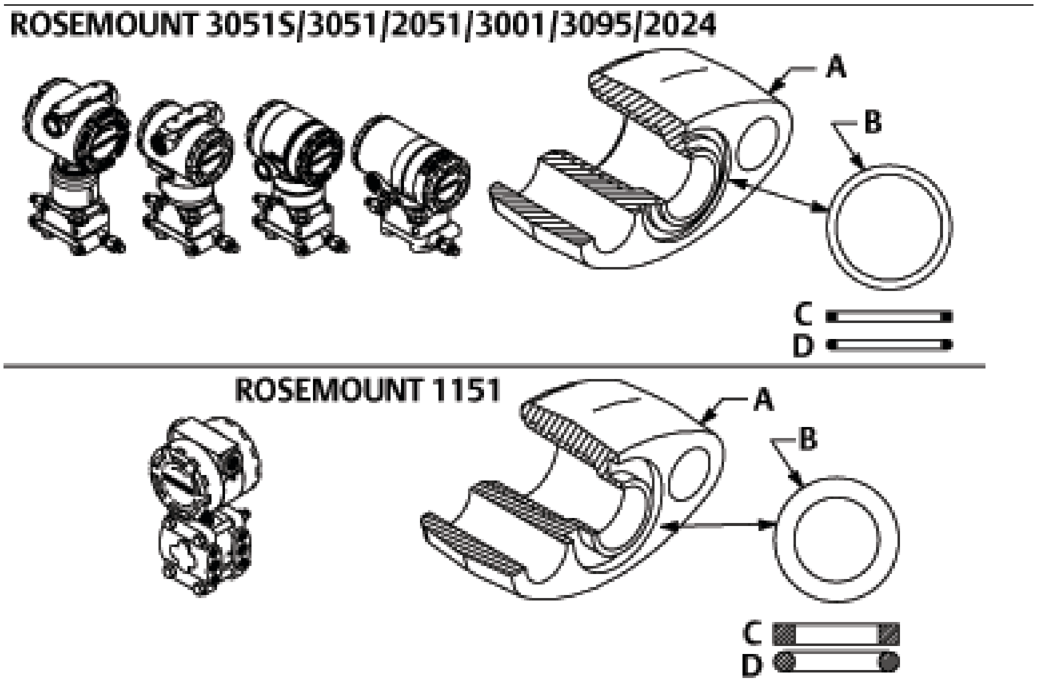
Whenever you remove flanges or adapters, visually inspect the PTFE O-rings. Replace with O-ring designed for the Rosemount transmitter if there are any signs of damage, such as nicks or cuts. You may reuse undamaged O-rings. If you replace the O-rings, retorque the flange bolts after installation to compensate for cold flow. Refer to the process sensor body reassembly procedure in Troubleshooting.

O-rings

The two styles of Rosemount flange adapters (Rosemount 1151 and 3051/2051/2024/3095) each require a unique O-ring. Use only the O-ring designed for the corresponding flange adapter.

⚠ 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:



A. *Flange adapter*
B. *O-ring*
C. *PFTE based*
D. *Elastomer*

When compressed, PTFE O-rings tend to *cold flow*, which aids in their sealing capabilities.

Note
Replace PTFE O-rings if the flange adapter is removed.

3.5.4 Inline process connection

Inline gage transmitter orientation

⚠ CAUTION

Erroneous pressure values

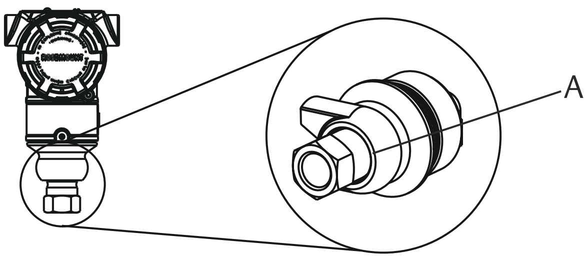
The transmitter may output erroneous pressure values.

Do not interfere or block the atmospheric reference port.

The low side pressure port on the inline gage transmitter is located in the neck of the transmitter, behind the housing. The vent path is 360 degrees around the transmitter between the housing and sensor (see Figure 3-11).

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

Figure 3-11: Inline Gage Low Side Pressure Port



A. *Low side pressure port (atmospheric reference)*

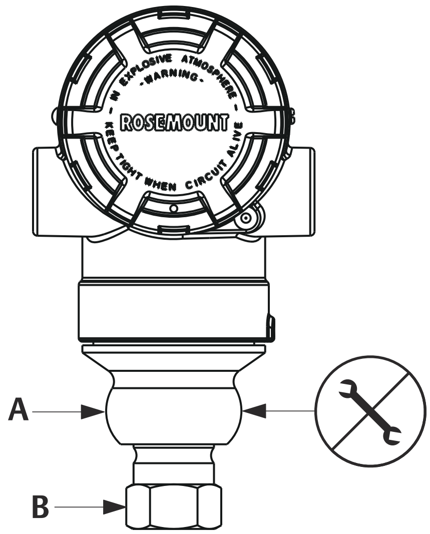
⚠ CAUTION

Electronics damage

Rotation between the sensor module and the process connection can damage the electronics.

Do not apply torque directly to the sensor module.
To avoid damage, apply torque only to the hex-shaped process connection.

Figure 3-12: Inline Gage

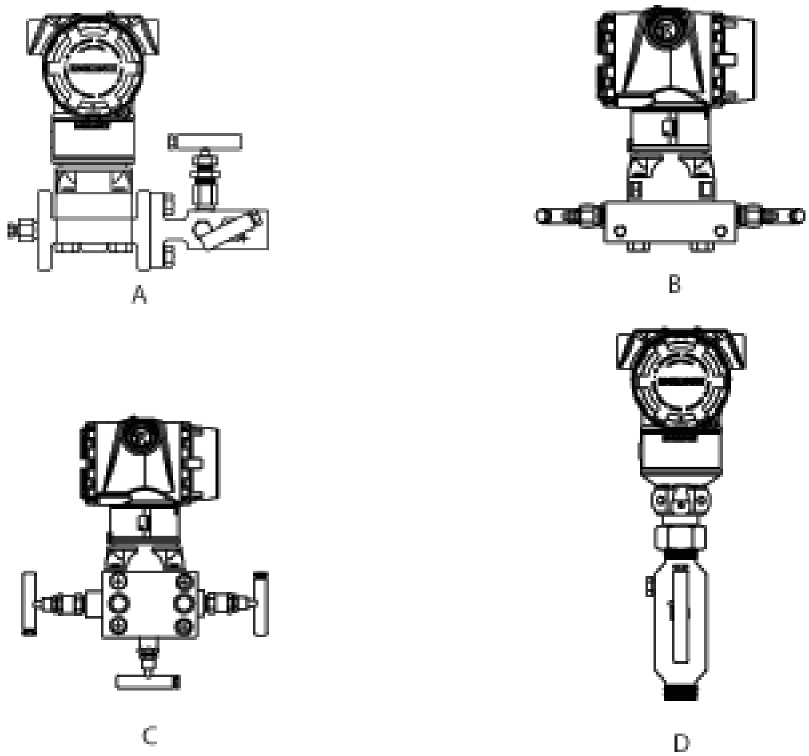


A. *Sensor module*
B. *Process connection*

3.6 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 traditional Rosemount 305 integral manifold can be mounted to most primary elements with mounting adapters in the market today. The Rosemount 306 integral manifold is used with the Rosemount 3051T In-Line Transmitters to provide block-and-bleed valve capabilities of up to 10000 psi (690 bar).

Figure 3-13: Manifolds



A. *Rosemount 3051C and 304 conventional*
B. *Rosemount 3051C and 305 integral coplanar*
C. *Rosemount 3051C and 305 integral traditional*
D. *Rosemount 3051T and 306 in-line*

The Rosemount 304 conventional manifold combines a traditional flange and manifold that can be mounted to most primary elements.

3.6.1 Install Rosemount 305 Integral Manifold

Procedure

1. Inspect the PTFE sensor module O-rings.

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

   Important
   If replacing the O-rings, take care not to scratch or deface the O-ring grooves or the surface of the isolating diaphragm while you remove the damaged O-rings.

2. Install the Integral Manifold on the sensor module. Use the four 2.25-in. (57.2 mm). manifold bolts for alignment.

When fully tightened, the bolts should extend through the top of the sensor module housing.

3. If you have replaced the PTFE sensor module O-rings, re-tighten the flange bolts after installation to compensate for cold flow of the O-rings.

3.6.2 Install Rosemount 306 integral manifold

The Rosemount 306 Manifold is for use only with in-line pressure transmitters such as the Rosemount 3051T and 2051T.

Assemble the Rosemount 306 manifold to the Rosemount 3051T or 2051T In-Line Transmitters with a thread sealant.

3.6.3 Install Rosemount 304 Conventional Manifold

Procedure

1. Align the Conventional Manifold with the transmitter flange. Use the four manifold bolts for alignment.
2. Finger tighten the bolts; then tighten the bolts incrementally in a cross pattern to final torque value.

   When fully tightened, the bolts should extend through the top of the sensor module housing.
3. Leak-check assembly to maximum pressure range of transmitter.

3.6.4 Manifold operation

⚠ WARNING

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

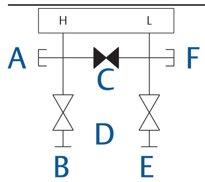
Always perform a zero trim on the transmitter/manifold assembly after installation to eliminate any shift due to mounting effects. See Sensor trim overview.

Coplanar transmitters

Operate three and five-valve manifolds

Performing zero trim at static line pressure

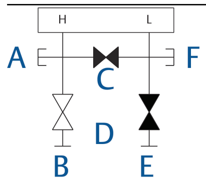
In normal operation, the two isolate (block) valves between the process ports and the transmitter will be open, and the equalize valve will be closed.



A. Drain/vent valve
B. Isolate (open)
C. Equalize (closed)
D. Process
E. Isolate (open)
F. Drain/vent valve

Procedure

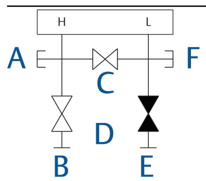
1. To zero trim the transmitter, close the isolate valve on the low side (downstream) side of the transmitter.



A. Drain/vent valve
B. Isolate (open)
C. Equalize (closed)
D. Process
E. Isolate (closed)
F. Drain/vent valve

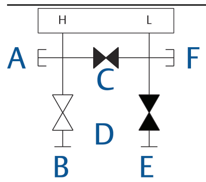
2. Open the equalize valve to equalize the pressure on both sides of the transmitter.

   The manifold is now in the proper configuration for performing a zero trim on the transmitter.



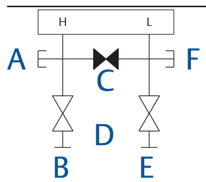
A. Drain/vent valve
B. Isolate (open)
C. Equalize (open)
D. Process
E. Isolate (closed)
F. Drain/vent valve

3. After zeroing the transmitter, close the equalize valve.



A. Drain/vent valve
B. Isolate (open)
C. Equalize (closed)
D. Process
E. Isolate (closed)
F. Drain/vent valve

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



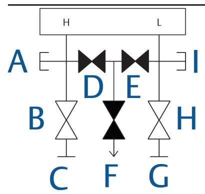
A. Drain/vent valve
B. Isolate (open)
C. Equalize (closed)
D. Process
E. Isolate (open)
F. Drain/vent valve

Operate five-valve natural gas manifold

Performing zero trim at static line pressure

Five-valve natural gas configurations shown:

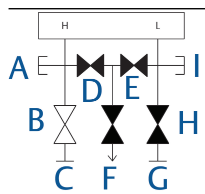
In normal operation, the two isolate (block) valves between the process ports and the transmitter will be open, and the equalize valves will be closed. Vent valves may be open or closed.



A. *Isolate (open)*
B. *Process*
C. *Equalize (closed)*
D. *Equalize (closed)*
E. *Drain vent (closed)*
F. *Process*
G. *Isolate (open)*

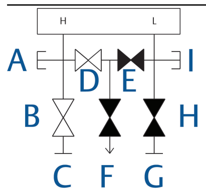
Procedure

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



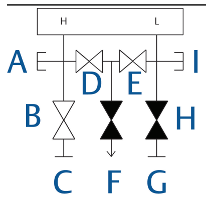
A. *Isolate (open)*
B. *Process*
C. *Equalize (closed)*
D. *Equalize (closed)*
E. *Drain vent (closed)*
F. *Process*
G. *Isolate (closed)*

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



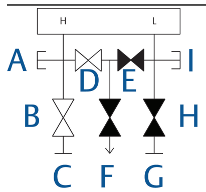
A. Isolate (open)
B. Process
C. Equalize (open)
D. Equalize (closed)
E. Drain vent (closed)
F. Process
G. Isolate (closed)

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



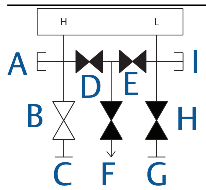
A. Isolate (open)
B. Process
C. Equalize (open)
D. Equalize (open)
E. Drain vent (closed)
F. Process
G. Isolate (closed)

4. After zeroing the transmitter, close the equalize valve on the low pressure (downstream) side of the transmitter.



A. *Isolate (open)*
B. *Process*
C. *Equalize (open)*
D. *Equalize (closed)*
E. *Drain vent (closed)*
F. *Process*
G. *Isolate (closed)*

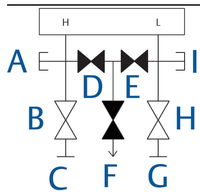
5. Close the equalize valve on the high pressure (upstream) side.



A. *Isolate (open)*
B. *Process*
C. *Equalize (closed)*
D. *Equalize (closed)*
E. *Drain vent (closed)*
F. *Process*
G. *Isolate (closed)*

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.



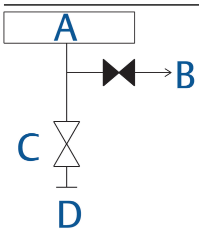
A. Isolate (open)
B. Process
C. Equalize (closed)
D. Equalize (closed)
E. Drain vent (closed)
F. Process
G. Isolate (open)

In-line transmitters

Two-valve and block and bleed style manifolds

Isolating the transmitter

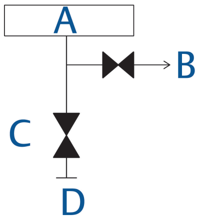
In normal operation, the isolate (block) valve between the process port and transmitter will be open and the test/vent valve will be closed. On a block and bleed style manifold, a single block valve provides transmitter isolation, and a bleed screw provides drain/vent capabilities.



A. Transmitter
B. Vent (closed)
C. Isolate
D. Process (open)

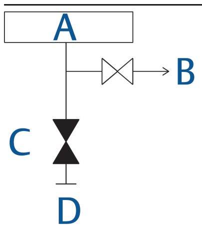
Procedure

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



A. Transmitter
B. Vent (closed)
C. Isolate
D. Process (closed)

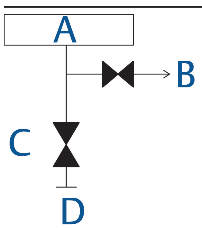
2. To bring the transmitter to atmospheric pressure, open the vent valve or bleed screw.



A. Transmitter
B. Vent (open)
C. Isolate
D. Process (closed)

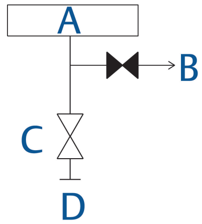
Note
A ¼-in (6.35 mm). male NPT pipe plug may be installed in the test/vent port; you will need to remove it with a wrench in order to vent the manifold properly. Always use caution when venting directly to atmosphere.

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



A. Transmitter
B. Vent (closed)
C. Isolate
D. Process (closed)

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



A. Transmitter
B. Vent (closed)
C. Isolate
D. Process (open)

Adjust 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 Rosemount manifolds have this adjustment capability. The Rosemount manifold model number will indicate what type of stem seal or packing material has been used.

The following steps are provided as a procedure to adjust valve packing:

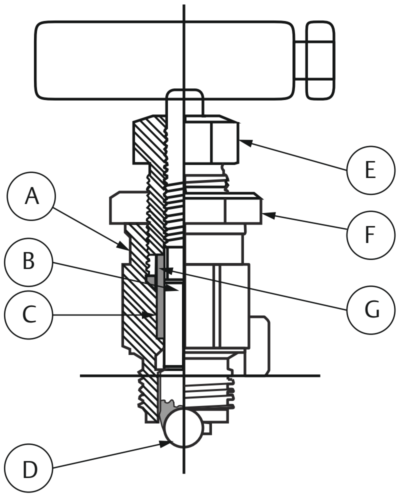
Procedure

1. Remove all pressure from device.
2. Loosen manifold valve jam nut.
3. Tighten manifold valve packing adjuster nut ¼ turn.
4. Tighten manifold valve jam nut.
5. Re-apply pressure and check for leaks.

Postrequisites

Repeat the above steps if necessary. If the above procedure does not result in proper pressure retention, replace the complete manifold.

Figure 3-14: Valve Components



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

4 Electrical installation

4.1 Overview

The information in this section covers installation considerations for the Rosemount 3051 Transmitter.

A Quick Start Guide is shipped with every transmitter to describe pipe-fitting, wiring procedures, and basic configuration for initial installation.

Note
For transmitter disassembly and reassembly, refer to Disassembly procedures and Reassemble.

4.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Installation of device in an explosive environment must be in accordance with appropriate local, national, and international standards, codes, and practices. Review the *Product certifications* section in the Rosemount 3051 Product Data Sheet for any restrictions associated with a safe installation.

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.

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

Electrical shock

Electrical shock can result in death or serious injury.

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

4.3 LCD display

Emerson ships transmitters ordered with the LCD display option (M5) with the display installed.

To install the display on an existing Rosemount 3051 Transmitter, you need a small instrument screwdriver. Carefully align the desired display connector with the electronics board connector. If connectors don't align, the display and electronics board are not compatible.

4.3.1 Rotate LCD display

Complete the following steps to rotate the LCD display.If you need to rotate the LOI or LCD display after it has been installed on the transmitter, complete the following steps.

Procedure

1. Secure the loop to manual control and remove power to transmitter.

   ⚠ WARNING

   Explosions

   Explosions could result in death or serious injury.

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

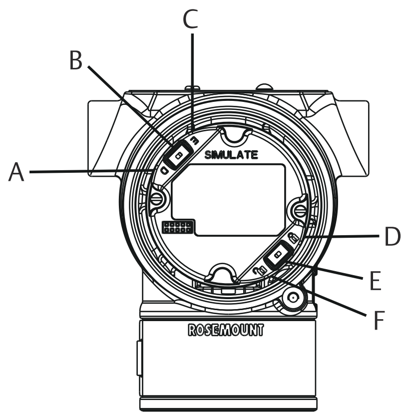
2. Remove transmitter housing cover.
3. Remove screws from the LCD display and rotate it to the desired orientation.
   a) Insert 10 pin connector into the display board for the correct orientation. Carefully align pins for insertion into the output board.
4. Re-insert screws.
5. Reattach transmitter housing cover.
   Emerson recommends that you tighten the cover until there is no gap between the cover and housing to comply with explosion proof requirements.
6. Re-attach power and return loop to automatic control.

4.4 Configuring transmitter security and simulation

There are two security methods with the transmitter: use of the security switch and configuring security using software (see Enable software write lock). Use of the security switch is described below.

- Security switch

Figure 4-1: Simulate and Security Switches



A. *Simulate disabled position*
B. *Simulate switch*
C. *Simulate enabled position (default)*
D. *Security locked position*
E. *Security switch*
F. *Security unlocked position (default)*

4.4.1 Setting Security switch

Set **Simulate** and **Security** switch configuration before installation as shown in Figure 4-1.

- The **Simulate** switch enables or disables simulated alerts and simulated AI Block status and values. The default **Simulate** switch position is enabled.
- The **Security** switch allows (unlocked symbol) or prevents (locked symbol) any configuration of the transmitter.
  - Default security is off (unlocked symbol).
  - The **Security** switch can be enabled or disabled in software.

Use the following procedure to change the switch configuration:

Procedure

1. If the transmitter is installed, secure the loop and remove power.
2. Remove the housing cover opposite the field terminal side. Do not remove the instrument cover in explosive atmospheres when the circuit is live.
3. Slide the **Security** and **Simulate** switches into the preferred position.
4. Reattach transmitter housing cover; Emerson recommends tightening the cover until there is no gap between the cover and housing to comply with explosion proof requirements.

4.4.2 Setting Simulate switch

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, move the **Simulate** switch to the Enable position and enable the software through the host. To disable simulation, move the **Simulate** switch to the Disable psoition or disable the Software Simulate parameter through the host.

4.5 Electrical considerations

Note
Make sure all electrical installation is in accordance with national and local code requirements.

⚠ WARNING

Electrical shock

Electrical shock can result in death or serious injury.

Do not run signal wiring in conduit or open trays with power wiring or near heavy electrical equipment.

4.5.1 Conduit installation

⚠ CAUTION

Transmitter damage

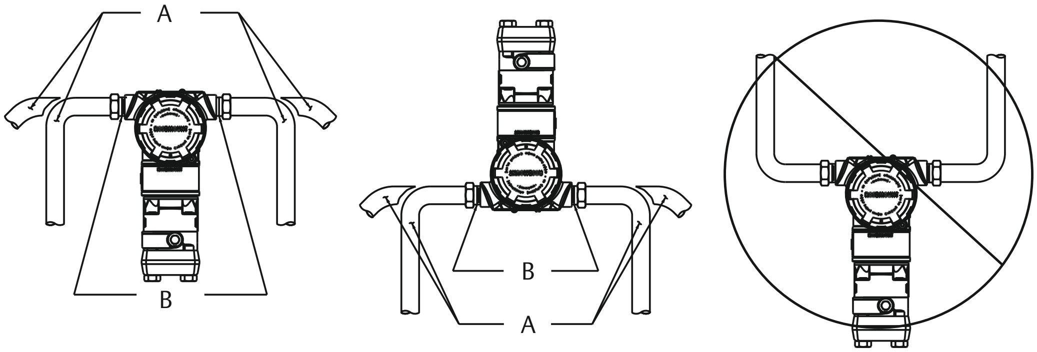
If all connections are not sealed, excess moisture accumulation can damage the transmitter.

Mount the transmitter with the electrical housing positioned downward for drainage.

To avoid moisture accumulation in the housing, install wiring with a drip loop and ensure the bottom of the drip loop is mounted lower than the conduit connections of the transmitter housing.

Figure 4-2 shows recommended conduit connections.

Figure 4-2: Conduit Installation Diagrams



A. *Possible conduit line positions*
B. *Sealing compound*

4.5.2 Power supply for FOUNDATION™ Fieldbus

Power supply

The transmitter requires between 9 and 32 Vdc (9 and 30 Vdc for intrinsic safety and 9 and 17.5 Vdc for FISCO intrinsic safety) to operate and provide complete functionality.

Power conditioner

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

4.6 Wiring

4.6.1 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 terminating resistors are required for proper operation. Figure 4-4 displays the standard Rosemount 3051 terminal block. The terminals are not polarity sensitive. The transmitter requires 9–32 Vdc to operate. Emerson recommends Type A FOUNDATION Fieldbus wiring 18 awg twisted shielded pair. Do not exceed 5000 ft. (1500 m) total segment length.

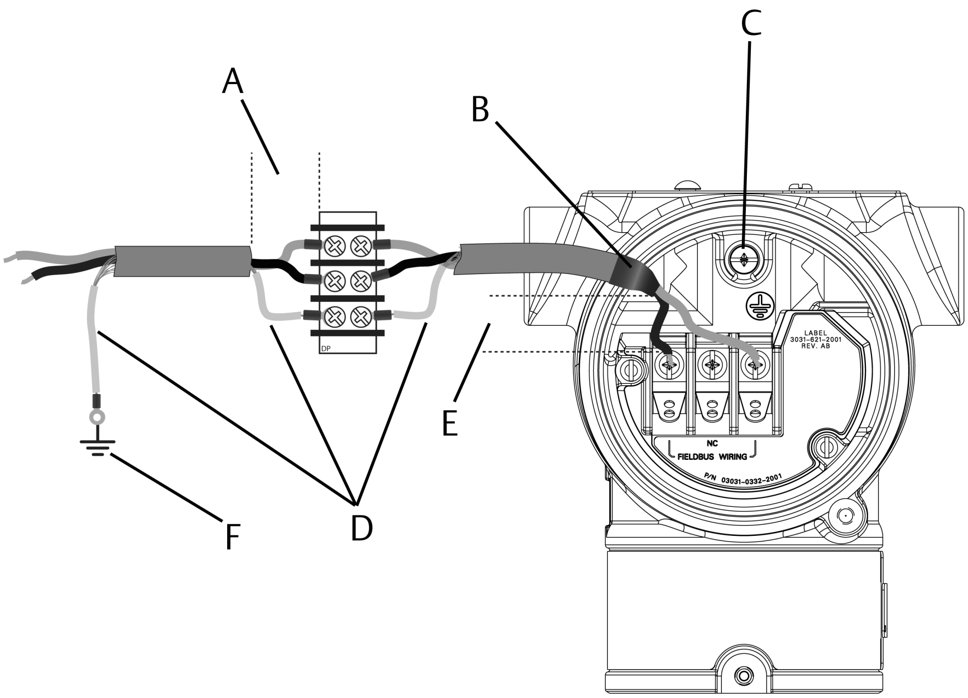
Note
Avoid running instrument cable next to power cables in cable trays or near heavy electrical equipment.

Note
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 4-3: Wiring Terminals



A. *Minimize distance.*
B. *Trim shield and insulate.*
C. *Protective grounding terminal (do not ground cable shield at the transmitter).*
D. *Insulate shield.*
E. *Minimize distance.*
F. *Connect shield back to the power supply ground.*

Perform the following procedure to make wiring connections:

Procedure

1. Remove the housing cover on terminal compartment side. Do not remove the cover in explosive atmospheres when the circuit is live. Signal wiring supplies all power to the transmitter.
2. Ensure full contact with terminal block screw and washer. When using a direct wiring method, wrap wire clockwise to ensure it is in place when tightening the terminal block screw.

   Note
   Emerson does not recommend using a pin or ferrule wire terminal, as the connection may be more susceptible to loosening over time or under vibration.

3. Plug and seal the unused conduit connection on the transmitter housing to avoid moisture accumulation in the terminal side. Install wiring with a drip loop. Arrange

the drip loop so the bottom is lower than the conduit connections and the transmitter housing.

4.6.2 Grounding the transmitter

Signal cable shield grounding

Signal cable shield grounding is summarized in Figure 4-3 and Figure 4-5. The signal cable shield and unused shield drain wire must be trimmed and insulated, ensuring that the signal cable shield and drain wire do not come in contact with the transmitter case. See Figure 4-4 and Figure 4-5 for instructions on grounding the transmitter case. Follow the steps below to correctly ground the signal cable shield.

Do not run signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment. Grounding terminations are provided on the outside of the electronics housing and inside the terminal compartment. Use these grounds when transient protect terminal blocks are installed or to fulfill local regulations.

Procedure

1. Remove the field terminals housing cover.
2. Connect the wiring pair and ground as indicated in Transmitter wiring.
    a) Trim the cable shield as short as practical and insulate from touching the transmitter housing.

    Note
    Do NOT ground the cable shield at the transmitter; if the cable shield touches the transmitter housing, it can create ground loops and interfere with communications.

3. Continuously connect the cable shields to the power supply ground.
    a) Connect the cable shields for the entire segment to a single good earth ground at the power supply.

    Note
    Improper grounding is the most frequent cause of poor segment communications.

4. Replace the housing cover.

    Emerson recommends tightening the cover until there is no gap between the cover and the housing.
5. Plug and seal unused conduit connections.

Transmitter case grounding

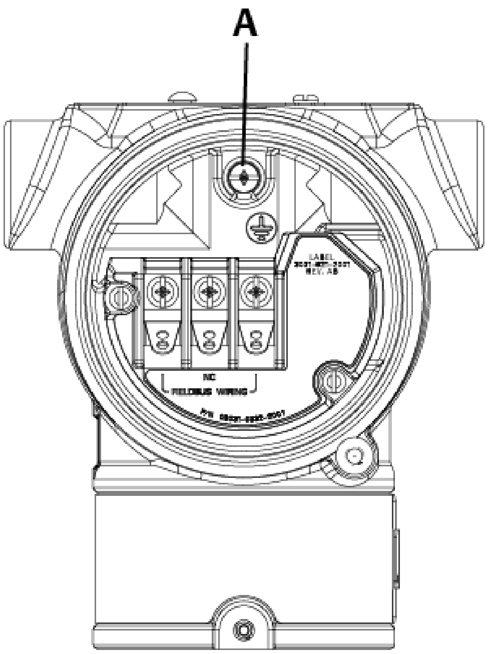
Always ground the transmitter case in accordance with national and local electrical codes. The most effective transmitter case grounding method is a direct connection to earth ground with minimal impedance. Methods for grounding the transmitter case include:

- Internal ground connection: The internal ground connection screw is inside the FIELD TERMINALS side of the electronics housing. This screw is identified by a ground symbol

(⏚). The ground connection screw is standard on all Rosemount™ transmitters. Refer to Figure 4-4.

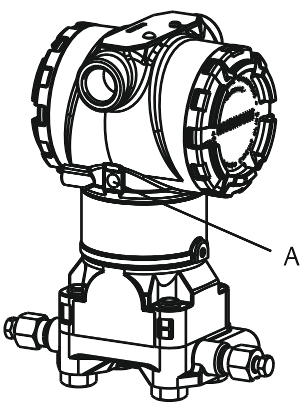
- External ground connection: The external ground connection is located on the exterior of the transmitter housing. Refer to Figure 4-5. This connection is only available with option V5 and T1.

Figure 4-4: Internal Ground Connection



A. *Internal ground location*

Figure 4-5: External Ground Connection (Option V5 or T1)



A. *External ground location*

Note

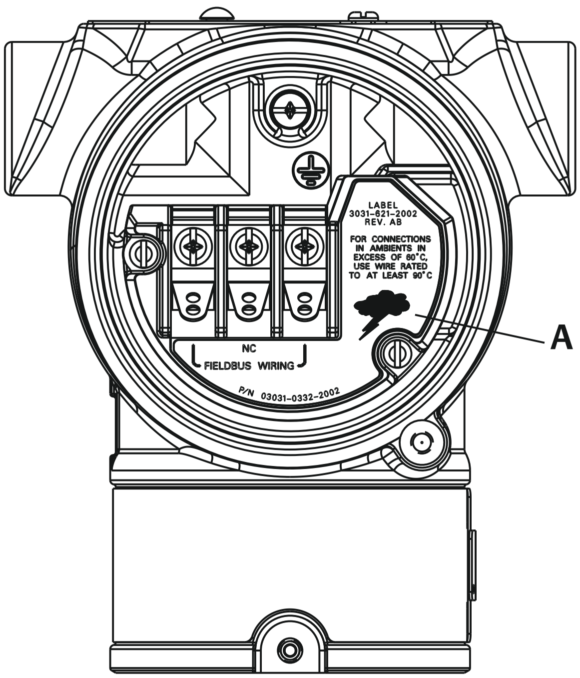
Grounding the transmitter case via threaded conduit connection may not provide sufficient ground continuity.

Transient protection terminal block grounding

The transmitter can withstand electrical transients of the energy level usually encountered in static discharges or induced switching transients. However, high-energy transients, such as those induced in wiring from nearby lightning strikes, can damage the transmitter.

You can order the transient protection terminal block as an installed option (Option Code T1) or as a spare part to retrofit existing transmitters in the field. See Spare parts for part numbers. The lightning bolt symbol shown in Figure 4-6 identifies the transient protection terminal block.

Figure 4-6: Transient Protection Terminal Block



A. *Lightning bolt location*

Note

The transient protection terminal block does not provide transient protection unless the transmitter case is properly grounded. Use the guidelines to ground the transmitter case. Refer to Figure 4-6.

5 Operation and maintenance

5.1 Overview

⚠ CAUTION

Calibration

It is possible to degrade performance of the transmitter if any trim is done improperly or with inaccurate equipment.

Emerson calibrates absolute pressure transmitters (Rosemount 3051CA and 3051TA) at the factory. Trimming adjusts the position of the factory characterization curve.

This section contains information on operation and maintenance procedures. It also provides Field Communicator and AMS Device Manager instructions to perform configuration functions.

5.1.1 Methods and manual operation

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 be found on Fieldbus Foundation's website at Fieldbus.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/DeltaV. The information in this section will describe how to use methods in a general fashion.

5.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of personnel performing the operations.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Installation of device in an explosive environment must be in accordance with appropriate local, national, and international standards, codes, and practices. Please review the *Product certifications* section in the Rosemount 3051 Product Data Sheet for any restrictions associated with a safe installation.

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

⚠ WARNING

Process leaks

Process leaks may cause harm or result in death.

Install and tighten process connectors before applying pressure.

⚠ WARNING

Electrical shock

Electrical shock can result in death or serious injury.

Spare parts

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.

5.3 Calibration overview

⚠ CAUTION

Emerson fully calibrates the Rosemount 3051 Pressure Transmitter at the factory. Emerson provides a field calibration option to meet plant requirements or industry standards.

⚠ CAUTION

Sensor calibration allows you to adjust the pressure (digital value) reported by the transmitter to be equal to a pressure standard. The sensor calibration can adjust the pressure offset to correct for mounting conditions or line pressure effects. Emerson recommends this correction. Emerson does not recommend calibrating the pressure range (pressure span or gain correction) for new instruments.

Calibrate the sensor

- Perform a calibration or sensor trim
- Perform a digital zero trim (option DZ)

5.3.1 Determine necessary sensor trims

Emerson does not recommend bench calibration for new instruments.

It is possible to degrade the performance of the transmitter if a trim is done improperly or with inaccurate equipment. You can set the transmitter back to factory settings using the Recall Factory Trim command shown in Figure 5-3.

For transmitters that are field installed, the manifolds discussed in Manifold operation allow the differential transmitter to be zeroed using the zero trim function. Manifold operation discusses both three-valve and five-valve manifolds. This field calibration eliminates any pressure offsets caused by mounting effects (head effect of the oil fill) and static pressure effects of the process.

Determine the necessary trims with the following steps.

Procedure

1. Apply pressure.
2. Check the pressure, if the pressure does not match the applied pressure, perform a sensor trim.

   See Perform a calibration or sensor trim.
3. Check reported analog output against the live analog output. If they do not match, perform an analog output trim.

   See Performing digital-to-analog trim (4-20 mA output trim).

5.3.2 Determine calibration frequency

Calibration frequency can vary greatly depending on the application, performance requirements, and process conditions. To determine calibration frequency:

Procedure

1. Determine the performance required for your application.
2. Determine the operating conditions.
3. Calculate the Total Probable Error (TPE).
4. Calculate the stability per month.
5. Calculate the calibration frequency.

Sample calculation for Rosemount 3051 (0.04 percent accuracy and five-year stability)

The following is an example of how to calculate calibration frequency.

Procedure

1. Determine the performance required for your application.

Required Performance:	0.20% of span

2. Determine the operating conditions.

Transmitter	Rosemount 3051CD, Range 2 [URL=250 inH_2O (623 mbar)]
Calibrated span	150 inH_2O (374 mbar)
Ambient temperature change	± 50 °F (28 °C)

Line pressure 500 psig (34,5 bar)

3. Calculate total probable error (TPE).

TPE = $\sqrt{(\text{ReferenceAccuracy})^2 + (\text{TemperatureEffect})^2 + (\text{StaticPressureEffect})^2}$ = 0.105% of span

Where:

Reference Accuracy = ± 0.04% of span

Ambient Temperature Effect = $\left(\frac{(0{,}0125 \times \text{URL})}{\text{Span}} + 0{,}0625\right)\%$ per 50 °F = ±0,0833% of span

Span Static Pressure Effect[(1)] = 0,1% reading per 1000 psi (69 bar) = ±0,05% of span at maximum span

(1) Zero static pressure effect removed by zero trimming at line pressure.

4. Calculate the stability per month.

$$\text{Stability} = \pm\left[\frac{(0{,}125 \times \text{URL})}{\text{Span}}\right]\% \text{ of span for 5 years} = \pm 0{,}0021\% \text{ of URL for 1 month}$$

5. Calculate calibration frequency.

$$\text{Cal. Freq.} = \frac{(\text{Req. Performance} - \text{TPE})}{\text{Stability per Month}} = \frac{(0{,}2\% - 0{,}105\%)}{0{,}0021\%} = 45 \text{ months}$$

5.3.3 Compensating for span line pressure effects (range 4 and 5)

Rosemount 2051 Range 4 and 5 Pressure Transmitters require a special calibration procedure when used in differential pressure applications. The purpose of this procedure is to optimize transmitter performance by reducing the effect of static line pressure in these applications.

The systematic span shift caused by the application of static line pressure is –0.95 percent of reading per 1000 psi (69 bar) for Range 4 transmitters and –1 percent of reading per 1000 psi (69 bar) for Range 5 transmitters. Using the following procedure, you can correct the span effect to ±0.2 percent of reading per 1000 psi (69 bar) for line pressures from 0 to 3626 psi (0 to 250 bar).

Use the following example to compute correct input values.

Example

A Range 4 differential pressure transmitter (Rosemount 3051CD4...) is used in an application with a static line pressure of 1200 psi (83 bar). The DP measurement span is from 500 in$H_2$0 (1, 2 bar) to 1500 inH_2O (3, 7 bar). To correct for systematic error caused by high static line pressure, first use the following formulas to determine the corrected values for the high trim value.

High trim value

HT = (URV – [S/100 ×P/1000 × LRV])

Where:	HT =	Corrected high trim value
	URV =	Upper range value
	S =	Span shift per specification (as a percent of reading)
	P =	Static Line Pressure in psi

In this example:

URV =	1500 inH_2O (3.74 bar)
S =	–0.95%
P =	1200 psi
LT =	1500 – (–0.95%/100 × 1200 psi/1000 psi × 1500 inH_2O)
LT =	1517.1 inH_2O

Complete the upper sensor trim procedure as described in Perform a calibration or sensor trim. However, enter the calculated correct upper sensor trim value of 1517.1 inH_2O with a Field Communicator.

5.4 Trim the pressure signal

5.4.1 Sensor trim overview

A sensor trim corrects the pressure offset and pressure range to match a pressure standard. The upper sensor trim corrects the pressure range and the lower sensor trim (zero trim) corrects the pressure offset. An accurate pressure standard is required for full calibration. You can perform a zero trim if the process is vented or the high and low side pressure are equal (for differential pressure transmitters).

Zero trim is a single-point offset adjustment. It is useful for compensating for mounting position effects and is most effective when performed with the transmitter installed in its final mounting position. As this correction maintains the slope of the characterization curve, do not use it in place of a sensor trim over the full sensor range.

When performing a zero trim, ensure that the equalizing valve is open and all wet legs are filled to the correct levels. Apply line pressure to the transmitter during a zero trim to eliminate line pressure errors. Refer to Manifold operation.

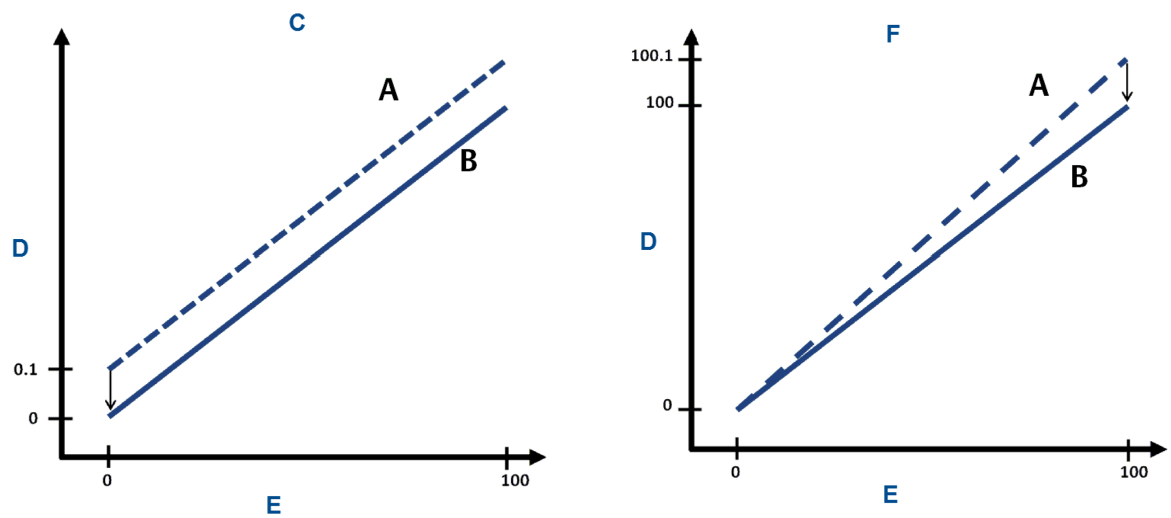
Note
FOUNDATION™ Fieldbus has no analog signal that needs ranging. Therefore, ranging a new device prior to installation is usually not necessary or recommended.

Note
Do not perform a zero trim on Rosemount 3051T Absolute Pressure Transmitters. Zero trim is zero based, and absolute pressure transmitters reference absolute zero. To correct mounting position effects on a Rosemount 3051T Absolute Pressure Transmitter, perform

a low trim within the sensor trim function. The low trim function provides an offset correction similar to the zero trim function, but it does not require zero-based input.

Upper and lower sensor trim is a two-point sensor calibration where two end-point pressures are applied and all output is linearized between them; this calibration also requires an accurate pressure source. Always adjust the low trim value first to establish the correct offset. Adjustment of the high trim value provides a slope correction to the characterization curve based on the low trim value. The trim values help optimize performance over a specific measurement range.

Figure 5-1: Sensor Trim Example



A. *Before trim*
B. *After trim*
C. *Zero/lower sensor trim*
D. *Pressure reading*
E. *Pressure input*
F. *Upper sensor trim*

5.4.2 Perform a calibration or sensor trim

If you need to perform both an upper and lower sensor trim, do the lower trim first.

Performing a sensor trim

Note
For block oriented user interfaces, perform calibrations and trims in the sensor transducer block.

Menu navigation: **Overview** → **Calibration** → **Sensor Trim**

You can perform all sensor trims and restore factory calibration using the *Overview* and *Service Tools* branches of the menu tree. In addition, you can document calibrations and trims with the information stored to an asset management system.

Navigate to the *Sensor Trim* screen and click the button for the type of trim desired. An automated procedure called a `Method` guides you through the desired trim procedure. The automated procedure for upper and lower sensor trims includes steps for documenting pressure, units, date, and name of person performing the trim and physical location where the trim was performed. You can enter or edit the information for full calibrations in *Last Calibration Points* and *Calibration Details*.

Note

Generally, only perform a zero trim. For high static pressure applications, you can perform a lower and upper trim.

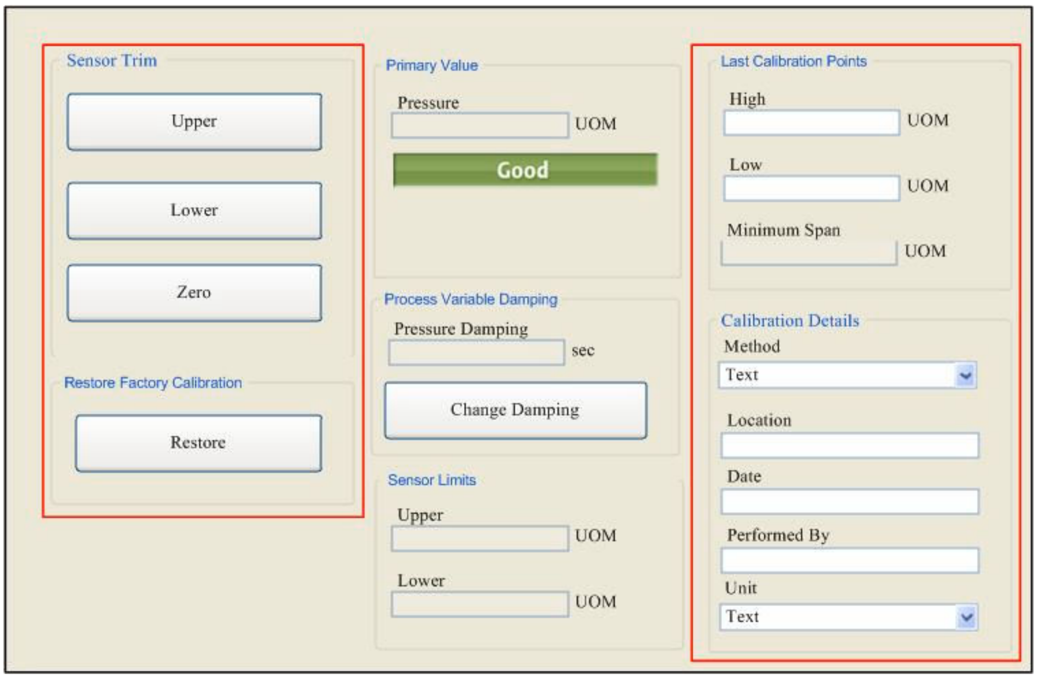
Note

Refer to Calibration overview through Sensor trim overview for information on the various types of trims. Refer to Rosemount 305, 306, and 304 manifolds for manifold operation instructions to properly drain/vent valves.

Note

If both an upper and lower sensor trim are needed, perform the lower trim first.

Figure 5-2: Sensor Trim Screen



The **Sensor Trim**, **Upper**, **Lower**, **Zero**, and **Restore** buttons start automated procedures called Methods which guide you through the sequence of steps needed to perform the desired trim. Upper and lower trims require a pressure source. In addition, for Upper, lower, and zero trims the you need to place manifold valves in the proper position to perform the trim and return the manifold valves to the proper positions for normal operation. `Restore Factory Calibration` doesn't require a pressure source or manipulation of manifold valves.

To calibrate the sensor using the Sensor Trim function, perform the following procedure:

Procedure

Select **Lower Sensor Trim**.

Note
Select pressure points so that lower and upper values are equal to or outside the expected process operation range.

5.5 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 that 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.

5.6 Master reset method

5.6.1 Resource block

Menu navigation: **Service Tools** → **Maintenance** → **Reset/Restore**

Note
Master reset (sometimes called restart) is performed in the resource block. For block oriented user interfaces, perform the reset in the resource block.

There are two master reset options. One restarts the transmitter processor but doesn't change device configuration. The second is a restart with factory defaults. It returns all device and function block parameters to the factory defaults. An automated procedure called a `Method` guides you through both reset options.

Figure 5-3: Master Reset Button

The **Master Reset** button starts the method that initiates the reset and verifies the reset is complete. Note that during the reset communication between the device and the host is lost. There may be some delay before the device is recognized again by the host.

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

5.7 Simulation

Simulate replaces the channel value coming from the Sensor Transducer Block. For testing purposes, you can manually drive the output of the Analog Input Block to a desired value. There are two ways to do this.

5.7.1 Manual mode

To change only the OUT_VALUE and not the OUT_STATUS of the AI Block, place the TARGET MODE of the block to MANUAL. Then, change the OUT_VALUE to the desired value.

5.7.2 Simulate

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. Set SIMULATE_ENABLE_DISABLE to Inactive to return the AI block to normal operation.

6 Troubleshooting

6.1 Overview

This section provides summarized troubleshooting suggestions for the most common operating problems. This section contains Rosemount 3051 Pressure Transmitter with FOUNDATION™ Fieldbus Protocol troubleshooting information only.

Disassembly and reassembly procedures can be found in Disassembly procedures and Reassemble.

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

Troubleshooting and diagnostic messages provides summarized maintenance and troubleshooting suggestions for the most common operating problems.

If you suspect malfunction despite the absence of any diagnostic messages on the Field Communicator display, consider using Troubleshooting guides to identify any potential problem.

6.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations.

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Installation of device in an explosive environment must be in accordance with appropriate local, national, and international standards, codes, and practices. Review the *Product Certifications* section of the Rosemount™ 3051 Product Data Sheet for any restrictions associated with a safe installation.

Before connecting a handheld communicator in an explosive atmosphere, ensure the instruments 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.

⚠ WARNING

Process leaks

Process leaks may cause harm or result in death.

Install and tighten process connectors before applying pressure.

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

⚠ WARNING

Electrical shock

Electrical shock can result in death or serious injury.

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

⚠ CAUTION

Static electricity

Static electricity can damage sensitive components.

Observe safe handling precautions for static-sensitive components.

6.3 Disassembly procedures

⚠ WARNING

Explosion

Explosions could result in death or serious injury.

Do not remove the instrument cover in explosive atmospheres when the circuit is live.

6.3.1 Remove from service

Follow these steps:

Procedure

1. Follow all plant safety rules and procedures.
2. Power down device.
3. Isolate and vent the process from the transmitter before removing the transmitter from service.
4. Remove all electrical leads and disconnect conduit.
5. Remove the transmitter from the process connection.
   - The Rosemount 3051C Transmitter is attached to the process connection by four bolts and two cap screws. Remove the bolts and screws and separate the transmitter from the process connection. Leave the process connection in place and ready for reinstallation.
   - The Rosemount 3051T Transmitter is attached to the process by a single hex nut process connection. Loosen the hex nut to separate the transmitter from the process. Do not wrench on neck of transmitter. See warning in Inline gage transmitter orientation.
6. Do not scratch, puncture, or depress the isolating diaphragms.

7. Clean isolating diaphragms with a soft rag and a mild cleaning solution, and rinse with clear water.
8. For the Rosemount 3051C, whenever you remove the process flange or flange adapters, visually inspect the PTFE O-rings. Replace the O-rings if they show any signs of damage, such as nicks or cuts.

   You may reuse undamaged O-rings.

6.3.2 Remove terminal block

Electrical connections are located on the terminal block in the compartment labeled FIELD TERMINALS.

Procedure

1. Remove the housing cover from the field terminal side.
2. Loosen the two small screws located on the assembly in the 9 o'clock and 5 o'clock positions relative to the top of the transmitter.
3. Pull the entire terminal block out to remove it.

6.3.3 Remove electronics board

The transmitter electronics board is located in the compartment opposite the terminal side.

Procedure

1. Remove the housing cover opposite the field terminal side.
2. Using the two captive screws, slowly pull the electronics board out of the housing. The sensor module ribbon cable holds the electronics board to the housing. Disengage the ribbon cable by pushing the connector release.

   Note
   If an LCD display is installed, use caution as there is an electronic pin connector that interfaces between the LCD display and electronics board.

6.3.4 Remove sensor module from the electronics housing

Procedure

1. Remove the electronics board.

   Refer to Remove electronics board.

   Important
   To prevent damage to the sensor module ribbon cable, disconnect it from the electronics board before you remove the sensor module from the electrical housing.

2. Carefully tuck the cable connector completely inside of the internal black cap.

Note
Do not remove the housing until after you tuck the cable connector completely inside of the internal black cap. The black cap protects the ribbon cable from damage that can occur when you rotate the housing.

3. Using a 5/64-in. hex wrench, loosen the housing rotation set screw one full turn.
4. Unscrew the module from the housing, making sure the black cap on the sensor module and sensor cable do not catch on the housing.

6.4 Reassemble

Complete the following steps to reassemble the transmitter.

Procedure

1. Inspect all cover and housing (non-process wetted) O-rings and replace if necessary. Lightly grease with silicone lubricant to ensure a good seal.
2. Carefully tuck the cable connector completely inside the internal black cap. To do so, turn the black cap and cable counterclockwise one rotation to tighten the cable.
3. Lower the electronics housing onto the module. Guide the internal black cap and cable on the sensor module through the housing and into the external black cap.
4. Turn the module clockwise into the housing.

   Important
   Ensure the sensor ribbon cable and internal black cap remain completely free of the housing as you rotate it. Damage can occur to the cable if the internal black cap and ribbon cable become hung up and rotate with the housing.

5. Thread the housing completely onto the sensor module.

   The housing must be no more than one full turn from flush with the sensor module to comply with explosion proof requirements. See Safety messages for complete warning information.

6. Tighten the housing rotation set screw to no more than 7 in.lb when desired location is reached.

6.4.1 Attach electronics board

Complete the following steps to attach the transmitter's electronics board.

Procedure

1. Remove the cable connector from its position inside of the internal black cap and attach it to the electronics board.
2. Using the two captive screws as handles, insert the electronics board into the housing.

   Ensure the power posts from the electronics housing properly engage the receptacles on the electronics board. Do not force. The electronics board should slide gently on the connections.

3. Tighten the captive mounting screws.

4. Replace the housing cover.

   Emerson recommends tightening the cover until there is no gap between the cover and the housing.

6.4.2 Install terminal block

Complete the following steps to reinstall the terminal block into the transmitter.

Procedure

1. Gently slide the terminal block into place, making sure the two power posts from the electronics housing properly engage the receptacles on the terminal block.
2. Tighten the captive screws.
3. Replace the electronics housing cover.

   ⚠ WARNING

   Explosions

   Explosions could result in death or serious injury.

   The transmitter covers must be fully engaged to meet Explosion-Proof requirements.

6.4.3 Reassemble the Rosemount 3051C process flange

Complete the following steps to reassemble the Rosemount 3051C process flange.

Procedure

1. Inspect the sensor module PTFE O-rings.

   You may reuse undamaged O-rings. Replace O-rings that show any signs of damage, such as nicks, cuts, or general wear.

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

2. Install the process connection. Possible options include:
   - Coplanar process flange:
     a. Hold the process flange in place by installing the two alignment screws to finger tightness (screws are not pressure retaining). Do not overtighten as this will affect module-to-flange alignment.
     b. Install the four 1.75-in. flange bolts by finger tightening them to the flange.
   - Coplanar process flange with flange adapters:
     a. Hold the process flange in place by installing the two alignment screws to finger tightness (screws are not pressure retaining). Do not overtighten as this will affect module-to-flange alignment.

b. Hold the flange adapters and adapter O-rings in place while installing (in the desired of the four possible process connection spacing configurations) using four 2.88-in. bolts to mount securely to the coplanar flange. For gage pressure configurations, use two 2.88-inch bolts and two 1.75-in. bolts.

- Manifold: Contact the manifold manufacturer for the appropriate bolts and procedures.

3. Tighten the bolts to the initial torque value using a crossed pattern.

   See Table 6-1 for appropriate torque values.

4. Using the same cross pattern, tighten bolts to final torque values seen in Table 6-1.

Table 6-1: Bolt Installation Torque Values

Bolt material	Initial torque value	Final torque value
CS-ASTM-A445 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-19 B7M—Option L5	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
ASTM-A-193 Class 2, Grade B8M—Option L8	150 in.-lb (17 N-m)	300 in.-lb (34 N-m)

Note

If you replaced the PTFE sensor module O-rings, re-torque the flange bolts after installation to compensate for cold flow of the O-ring material.

Note

For Range 1 transmitters, after replacing O-rings and re-installing the process flange, expose the transmitter to a temperature of 185 °F (85 °C) for two hours. Then re-tighten the flange bolts in a cross pattern and again expose the transmitter to a temperature of 185 °F (85 °C) for two hours before calibration.

See Safety messages for complete warning information.

6.4.4 Install drain/vent valve

Complete the following steps to reinstall the drain/vent valve in the Rosemount 3051 Transmitter.

Procedure

1. Apply sealing tape to the threads on the seat. Starting at the base of the valve with the threaded end pointing toward the installer, apply five clockwise turns of sealing tape.
2. Tighten the drain/vent valve to 250 in.-lb. (28.25 N-m).
3. Take care to place the opening on the valve so that process fluid will drain toward the ground and away from human contact when the valve is opened.

6.5 Troubleshooting guides

6.5.1 Problems with communications

Identify the cause

Recommended Actions

1. Check wiring and power to device.
2. Recycle power to device.
3. If you can identify the problem, perform the Recommended Action in Device does not show up on segment.
4. If the problem persists, contact your local Emerson representative.

Device does not stay on segment

Steps to identify cause

Check segment

Recommended actions

1. If you can identify the problem, perform the Recommended Action in Device does not show up on segment.
2. If the problem persists, contact your local Rosemount™ representative.

6.5.2 Troubleshooting guide

Note
Use the sections below if other devices appear on the segment, communicate, and remain on the segment. If other devices don't appear on the segment, communicate, or stay on the segment, check the electrical characteristics of the segment.

If you have established communications, but you see a `Block_err` or an `Alarm` condition, see Problems with communications. If you can identify the problem perform the recommended action (see Recommended actions).(2)

Device does not show up on segment

Potential cause

Unknown

Recommended action

Recycle power to the device.

Potential cause

No power to device

(2) *Consult your system integrator before performing the corrective action.*

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.

Pontential cause

Segment problems

Recommended action

N/A

Pontential cause

Electronics board loose in housing.

Recommended action

Replace electronics.

Potential cause

Incompatible network settings

- Change host network parameters.
- Refer to host documentation for procedure.
- See Device capabilities for device network parameter values.

Device does not stay on segment

Note
Wiring and installation 31.25 kbit/s, voltage mode, and wire medium application guide AG-140 available from FOUNDATION™ Fieldbus.

Incorrect signal levels

Refer to host documentation for procedure.

Recommended actions

1. Check for two terminators.
2. Check for excess cable length.
3. Check for bad power supply or conditioner.

Excess noise on segment

Refer to host documentation for procedure.

Recommended actions

1. Check for incorrect grounding.
2. Check for correct shielded wire.
3. Tighten all wiring and shield connections on the effected part of the segment.

4. Check for corrosion or moisture on terminals.
5. Check for bad power supply.
6. Check for electrically noisy equipment attached to the instrument ground.

Electronics failing

Recommended actions

1. Tighten electronics board.
2. Replace electronics.

Other

Recommended action

Check for water in the terminal housing.

6.6 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.

6.6.1 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

0x10000000

6.6.2 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

6.6.3 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

6.6.4 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

0x00100000

6.6.5 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

6.6.6 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

0x00000010

6.6.7 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

0x00000008

6.6.8 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

6.6.9 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

6.7 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 6-2: 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.
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.

6.7.1 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.

6.7.2 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 3051 Product Data Sheet.

6.8 Service support

Within the United States, call the Emerson Instrument and Valve 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.

For inquiries outside of the United States, contact the nearest Emerson representative for RMA instructions.

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

⚠ WARNING

Hazardous substances

Individuals who handle products exposed to a hazardous substance may be injured.

You can avoid injury by learning about and understanding the hazard.
Include a copy of the required Material Safety Data Sheet (MSDS) for each substance with the returned goods.
Emerson Instrument and Valve Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

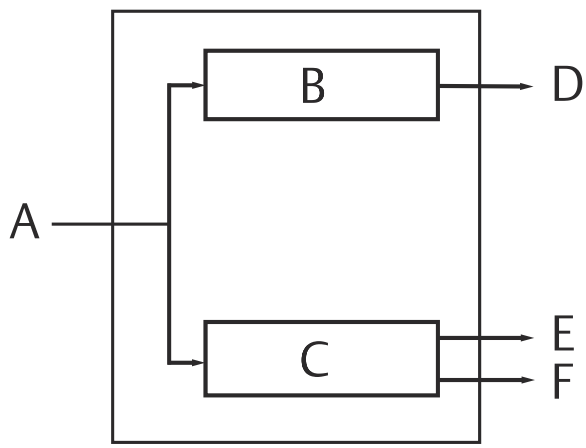
7 Advanced pressure diagnostics

7.1 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 an order 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 7-1 illustrates an overview of these two functions within the Fieldbus Advanced Diagnostics Transducer Block.

Figure 7-1: Advanced Diagnostics Transducer Block Overview



A. *Pressure measurement*
B. *Plugged impulse line detection*
C. *Preocess intelligence*
D. *Plugged impulse line alert*
E. *Process intelligence alert*
F. *Statistical parameters*

7.2 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. The 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.

7.3 PIL diagnostics

The Advanced Diagnostics Suite also implements a Plugged Impulse Line (PIL) detection algorithm. PIL 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 PIL also provides the ability to automatically relearn new baseline values if the process condition changes. When PIL detects a plug, a “Plugged Impulse Line Detected” Plantweb™ alert is generated. Optionally, the user can configure the PIL 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.

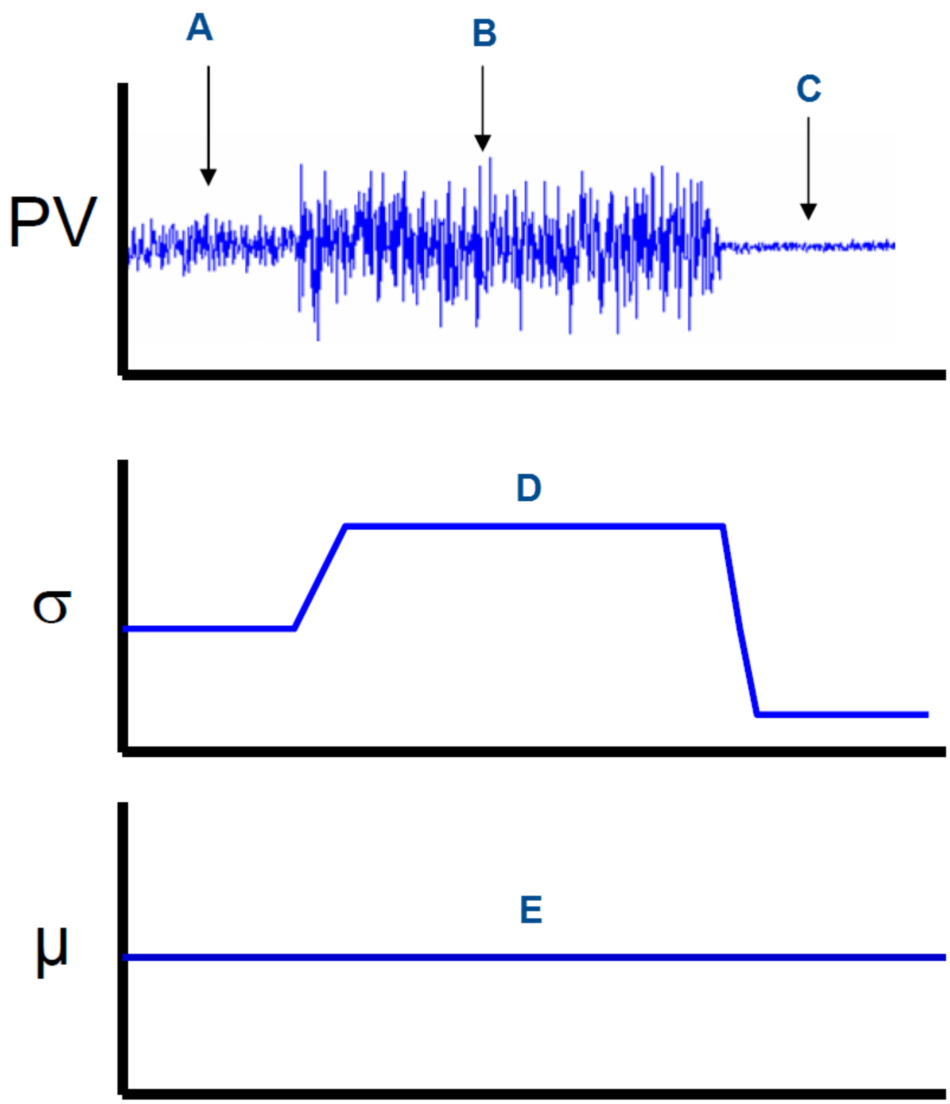
Important
Running the Advanced Diagnostics Block could affect other block execution times. We recommend the device be configured as a basic device versus a Link Master device if this is a concern.

7.4 Process Intelligence technology

Emerson has developed a unique technology, Process Intelligence, which 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 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. Emerson provides filtering capability to separate slow changes in the process due to setpoint changes from the process noise or variation of interest. Figure 7-2 shows an example of how the standard deviation value (*s*) is affected by changes in noise level while the mean or average value (*m*) remains constant. The device calculates statistical parameters 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 7-2: Changes in Process Noise or Variability and Affect on Statistical Parameters



A. *Normal.*
B. *Increased noise.*
C. *Reduced noise.*
D. *Standard deviation increases or decreases with changing noise level.*
E. *Mean is unchanged.*

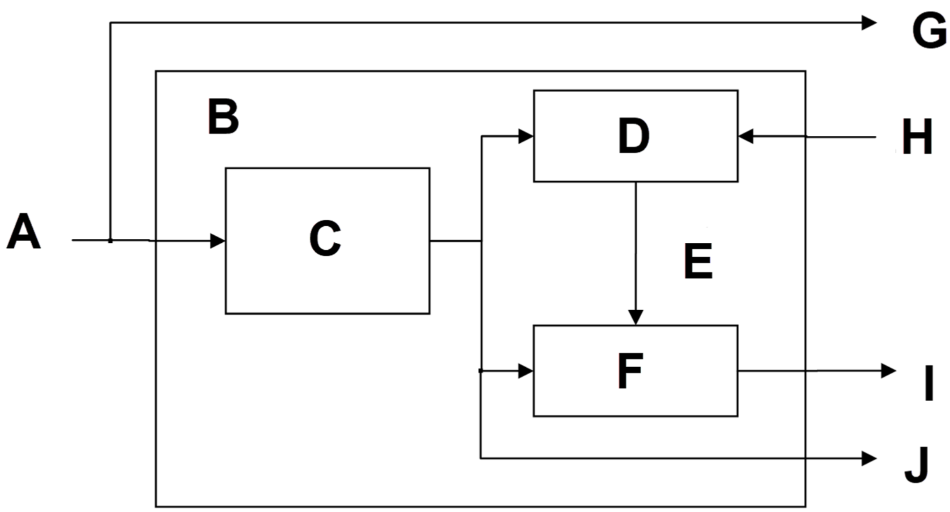
The device can provide the statistical information in two ways. First, it can make the statistical parameters available to the host system directly via FOUNDATION™ Fieldbus communication protocol or FF to other protocol converters. Once available, the system may make use of these statistical parameters 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 device can then make the statistical values available to the operator directly or 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® alert or NE107 status signal. Typical applications are change in fluid composition or equipment related problems.

7.4.1 SPM functionality

A block diagram of the SPM diagnostic is shown in Figure 7-4. 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, and the standard deviation is calculated from the filtered pressure signal. These statistical values are available via handheld communication devices like the Handheld Communicator, asset management software, or distributed control systems with FOUNDATION™ Fieldbus.

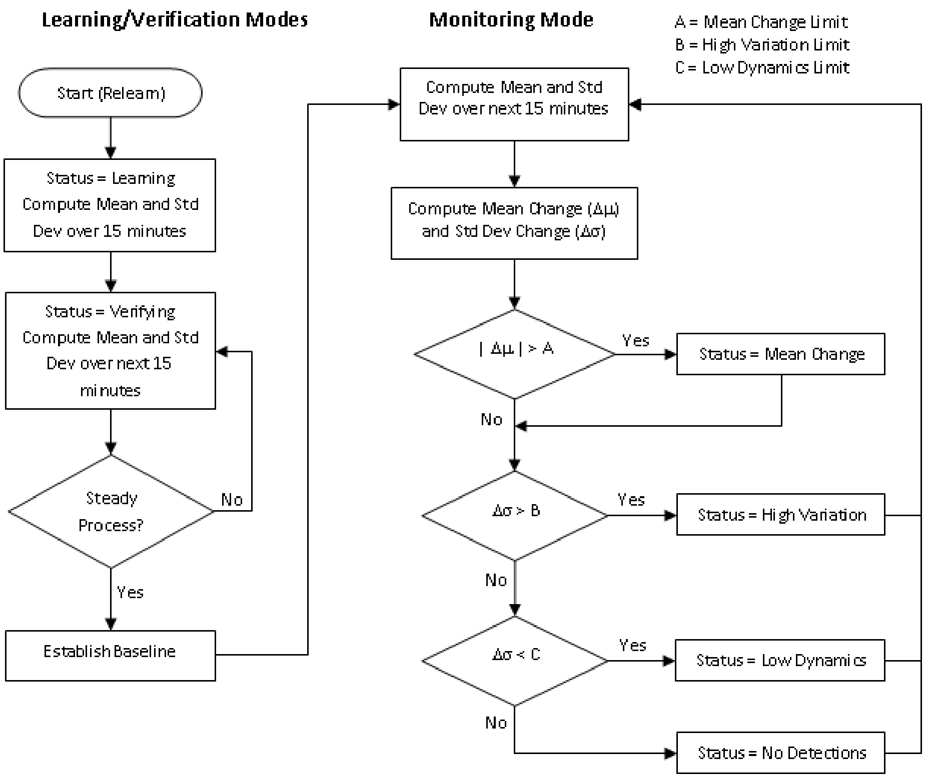
Figure 7-3: Rosemount 3051 FF Statistical Process Monitoring



A. *Process variable*
B. *SPM #*
C. *Statistical calculations module*
D. *Learning module*
E. *Baseline values*
F. *Decision module*
G. *Standard FF output*
H. *User configuration*
I. *SPM alert*
J. *Statistical parameters*

SPM also contains a learning module that establishes the baseline values for the process. The learning module establishes baseline values under user control at conditions considered normal for the process and installation. The learning module makes these baseline values available to a decision module, which compares the baseline values to the most current values of the mean and standard deviation. Based on sensitivity settings and actions you select via the control input, the diagnostic generates a device alert when it detects a significant change in either mean or standard deviation.

Figure 7-4: Rosemount 3051 FF SPM



Further detail of the operation of the SPM diagnostic is shown in the Figure 7-4 flowchart. This is a simplified version showing operation using the default values. After configuration, SPM calculates mean and standard deviation, used in both the learning and the monitoring modes. Once enabled, SPM enters the learning/verification mode. SPM calculates the baseline mean and standard deviation over a period of time you control (SPM Monitoring Cycle; default is 15 minutes). The status will be `Learning`. SPm calculates a second set of values and compares them 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, SPM continuously calculates new mean and standard deviation values, with new values available every few seconds. SPM compares the mean value to the baseline mean value and the standard deviation to the baseline standard deviation value. If either the mean or the standard deviation has changed more than user-defined sensitivity settings, SPM generates an alert via FOUNDATION Fieldbus. The alert may indicate a change in the process, equipment, or transmitter installation.

Note
The SPM diagnostic capability in the Rosemount 3051 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 SPM will accurately detect each specific condition under all circumstances.

7.5 SPM configuration and operation

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

7.5.1 SPM configuration for monitoring pressure

The device's pressure measurement is permanently factory pre-configured as the SPM input. To configure the SPM Block, set the following parameters:

Learning the process dynamics

Procedure

Using guided configuration, enter the monitoring cycle for SPM to learn the process.

Note
The minimum monitoring cycle value is one minute; the typical recommended monitoring cycle is three minutes.

Verification

Normally SPM uses a verification period to determine the stability of the process noise before beginning monitoring. You can bypass this step to reduce SPM setup time.

Note
Emerson™ does not recommend bypassing the verification.

SPM_Monitoring_Cycle = [1 – 1440] minutes (see Other SPM settings)

(Optional) SPM_Bypass_Verification = [Yes/No] (see SPM_Bypass_Verification)

After you enable SPM, it will spend time equal to one SPM_Monitoring_Cycle (e.g., five minutes) in the learning phase and then another time period equal to one SPM_Monitoring_Cycle in the verification phase. If it detects a steady process at the end of the verification phase, the SPM will move into the monitoring phase. After five minutes in the monitoring phase, SPM 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 an SPM Alert is detected.

7.5.2 Other SPM settings

Additional information on other SPM settings is shown below.

SPM_Bypass_Verification

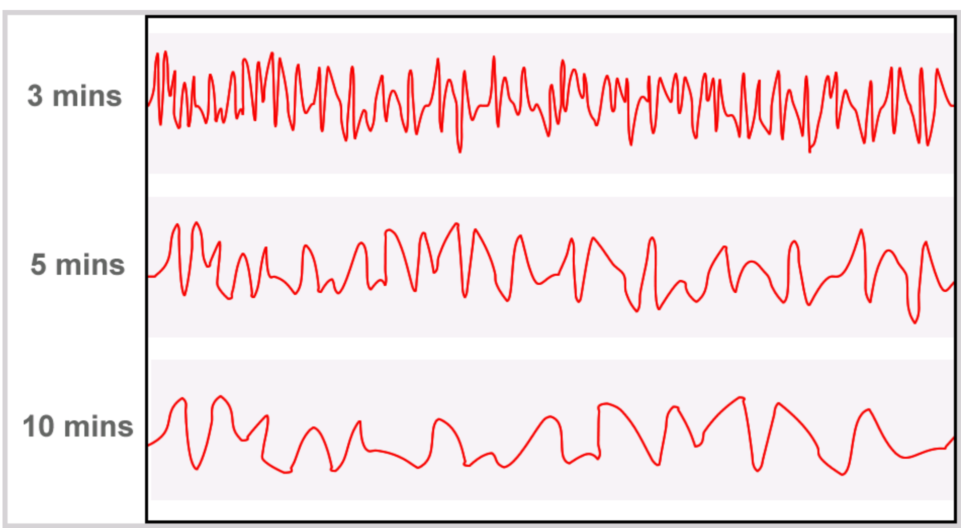
If this is set to Yes, SPM will skip the verification process and take the first mean and standard deviation from the learning phase as the baseline mean and standard deviation. By skipping the verification, the SPM can move into the monitoring phase more quickly. Only set this parameter set to Yes if you are certain that the process is at a steady-state at the time you start the learning phase. 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 1 to 1440 minutes.

Figure 7-5 illustrates the effect of the SPM 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 SPM uses process data averaged over a longer period of time.

Figure 7-5: Effect of SPM Monitoring Cycle on Statistical Values



SPM_User_Command

Select **Learn** after all the parameters have been configured to begin the Learning Phase. The monitoring phase starts automatically after the learning process is complete. Select **Quit** to stop the SPM. Select **Detect** to return to the monitoring phase.

SPM_Active

The SPM_Active parameter starts the statistical process monitoring when Enabled. Disabled (default) turns the diagnostic monitoring off. You must set this parameter to Disabled for configuration. Only set it to Enabled after fully configuring the SPM. When enabling SPM, you may select one of two options:

Enabled with 1st-order HP filter

This 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. For most diagnostics applications, you will want to use the filter.

Enabled without filter

This enables SPM without applying the high-pass filter. Without the filter, changes in the mean of the process variable will cause an increase in the standard deviation. Use this option only if there are very slow process changes (e.g., an oscillation with a long period), which you wish to monitor using the standard deviation.

7.5.3 Configuration of alerts

In order to have SPM generate a NE107 or Plantweb® alert, you must configure the alert limits 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; typical values for high variation limit are 40 percent change for high sensitivity, 60% change for medium sensitivity, and 80 percent change for low sensitivity.

SPM_Low_Dynamics_Lim

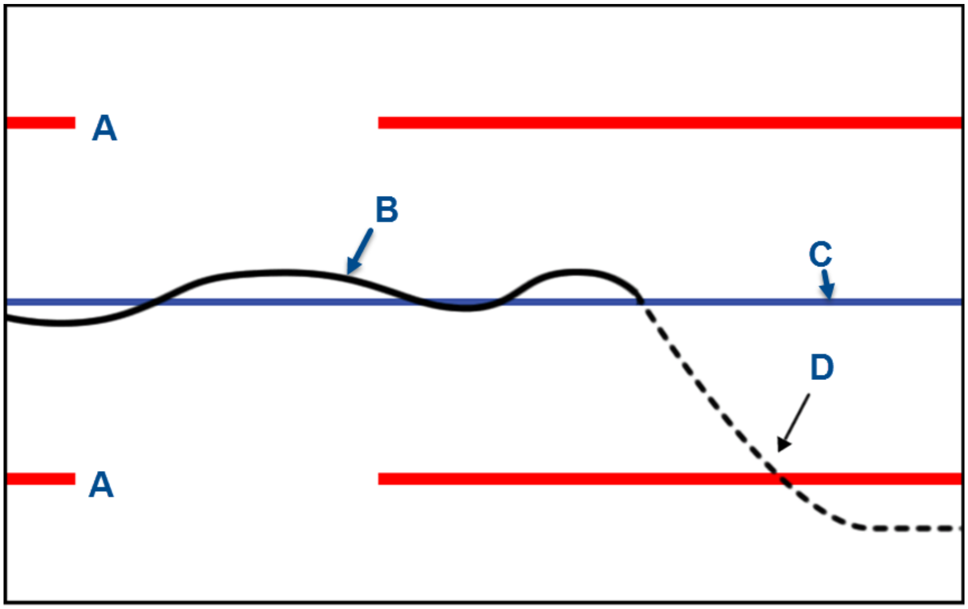
Lower limit on standard deviation for detecting a low dynamics condition (must be specified as a negative number).

All of these 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 SPM does not detect an increase in standard deviation.

Figure 7-6 illustrates an example of the standard deviation, with its baseline value and alert limits. During the monitoring phase, the SPM will continuously evaluate the standard deviation and compare it against the baseline value. SPM detects an alert 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 SPM 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 sensitiv, and could potentially lead to false detections.

Figure 7-6: Example Alerts for Standard Deviation



A. *Alert limit*
B. *Standard deviation*
C. *Baseline*
D. *Alert*

7.5.4 SPM operations

During operation, the following values are updated for the SPM Block.

SPM_Baseline_Mean

Baseline Mean (calculated average) of the process variable is determined during the learning/verification process and represents 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

The Baseline Standard Deviation of the process variable is determined during the learning/verification process and represents 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

Timestamp of the last values and status for the SPM.

SPM_Status

Current state of the SPM Block; possible values for SPM status are as follows:

SPM_Status

Status value	Description
Inactive	User command in Idle, SPM 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 are 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.
Not Licensed	SPM is not currently purchased in this device.

In most cases, only one of the above SPM 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.

7.5.5 Alerts

When any of the SPM detections (Mean Change, High Variation, or Low Dynamics) is active, SPM generates a Fieldbus NE107 or Plantweb® alert in the device `Variation Change Detected (SPM)` and sends it to the host system. Note that there is just one SPM NE107 or Plantweb alert.

7.5.6 Trending statistical values in control system

You may view and/or trend SPM Mean and Standard Deviation values in a Fieldbus host system through the AI function blocks.

You may use an Analog Input (AI) block to read either the Mean or the Standard Deviation from the SPM Blocks. To use the AI block to trend SPM data, set the CHANNEL parameter to one of the following values:

Table 7-1: Valid SPM Channels for the AI Block

Channel	SPM variable
12	SPM mean
13	SPM standard deviation

See Table 1 for a complete listing of valid Channels for the AI Block.

Set the OUT_SCALE parameter to the engineering unit and range which are desired for the mean and standard deviation output. For example, you can use the OUT_SCALE parameter to convert mean and standard deviation to some other pressure unit. See Analog input (AI) function block for additional details on setting the XD_SCALE, OUT_SCALE, and L_TYPE parameters of the AI function block.

7.5.7 SPM configuration with EDDL

SPM configuration provides the capability to configure SPM for use in plugged line detection, or other abnormal process conditions.

Menu navigation: **Configure>Guided Setup>Basic SPM Setup**

See Advanced pressure diagnostics for more information on SPM functions and uses.

Note
SPM is a factory only option, option code D01, and can't be licensed/installed in the field.

An automated task procedure called a `Method` guides you through SPM setup. The basic sequence of steps is:

Procedure

1. Enter the `Monitoring Cycle`.

   The minimum monitoring time is one minute; three minutes is a typical monitoring cycle.

2. Bypass Verification, Yes or No.

   Emerson™ recommends verification for applications where you have not done SPM monitoring previously or where process changes may cause significant changes in mean or standard deviation.

3. Enter the thresholds in percent.
   a) The first threshold is the Mean Change that will trigger an alert.
   b) The second threshold is the High Variation Limit that will trigger an alert. Typical values are from 40 to 80 percent.

c) The third threshold is the Low Dynamics Limit that will trigger an alert.

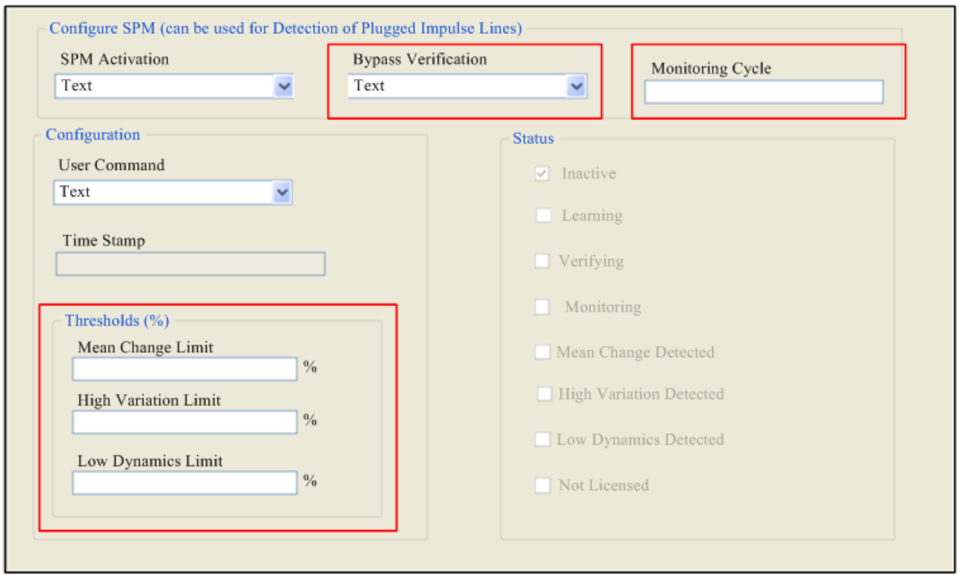
d) Select or disable Filtering.

Note

To enable or disable monitoring or make configuration changes, you may prefer the manual *SPM Configuration* screen.

Menu navigation: **Configure>Manual Setup>Basic SPM**

Figure 7-7: Configure SPM Display Screen



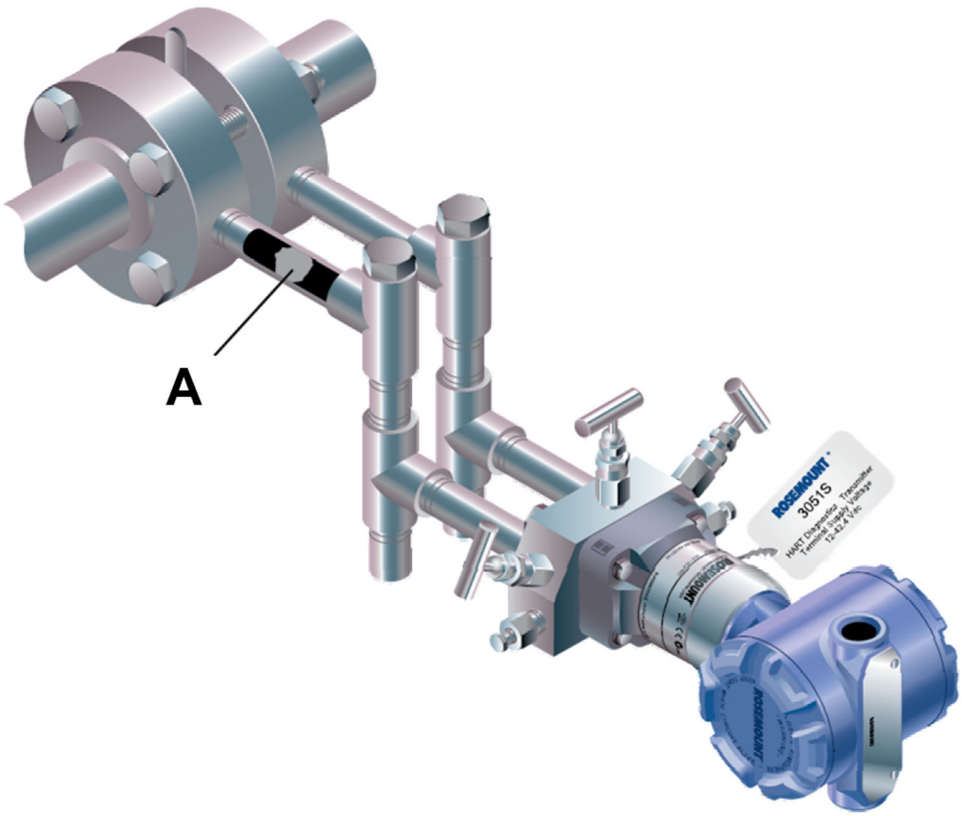
The screen shown in Figure 7-7 above allows full SPM configuration, configuration edits, and enabling and disabling monitoring and provides an indication of the status of the monitored variable.

7.6 Plugged impulse line detection using SPM

7.6.1 Introduction

You can use pressure transmitters 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 7-8). You typically do 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 you recognize that plugging has occurred. This is a typical problem for pressure measurement, and operators recognize the need for a plugged impulse line diagnostic for this condition.

Figure 7-8: Basics of Plugged Impulse Line



A. Clog

Testing at Emerson™ and other sites indicates that SPM 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 you with the basics of the plugged impulse lines and the PLD 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 PLD diagnostic.

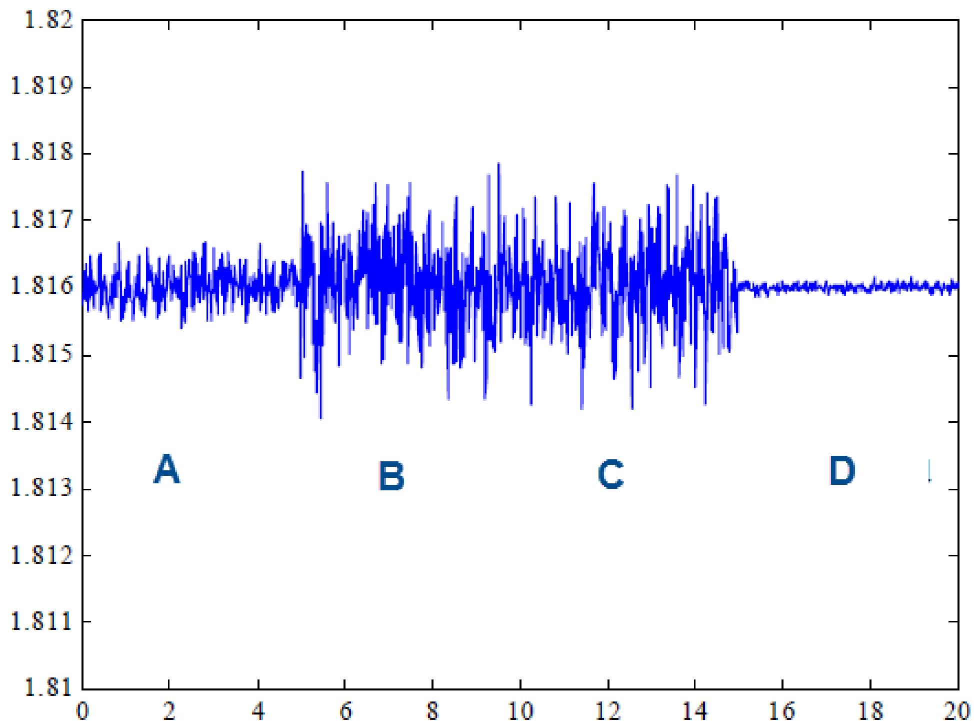
7.6.2 Plugged impulse line physics

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, the flowing fluid produces these fluctuations, which are a function of the geometric and physical properties of the system. The pump or control system can also produce the noise. This is also true for pressure measurements in flow applications, although 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, small changes in the average value of the flow rate or pressure do not affect these noise signatures significantly. 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.

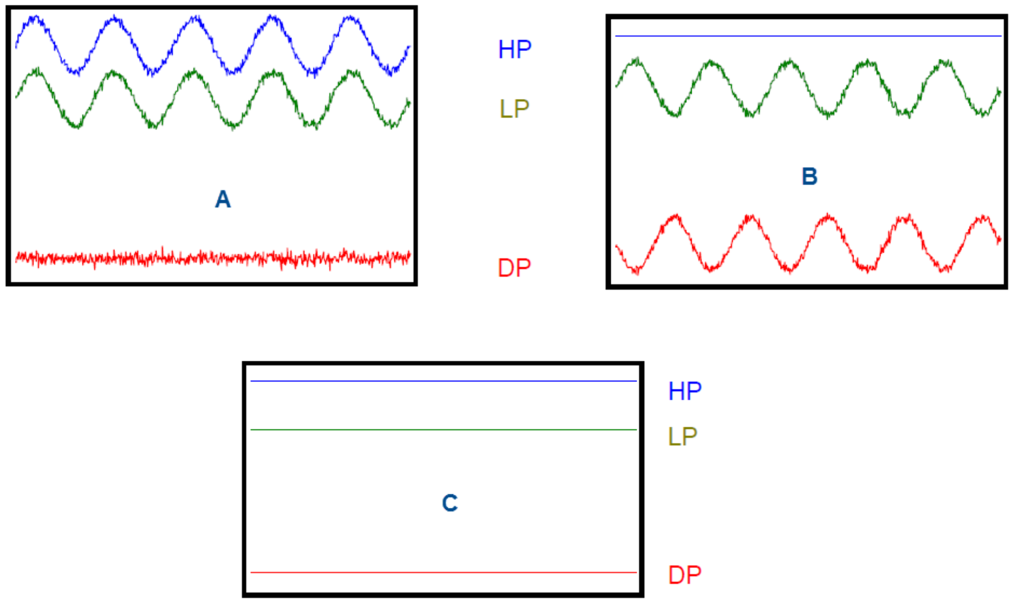
The case of the differential pressure measurement in a flow application with a single line plugged is more complicated, and the behavior of the transmitter may vary depending on a number of factors. First the basics: a differential pressure transmitter in a flow application is equipped with two impulse 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 7-9. 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 7-10.

Figure 7-9: Differential Pressure Signals under Different Plugging Conditions



A. *Both open*
B. *HP closed*
C. *LP closed*
D. *Both closed*

Figure 7-10: Differential Pressure (DP) Signals under Different Plugged Conditions



A. *Both lines open*
B. *HP line clogged*
C. *Both lines clogged*

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 PLD diagnostic can detect these changes in the noise levels through the operation described previously.

7.6.3 Plugged 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. The following sections discuss each factor pair.

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, you 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 PLD 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 the next paragraph and Impulse line length for further explanation. Liquid DP flow applications require elimination of all the air to insure 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 presence of air in the impulse lines and transmitter in liquid applications further enhances the low noise condition. The PLD diagnostic alerts you 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 bubbler.

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, 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:

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

where:

fn is the resonant frequency,

n is the mode number,

C is the speed of sound in the fluid, and

L is the impulse length in meters.

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:

$t = RC$ and $t = ½ p f_c$

$R = 8 y L / p r^4$

$C = \Delta Volume / \Delta Pressure$

where:

f_c is the cut-off frequency,

y is the viscosity in centipoises,

L is the impulse line length in meters, and

r is the radius of the impulse line.

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 3051 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 flowmeter.

Note

The plugged impulse line diagnostic capability in the Rosemount 3051calculates 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 that the plugged impulse line diagnostic will accurately detect each specific plugged impulse line condition under all circumstances.

A Reference data

A.1 Ordering information, specifications, and drawings

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

Procedure

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

A.2 Product certifications

To view current Rosemount 3051 product certifications, follow these steps:

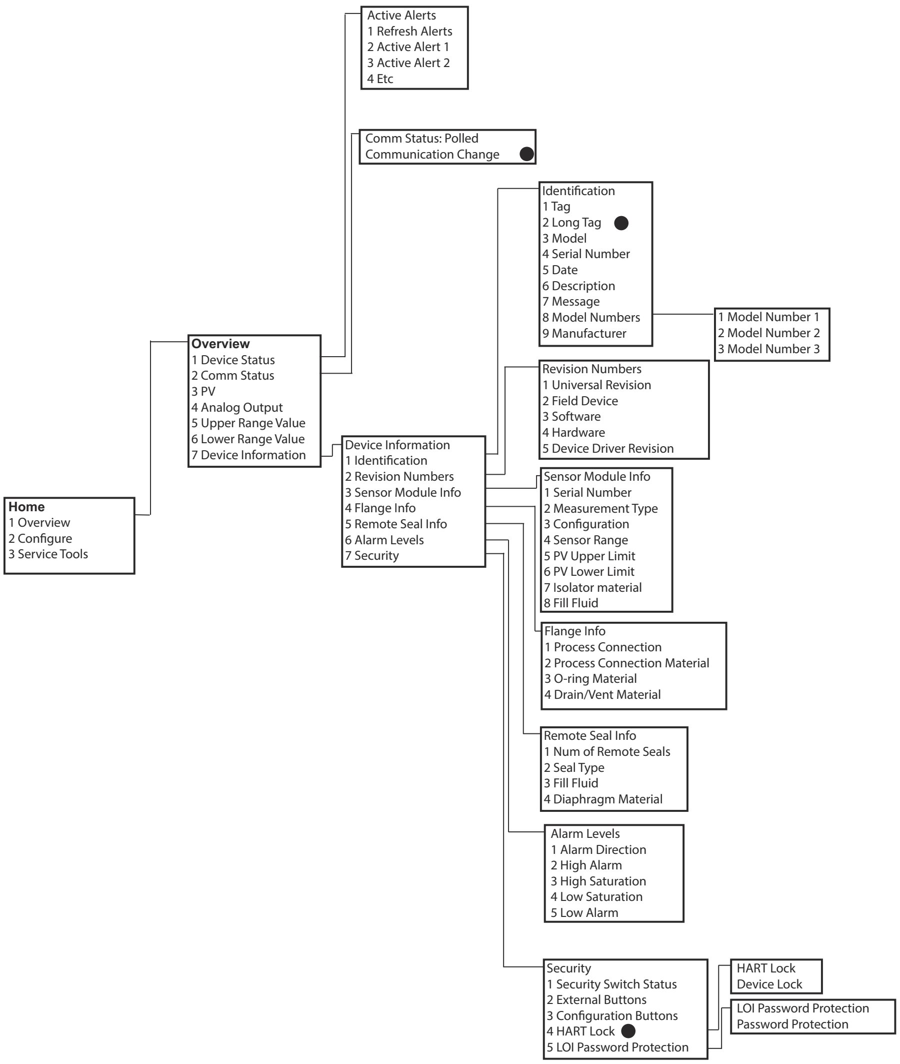
Procedure

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

B Field Communicator

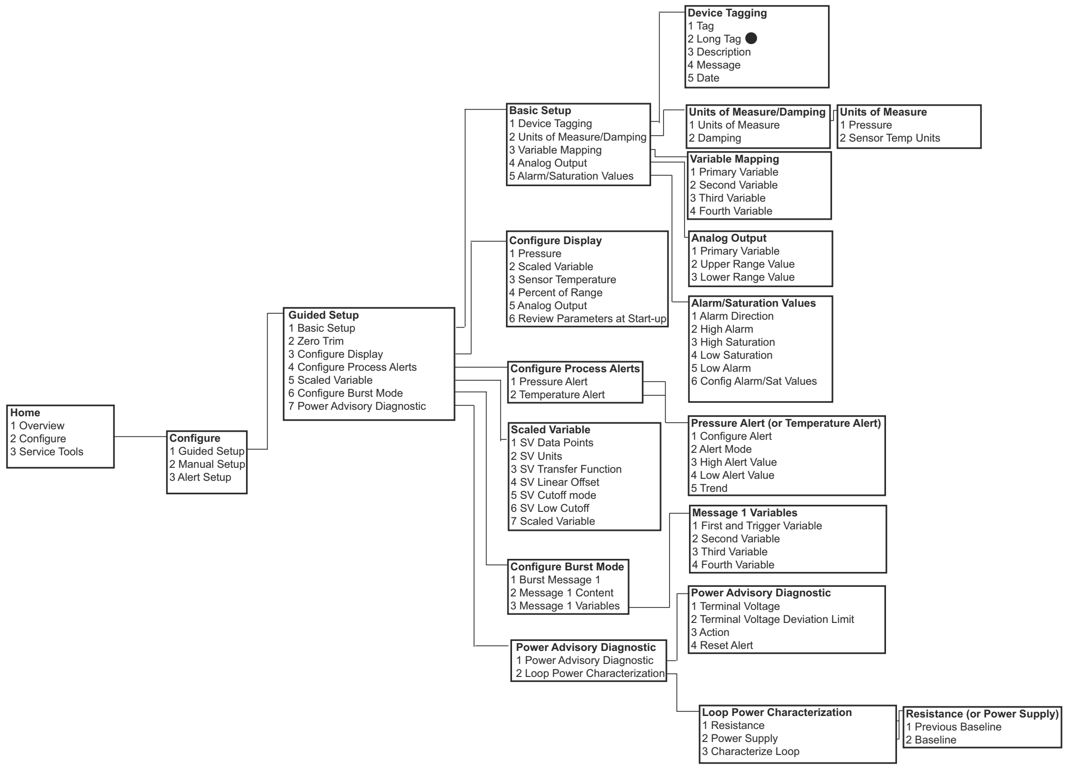
B.1 Field Communicator menu trees

Figure B-1: Overview



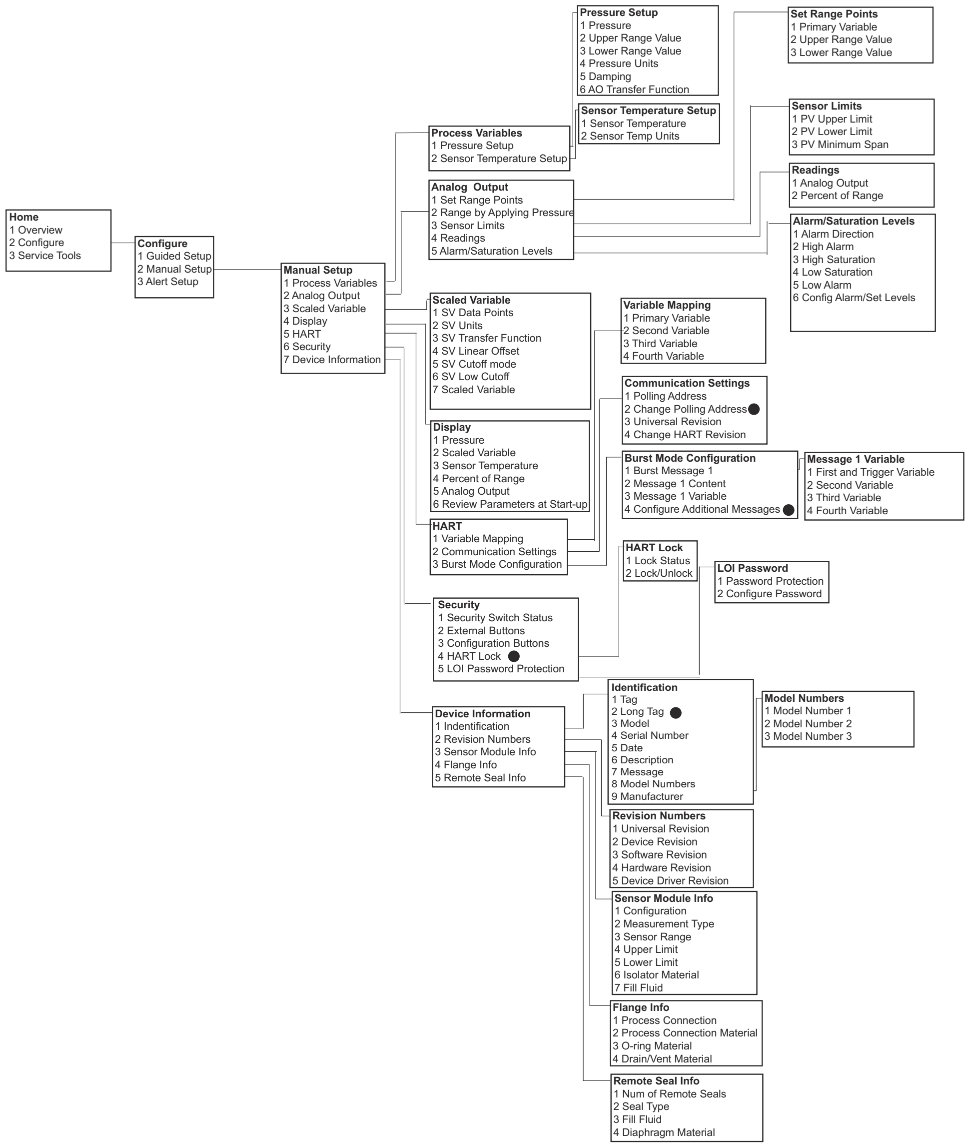
Selections with black circle are only available in HART® Revision 7 mode. Selection will not appear in HART Revision 5 DD.

Figure B-2: Configure - Guided Setup



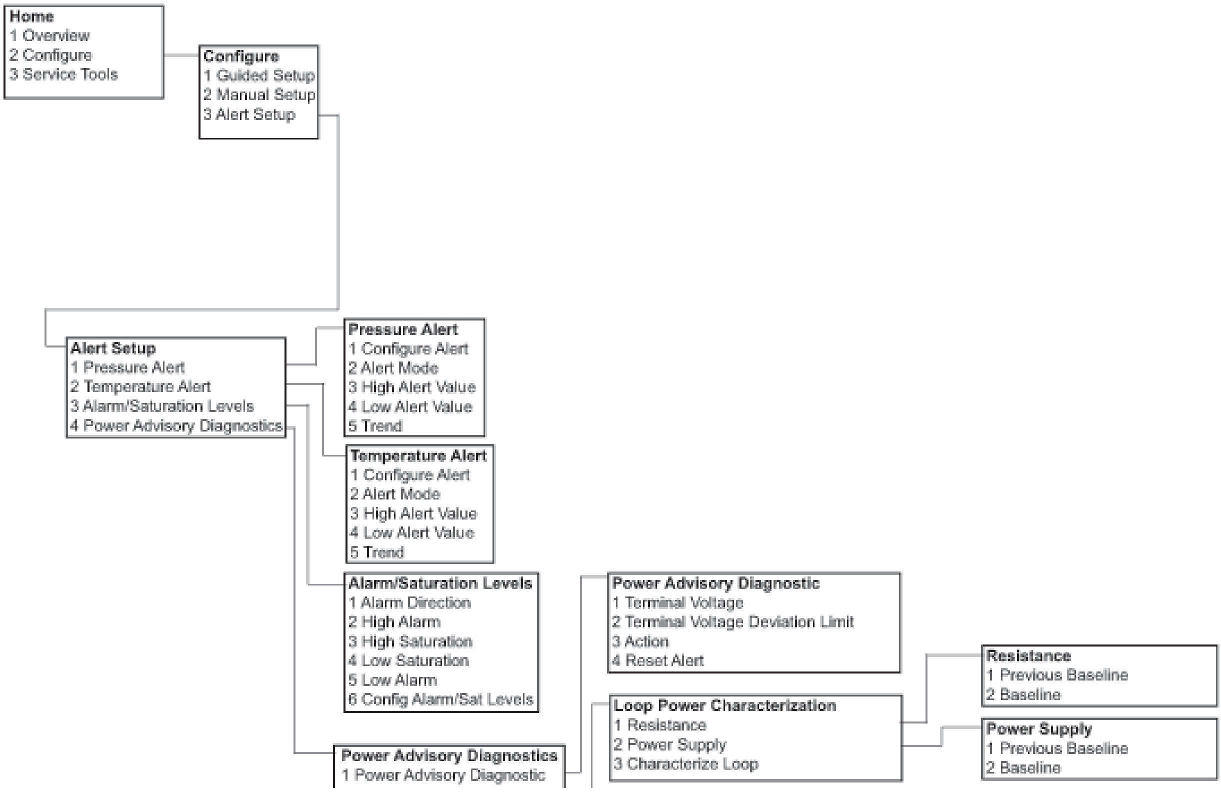
Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

Figure B-3: Configure - Manual Setup



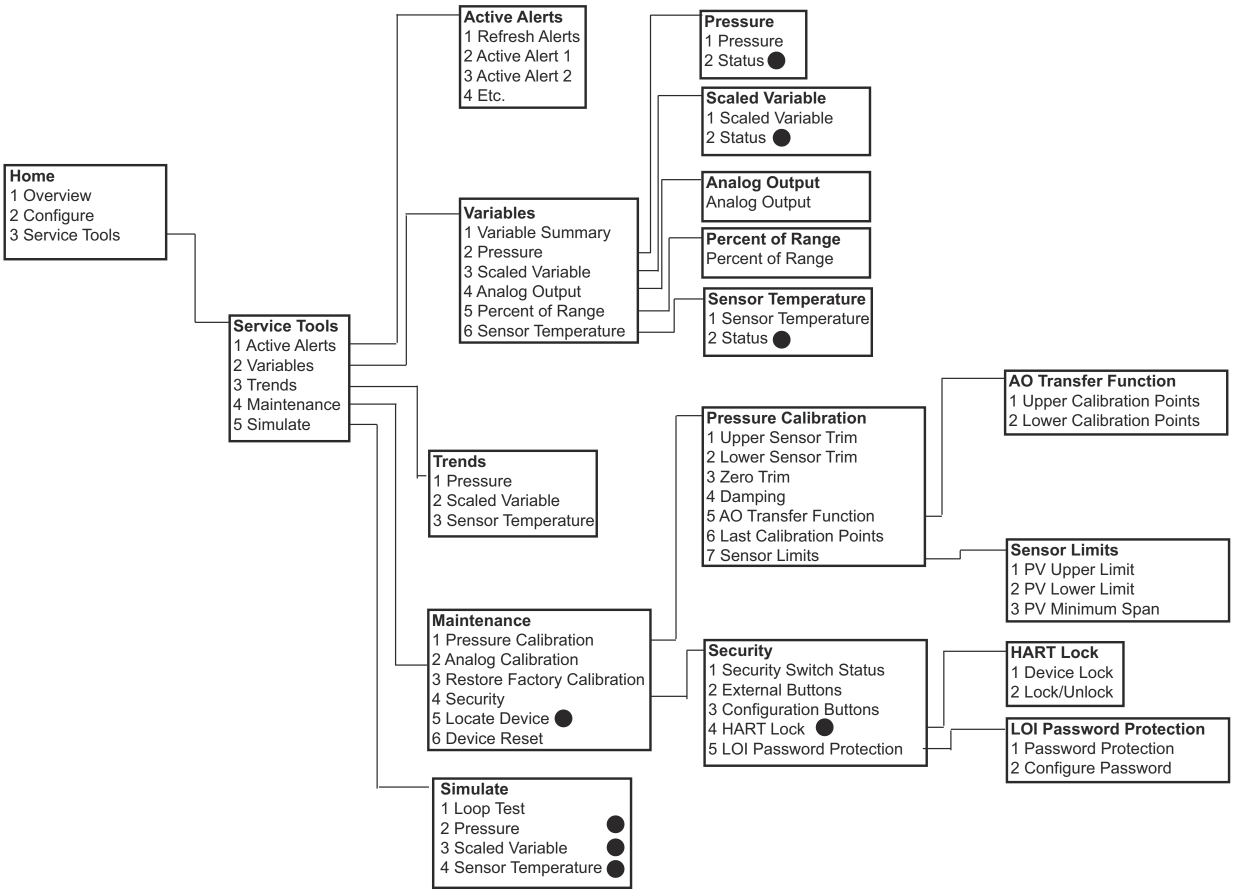
Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

Figure B-4: Configure - Alert Setup



Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

Figure B-5: Service Tools



Selections with black circle are only available in HART Revision 7 mode. Selection will not appear in HART Revision 5 DD.

B.2 Field Communicator Fast Keys

- A (✓) indicates the basic configuration parameters. At minimum, verify these parameters as a part of configuration and startup.
- A (7) indicates availability only in HART® revision 7 mode.

Table B-1: Device Revision 9 and 10 (HART 7), DD Revision 1 Fast Key sequence

	Function	Fast Key sequence	
		HART 7	HART 5
✓	Alarm and Saturation Levels	2, 2, 2, 5	2, 2, 2, 5
✓	Damping	2, 2, 1, 1, 5	2, 2, 1, 1, 5
✓	Primary Variable	2, 2, 5, 1, 1	2, 2, 5, 1, 1
✓	Range Values	2, 2, 2, 1	2, 2, 2, 1
✓	Tag	2, 2, 7, 1, 1	2, 2, 7, 1, 1
✓	Transfer Function	2, 2, 1, 1, 6	2, 2, 1, 1, 6
✓	Pressure Units	2, 2, 1, 1, 4	2, 2, 1, 1, 4
	Date	2, 2, 7, 1, 5	2, 2, 7, 1, 4
	Descriptor	2, 2, 7, 1, 6	2, 2, 7, 1, 5
	Digital to Analog Trim (4 - 20 mA Output)	3, 4, 2, 1	3, 4, 2, 1
	Digital Zero Trim	3, 4, 1, 3	3, 4, 1, 3
	Display Configuration	2, 2, 4	2, 2, 4
	LOI Password Protection	2, 2, 6, 5	2, 2, 6, 4
	Loop Test	3, 5, 1	3, 5, 1
	Lower Sensor Trim	3, 4, 1, 2	3, 4, 1, 2
	Message	2, 2, 7, 1, 7	2, 2, 7, 1, 6
	Pressure Trend	3, 3, 1	3, 3, 1
	Rerange with Keypad	2, 2, 2, 1	2, 2, 2, 1
	Scaled D/A Trim (4–20 mA Output)	3, 4, 2, 2	3, 4, 2, 2
	Scaled Variable	2, 2, 3	2, 2, 3
	Sensor Temperature Trend	3, 3, 3	3, 3, 3
	Switch HART Revision	2, 2, 5, 2, 4	2, 2, 5, 2, 3
	Upper Sensor Trim	3, 4, 1, 1	3, 4, 1, 1
7	Long Tag	2, 2, 7, 1, 2	
7	Locate Device	3, 4, 5	
7	Simulate Digital Signal	3, 5	

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