Reference Manual
00809-0200-4101, Rev CB
December 2024

Rosemount™ 2051 Pressure Transmitter

with FOUNDATION™ Fieldbus Protocol

ROSEMOUNT™

EMERSON™

Safety messages

⚠ WARNING

Explosions

Explosions could result in death or serious injury.

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Review the *Product certifications* section of the *Quick Start Guide* for any restrictions associated with a safe installation.

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 transmitter.

⚠ WARNING

Process leaks

Process leaks could result in death or serious injury.

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.

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 transmitter.

⚠ WARNING

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 in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

⚠ WARNING

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

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

NOTICE

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 (bolt hole) but must not contact sensor module housing.

⚠ CAUTION

Static electricity

Static electricity can damage sensitive components.

Observe safe handling precautions for static-sensitive components.

NOTICE

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 Overview

This manual is for the Rosemount 2051 Pressure Transmitter with FOUNDATION™ fieldbus communications.

This manual only describes the topics required for installation, operation, configuration, and troubleshooting the Foundation fieldbus transmitter.

1.2 Models covered

The following Rosemount 2051 Transmitters are covered by this manual:

- 2051C Coplanar™ Pressure Transmitter
  - — Measures differential and gauge pressure up to 2000 psi (137.9 bar).
  - — Measures absolute pressure up to 4000 psi (275.8 bar).
- 2051T In-Line Pressure Transmitter
  - — Measures gauge/absolute pressure up to 10,000 psi (689.5 bar).
- 2051L Level Transmitter
  - — Measures level and specific gravity up to 300 psi (20.7 bar).
- 2051CF Series Flow Meter
  - — Measures flow in line sizes from ½-in. (15 mm) to 96 in. (2400 mm).

Note
For 2051 with HART Protocol, see 2051 Pressure Transmitter with HART Protocol Reference Manual. For 2051 with PROFIBUS PA Protocol, see 2051 Pressure Transmitter with PROFIBUS PA Reference Manual.

1.3 FOUNDATION™ Fieldbus installation

Procedure

1. Transmitter installation
2. Commissioning tag.
3. Housing rotation
4. Set switches and software write lock
5. Grounding, wiring, and power up
6. Locate the device.
7. Configuration overview
8. Zero trim the transmitter

1.4 Transmitter overview

The Rosemount 2051C Coplanar™ design is offered for Differential Pressure (DP), Gage Pressure (GP) and Absolute Pressure (AP) measurements. The Rosemount 2051C utilizes capacitance sensor technology for DP and GP measurements. The Rosemount 2051T and 2051CA utilize piezoresistive sensor technology for AP and GP measurements.

The major components of the Rosemount 2051 are the sensor module and the electronics housing. The sensor module contains the oil filled sensor system (isolating diaphragms, oil fill system, and sensor) and the sensor electronics. The sensor electronics are installed within the sensor module and include a temperature sensor and a memory module. The electrical signals from the sensor module are transmitted to the output electronics in the electronics housing. The electronics housing contains the output electronics board and the terminal block. The basic block diagram of the Rosemount 2051CD is illustrated in Figure 1-2.

For the Rosemount 2051, pressure is applied to the isolating diaphragm(s). The oil deflects the sensor which then changes its capacitance or voltage signal. This signal is then changed to a digital signal by the Signal Processing. The microprocessor then takes the signals from the Signal Processing and calculates the correct output of the transmitter.

An optional 2-line LCD display can be ordered that connects directly to the interface board which maintains direct access to the signal terminals. The display indicates output and abbreviated diagnostic messages. A glass display cover is provided. The first line of eight characters displays the actual measured value, the second line of six characters displays the engineering units. The LCD display can also display diagnostic messages.

Figure 1-1: LCD display

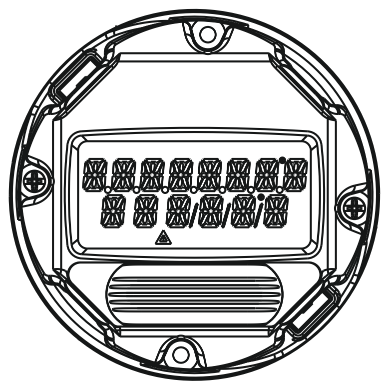
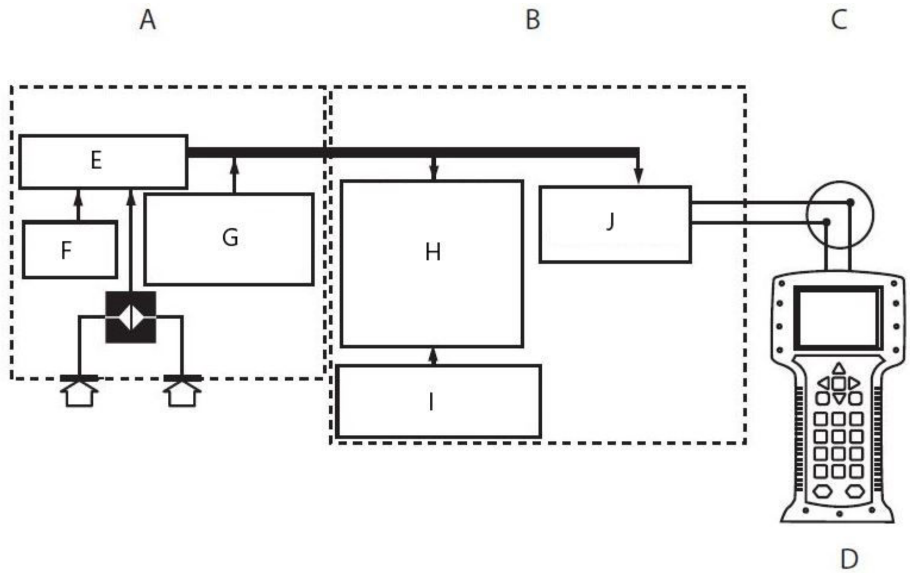


Figure 1-2: Block Diagram of Operation



A. *Sensor Module*
B. *Electronics Board*
C. *FOUNDATION™ Fieldbus Signal to Control System*
D. *Field Communicator*
E. *Signal processing*
F. *Temperature sensor*
G. *Sensor module memory*
H. *Microprocessor:*
   - *Sensor linearization*
   - *Damping*
   - *Diagnostics*
   - *Engineering units*
   - *Control function blocks*
   - *Communication*
I. *Memory:*
   - *Configuration*
J. *Digital communication*

1.5 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 DD can be found on Field Comm Group. The DTM can be found at Software & Drivers. The current release of the Rosemount 2051 with FOUNDATION™ Fieldbus protocol is Device Revision 2. This manual is for Revision 2.

1.6 Product recycling/disposal

Consider recycling equipment and packaging.

Dispose of the product and packaging in accordance with local and national legislation.

2 Configuration

2.1 Configuration overview

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

2.1.1 DD and DTM™ based interfaces

The Rosemount 2051 Pressure Transmitter Rev 2 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.

2.1.2 The device menu tree

Device information and device tasks are organized in a menu tree structure. The complete menu tree is shown in Figure 2-10. A partial menu tree covering the most common device tasks is shown in Figure 2-11.

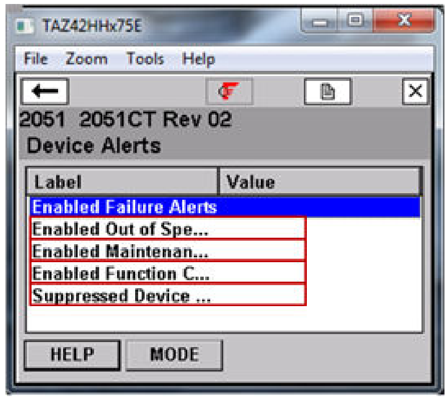
2.1.3 Basic organization

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 the menu tree can be expanded or collapsed as needed to facilitate navigation.

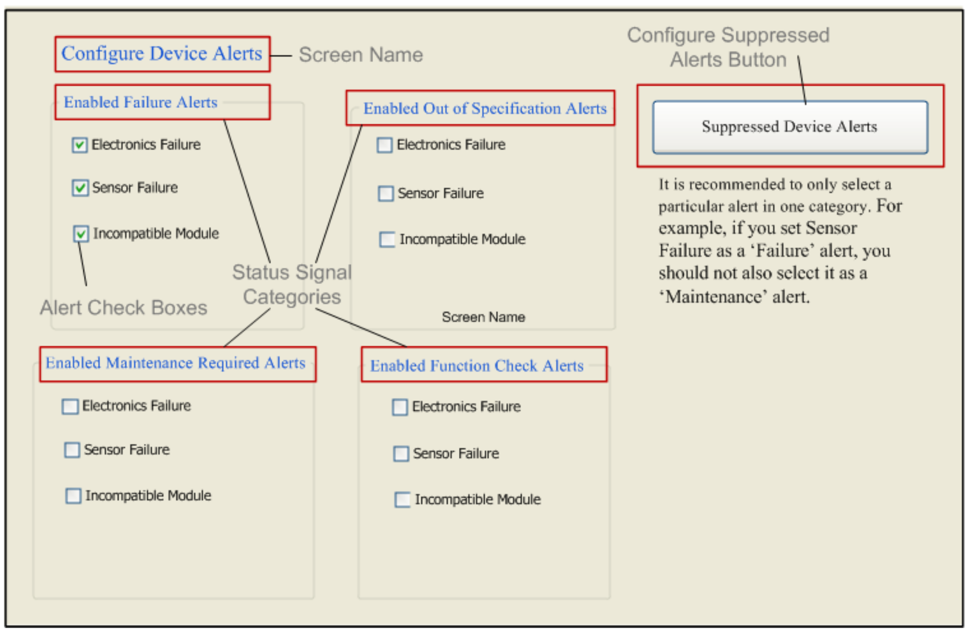
The same device menu tree applies for both handheld and PC based user interfaces. On the handheld, each menu tree entry has a dedicated screen (see Figure 2-3). On PC based user interfaces, several menu tree entries may be displayed on a single screen with each menu tree entry used as the heading for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



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

2.2 The *Home* screen

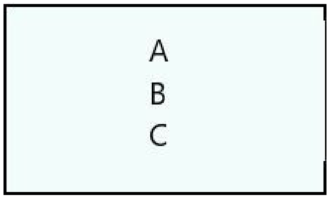
The ***Home*** screen provides access to the three main branches of the menu tree.

- ***Overview***
- ***Configure***

- ***Service Tools***

From this screen, select any of the three main branches to access detailed device functionality.

Figure 2-3: *Home* Screen Menu Tree Main Navigation Branches

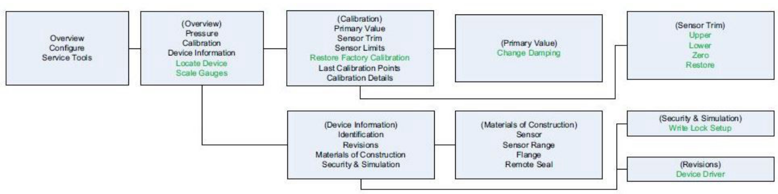


A. Overview
B. Configure
C. Service tools

2.3 *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.

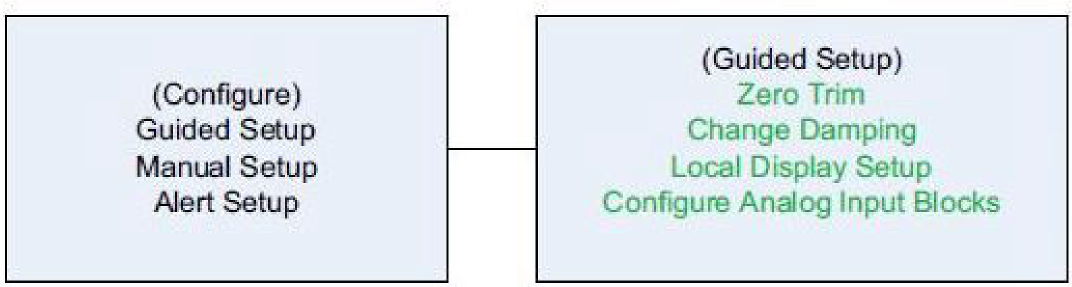
Figure 2-4: *Overview* section of the Menu Tree



Black text	Navigation selections available
(Text)	Name of selection used on parent menu screen to access this screen
Green text	Automated methods

2.4 *Configure*

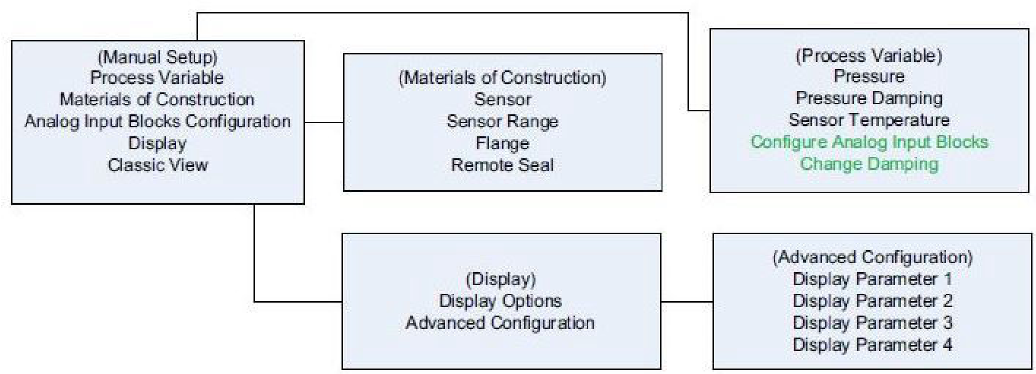
Figure 2-5: *Guided Setup* branch of the Menu Tree



Black text	Navigation selections available
(Text)	Name of selection used on parent menu screen to access this screen
Green text	Automated methods

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 the user can perform a configuration task by selecting or entering the necessary parameters without step by step guidance.

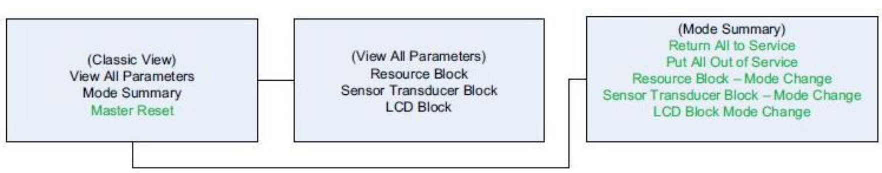
Figure 2-6: *Manual Setup* branch of the Menu Tree



Black text	Navigation selections 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

Manual Setup can take less time than ***Guided Setup*** if the user is familiar with the task to be performed. ***Manual Setup*** also allows users to edit specific parameters without needing to step through all the setup steps. If the user is not familiar with a specific task, ***Guided Setup*** is recommended so task steps are done in the correct order and all needed steps are performed.

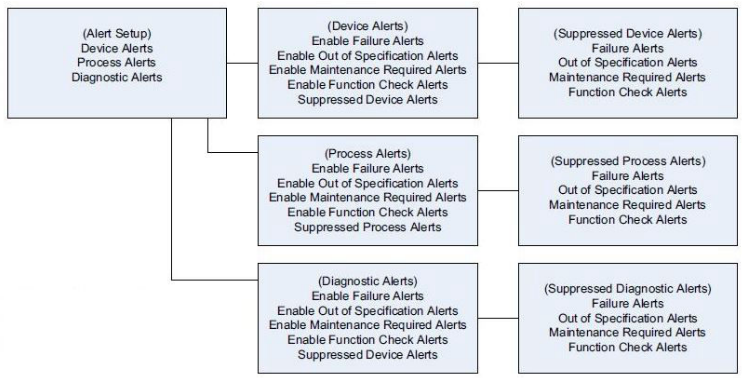
Figure 2-7: *Classic View* of the Menu Tree



Black text	Navigation selections 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

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 multiple configuration tasks can be performed without leaving the single menu screen.

Figure 2-8: *Alert Setup* branch of the Menu Tree



Black text	Navigation selections available
(Text)	Name of selection used on parent menu screen to access this screen

The final ***Configure*** branch supports alert setup of NE107 alerts (i.e.: the factory default Device Alerts), or PlantWeb™ Alerts. Note that 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 users to enable, suppress, and re-categorize alerts. The Rosemount 2051 organizes alerts as:

- **Device Alerts**
- **Process Alerts**
- **Diagnostic Alerts**

NE107 alerts can be defined as any of four categories:

- **Failure Alerts**
- **Out of Specification Alerts**
- **Maintenance Required Alerts**
- **Function Check Alerts**

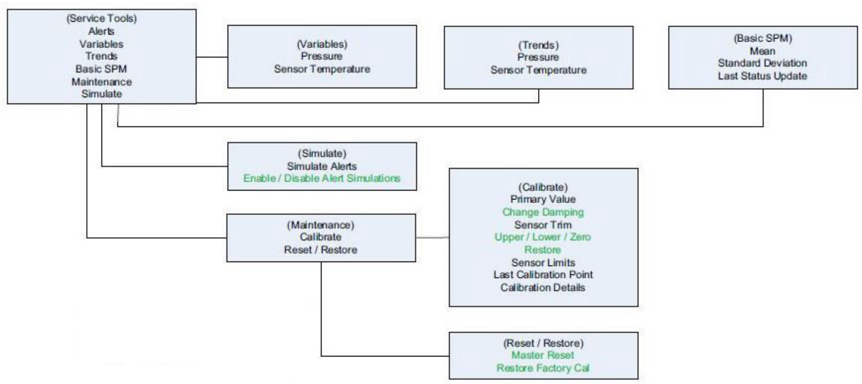
To minimize configuration tasks and time, the Rosemount 2051 ships from the factory with alerts enabled and pre-categorized. The use of factory default categories is recommended if the defaults meet plant standards, and there is no identified benefit to changing categories.

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

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

2.5 Service Tools

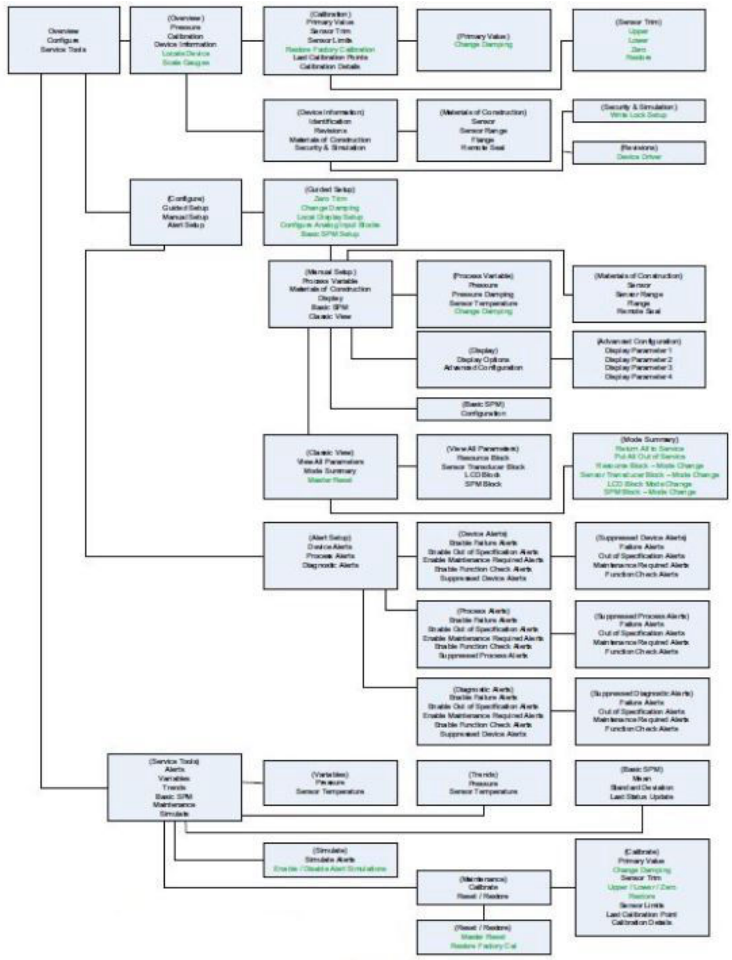
Figure 2-9: *Service Tools*



Black text	Navigation selections available
(Text)	Name of selection used on parent menu screen to access this screen
Green text	Automated methods

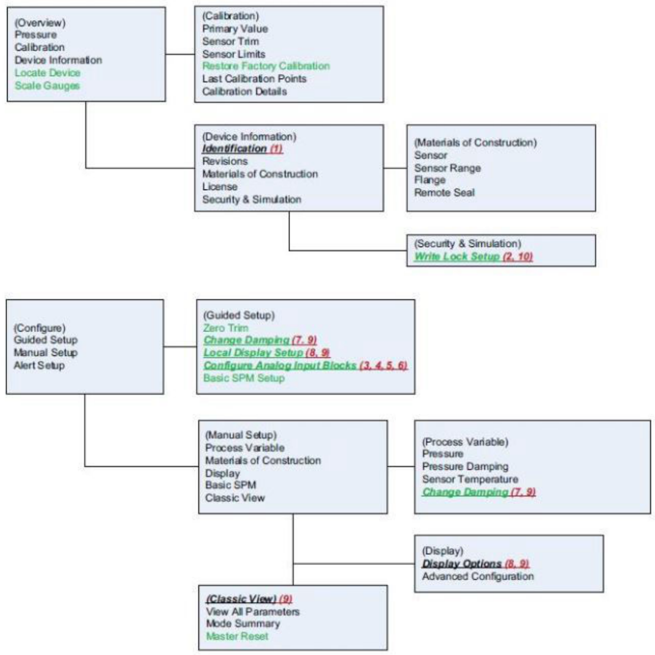
The ***Service Tools*** branch of the menu tree allows users to perform typical device maintenance tasks, simulate alerts and parameters, and perform some configuration resets to return devices to as-manufactured settings.

Figure 2-10: Complete Menu Tree



Black text	Navigation selections available
(Text)	Name of selection used on parent menu screen to access this screen
Green text	Automated methods

Figure 2-11: Partial Menu Tree



Black text	Navigation selections 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

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

2.6 Navigation

Navigation is performed by selecting the navigation button labeled with the task the user wishes to perform. This takes the user to the next navigation screen, or the screen where the desired function is performed, or launches a guided configuration automated procedure.

Note that some tasks can be performed from several different locations in the menu tree. For example, a **Sensor Zero Trim** can be performed from the **Overview** branch, the **Configure, Guided Setup** branch, or the **Service Tools** branch. This allows users to perform multiple tasks while minimizing the total navigation required to access and use the desired functions.

2.6.1 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** will help the user 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.

Note
Users who are not very familiar with a device should consider using **Guided Configuration** first.

Guided Setup will generally proceed in three stages.

The first is preparation. In this stage, user notifications are given, and steps needed to prepare the device for task setup are performed.

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 the need for the user 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, actions needed to return the device to operation, or gracefully cancel a task are performed.

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.

2.6.2 **Manual Setup** with manual and automated task procedures

Manual Setup should be used by users who are familiar with the mode changes and configuration steps needed to complete a task and properly return the device to service. **Manual Setup** is also sometimes used where a single parameter needs to be changed, and the user doesn't want to execute the full sequence of steps that are part of **Guided Configuration**.

Note
Users who are very familiar with tasks and wish to perform them in the least time should consider using **Manual Setup**.

Manual Setup can sometimes be performed in less time than **Guided Setup**, however **Manual Setup** doesn't provide the comprehensive guidance or graceful task termination of **Guided Setup**.

2.7 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 the user know all the parameters which need to be used, and the order of those parameters, to perform each task. The user also needs to know how to manage modes, both to perform tasks, and to return devices to operation.

Note
Classic View is NOT recommended for anyone who is not a device and FOUNDATION™ Fieldbus expert.

Expert users will use **Classic View** to review all block parameters, and to perform some configuration or service tasks.

2.7.1 Control function block configuration

The transmitter uses standard control function blocks. Configuration of these function blocks, and linking them into control strategies is performed 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 users' documentation.

The transmitter device configuration tools support configuration of Analog Input Blocks as needed to select the channel and perform signal conditioning and scaling. The 2051 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. The user is encouraged to use Analog Input Block 1 for the Primary Variable when configuring control strategies.

2.8 Confirm correct device driver

Verify the latest Device Driver (DD/DTM) is loaded on your systems to ensure proper communications.

1. Download the latest DD at Software & Drivers or Fieldbus.org.
2. Select Device Driver.
3. Search by product name.
4. Within Table 2-1, use the Device Revision numbers to find the correct Device Driver.

Table 2-1: Rosemount 2051 FOUNDATION™ Fieldbus Device Revisions and Files

Device Revision[1]	Host	Device driver (DD)[2]	Obtain at	Device driver (DTM)	Manual Document Number
2	All	DD4: DD Rev 1	Fieldbus.org	Software & Drivers	00809-0200-4101 Rev. BA or newer
	All	DD5: DD Rev 1	Fieldbus.org		
	Emerson	AMS V 10.5 or higher: DD Rev 2	Software & Drivers		
	Emerson	AMS V 8 to 10.5: DD Rev 1	Software & Drivers		
1	All	DD4: DD Rev 4	Fieldbus.org	Software & Drivers	00809-0200-4101 Rev. AA
	All	DD5: NA	N/A		
	Emerson	AMS Rev 8 or higher: DD Rev 2	Software & Drivers		

(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.*

2.9 Device capabilities

2.9.1 Link active scheduler

The Rosemount 2051 can be designated to act as the backup Link Active Scheduler (LAS) in the event that the LAS is disconnected from the segment. As the backup LAS, the 2051 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.

2.9.2 Capabilities

Virtual Communication Relationship (VCRs)

There are a total of 20 VCRs. Two are permanent and 18 are fully configurable by the host system. Twenty-five 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 (1ms)
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 Execution Times

Block	Time (in ms)
Analog Input	20
PID	25
Arithmetic	20
Input Selection	20
Signal Characterizer	20
Integrator	20
Output Splitter	20
Control Selector	20

2.10 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.

2.11 General block information

2.11.1 FOUNDATION™ Fieldbus function blocks

Reference information on the process control function blocks can be found in the Function Block manual document number 00809-0100-4783.

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.

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
The channel, Set XD_Scale, Set L_Type, and sometimes Set Out_Scale are typically configured by instrument personnel. Other AI block parameters, block links, and schedule are typically configured by the control systems configuration engineer.

Input selector block

The Input Selector (ISEL) Function Block can be used to select the first good, Hot Backup™, maximum, minimum, or average of as many as 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 Integrator Block is used as a totalizer. This block will accept up to two inputs, has six options how 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. It can also be used 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 twenty X,Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates. Two separate analog input signals can be processed simultaneously to give two corresponding separate output values using the same defined curve.

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
- Signal status propagation

The block supports two forms of the PID equation: Standard and Series. You can choose 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 1	Revision 2
Resource Block	1000	1000
Sensor Transducer Block	1100	1100
Display Transducer Block	1200	1200
Analog Input Block	1400, 1500	1400, 1500
PID Block	1600	1600
Input Selector Block	1700	1700
Signal Characterizer Block	1800	1800

Table 2-3: Block Index Numbers *(continued)*

Block name	Revision 1	Revision 2
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 index numbers up to 1500 are permanent. Function Blocks with default block indexes 1600 and higher are instantiated and can be deleted by the user.

2.11.2 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. Other modes may also be supported.

Changing modes

To change the operating mode, set the **MODE_BLK.TARGET** to the desired mode. After a short delay, the parameter **MODE_BLK.ACTUAL** should reflect the mode change if the block is operating properly. Appropriate resource, transducer, and Analog Input block mode changes are made by the automated procedures (Methods) for most configuration tasks.

Permitted modes

It is possible to prevent unauthorized changes to the operating mode of a block. To do this, configure **MODE_BLK.PERMITTED** to allow only the desired operating modes.

Note
Emerson recommends always selecting OOS as one of the permitted modes.

Types of modes

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

AUTO
The functions performed by the block will execute. If the block has any outputs, these will continue to update. This is typically the normal operating mode.

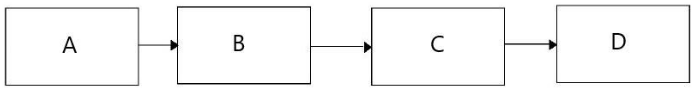
Out of Service (OOS)
The functions performed by the block will not execute. If the block has any outputs, these will typically not update and the status of any values passed to downstream blocks will be **BAD**. To make some changes to the configuration of the block, change the mode of the block to OOS. When the changes are complete, change the mode back to **AUTO**.

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

Other types of modes
Other types of modes are Cas, RCas, ROut, IMan and LO. Some of these may be supported by different function blocks in the Rosemount 2051.

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:



1. Resource block
2. Transducer block
3. Analog block (AI blocks)
4. Other function blocks

Related information

Function Block manual (00809-0100-4783)

2.11.3 Block instantiation

The Rosemount 2051 supports the use of Function Block Instantiation. When a device supports block instantiation, the number of blocks and block types can be defined to match specific application needs.The number of blocks that can be instantiated is only limited by the amount of memory within the device and the block types that are supported by the device. Instantiation does not apply to standard device blocks like the Resource, Sensor Transducer, and LCD Display Transducer Blocks.

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

2.11.4 Simulation

Simulation is the functionality of the AI block.

Procedure

There are two ways to simulate values:

- Change the mode of the block to **Manual** and adjust the output value.
- 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.

2.12 Resource Block

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

2.12.1 FEATURES and FEATURES_SEL

The **FEATURES** parameter is read-only and defines which host accessible features are supported by the 2051. Below is a list of the **FEATURES** the 2051 supports. See Specifications and Reference Data for the complete list.

Reference the feature list in the parameter table in Specifications and Reference Data.

FEATURES_SEL is used to turn on any of the supported features that are found in the FEATURES parameter. The default setting of the Rosemount 2051 does not select any of these features. Choose one or more of the supported features if any.

UNICODE

All configurable string variables in the 2051, except tag names, are octet strings. Either ASCII or Unicode may be used. If the configuration device is generating Unicode octet strings, then the Unicode option bit must be selected.

REPORTS

The 2051 supports alert reports. The Reports option bit must be set 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 WRITE_LOCK condition is cleared, a WRITE_ALM alert is generated with a priority that corresponds to the WRITE_PRI parameter.

The FEATURE_SEL parameter enables the user 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 FEATURE_SEL parameter. When this bit has been enabled the WRITE_LOCK parameter becomes read only and will reflect 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 the SOFT W LOCK bit must be set in the FEATURE_SEL parameter. Once this bit is set, the WRITE_LOCK parameter may be set to “Locked” or “Not Locked.” Once the WRITE_LOCK parameter is set to “Locked” by either the software or the hardware lock, all user requested writes shall be rejected.

2.12.2 MAX_NOTIFY

The **MAX_NOTIFY** parameter value of 7 is the maximum number of alert reports that the resource can have sent without getting a confirmation from the host, corresponding to the amount of buffer space available for alert messages. The number can be set lower, to control alert flooding, by adjusting the **LIM_NOTIFY** parameter value. If **LIM_NOTIFY** is set to zero, then no alerts are reported.

2.12.3 Alerts/alarms

Note
See Damping for Alert Configuration.

The 2051 Rev 2 pressure transmitter supports both PlantWeb Alerts and NE107 alerts. 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 will act as a coordinator for alerts. Depending on user configuration, each device will have either three or four alert Parameters. If PlantWeb alerts are configured, then the three alert parameters will be: **FAILED_ALARM**, **MAINT_ALARM**, and **ADVISE_ALARM**. If NE107 alerts are configured the four alert parameters 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 used to annunciate the alert conditions. The default factory configuration has NE107 alerts enabled.

Alerts processing within the device

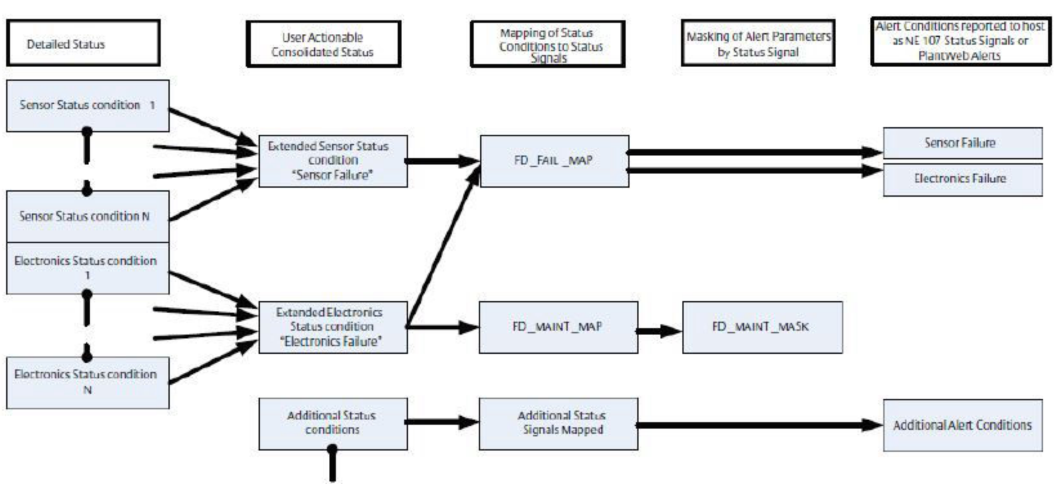
Procedure

1. Diagnostics perform comprehensive checks and update status within the device. These status conditions allow the user 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 the user has 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.

Example

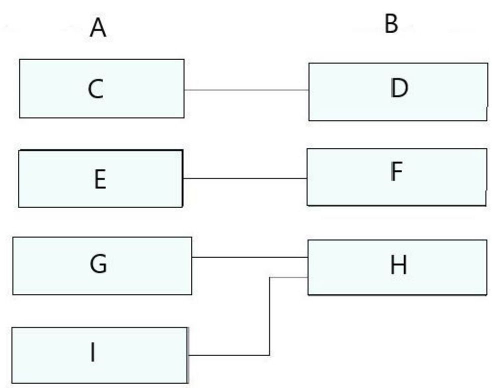
PlantWeb Alerts and NE107 alerts are both processed using the steps described above, and annunciate the same consolidated status parameters.

Figure 2-12: NE107 Alert Processing Diagram



1. Detailed status includes conditions found by all diagnostics the device runs. Detailed status for NE 107 and PlantWeb™ alerts are identical.
2. Consolidated status groups diagnostics by probable cause and corrective action. Consolidated status for NE 107 and PlantWeb™ alerts are identical.
3. Mapping of conditions defines how conditions will be reported. NE 107 mapping can be user modified.
4. Masking of conditions within each status signal determines which conditions are reported to the host and which are not by status signal. All diagnositc conditions and status signals remain visible within the device.
5. Unmasked active conditions are reported to the host. The unmasked conditions are reported by status signal categories or PlantWeb™ Alert categories.

Figure 2-13: NE 107 Status Signal to PlantWeb Alert Mapping



A. *NE 107 status signal*
B. *PlantWeb™ alert*
C. ***FD_FAIL***
D. ***FAILED***
E. ***FD_OFFSPEC***
F. ***MAINT***
G. ***FD_MAINT***
H. ***ADVISE***
I. ***FD_CHECK***

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, then the alert 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.

NE107 alerts overview

NE107 alert parameters

NE107 has four alert parameters. 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

Any of the seven alert conditions can be user configured to annunciate as any of the four alert parameters. Individual alert conditions can also be mapped into multiple alert parameters.

Alert parameter definitions and factory defaults

Note
All seven alert conditions are factory assigned to appropriate alert parameters. 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 parameter are:

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

   A **FD_FAIL_ACTIVE** alert 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** alert 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

   A **FD_MAINT_ACTIVE** alert indicates the device is still functioning but an abnormal 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** alert indicates a transducer block is not in **Auto** mode. This may be due to configuration or maintenance activities.

Mapping alert conditions

Any of the alert conditions can be mapped into any of the NE107 alert parameters. This is done 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

Any combination of alert conditions can be masked. 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 condition 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** conditions
2. **FD_OFFSPEC_MASK** to mask **FD_OFFSPEC_ACTIVE** conditions
3. **FD_MAINT_MASK** to mask **FD_MAINT_ACTIVE** conditions
4. **FD_CHECK_MASK** to mask **FD_CHECK_ACTIVE** conditions

If a consolidated diagnostic condition is configured 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** conditions
2. **FD_OFFSPEC_PRI** to specify the priority **FD_OFFSPEC_ACTIVE** conditions
3. **FD_MAINT_PRI** to specify the priority **FD_MAINT_ACTIVE** conditions
4. **FD_CHECK_PRI** to specify the priority **FD_CHECK_ACTIVE** conditions

---

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 2 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.

2.12.4 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

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

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

   Note
   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

   Note
   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

   Note
   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. The device should be checked to determine the type of abnormal condition and recommended actions to resolve it.

PlantWeb™ alert priorities

PlantWeb alert priorities are configured in DeltaV. PlantWeb 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. **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**

Note
PlantWeb alert priority is configured using DeltaV and is not part of the Device Description functionality.

2.13 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 this section is the same as in the Quick Start Guide. Reference Analog Input (AI) function block through Advanced device setup for more detailed configuration information.

2.13.1 AI block quick configuration

Before you begin

Before beginning configuration, you may need to verify the Device Tag or deactivate hardware and software write protection on the transmitter. Otherwise, continue at Configure the AI block below.

Procedure

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 2-26):
   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):
      - Navigation: 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
Before beginning Analog Input Block configuration, place the control loop into **Manual** mode.

AI block configuration

Always check and reconcile function block configuration (with the exception of Resource and Transducer blocks) after commissioning the transmitter to the control host. Function block configuration, including AI blocks, made prior to device commissioning to the control host may not be saved 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
Changes to the AI block configuration performed after the transmitter is commissioned are typically performed 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, final AI block configuration and AI block configuration changes should only be made using the DeltaV Explorer.

Procedure

1. 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.

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. The control host, and some asset management hosts can reconfigure 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.

Note
Step 4 through Step 6 are all performed in a single step by step method under guided setup, or on a single screen using **Manual** setup.

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

2. To select the Signal Conditioning **L_TYPE** from the drop-down 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. To set **XD_SCALE** to the 0% and 100% scale points (the transmitter range):
    a) Select the **XD_SCALE_UNITS** from the drop-down 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**, the AI Block may be placed 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 drop-down 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**, the AI Block may be placed 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) The AI Block may be placed in **AUTO** mode to return the device to service. **Guided Setup** does this automatically.
6. Change Damping:
    - To use **Manual Setup**:
        a. Navigate to **Configure** → **Manual Setup** → **Process Variable** → **Change Damping**.
        b. Enter the desired damping value in seconds. The permitted range of values is 0.4 to 60 seconds.
        c. Check each parameter to be displayed. The LCD display will continuously scroll through the selected parameters.
    - To use **Guided Setup**:

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

        a. Navigate to **Configure** → **Guided Setup** → **Local Display Setup**.
        b. 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.
7. Review transmitter configuration and place in service:
    a) To review the transmitter configuration, navigate using the **Manual** 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 on the **Change** button, and then click on **Return All to Service**.

8. Set switches and software write lock.
   a) Check switches (see Figure 4-2).

Note
The **Write lock** switch can be left 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.

2.14 Analog Input (AI) function block

2.14.1 Configure the AI block

Always check and reconcile function block configuration (with the exception of Resource and Transducer blocks) after commissioning the transmitter to the control host. Function block configuration, including AI blocks, made prior to device commissioning to the control host may not be saved 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
Changes to the AI block configuration performed after the transmitter is commissioned are typically performed 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, final AI block configuration and AI block configuration changes should only be made 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 2051 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

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
L-Type	Direct, Indirect, or Square Root

Parameters	Enter data				
XD_Scale	Scale and Engineering Units				
Note Select only the units that are supported by the device.	Pa	bar	torr @ 0 °C	ft $H_2$0 @ 4°C	m $H_2$0 @ 4 °C
	kPa	mbar	kg/cm^2	ft $H_2$0 @ 60 °F	mm Hg @ 0 °C
	mPa	psf	kg/m^2	ft $H_2$0 @ 68 °F	cm Hg @ 0 °C
	hPa	Atm	in $H_2$0 @ 4°C	mm $H_2$0 @ 4 °C	in Hg @ 0 °C
	Deg C	psi	in $H_2$0 @ 60 °F	mm $H_2$0 @ 68 °C	m Hg @ 0 °C
	Deg F	g/cm^2	in $H_2$0 @ 68 °F	cm $H_2$0 @ 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

Pressure transmitter

Situation #1

A pressure transmitter with a range of 0 – 100 psi.

Solution

Table 2-5 lists the appropriate configuration settings.

Table 2-5: Analog Input function block configuration for a typical pressure transmitter

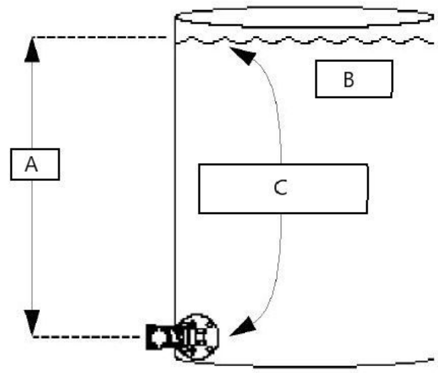
Parameter	Configured values
L_TYPE	Direct
XD_SCALE	Primary_Value_Range
OUT_SCALE	Primary_Value_Range
Channel	1 - pressure

Pressure transmitter used to measure level in an open tank

Situation #2

The level of an open tank is to be measured using a pressure tap at the bottom of the tank. The maximum level at the tank is 16 ft. The liquid in the tank has a density that makes the maximum level correspond to a pressure of 7.0 psi at the pressure tap (see Figure 2-14).

Figure 2-14: Situation #2 Diagram



A. *16 ft (4.8 m)*
B. *Full tank*
C. *7.0 psi measured at the transmitter*

Solution to Situation #2

The table below lists the appropriate configuration settings.

Analog Input function block configuration for a pressure transmitter used in level measurement (Situation #1).

Parameter	Configured values
L_TYPE	Indirect
XD_SCALE	0 to 7 psi
OUT_SCALE	0 to 16 ft
Channel	1 - pressure

Output calculation for Situation #2

When the **L_Type** is configured as Indirect, the **OUT** parameter is calculated as:

$$OUT = \frac{PV - XD\_SCALE\_0\%}{XD\_SCALE\_100\% - XD\_SCALE\_0\%} * (OUT\_SCALE\_100\% - OUT\_SCALE\_0\%) + OUT\_SCALE\_0\%$$

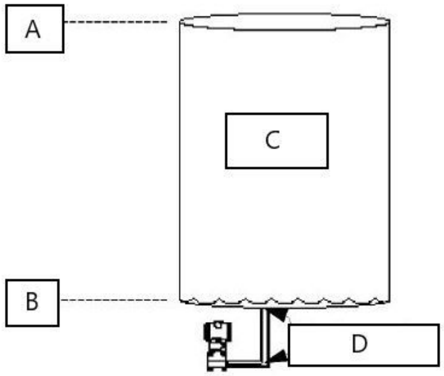
In this example, when PV is 5 psi, then the **OUT** parameter will be calculated as follows:

$$OUT = \frac{5\ psi - 0\ psi}{7\ psi - 0\ psi} * (16\ ft. - 0\ ft.) + 0\ ft. = 11.43\ ft.$$

Situation #3

The transmitter in Situation #3 is installed below the tank in a position where the liquid column in the impulse line, with an empty tank, is equivalent to 2.0 psi (see Figure 2-15).

Figure 2-15: Situation #3 Diagram



A. *16 feet (4.8 m)*
B. *0 feet (0 m)*
C. *Empty tank*
D. *2.0 psi measured at the transmitter*

Solution to Situation #3

The table below lists the appropriate configuration settings.

Analog Input function block configuration for a pressure transmitter used in level measurement (Situation #3).

Parameter	Configured values
L_TYPE	Indirect
XD_SCALE	2 to 9 psi
OUT_SCALE	0 to 16 ft
Channel	1 - pressure

In this example, when the PV is 4 psi, **OUT** will be calculated as follows:

$$OUT = \frac{4\ psi - 2\ psi}{9\ psi - 2\ psi} * (16\ ft. - 0\ ft.) + 0\ ft. = 4.57\ ft.$$

Differential pressure transmitter to measure flow

Situation #4

The liquid flow in a line is to be measured using the differential pressure across an orifice plate in the line. Based on the orifice specification sheet, the differential pressure transmitter was calibrated for 0 to 20 inH_20 for a flow of 0 to 800 gal/min.

Solution

The table below lists the appropriate configuration settings.

Parameter	Configured values
L_TYPE	Indirect Square Root
XD_SCALE	0 to 20 in.H_2O

Parameter	Configured values
OUT_SCALE	0 to 800 gal/min.
Channel	1 - pressure

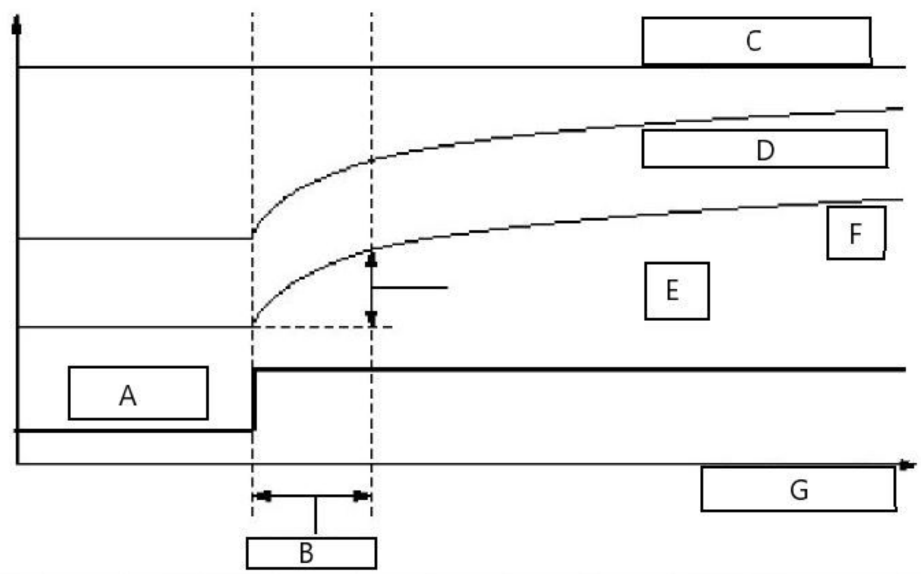
$$\text{Out} = \sqrt{\frac{PV - XDSCALE0}{XDSCALE100}}(OUTSCALE100 - OUTSCALE0) + OUTSCALE0$$

$$\text{OUT} = \sqrt{\frac{8inH_2O - 0inH_2O}{20inH_2O - 0inH_2O}}(800gal/min. - 0gal/min.) + 0gal/min. = 505.96gal/min.$$

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 2-16: Analog Input PV_FTIME filtering Diagram



A. ***FIELD_VAL***
B. ***PV_FTIME***
C. ***OUT*** *(Mode in* ***Manual****)*
D. ***OUT*** *(Mode in* ***Auto****)*
E. ***PV***
F. *6*
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:

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**, then 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.

2.15 Advanced device setup

2.15.1 Overall configuration

Configuration tasks will be listed in alphabetical order. Each task will start with navigation per the menu tree navigation diagram, to an appropriate configuration starting screen. Next, individual configuration steps will be listed. In many cases, the steps can be used for either guided or manual configuration.

The summary of the sections are as follows:

Note
Many configuration tasks can be initiated from more than one appropriate configuration starting screen. This manual will describe configuration from one starting screen only. The starting screen used in the manual should not be interpreted 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.

2.15.2 Damping

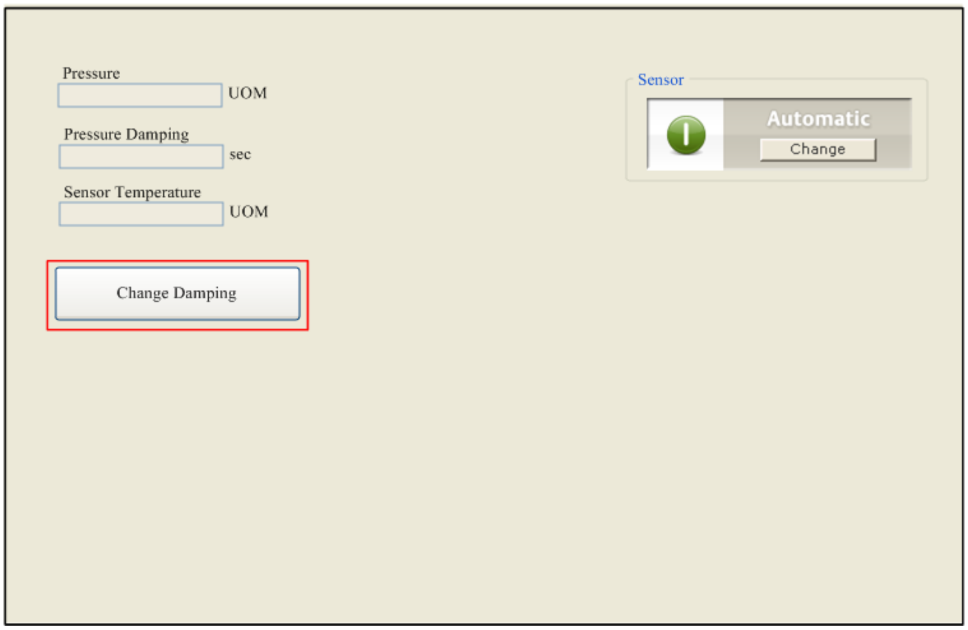
Note
Damping, gauge scaling, calibration, and sensor trims are performed in the Sensor Transducer Block. For block-oriented user interfaces, configure **Damping** in the Sensor Transducer Block.

Menu Navigation: **Configure Manual Setup Process Variable**

Damping can be changed using 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 on the **Change Damping** button. An automated task procedure called a **Method** will guide the user 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 2-17: Process Variables Screen



The **Change Damping** button shown in Figure 2-17 above starts an automated procedure called a **Method** which allows damping to be changed.

Procedure

1. The device will be placed **Out of service**.
2. Enter the new damping value in seconds.
3. The device will be returned to **Auto** mode.

2.15.3 Gauge scaling

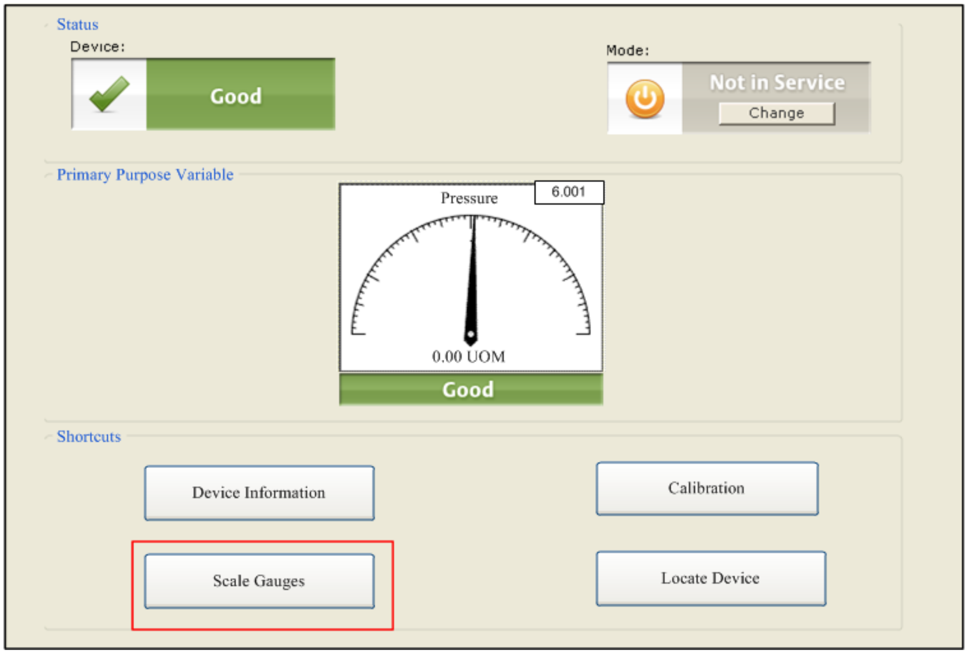
Menu Navigation: ***Overview***

Scale Gauges is used to change the scaling displayed on the Gauges used to view variables. From the ***Overview*** screen, click on the **Scale Gauges** button. An automated task procedure called a **Method** will guide the user 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 2-18: Overview Screen



The **Scale Gauges** button shown in Figure 2-18 above starts an automated procedure called a method which allows the user to change the scaling on the gauge.

2.15.4 Local display (LCD display)

Note
Local Display setup is performed 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

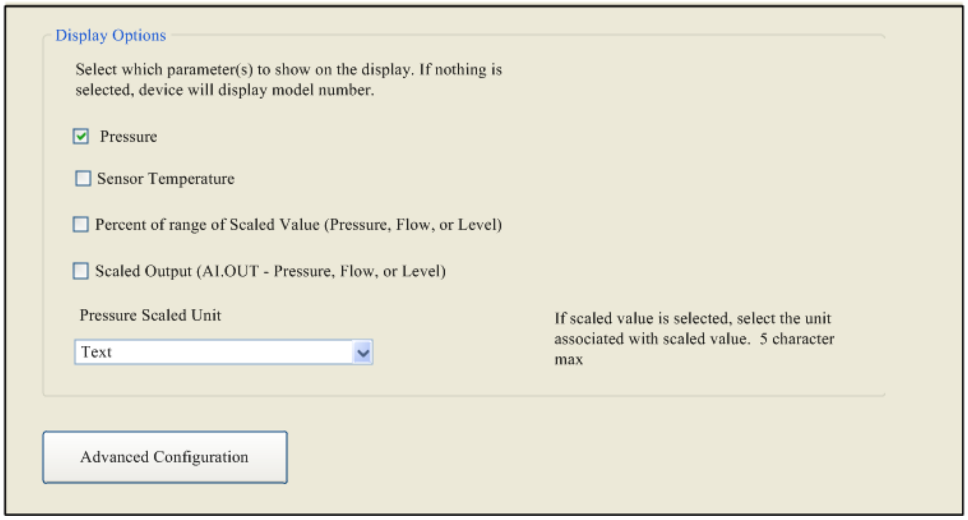
Basic Display Setup provides a check-the-box way for the user to configure up to four parameters to display on the LCD display. These parameters are displayed on a rotating basis.

Procedure

1. Check the box next to each parameter the LCD display should display.

2. If **Scaled Output** is selected, use the **Pressure Scaled Unit** drop-down menu to select units.

Figure 2-19: Local Display Basic Configuration Screen



The screen shown in Figure 2-19 above allows the user to select parameters to be displayed on the LCD display by checking the box next to each parameter. Clicking on the **Advanced Configuration** button accesses more display configuration options.

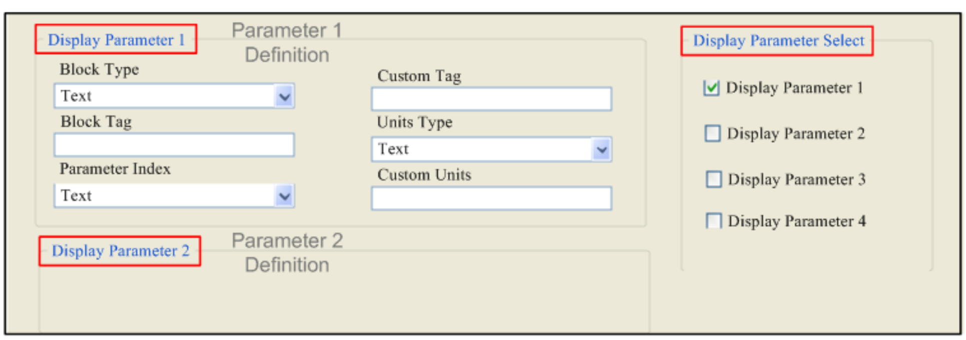
Advanced display setup

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

Advanced Display Setup provides a fill in the blanks screen where the user can configure parameters from any function block in the device to be displayed on the LCD display. Setup is a two-step process. First, each of up to four parameters is defined. To define a parameter, the user selects the ***Block Type***, ***Parameter Index***, and ***Units Type*** from drop-down menus. The user can enter ***Block Tag***, ***Custom Tag***, and ***Custom Units***.

Once all desired parameters have been defined, the second step is parameters are selected for display by checking the box in the ***Display Parameter Select*** area.

Figure 2-20: LCD Display Advanced Configuration Screen



The screen shown in Figure 2-20 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
The LCD display can be configured to display a mix of basic and advanced parameters.

2.15.5 Mode

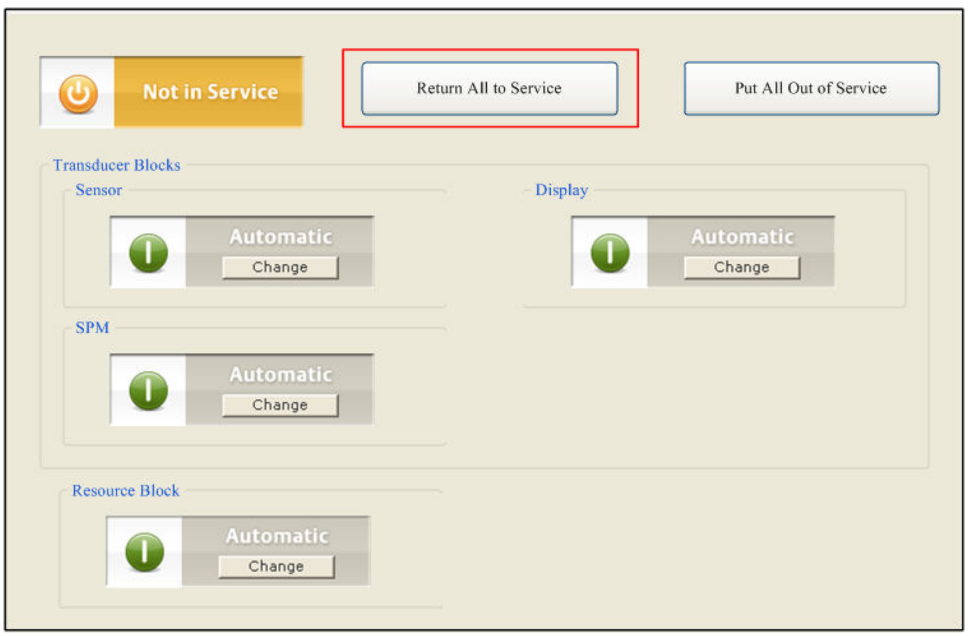
Note
Each block has modes. For block-oriented user interfaces, modes must be managed individually in each block.

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 2051 DDs and DTMs 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 tasks are done using **Manual** procedures, the user is responsible for managing modes.

The 'Mode Summary' function displays the active mode for all resource and transducer blocks, and allows the user to change modes of those blocks individually, or collectively. This is most frequently used to **Return All to Service**. Analog input modes are managed from the analog input block configuration screens, or from the control host.

Figure 2-21: Mode Summary Screen



The screen shown in Figure 2-21 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.

2.15.6 Alert configuration NE107 and PlantWeb™

The objective of alerts is to inform users of conditions of interest, and guide the user to effective corrective actions. The Rosemount 2051 Revision 2 Pressure Transmitter with FOUNDATION™ Fieldbus communications provides alerts in both NE107 format and PlantWeb

Alerts format. 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** OR **PlantWeb Alerts**

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

Note
Device Alerts Suppression, **Process Alerts Suppression**, and **Diagnostic Alerts Suppression** are configured the same way. One example will be shown.

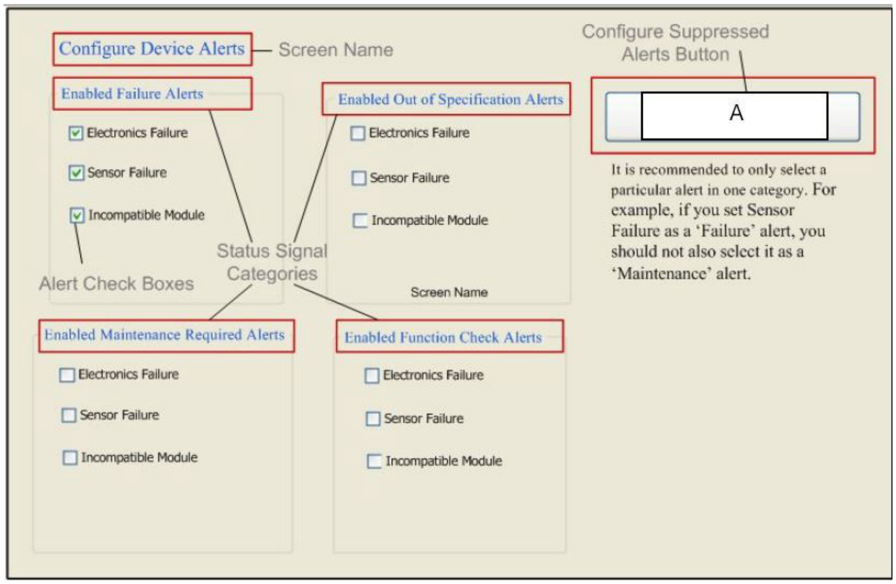
NE107 Alerts category configuration

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 checkboxes. Alerts are assigned to a category by checking the check box next to the alert. This activates the alert in that category. Alerts can be assigned to more than a single category by checking the same alert check box in multiple categories.

Note
Emerson does not recommend this as alarms can proliferate increasing the complexity of alarm management and delaying corrective action. Use of the factory default alert categories is recommended.

Figure 2-22: *Configure Device Alerts* Screen



A. Suppressed Device Alerts

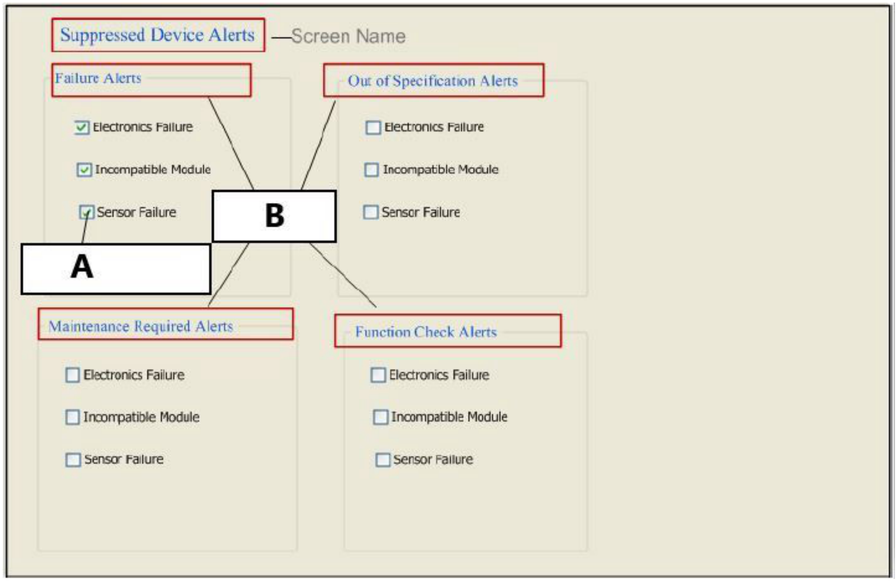
The screen shown in Figure 2-22 above is where the alerts are assigned by checking the box next to the desired alert in the desired category.

Alerts suppression

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

Once alerts have been configured they can be suppressed. To suppress alerts, click on the ***Suppressed Device Alerts*** button on the configuration screen. Alerts can be suppressed by checking the check box next to the alert. This suppresses the alert in that category. Alerts can be suppressed by category if the alert is configured to multiple categories. This allows alerts to be selectively suppressed. To stop suppressing an alert, click on the checked box suppressing the alert.

Figure 2-23: NE107 *Suppressed Device Alerts* Screen



A. *Suppress alert checkboxes*
B. *Status signal categories*

The screen shown in Figure 2-23 above is where alerts are suppressed by checking the box next to the alert to be suppressed.

PlantWeb™ alerts configuration

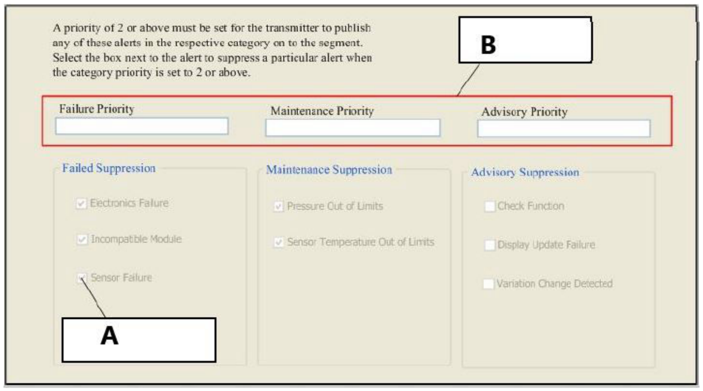
PlantWeb alerts are automatically configured during the NE 107 alert configuration process. There is not a separate process for configuration of PlantWeb alerts.

PlantWeb™ alerts suppression

Menu Navigation: **Configure** → **Alert Setup** → **PlantWeb Alerts** →

There are two methods to suppress PlantWeb Alerts. The first is to assign an alert category, Failed, Maintenance, or Advisory, a priority of 0 or 1. This will suppress all alerts in that category. The second is to suppress individual alerts using NE 107 Alert suppression.

Figure 2-24: PlantWeb Alerts Suppression Screen



A. Suppress alert checkboxes
B. Alert priority entry fields

The screen shown in Figure 2-24 above allows categories of alerts or individual alerts to be suppressed.

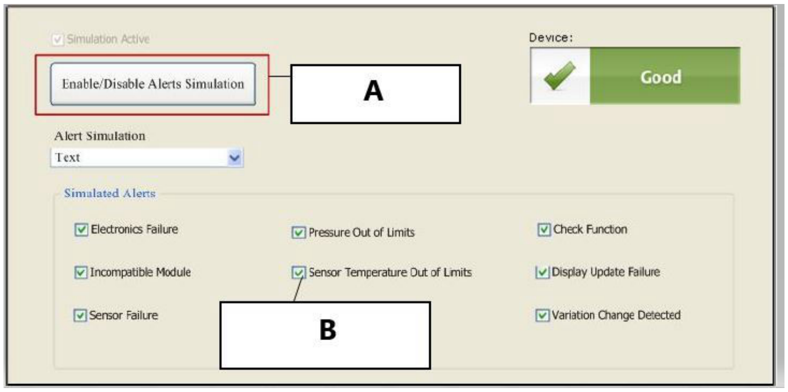
2.15.7 Alert simulation

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**, individual alerts can be simulated by checking the checkbox next to the desired alert condition. The device status indication located on the upper right corner of the screen will change to show the device status associated with the simulated alert. The simulated status will be displayed everywhere device status is displayed. ***Alert Simulation*** is **Enabled** and **Disabled** using an automated procedure called a 'Method'.

Figure 2-25: Enable/Disable Alert Simulation Screen



A. Enable/disable alert suppression button
B. Checkboxes to activate/deactivate simulation of specific alerts

The screen shown in Figure 2-25 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***. Select the ***Yes*** radio button.

   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***. Select the ***Yes*** radio button.

2.15.8 Write lock

Note
Write lock functions are performed 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** will guide the user through Write Lock setup. Write lock permits users to configure, enable, and disable the various write lock options. Write lock can be implemented as a hardware lock or a software lock. If it is implemented as a hardware lock, the position of the hardware lock switch on the 2051 electronics board will determine if device writes are permitted.

Note
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.

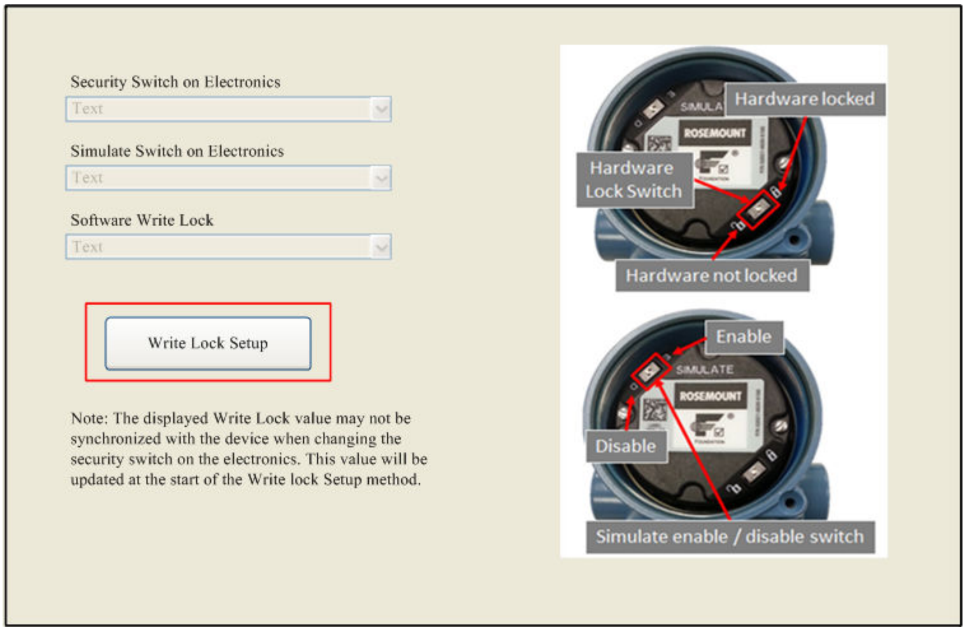
When the write lock procedure is initiated, it first informs the user if write lock is currently enabled, and if it is configured as hardware or software write lock.

If hardware write lock is enabled, the physical switch on the electronics board must be set 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.

The selection of the hardware or software write lock is done by clicking on the radio button next to the desired option.

Figure 2-26: Security and Simulation Display Screen



The screen shown in Figure 2-26 above allows users 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 2051 with FOUNDATION™ Fieldbus protocols. A Quick Start Guide (document number 00825-0200-4101) is shipped with every transmitter to describe recommended pipe-fitting and wiring procedures for initial installation. For dimensional drawing information, refer to the Dimensional Drawings section of the Rosemount 2051 Product Data Sheet.

Note
For transmitter disassembly and reassembly, refer to Disassembling the transmitter and Reassemble the transmitter.

3.2 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. Also, consider the need for easy access, personnel safety, practical field calibration, and a suitable transmitter environment. Install the transmitter to minimize vibration, shock, and temperature fluctuation.

⚠ WARNING

Install the enclosed pipe plug (found in the box) in unused conduit opening with a minimum of five threads engaged to comply with explosion-proof requirements.
For tapered threads, install the plug wrench tight. For material compatibility considerations, see Material Selection and Compatibility Considerations for Rosemount Pressure Transmitter Technical Note on Emerson.com/Global.

3.2.1 Mechanical considerations

Steam service

NOTICE

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.

Side mounted

Note
When the transmitter is mounted on its side, position the Coplanar™ flange to ensure proper venting or draining.

Keep drain/vent connections on the bottom for gas service and on the top for liquid service.

3.2.2 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.

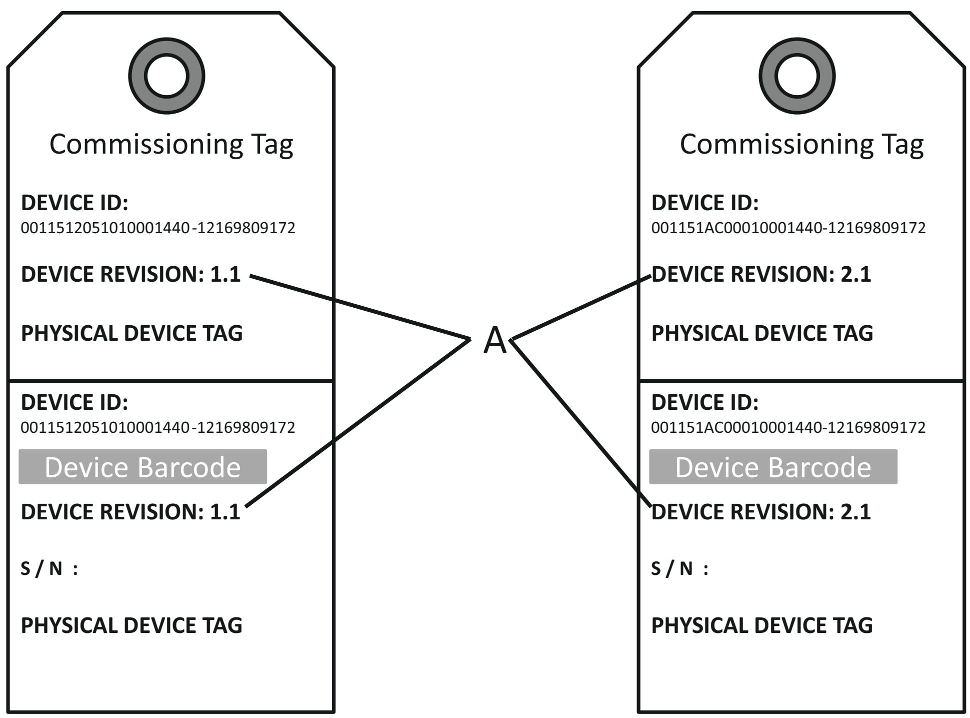
3.3 Tagging

3.3.1 Commissioning tag

The 2051 has been supplied with a removable commissioning tag that contains both the `Device ID` (the unique code that identifies a particular device in the absence of a device tag) and a space to record the device tag (`PD_TAG`) (the operational identification for the device as defined by the Piping and Instrumentation Diagram [P&ID]).

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

Figure 3-1: Commissioning Tag



A. Device revision

3.3.2 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.

3.4 Installation procedures

3.4.1 Mounting options

For dimensional drawing information, refer to the *Dimensional Drawings* section of the Rosemount 2051 Product Data Sheet.

Process flange orientation

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

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

Terminal side of electronics housing

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 on the unused side of the conduit opening.

Circuit side of electronics housing

Provide 0.75-in. (19 mm) of clearance for units without an LCD display. Provide 3-in. (76 mm) of clearance for units installed with LCD display.

Cover installation

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

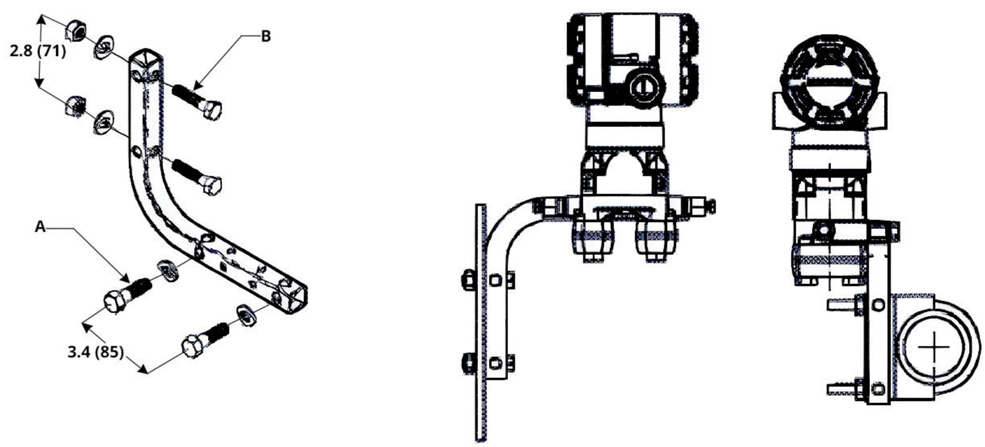
Mounting brackets

You can panel mount or pipe mount the transmitter through an optional mounting bracket. Refer to Table 3-1 for the complete offering and see Figure 3-2 through Figure 3-5 for dimensions and mounting configurations.

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	✓	✓	N/A	✓	✓	✓	N/A	✓	N/A	✓
B1	N/A	N/A	✓	✓	N/A	N/A	✓	N/A	✓	N/A
B2	N/A	N/A	✓	N/A	✓	N/A	✓	N/A	✓	N/A
B3	N/A	N/A	✓	N/A	N/A	✓	✓	N/A	✓	N/A
B7	N/A	N/A	✓	✓	N/A	N/A	✓	N/A	N/A	✓
B8	N/A	N/A	✓	N/A	✓	N/A	✓	N/A	N/A	✓
B9	N/A	N/A	✓	N/A	N/A	✓	✓	N/A	N/A	✓
BA	N/A	N/A	✓	✓	N/A	N/A	N/A	✓	N/A	✓
BC	N/A	N/A	✓	N/A	N/A	✓	N/A	✓	N/A	✓

Figure 3-2: Mounting bracket option code B4



A. ⅜ - 16 x 1¼ bolts for mounting to transmitter
B. 5/16 x 3½ bolts for panel mounting (not supplied)

Figure 3-3: Mounting bracket option codes B1, B7, and BA

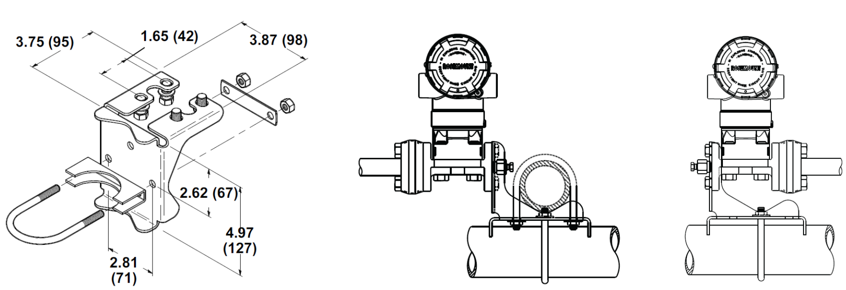


Figure 3-4: Panel mounting bracket code options B2 and B8

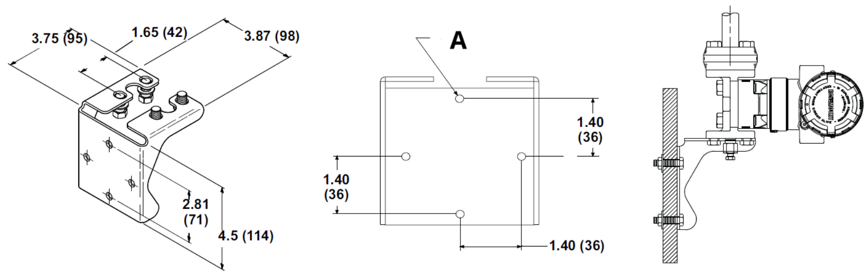
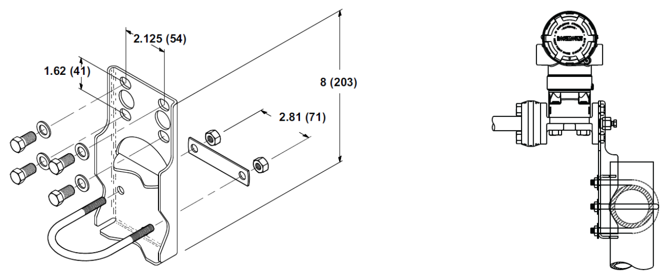


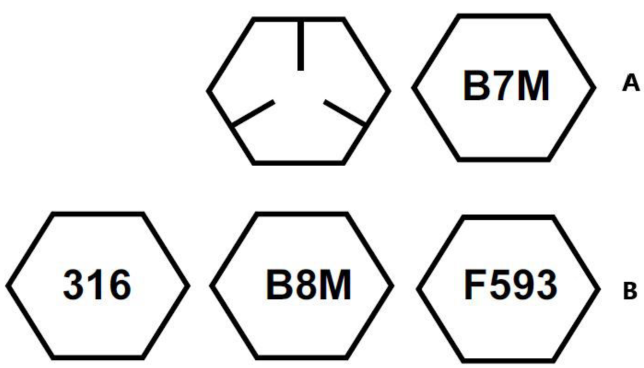
Figure 3-5: Flat mounting bracket option codes B3 and B3



Flange bolts

The 2051 is shipped with a coplanar flange installed with four 1.75-in. (44 mm) flange bolts. See Figure 3-6 and Figure 3-8. Stainless steel bolts are coated with a lubricant to ease installation. Carbon steel bolts do not require lubrication. No additional lubricant should be applied when installing either type of bolt.

Bolts are identified by their head markings:



A. *Carbon steel (CS) head markings*
B. *Stainless steel (SST) head markings*

Note
The last digit in the `F593_` head marking may be any letter between `A` and `M`.

Bolt installation

Only use bolts supplied with the 2051 or provided by Emerson as spare parts. When installing the transmitter to one of the optional mounting brackets, torque the bolts to 125 in-lb. (0,9 N-m). Use the following bolt installation procedure:

Procedure

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

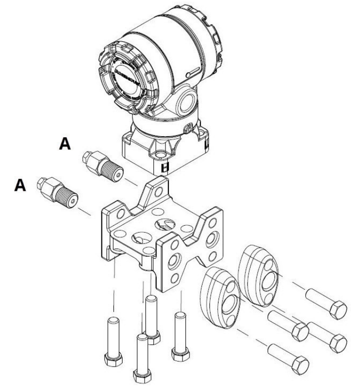
Example

Torque values for the flange and manifold adapter bolts are as follows:

Table 3-2: Bolt Installation Torque Values

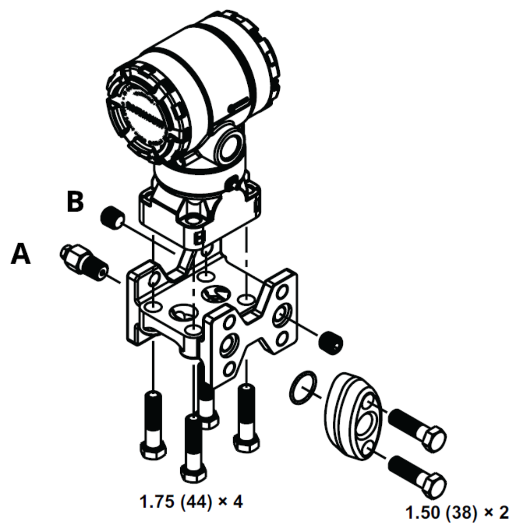
Bolt material	Initial torque value	Final torque value
CS-ASTM-A449 Standard	300 in-lb. (34 N-m)	650 in-lb. (73 N-m)
316 SST—Option L4	150 in-lb. (17 N-m)	300 in-lb. (34 N-m)
ASTM-A-193-B7M—Option L5	300 in-lb. (34 N-m)	650 in-lb. (73 N-m)
ASTM-A-193 Class 2, Grade B8M—Option L8	150 in-lb. (17 N-m)	300 in-lb. (34 N-m)

Figure 3-6: Traditional Flange Bolt Configurations - Differential transmitter



A. Drain/vent

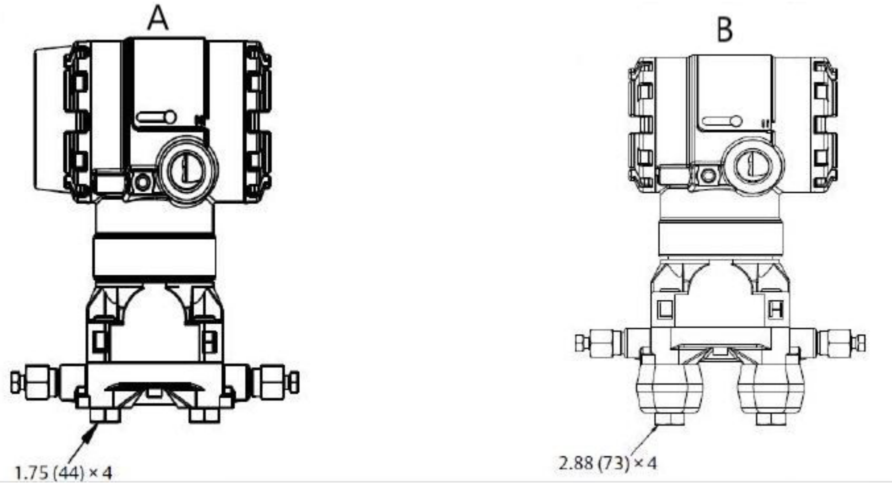
Figure 3-7: Traditional Flange Bolt Configurations - Gauge transmitter



Note
Dimensions are in inches (millimeters).

A. Drain/vent
B. Plug

Figure 3-8: Mounting Bolts and Bolt Configurations for Coplanar Flange



A. *Transmitter with Flange Bolts*
B. *Transmitter with Flange Adapters a Flange/Adapter Bolts*

Note
Dimensions are in inches (millimeters).

Description	Size in inches (mm)
Flange bolts	1.75 (44)
Flange/adapter bolts	2.88 (73)
Manifold/flange bolts	2.25 (57)

Note
Rosemount 2051T transmitters are direct mount and do not require bolts for process connection.

3.4.2 Impulse piping

The piping between the process and the transmitter must accurately transfer the pressure to obtain accurate measurements.

There are six possible sources of impulse piping error:

- Pressure transfer
- Leaks
- Friction loss (particularly if purging is used)
- Trapped gas in a liquid line
- Liquid in a gas line
- Density variations between the legs

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./foot (8 cm/m) upward from the transmitter toward the process connection.
- For gas service, slope the impulse piping at least 1 in./foot (8 cm/m) downward from the transmitter toward the process connection.
- Avoid high points in liquid lines and low points in gas lines.
- Ensure 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.

Mounting requirements

Impulse piping configurations depend on specific measurement conditions.

Refer to Figure 3-8 for examples of the following mounting configurations:

Liquid flow measurement

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

Gas flow measurement

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

Steam flow measurement

- Place taps to the side of the line.
- Mount the transmitter below the taps to ensure that impulse piping will remain 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 startup.

NOTICE

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. See Temperature Limits in the 2051 Product Data Sheet for details.

Figure 3-9: Liquid applications installation example

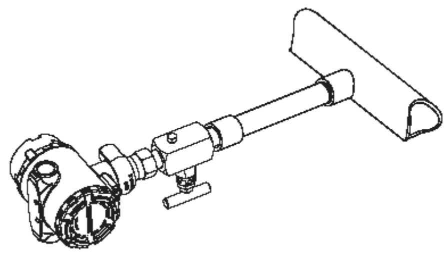
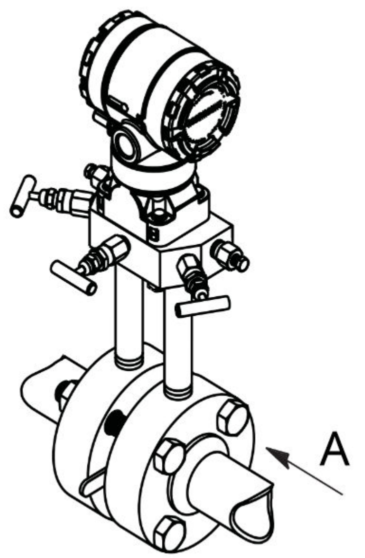
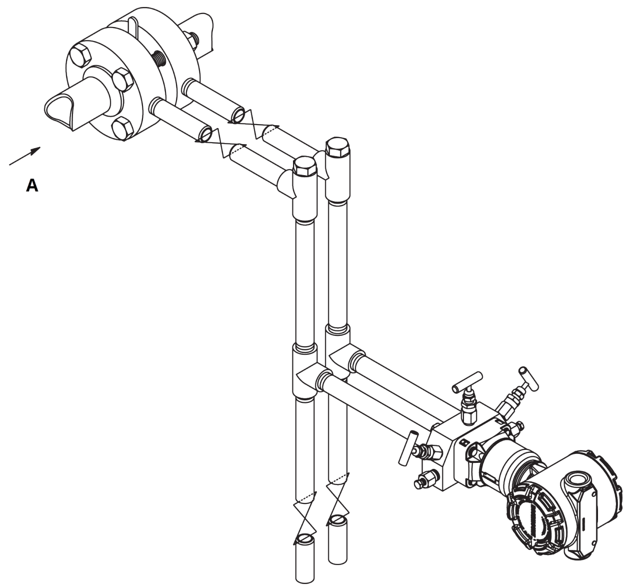


Figure 3-10: Gas installation example



A. Flow

Figure 3-11: Steam applications installation example



A. *Flow*

3.4.3 Process connections

Coplanar or traditional process connection

NOTICE

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.

⚠ CAUTION

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

Install flange adapters

Rosemount 2051DP and GP process connections on the transmitter flanges are ¼–18 NPT. Flange adapters are available with standard ½–14 NPT Class 2 connections. Use the flange adapters to disconnect from the process by removing the flange adapter bolts.

⚠ WARNING

Process leaks

Process leaks could result in death or serious injury.

Install and tighten all four flange bolts before applying pressure.
Do not attempt to loosen or remove flange bolts while the transmitter is in service.

Use plant-approved lubricant or sealant when making the process connections. This distance may be varied ±⅛ in. (3.2 mm) by rotating one or both of the flange adapters.

To install adapters to a Coplanar flange:

Procedure

1. Remove the flange bolts.

   Whenever you remove flanges or adapters, visually inspect the PTFE O-rings. If there are any signs of damage, such as nicks or cuts, replace the O-rings with O-rings designed for Rosemount transmitters. You may reuse undamaged O-rings. If you replace the O-rings, retorque the flange bolts after installation to compensate for cold flow.
2. Leaving the flange in place, move the adapters into position with the O-rings 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.

O-rings

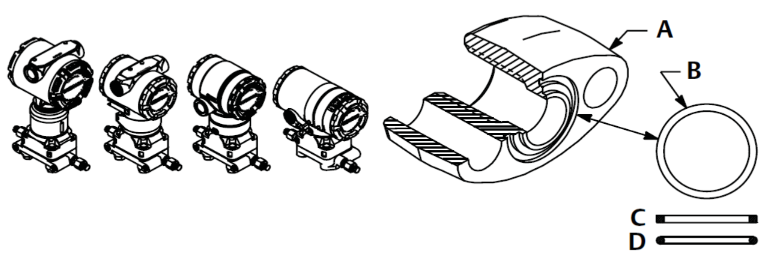
The two styles of Rosemount flange adapters (Rosemount 3051/2051/2024/3095) each require a unique O-ring (see Figure 3-12). Use only the O-ring designed for the corresponding flange adapter.

⚠ 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 in Figure 3-12. When compressed, PTFE O-rings tend to cold flow, which aids in their sealing capabilities.

Figure 3-12: O-rings for Rosemount 3051S, 3051, 2051, 3001, 3095, and 2024



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

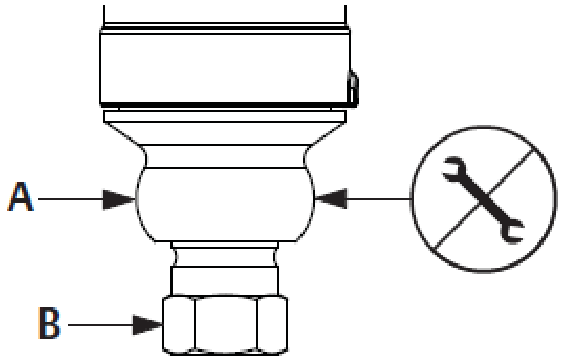
NOTICE

If the flange adapter is removed, then the PTFE O-rings must be replaced.

Inline process connection

NOTICE

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



A. Sensor module

B. Process connection

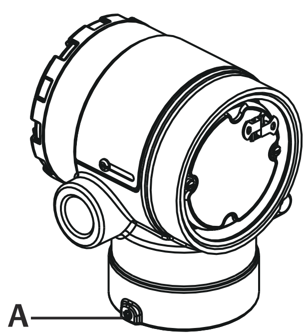
3.4.4 Rotate housing

You can rotate the electronics housing up to 180 degrees in either direction 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-inch hex wrench.

Figure 3-13: Housing Rotation



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

2. Rotate the housing clockwise to the desired location.
3. If the desired location cannot be achieved due to thread limitation, rotate the housing counterclockwise to the desired location (up to 360° from thread limit).
4. Retighten the housing rotation set screw to no more than 7 in-lb when desired location is reached.

3.5 Hazardous locations certifications

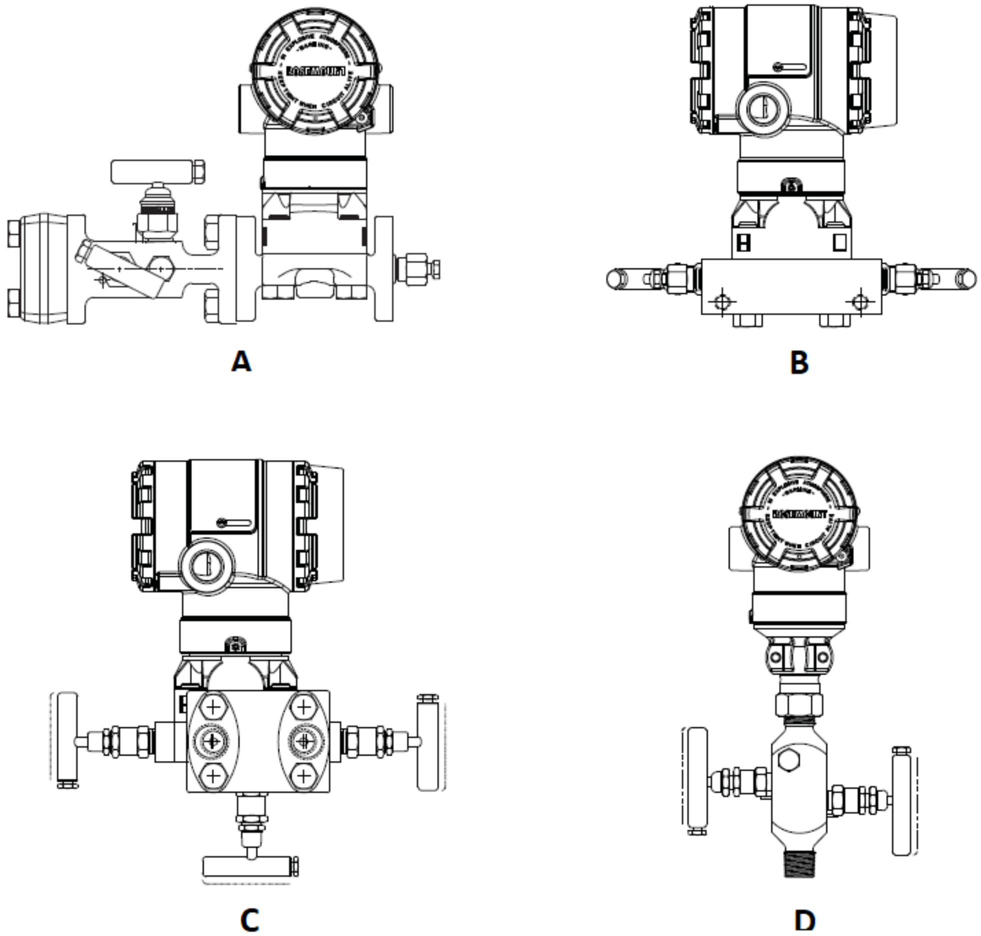
Individual transmitters are clearly marked with a tag indicating the approvals they carry. Transmitters must be installed in accordance with all applicable codes and standards to maintain these certified ratings. For information on these approvals, refer to Product Certifications in the 2051 Pressure Transmitter and Rosemount 2051CF Series Flow Meter QSG.

3.6 Rosemount 304, 305, and 306 Manifolds

The 305 Integral Manifold is available in two designs: Traditional and Coplanar™.

You can mount the traditional 305 Integral Manifold to most primary elements with mounting adapters in the market today. The 306 Integral Manifold is used with the 2051T In-Line Transmitters to provide block-and-bleed valve capabilities of up to 10,000 psi (690 bar).

Figure 3-14: Manifolds



A. *2051C and 304 Conventional*
B. *2051C and 305 Integral Coplanar*
C. *2051C and 305 Integral Traditional*
D. *2051T and 306 In-Line*

3.6.1 Install 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.

   NOTICE

   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 2¼-inch (57 mm) manifold bolts for alignment. 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. 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.

NOTICE

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

3.6.2 Install Rosemount 306 Integral Manifold

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

Assemble the 306 Manifold to the in-line transmitters with a thread sealant.

3.6.3 Install 304 Conventional Manifold

Procedure

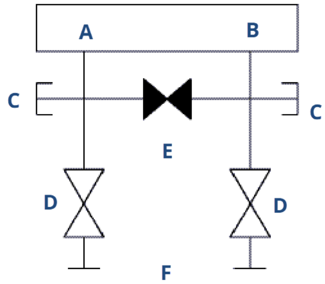
1. Align the conventional manifold with the transmitter flange. Use the four manifold bolts for alignment.
2. Finger tighten the bolts; then tighten the bolts incrementally in a cross pattern to the final torque value.
   When fully tightened, the bolts extend through the top of the sensor module housing.
3. Leak-check assembly to maximum pressure range of transmitter.

3.6.4 Integral manifold operation

Operate three-valve manifold

Prerequisites

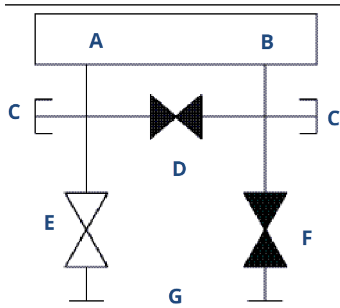
In normal operation, the two block valves between the process and instrument ports will be open, and the equalizing valve(s) will be closed.



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

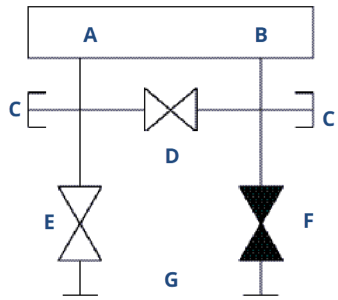
Procedure

1. To zero the transmitter, close the isolate valve to the low pressure (downstream) side of the transmitter first.



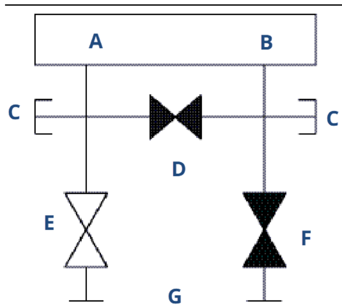
A. High
B. Low
C. Drain/vent valve
D. Equalize (closed)
E. Isolate (open)
F. Isolate (closed)
G. Process

2. Open the center (equalize) valve to equalize the pressure on both sides of the transmitter.
   The valves are now in the proper configuration for zeroing the transmitter.



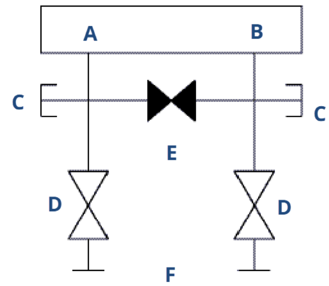
A. High
B. Low
C. Drain/vent valve
D. Equalize (open)
E. Isolate (open)
F. Isolate (closed)
G. Process

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



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

4. Open the isolate valve on the low pressure side of the transmitter to return the transmitter to service.

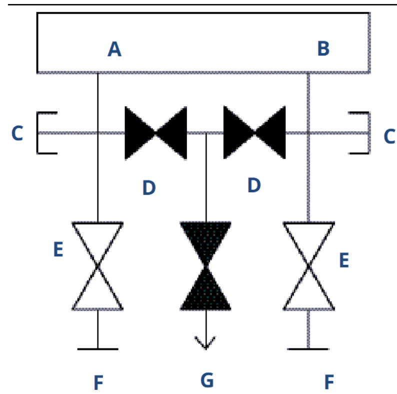


A. High
B. Low
C. Drain/vent valve
D. Isolate (open)
E. Equalize (closed)
F. Process

Operate five-valve manifold

Five-valve natural gas configurations are shown.

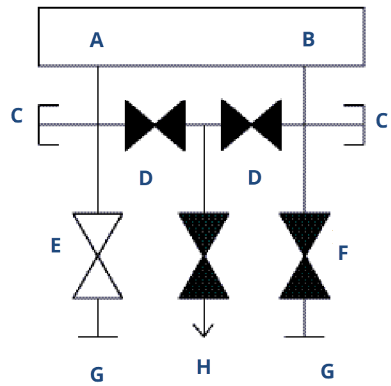
In normal operation, the two block valves between the process and instrument ports will be open, and the equalizing valves will be closed.



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

Procedure

1. To zero the transmitter, first close the block valve on the low pressure (downstream) side of the transmitter.



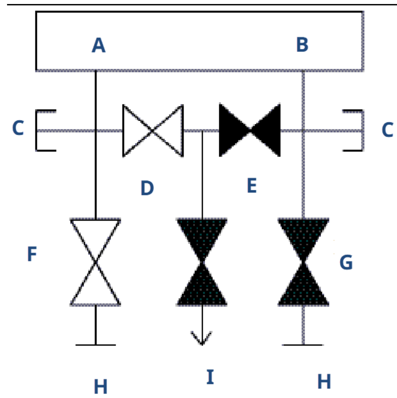
A. High
B. Low
C. Test (plugged)
D. Equalize (closed)
E. Isolate (open)
F. Isolate (closed)
G. Process
H. Drain vent

NOTICE

Opening the low side equalize valve before the high side equalize valve will overpressure the transmitter.

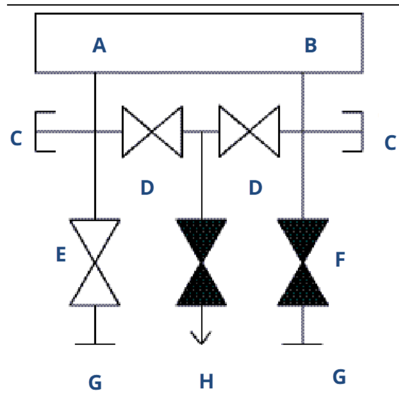
Do not open the low side equalize valve before the high side equalize valve.

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



A. High
B. Low
C. Test (plugged)
D. Equalize (open)
E. Equalize (closed)
F. Isolate (open)
G. Isolate (closed)
H. Process
I. Drain vent (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. High
B. Low
C. Test (plugged)
D. Equalize (open)
E. Isolate (open)
F. Isolate (closed)
G. Process
H. Drain vent (closed)

3.7 Liquid level measurement

Differential pressure transmitters used for liquid level applications measure hydrostatic pressure head. Liquid level and specific gravity of a liquid are factors in determining pressure head. This pressure is equal to the liquid height above the tap multiplied by the specific gravity of the liquid. Pressure head is independent of volume or vessel shape.

3.7.1 Open vessels

A pressure transmitter mounted near a tank bottom measures the pressure of the liquid above.

Make a connection to the high pressure side of the transmitter and vent the low pressure side to the atmosphere. Pressure head equals the liquid's specific gravity multiplied by the liquid height above the tap.

Zero range suppression is required if the transmitter lies below the zero point of the desired level range. Figure 1 shows a liquid level measurement example.

3.7.2 Closed vessels

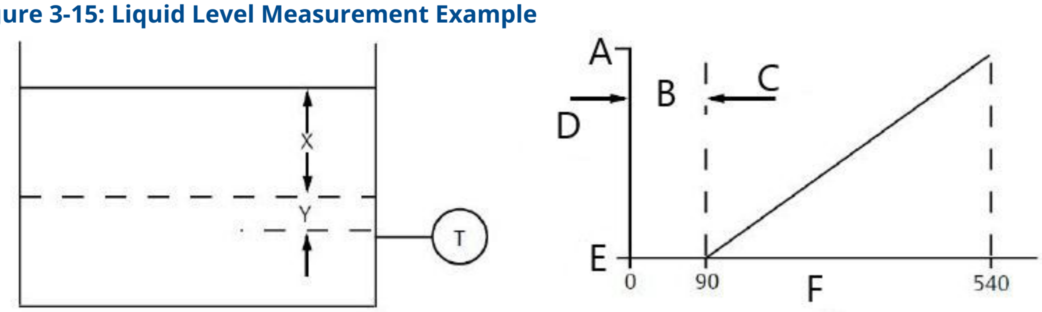
Pressure above a liquid affects the pressure measured at the bottom of a closed vessel. The liquid specific gravity multiplied by the liquid height plus the vessel pressure equals the pressure at the bottom of the vessel.

To measure true level, the vessel pressure must be subtracted from the vessel bottom pressure. To do this, make a pressure tap at the top of the vessel and connect this to the low side of the transmitter. Vessel pressure is then equally applied to both the high and low sides of the transmitter. The resulting differential pressure is proportional to liquid height multiplied by the liquid specific gravity.

Dry leg condition

Low-side transmitter piping will remain empty if gas above the liquid does not condense. This is a dry leg condition. Range determination calculations are the same as those described for bottom-mounted transmitters in open vessels, as shown in Figure 3-15.

Figure 3-15: Liquid Level Measurement Example



A. H_i
B. Zero
C. Suppression
D. Range
E. L_o
F. inH_20

Let X equal the vertical distance between the minimum and maximum measurable levels (500 in. [12700 mm]).

Let Y equal the vertical distance between the transmitter datum line and the minimum measurable level (100 in. [2540 mm]).

Let SG equal the specific gravity of the fluid (0.9).

Let h equal the maximum head pressure to be measured in inches of water.

Let e equal head pressure produced by Y expressed in inches of water.

Let Range equal e to e + h.

Then h = (X)(SG)

= 500 x 0.9

= 450 inH_2O

e = (Y)(SG)

= 100 x 0.9

= 90 inH_2O

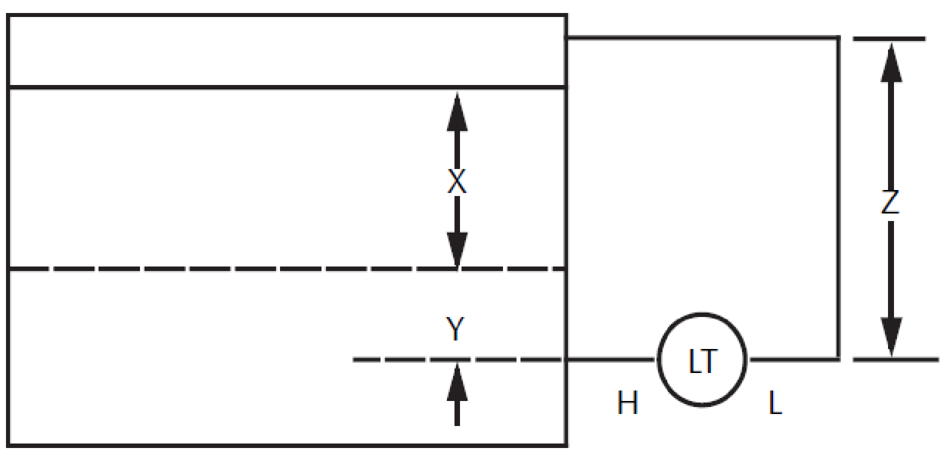
Range = 90 to 540 inH_2O

Wet leg condition

Condensation of the gas above the liquid slowly causes the low side of the transmitter piping to fill with liquid. The pipe is purposely filled with a convenient reference fluid to eliminate this potential error. This is a wet leg condition.

The reference fluid will exert a head pressure on the low side of the transmitter. You must then make zero elevation of the range.

Figure 3-16: Wet Leg Example



Let X equal the vertical distance between the minimum and maximum measurable levels (500 in. [12700 mm]).

Let Y equal the vertical distance between the transmitter datum line and the minimum measurable level (50 in. [1270 mm]).

Let z equal the vertical distance between the top of the liquid in the wet leg and the transmitter datum line (600 in. [15240 mm]).

Let SG1 equal the specific gravity of the fluid (1.0).

Let SG2 equal the specific gravity of the fluid in the wet leg (1.1).

Let h equal the maximum head pressure to be measured in inches of water.

Let e equal the head pressure produced by Y expressed in inches of water.

Let s equal head pressure produced by z expressed in inches of water.

Let Range equal e – s to h + e – s.

Then h = (X)(SG1)

= 500 x 1.0

= 500 in H_2O

e = (Y)(SG1)

= 50 x 1.0

= 50 in H_2O

s = (z)(SG2)

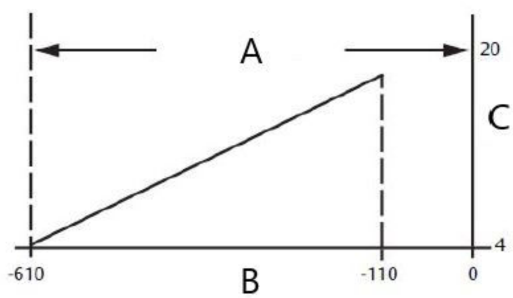
= 600 x 1.1

= 660 in H_20

Range = e – s to h + e – s.

= 50 – 660 to 500 + 50 – 660

= –610 to –110 in H_20



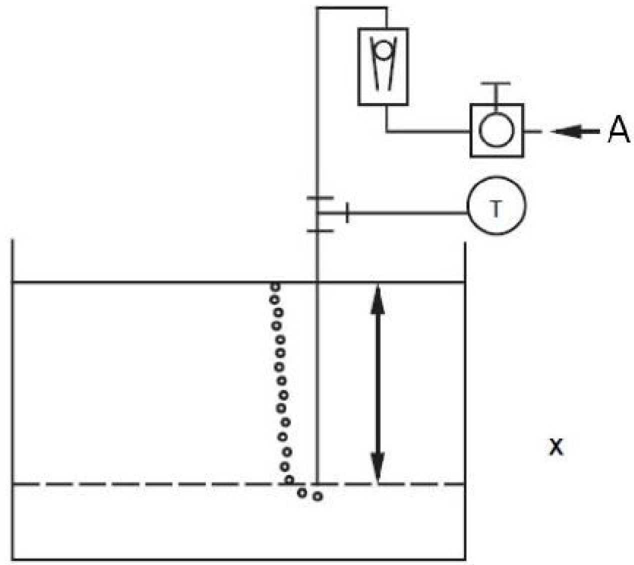
A. Zero elevation
B. inH_20
C. mA DC

Bubbler system in open vessel

A bubbler system that has a top-mounted pressure transmitter can be used in open vessels. This system consists of an air supply, pressure regulator, constant flow meter, pressure transmitter, and a tube that extends down into the vessel.

Bubble air through the tube at a constant flow rate. The pressure required to maintain flow equals the liquid's specific gravity multiplied by the vertical height of the liquid above the tube opening. Figure 3-17 shows a bubbler liquid level measurement example.

Figure 3-17: Bubbler Liquid Level Measurement Example



A. Air

Let X equal the vertical distance between the minimum and maximum measurable levels (100 in. [2540 mm]).

Let SG equal the specific gravity of the fluid (1.1).

Let h equal the maximum head pressure to be measured in inches of water.

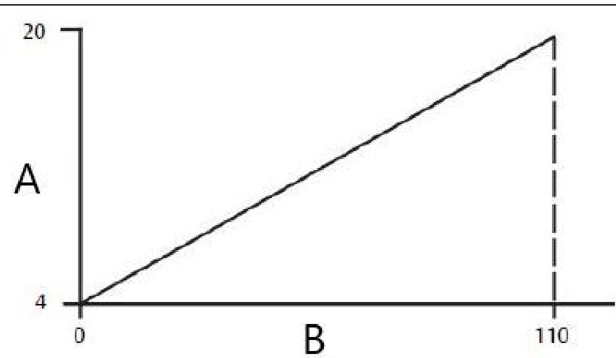
Let Range equal zero to h.

Then h = (X)(SG)

= 100 x 1.1

= 110 inH_2O

Range = 0 to 110 inH_2O



A. mA DC
B. in$H_2$0

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.

Related information

Disassembling the transmitter
Reassemble the transmitter

4.2 Install LCD display

To install the display on an existing transmitter:

Prerequisites

Required tool: small instrument screwdriver

Procedure

Carefully align the desired display connectors with the electronics board connector.

If the connectors don't align, the display and electronics board are not compatible.

4.2.1 Rotate LCD display

If you need to rotate the Local Operator Interface (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 that 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 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.

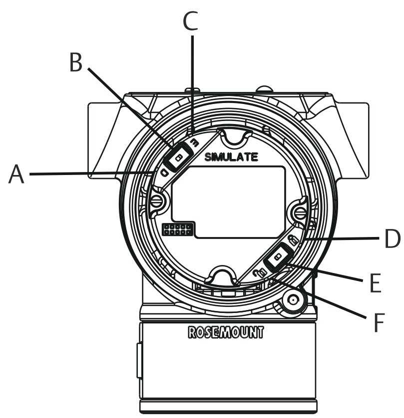
6. Re-attach power and return loop to **Automatic** control.

Note
The graphical LCD display can be rotated with the software 180 degrees. You can access this feature with any configuration tool or the **Quick Service** buttons. For 90 degree and 270 degree orientation, the physical display rotation is still required.

4.3 Configuring transmitter security and simulation

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

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)*

4.3.1 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.

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.

⚠ WARNING

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.

⚠ CAUTION

Emerson recommends tightening the cover until there is no gap between the cover and housing to comply with explosion-proof requirements.

4.3.2 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** position or disable the Software Simulate parameter through the host.

4.4 Electrical considerations

⚠ WARNING

Ensure all electrical installation is in accordance with national and local code requirements.

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.

4.4.1 Conduit installation

NOTICE

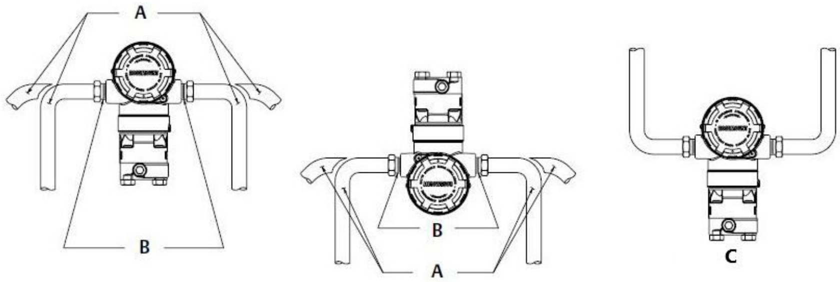
Transmitter damage

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
C. Incorrect

4.4.2 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.

4.5 Wiring

4.5.1 Transmitter wiring

Wiring and power supply requirements can be dependent upon the approval certification. As with all FOUNDATION™ Fieldbus requirements, a conditioned power supply and terminating resistors are required for proper operation. Figure 4-4 displays the standard transmitter terminal block.

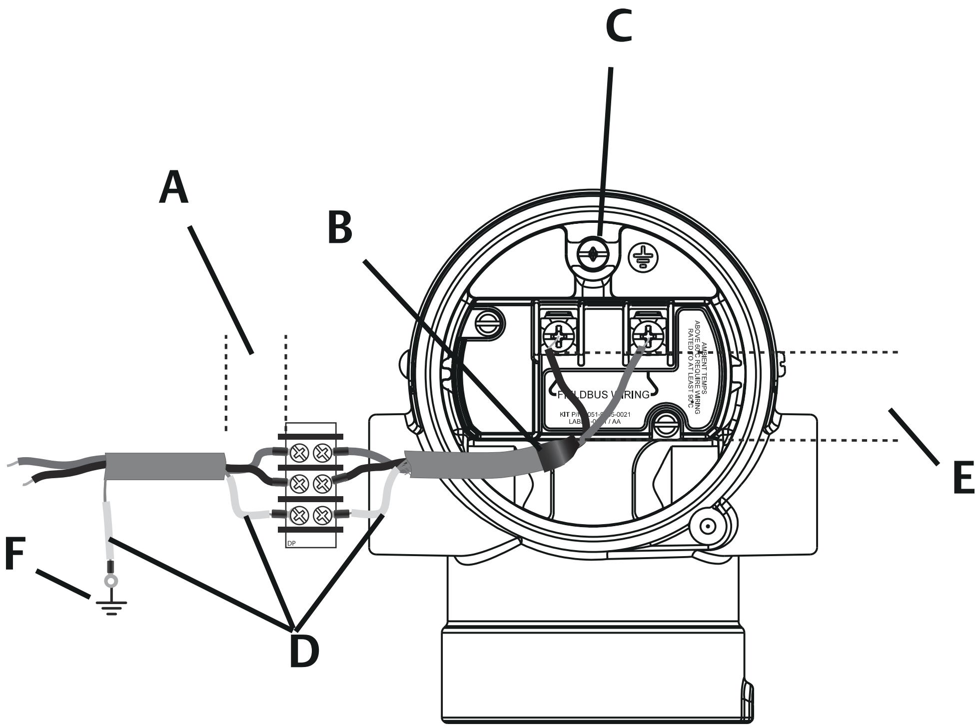
Note
The terminals are not polarity sensitive. The transmitter requires 9–32 Vdc to operate. Emerson recommends Type A FOUNDATION Fieldbus wiring 18 awg twisted shielded pair. Do not exceed 5000 ft. (1500 m) total segment length.

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

To make wiring connections:

Procedure

1. Remove the housing cover on terminal compartment side.

⚠ WARNING

Do not remove the cover in explosive atmospheres when the circuit is live. Signal wiring supplies all power to the transmitter.

2. Plug and seal the unused conduit connection on the transmitter housing to avoid moisture accumulation in the terminal side.

4.5.2 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.

    b) Continuously connect the cable shields to the power supply ground.
    c) 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.

3. Replace the housing cover.

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

4. Plug and seal unused conduit connections.

Transmitter case grounding

⚠ WARNING

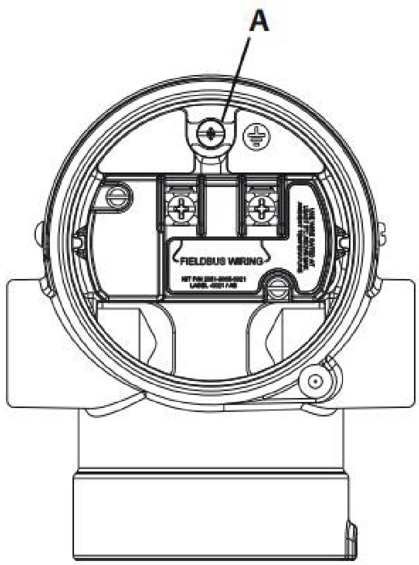
Always ground the transmitter case in accordance with national and local electrical codes.

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.

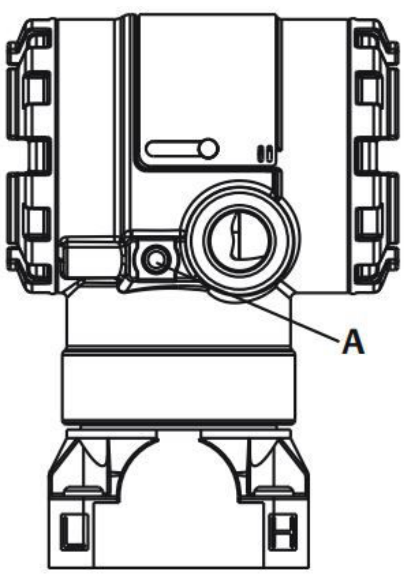
- External ground connection: The external ground connection is located on the exterior of the transmitter housing. Refer to Figure 4-5. This connection is only available with option V5 and T1.

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

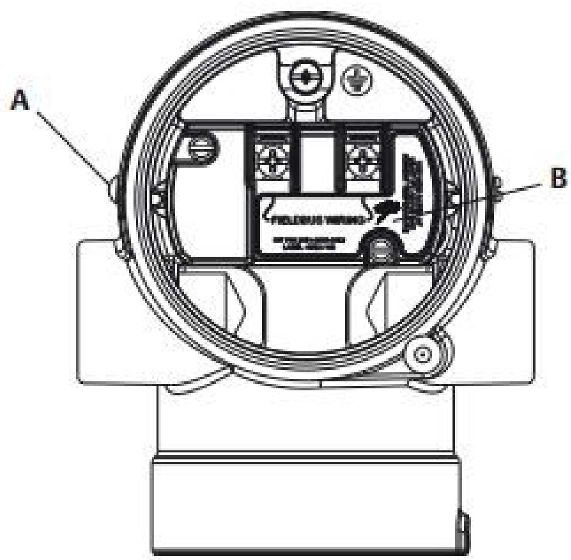
The transmitter can withstand electrical transients of the energy level usually encountered in static discharges or induced switching transients.

NOTICE

High-energy transients, such as those induced in wiring from nearby lightning strikes, can damage the transmitter.

The transient protection terminal block can be ordered as an installed option (Option Code T1) or as a spare part to retrofit existing transmitters in the field. See Spare Parts in Rosemount 2051 Pressure Transmitter PDS 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. *External ground connection location*
B. *Lightning bolt location*

NOTICE

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

Note
Calibration
If any trim is done improperly or with inaccurate equipment, it may degrade the transmitter's performance.

Emerson calibrates absolute pressure transmitters (Rosemount 2051CA and 2051TA) at the factory. Trimming adjusts the position of the factory characterization curve.

5.2 Calibration overview

Note
Emerson fully calibrates the transmitter at the factory. Emerson provides a field calibration option to meet plant requirements or industry standards.

Note
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.

Calibrate the sensor

To perform a sensor trim or a digital zero trim, see Trimming the pressure signal.

5.2.1 Determine necessary sensor trims

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

This field calibration eliminates any pressure offsets caused by mounting effects (head effect of the oil fill) and static pressure effects of the process.

To determine the necessary trims:

Procedure

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

   See Trimming the pressure signal.
3. Check reported analog output against the live analog output. If they do not match, perform an analog output trim.

   See Determine calibration frequency.

5.2.2 Determine calibration frequency

Calibration frequency can vary greatly depending on the application, performance requirements, and process conditions. See How to Calculate Pressure Transmitter Calibration Intervals Technical Note.

To determine the calibration frequency that meets the needs of your application:

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 10-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 (upper range value URL = 250 inH_2O [6.2 bar])
Calibrated span	150 inH_2O (3.7 bar)
Line pressure	500 psig (34.5 barg)

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

4. Calculate the stability per month.

$$\text{Stability} = \pm\left[\frac{0{,}2 \text{ x URL}}{\text{Span}}\right]\% \text{ of span for 10 years} = \pm 0{,}00278\% \text{ of span for 1 month}$$

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

5. Calculate calibration frequency.

$$\text{Calibration frequency} = \frac{\text{Req. Performance - TPE}}{\text{Stability per month}} = \frac{0{,}2\% - 0{,}105\%}{0{,}00278\%} = 34 \text{ months}$$

5.2.3 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 Rosemount Differential Pressure Transmitters (Ranges 1 through 3) do not require this procedure because optimization occurs at the sensor.

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.

Compensate for span line pressure effect (example)

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 percent of reading)
P	Static line pressure in psi.

In this example:

URV	1500 inH_2O (3.7 bar)
S	-0.95%
P	1200 psi
LT	1500 inH_2O + (0.95%/100 x 1200 psi/100 psi x 1500 inH_2O)
LT	1517.1 inH_2O

Complete the upper sensor trim procedure as described in Trimming the pressure signal. However, enter the calculated correct upper sensor trim value of 1517.1 inH_2O with a communication device.

5.3 Trimming the pressure signal

5.3.1 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).

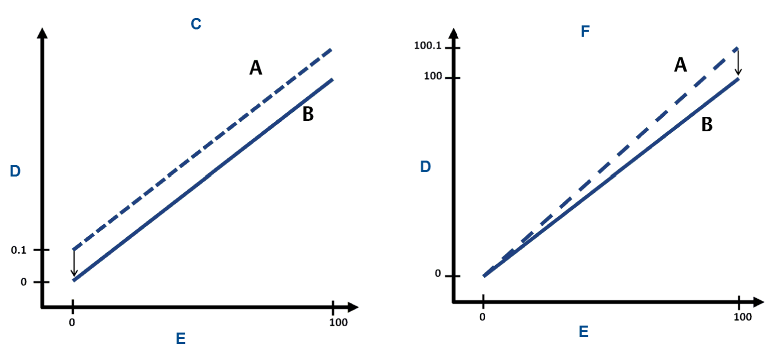
Zero trim is a single-point offset adjustment. It is useful for compensating for mounting position effects and is most effective when performed with the transmitter installed in its final mounting position. As this correction maintains the slope of the characterization curve, do not use it in place of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

Note
Do not perform a zero trim on Rosemount 2051T Absolute Pressure Transmitters. Zero trim is zero based, and absolute pressure transmitters reference absolute zero. To correct mounting position effects on a Rosemount 2051T Absolute Pressure Transmitter, perform a lower sensor trim within the sensor trim function. The lower sensor 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

6 Troubleshooting

6.1 Overview

This section provides summarized troubleshooting suggestions for the most common operating problems.

6.2 Disassembling the transmitter

⚠ WARNING

Explosion

Explosions could result in death or serious injury.

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

6.2.1 Remove from service

⚠ WARNING

Follow all plant safety rules and procedures.

Procedure

1. Power down device.
2. Isolate and vent the process from the transmitter before removing the transmitter from service.
3. Remove all electrical leads and disconnect conduit.
4. Remove the transmitter from the process connection.
   - The Rosemount 2051C 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 2051T 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 gauge transmitter orientation.
5. Clean isolating diaphragms with a soft rag and a mild cleaning solution, and rinse with clear water.

   NOTICE

   Do not scratch, puncture, or depress the isolating diaphragms.
6. For the Rosemount 2051C, 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.

Note
You may reuse undamaged O-rings.

6.2.2 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.

6.2.3 Remove electronics board

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

Procedure

Remove the housing cover opposite the field terminal side.

6.2.4 Remove sensor module from the electronics housing

Procedure

1. Remove the electronics board.

   Refer to Remove electronics board.

   NOTICE

   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.

   NOTICE

   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.

6.3 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.

   Note
   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.

6.3.1 Attach electronics board

⚠ 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 transmitter.

The transmitter covers must be engaged metal-to-metal to ensure a proper seal and to meet explosion-proof requirements.

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.

6.3.2 Install terminal block

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.

6.3.3 Reassemble the Rosemount 2051C process flange

See Safety messages for complete warning information.

Procedure

1. Inspect the sensor module PTFE O-rings.

   Note
   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 over-tighten, as this will affect module-to-flange alignment.
     b. Install the four 1.75-in. (44 mm) 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 over-tighten, 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. (73 mm) bolts to mount securely to the coplanar flange. For gauge pressure configurations, use two 2.88-in. (73 mm) bolts and two 1.75-in. (44 mm) 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.

   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.

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)

6.3.4 Install drain/vent valve

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.

   NOTICE

   Ensure the opening on the valve is placed so that process fluid will drain toward the ground and away from human contact when the valve is opened.

2. Tighten the drain/vent valve to 250 in.-lb. (28.25 N-m).

6.4 Troubleshooting guides

6.4.1 Communication problems

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

Device not appearing

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 appear on segment.
4. If the problem persists, contact your local Emerson representative.

Device does not stay on segment

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

Potential cause

Incorrect signal levels.

Note
Reference host documentation for procedure.

Recommended actions

1. Check for two terminators.
2. Check for excess cable length.
3. Verify power supply or conditioner is good.
4. If the problem persists, contact your local Emerson representative.

Potential cause

Excess noise on segment

Note
Reference host documentation for procedure.

Recommended actions

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

Potential cause

Electronics failure

Recommended actions

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

Potential cause

Other

Recommended actions

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

6.4.2 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 Communication problems. If you can identify the problem perform the recommended action.(2)

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

Device does not appear on segment

Potential cause

Unknown

Recommended action

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

Potential cause

No power to device

Recommended actions

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

Potential cause

Segment problems: Electronics failing

Recommended action

Replace loose electronics board in housing.

Potential cause

Segment problems: Incompatible network settings

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

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.

6.5 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.

6.5.1 Incompatible module

NE107 and Plantweb™ alert: Failure

The pressure sensor is incompatible with the attached electronics.

Recommended actions

- Replace electronics board or sensor module with compatible hardware.

Default configuration

Enabled

LCD display message

^^^^XMTR MSMTCH

Associated status bits

0x08000000

6.5.2 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

6.5.3 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

6.5.4 Pressure out of limits

NE107 alert: Offspec; Plantweb™ alert: Maintenance

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

Recommended actions

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

Default configuration

Enabled

LCD display message

PRES^OUT LIMITS

Associated status bits

0x00200000

6.5.5 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

6.5.6 Display update failure

NE107 and Plantweb™ alert: Maintenance

The display is not receiving updates from the electronics board.

Recommended actions

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

Default configuration

Enabled

LCD display message

N/A

Associated status bits

0x00000020

6.5.7 Variation change detected

NE107 and Plantweb™ alert: Maintenance

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

Recommended actions

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

Default configuration

Enabled

LCD display message

^^^^^SPM^ALERT

Associated status bits

0x00000080

6.5.8 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

6.5.9 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

6.6 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.

6.6.1 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 FOUNDATION™ 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 Recommended calibration tasks to determine the appropriate trimming or calibration procedure.

6.6.2 **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 2051 Product Data Sheet.

7 Reference data

7.1 Ordering information, specifications, and drawings

To view current Rosemount 2051 Pressure Transmitter ordering information, specifications, and drawings:

Procedure

1. Go to the Rosemount 2051 Coplanar™ Pressure Transmitter Product Detail Page.
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.

7.2 Product certifications

To view current Rosemount 2051 Pressure Transmitter product certifications:

Procedure

1. Go to the Rosemount 2051 Coplanar™ Pressure Transmitter Product Detail Page.
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. Click **Manuals & Guides**.
4. Select the appropriate Quick Start Guide.

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For more information: **Emerson.com/global**

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