

ST 3000 FF Transmitter

With FOUNDATION™ Fieldbus Option

Installation & Device Reference Guide

34-ST-25-15

July 2011

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About This Publication

This manual is intended as a “how to” reference for installing, piping, wiring, configuring, starting up, operating, maintaining, calibrating, and servicing Honeywell’s Smartline family of Series 100 and 900 ST 3000[®] Transmitters with FOUNDATION[™] Fieldbus (FF) option.

This manual provides detailed procedures for transmitter installation to assist first time users.

This manual applies **only** to Honeywell's ST 3000 FF, Series 100 and 900 Transmitters. If you have any of the following ST 3000 transmitter types, refer to the appropriate documents listed below:

ST 3000 Transmitter Type	Corresponding Honeywell Documents
Series 100 and Series 900, Release 300	<i>Installation Guide 34-ST-33-39</i> <i>User's Manual 34-ST-25-14</i>

Patent Notice

This product is covered by one or more of the following U.S. Patents: 4,520,488; 4,567,466; 4,494,183; 4,502,335; 4,592,002; 4,553,104; 4,541,282; 4,806,905; 4,797,669; 4,735,090; 4,768,382; 4,787,250; 4,888,992; 5,811,690; 5,875,150; 5,765,436; 4,734,873; 6,041,659 and other patents pending.

References

Publications from the Fieldbus Foundation™

We recommend that you obtain these publications which provide additional information on Fieldbus technology:

Publication Title	Publication Number	Publisher
<i>Technical Overview, FOUNDATION™ Fieldbus</i>	FD-043	Available from the Fieldbus Foundation™.
<i>Wiring and Installation 31.25 kbit/s, Voltage Mode, Wire Medium Application Guide</i>	AG-140	
<i>31.25 kbit/s Intrinsically Safe Systems Application Guide</i>	AG-163	
Fieldbus Specifications	Various Documents	

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or via the World Wide Web at:

<http://www.fieldbus.org>

Symbol Definitions

Symbol

Definition



This CAUTION symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.



This WARNING symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.



ATTENTION, Electrostatic Discharge (ESD) hazards. Observe precautions for handling electrostatic sensitive devices



Protective Earth (PE) terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.



Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.

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ABBREVIATIONS AND DEFINITIONS

Term	Abbreviation	Definition
Alarm		The detection of a block leaving a particular state and when it returns back to that state.
Analog Input (function block)	AI	One of the standard function blocks define by the Foundation™ Fieldbus
Application		A software program that interacts with blocks, events and objects. One application may interface with other applications or contain more than one application.
Block		A logical software unit that makes up one named copy of a block and the associated parameters its block type specifies. It can be a resource block, transducer block or a function block.
Configuration (of a system or device)		A step in system design: selecting functional units, assigning their locations and identifiers, and defining their interconnections.
Device		A physical entity capable of performing one or more specific functions. Examples include transmitters, actuators, controllers, operator interfaces.
Device Description	DD	Description of FBAPs within a device. Files that describe the software objects in a device, such as function blocks and parameters. The DD binary are created by passing DD source files through a standard tool called a tokenizer.
Device Description Language	DDL	A standardized programming language (similar to C) used to write device description source files.
Device Tag		The Physical Device Tag of the device as specified in the Foundation™ Fieldbus specifications.
Event		An instantaneous occurrence that is significant to scheduling block execution and to the operational (event) view of the application.
Field Device		A fieldbus-compatible device that contains and executes function blocks.
FOUNDATION™ Fieldbus	FF	Communications protocol for a digital, serial, two-way system which interconnects industrial field equipment such as sensors, actuators and controllers.
Function Block	FB	An executable software object that performs a specific task, such as measurement or control, with inputs and outputs that connect to other function blocks in a standard way.
Function Block Application Process	FBAP	The part of the device software that executes the blocks (function, transducer, or resource blocks).
Link Active Scheduler	LAS	A device which is responsible for keeping a link operational. The LAS executes the link schedule, circulates tokens, distributes time messages and probes for new devices.
Macrocycle		The least common multiple of all the loop times on a given link.
Manufacturer's Signal Processing	MSP	A term used to describe signal processing in a device that is not defined by FF specifications.

Continued on next page

Abbreviations and Definitions

Term	Abbreviation	Definition
Network Management	NM	A part of the software and configuration data in a Foundation™ Fieldbus device that handles the management of the network.
Network Management Agent	NMA	Part of the device software that operates on network management objects.
Network Management Information Base	NMIB	A collection of objects and parameters comprising configuration, performance and fault-related information for the communication system of a device.
Objects		Entities within the FBAP, such as blocks, alert objects, trend objects, parameters, display lists, etc.
Object Dictionary	OD	Definitions and descriptions of network visible objects of a device. There are various object dictionaries within a device. The dictionaries contain objects and their associated parameters which support the application in which they are contained.
Parameters		A value or variable which resides in block objects
Proportional Integral Derivative control	PID	A standard control algorithm. Also refers to a PID function block.
Stack		The software component that implement the Foundation™ Fieldbus communications protocol specifications, including FMS, FAS, DLL, SM and NM.
System Management	SM	Provides services that coordinate the operation of various devices in a distributed fieldbus system.
System Management Agent	SMA	Part of the device software that operates on system management objects.
System Management Information Base	SMIB	A collection of objects and parameters comprising configuration and operational information used for control of system management operations.
Status		A coded value that qualifies dynamic variables (parameters) in function blocks. This value is usually passed along with the value from block to block. Status is fully defined in the FF FBAP specifications.
Trim Point		A selected reference point at which a measurement is calibrated.
Virtual Communication Reference	VCR	A defined communication endpoint. Fieldbus communications can primarily only take place along a active communications "path" that consists of two VCR endpoints. For example, to establish communications between a transducer block and a function block, a VCR must be defined at the transducer block and a VCR must be defined at the function block.
Virtual Field Device	VFD	A logical grouping of "user layer" functions. Function blocks are grouped into a VFD, and system and network management are grouped into a VFD.

Technical Assistance

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our customers.

Honeywell Organization	WWW Address (URL)
Corporate	http://www.honeywell.com
Honeywell Process Solutions	http://hpsweb.honeywell.com/ps
Technical tips	http://content.honeywell.com/ipc/faq

Telephone

Contact us by telephone at the numbers listed below.

Organization		Phone Number	
United States and Canada	Honeywell	1-800-423-9883	Tech. Support
		1-800-525-7439	Service

Where to Find Information in This Manual

About this Manual

This manual provides installation, operation, maintenance for the ST 3000 Series 100 Transmitter with Fieldbus FOUNDATION™ communications option. Reference information is also provided. The sections of information contained in the manual follow this order:

- Background and Pre-installation
 - Transmitter mechanical and electrical installation
 - Transmitter configuration
 - Operation and maintenance
 - Reference Information
-

Background and Pre-installation Information

Sections 1 through 4 provide background and pre-installation information if you are not familiar with the ST 3000 FF transmitter, or if this is a new installation.

- Section 1 covers the basic transmitter description.
 - Section 2 provides a listing of fieldbus network components and installation tasks.
 - Section 3 provides a procedure for performing a bench check or off-line configuration to the transmitter.
 - Section 4 gives installation and operating considerations before you install the transmitter.
-

Transmitter Installation Procedures

Section 5 covers mechanical and electrical installation procedures for the transmitter. These procedures instruct you on how to properly:

- Mount the transmitter
 - Install piping to the transmitter
 - Make the electrical connections and
 - Apply power to the transmitter.
-

Transmitter Configuration

Section 6 tells you how to configure the transmitter so it will operate according to your process application. This information outlines the configuration procedure which can be done through an operator station or host computer. (An example showing a sample configuration of the transmitter's parameters is listed in Appendix B.)

Continued on next page

Where to Find Information in This Manual Continued

Operation, Maintenance, Calibration and Troubleshooting

- Section 7 covers operation information.
 - Section 9 provides routine maintenance procedures as well as removal and replacement of key transmitter components.
 - Calibration procedures are given in Section 10.
 - Troubleshooting routines and diagnostic information is covered in Section 11.
-

Reference Information

Sections 8, 12 and 13 contain reference information:

- Section 8 provides descriptions of fieldbus elements that make up the transmitter (device) configuration. These elements are block parameters and device objects that comprise the software application of the transmitter. Background information also is provided on device configuration as it relates to the ST 3000 FF application. A dictionary listing of Honeywell-defined parameters is given.
 - Section 12 contains figures and listings of replacement parts for all models of the ST 3000 FF transmitters.
 - Reference drawings and wiring diagrams are furnished in Section 13.
-

Additional Reference Material

Appendixes A, B and C provide additional reference information on:

- Hazardous location standards and approval body options
 - Sample configuration printouts.
 - Recommendations for freeze protection of transmitters in cold environments.
-

ST 3000 FF Fieldbus Pressure Transmitter

Operational Note

Overview

This document provides important supplementary information to the *ST 3000 FF Transmitter With FOUNDATION™ Fieldbus Option, Installation and Device Reference Guide*, #34-ST-25-15. Specifically, this document covers an important operational note which operators should be aware of.



— IMPORTANT —

BLOCK_ERR Indication

If the Resource Block BLOCK_ERR parameter indicates that a MEMORY FAILURE is detected. It is possible that:

- a real failure has occurred in the processor memories, or
- the error was caused by transient noise.

In either case, it may be possible to restore transmitter operation with the suspect device.

Recommended Action

If this BLOCK_ERR condition occurs, follow the recommended actions below to properly diagnose and correct the fault.

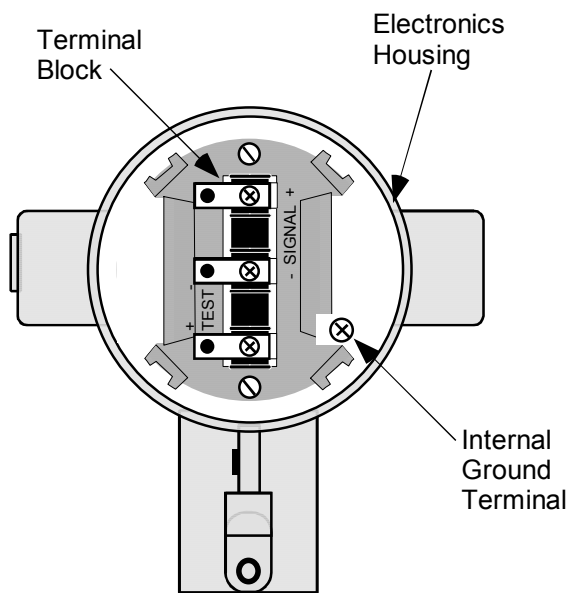
Step	Action
1	Write Resource block MODE_BLK.TARGET to Out of Service (O/S).
2	Write RESTART parameter to PROCESSOR. This will restart the processor and allow the BLOCK_ERR to be recalculated.
3	Allow the transmitter to run for 10 seconds so that the diagnostic rechecks for any memory failures.
4	After 10 seconds, if: • Errors are reported, then replace transmitter electronics. • No errors are reported, then write MODE_BLK.TARGET to AUTO in resource block.

— IMPORTANT —

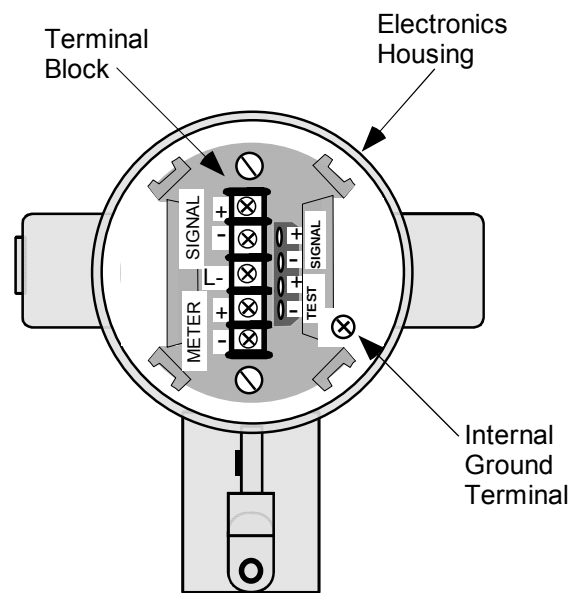
Before You Begin, Please Note

Transmitter Terminal Blocks

Depending on your transmitter options, the transmitter may be equipped with either a 3-screw or 5-screw terminal block inside the electronics housing. This may affect how to connect the fieldbus cable wiring to the transmitter. See Section 5.4 for the terminal block connections for each type terminal. Section 13 provides additional wiring diagrams showing alternate wiring methods.



3-Screw Terminal Block



5-Screw Terminal Block

Section 1 – ST 3000 FF Description

1.1 Introduction

Section Contents

This section includes these topics:

Section	Topic	See Page
1.1	Introduction	1
1.2	CE Conformity	2
1.3	ST 3000 FF Transmitters.....	3
1.4	Fieldbus Overview.....	7
1.5	Transmitter Order	10
1.6	Local Meter Option	11

About this Section

This section is intended for users who have never worked with our ST 3000 FF Transmitter. It provides some general information to acquaint you with the transmitter.

ATTENTION

For communication, configuration and monitoring of the ST 3000 FF transmitter, Honeywell offers NI-FBUS Configurator software. The Configurator runs on a variety of Personal Computer (PC) platforms using Windows® 95 or Windows NT™. It is a bundled Windows software and PC-interface hardware solution that allows quick, error-free configuration and diagnosis of Honeywell Smartline instruments with FOUNDATION™ Fieldbus communications. The NI-FBUS Configurator allows users to communicate with the transmitter from a remote location to:

- Configure the transmitter by selecting and setting operating parameters.
- Request and display transmitter data.
- Access diagnostic information to identify configuration, communication, transmitter or process problems.
- Calibrate transmitter.

NI-FBUS Configurator, version 2.3 is compatible with our latest ST 3000 FF transmitters. Refer to *Honeywell ST 3000 FF Fieldbus Pressure Transmitter Software Release Guide* for additional information on NI-FBUS Configurator compatibility, or contact your Honeywell representative for more information.

1.2 CE Conformity

CE Conformity (Europe)

This product is in conformity with the protection requirements of **2004/108/EC**, the EMC Directive. Conformity of this product with any other “CE Mark” Directive(s) shall not be assumed.

Deviation from the installation conditions specified in this manual, and the following special conditions, may invalidate this product’s conformity with the EMC Directive.

CE Conformity Special Conditions (Europe)

Shielded twisted pair cables are required for I/O interface circuits.

ATTENTION

The emission limits of EN 50081-2 are designed to provide reasonable protection against harmful interference when this equipment is operated in an industrial environment. Operation of this equipment in a residential area may cause harmful interference. This equipment generates, uses, and can radiate radio frequency energy and may cause interference to radio and television reception when the equipment is used closer than 30 m to the antenna(e). In special cases, when highly susceptible apparatus is used in close proximity, the user may have to employ additional mitigating measures to further reduce the electromagnetic emissions of this equipment.

1.3 ST 3000 FF Transmitters

About the Transmitter The ST 3000 Transmitter with FF option is furnished with FOUNDATION™ Fieldbus interface to operate in a compatible distributed fieldbus system. The transmitter will interoperate with any FOUNDATION™ -registered device. See Section 1.4 for an overview of fieldbus.

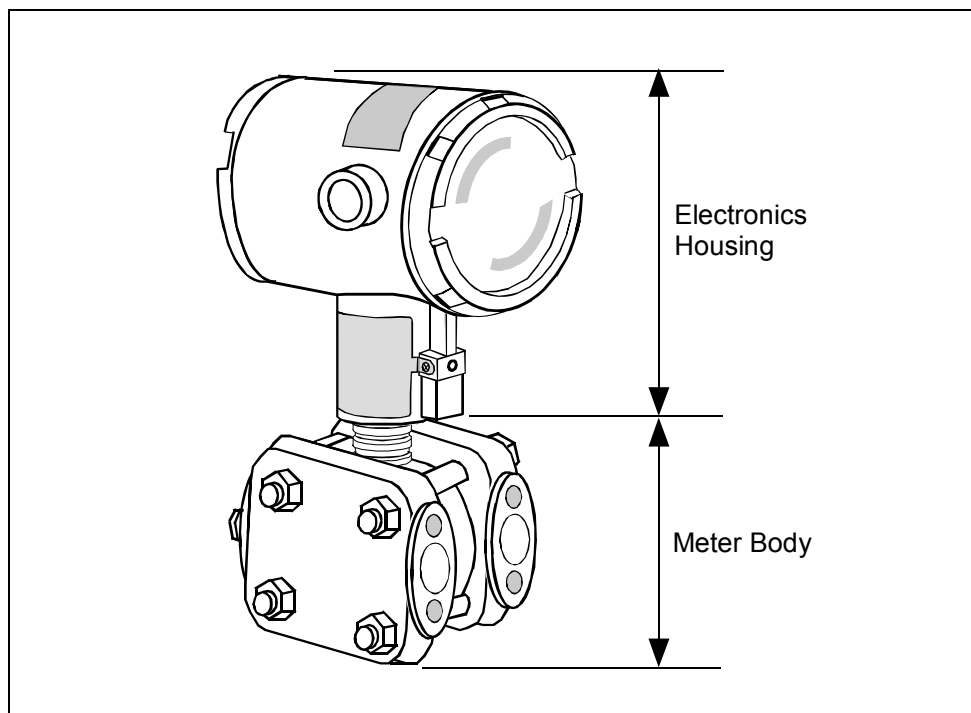
The transmitter includes FOUNDATION™ Fieldbus electronics for operating in a 31.25 kbit/s fieldbus network. It features standard fieldbus function blocks with manufacturer-specific additions for enhanced operation. This transmitter can function as a Link Active Scheduler in a fieldbus network.

The ST 3000 FF comes in a variety of models for measurement applications involving one of these basic types of pressure:

- Differential Pressure
- Gauge Pressure
- Absolute Pressure

The transmitter measures the process pressure and transmits a digital output signal proportional to the measured variable over a two-wire pair. Its major components are an electronics housing and a meter body as shown in Figure 1 for a typical differential pressure model transmitter.

Figure 1 Typical ST 3000 FF Differential Pressure Transmitter.



Continued on next page

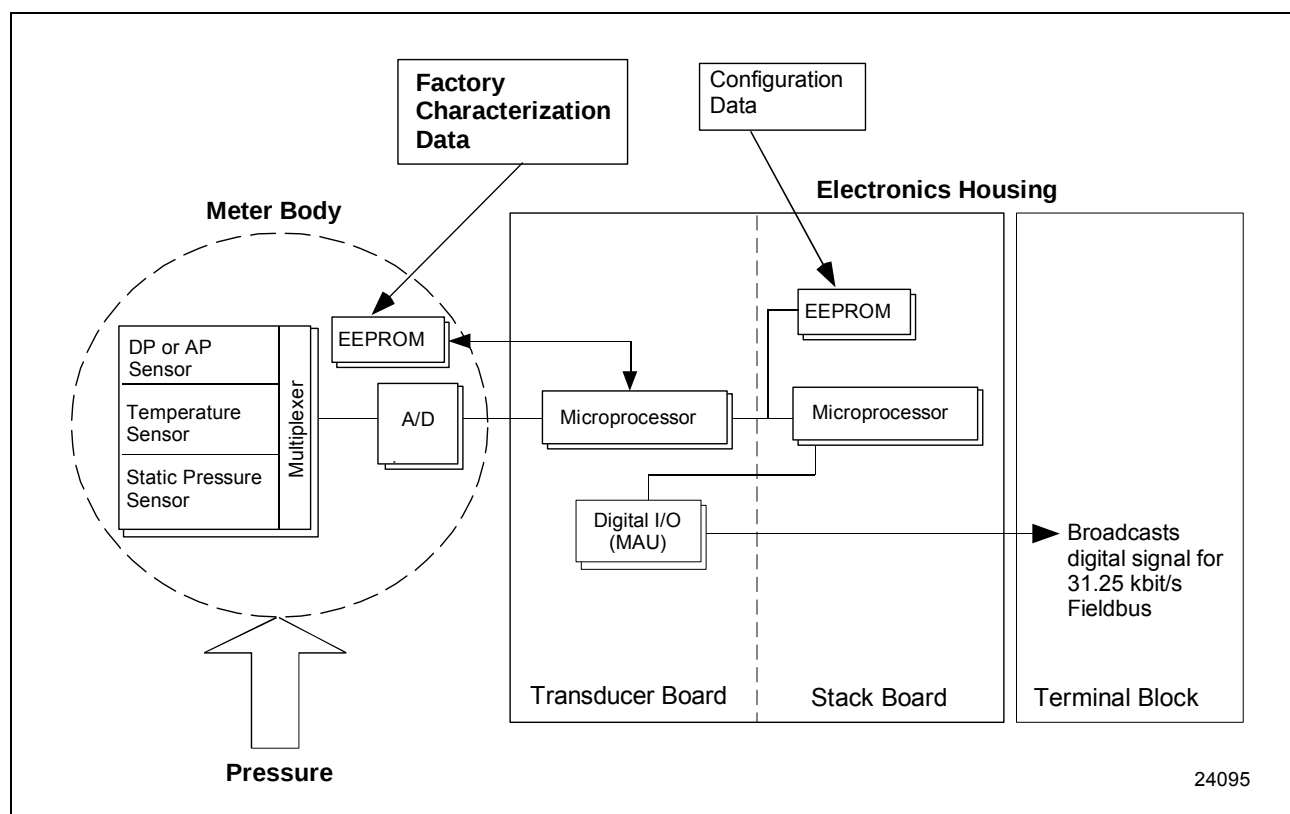
1.3 ST 3000 FF Transmitters Continued

About the Transmitter, continued

The ST 3000 transmits its output in a digital fieldbus protocol format for direct digital communications with control systems.

The Process Variable (PV) is available for monitoring and control purposes (maximum update rate for PV is 8 times per second). The meter body temperature is also available as a secondary variable for monitoring purposes only through the operator interface. Figure 2 shows a block diagram of the ST 3000 FF operating functions.

Figure 2 Functional Block Diagram of ST 3000 FF Transmitter Operation

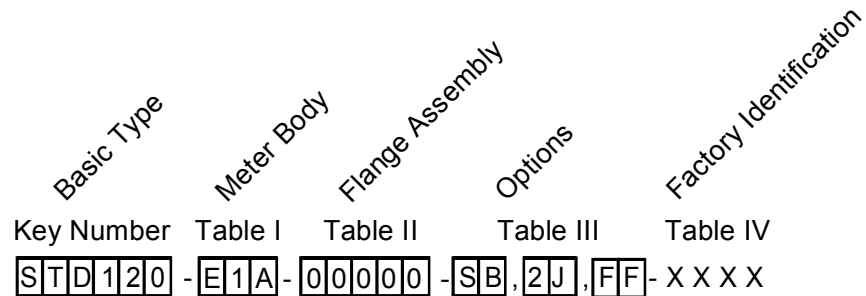


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1.3 ST 3000 FF Transmitters Continued

Series and Model Number Data

Honeywell's line of Smart ST 3000 FF Transmitters includes the Series 100 and Series 900 with several models to meet various process pressure measurement and interface requirements. Each transmitter comes with a nameplate that lists its given "model number". The model number format consists of a Key Number with several Table selections as shown below.



You can quickly identify what series and basic type of transmitter you have from the third and fourth digits in the key number. The letter in the third digit represents one of these basic transmitter types:

- A = Absolute Pressure
- D = Differential Pressure
- F = Flange Mounted
- G = Gauge Pressure
- R = Remote Seals

The number in the fourth digit matches the first digit in the transmitter Series. Thus, a "1" means the transmitter is a Series 100.

Refer to the Model Selection Guide for a complete description of the model number for your transmitter.

ATTENTION

Previous versions of the ST 3000 transmitter with designations of Series 100, Series 100e, Series 600, and Series 900 have been supplied at various times since the ST 3000 was introduced in 1983. While all these transmitters are functionally alike, there are differences in housing and electronics design. This manual only applies for ST 3000 Series 100 and 900 transmitters with FOUNDATION™ Fieldbus option (FF).

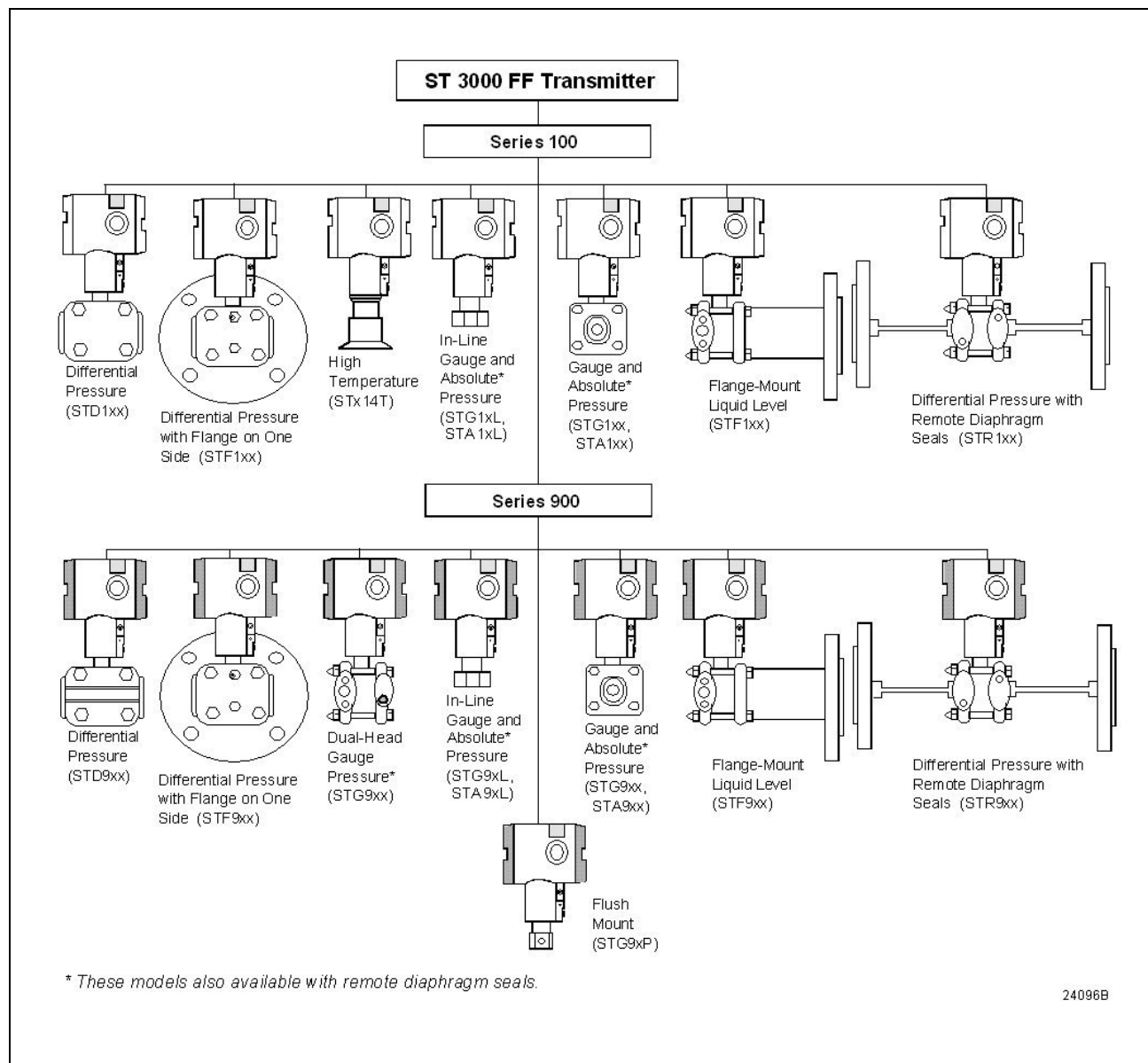
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1.3 ST 3000 FF Transmitters Continued

ST 3000 Pressure Transmitter Models

Figure 3 illustrates the present ST 3000 FF pressure transmitter family tree.

Figure 3 ST 3000 FF Pressure Transmitter Family Tree.



Transmitter Adjustments

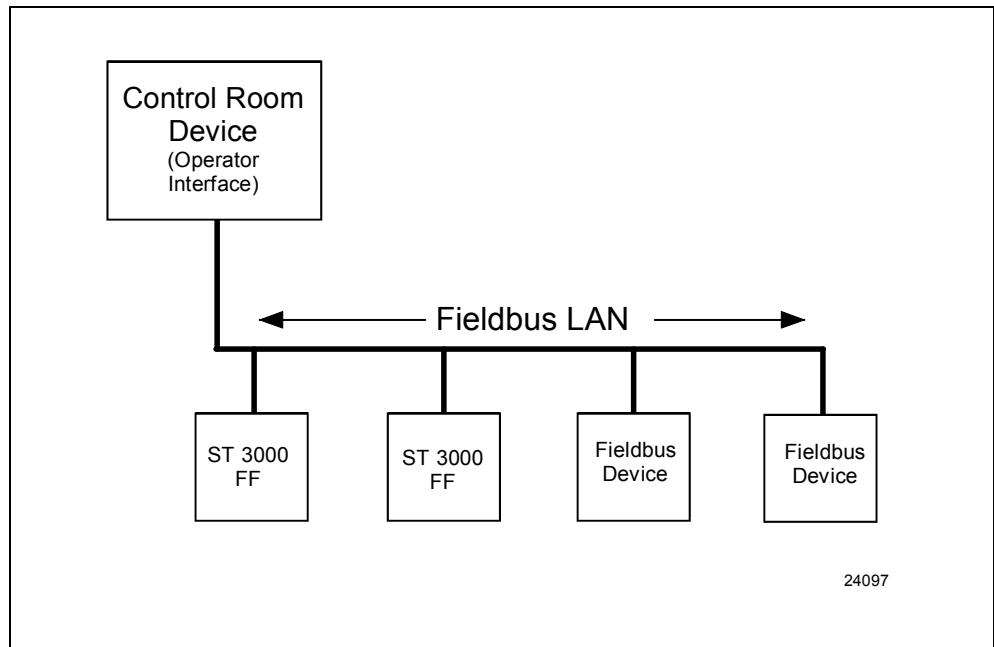
The ST 3000 FF equipped with a local smart meter allows you to perform a zero correction using the meter pushbuttons. A PC running a fieldbus configuration software application (such as NI-FBUS Configurator) can be used to make all other adjustments in the transmitter.

1.4 Fieldbus Overview

What is Fieldbus

Fieldbus is an all digital, serial, two-way communication system which interconnects industrial "field" equipment such as sensors, actuators, and controllers. Fieldbus is a Local Area Network (LAN) for field instruments with built-in capability to distribute the control application across the network. See Figure 4.

Figure 4 Fieldbus Connecting Control Room and Field Devices



Open System Design

The Foundation™ Fieldbus has defined standards to which field devices and operator/control stations communicate with one another. The communications protocol is built as an "open system" to allow all field devices and control equipment which are built to fieldbus standards to be integrated into a control system, regardless of the device manufacturer. This interoperability of devices using fieldbus technology is to become the industry standard for automation and distributed control systems.

Continued on next page

1.4 Fieldbus Overview Continued

Hardware Architecture

The physical architecture of fieldbus allows installation of fieldbus devices using a twisted-pair cable. Often, existing wiring from analog devices can be used to wire up digital fieldbus devices. Multiple field devices can be connected on one cable (a multi-drop link), rather than conventional point-to-point wiring used for analog devices. For more details on wiring fieldbus networks, see Section 5.4.

Software Architecture

Fieldbus software architecture provides for more control functions to be available in the microprocessor-based field device. Since fieldbus is a digital communication system, more data is available to operators for process monitoring, trend analysis, report generation, and trouble analysis. Device software changes can be downloaded to field devices remotely from the operator station (or PC) in the control room.

Application

An application is software that contains function block data and operating parameters (objects) which help define the operation of a device such as, sensor data acquisition or control algorithm processing. Some devices may contain more than one application.

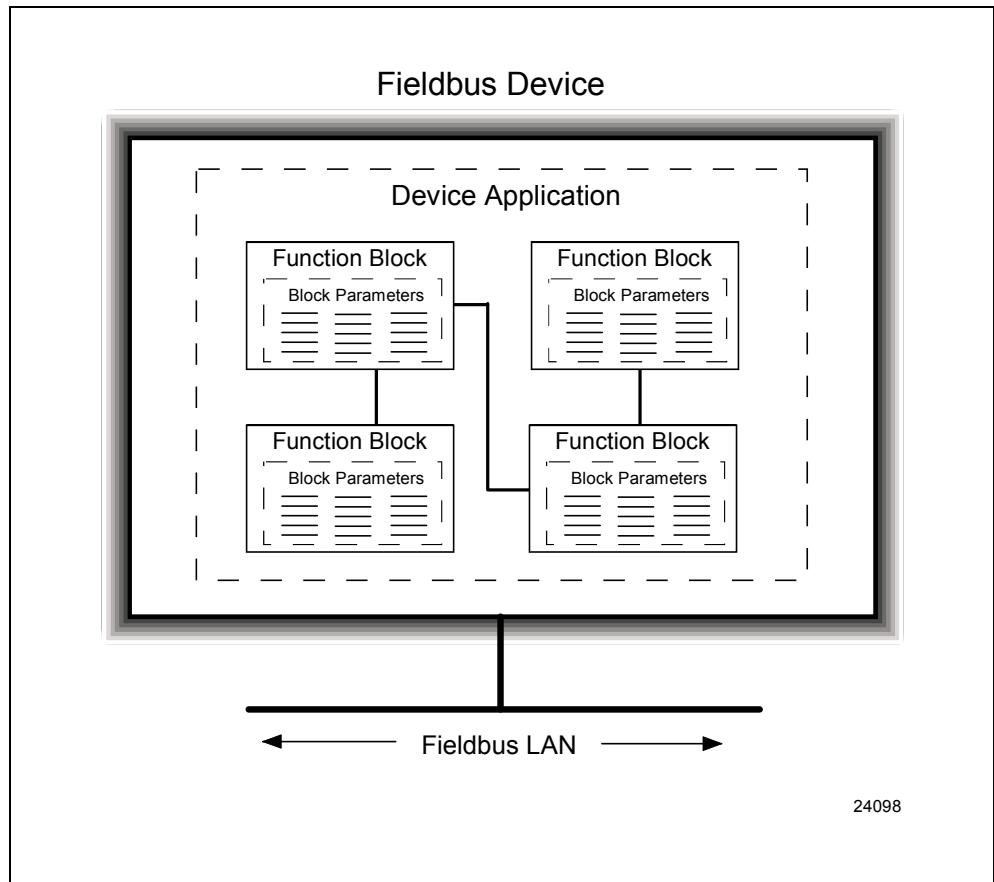
Function Blocks

Usually, a device has a set of functions it can perform. These functions are represented as function blocks within the device. See Figure 5. Function blocks are software that provide a general structure for specifying different device functions. Each function block is capable of performing a control function or algorithm. Device functions may include analog input, analog output, and Proportional Integral Derivative (PID) control. These blocks can be connected together to build a process loop. The action of these blocks can be changed by adjusting the block's configuration and operating parameters.

Continued on next page

1.4 Fieldbus Overview Continued

Figure 5 Fieldbus Devices Contain Device Applications and Function Blocks



ST3000 FF Transmitter Application

The ST 3000 FF Fieldbus Transmitter contains the electronics interface compatible for connecting to a fieldbus network. ST 3000 FF application is configured using a fieldbus configuration software program. The configurator software allows the user to configure blocks, change operating parameters and create linkages between blocks that make up the ST 3000 application. The changes to the ST 3000 application are then written to the device and initialized.

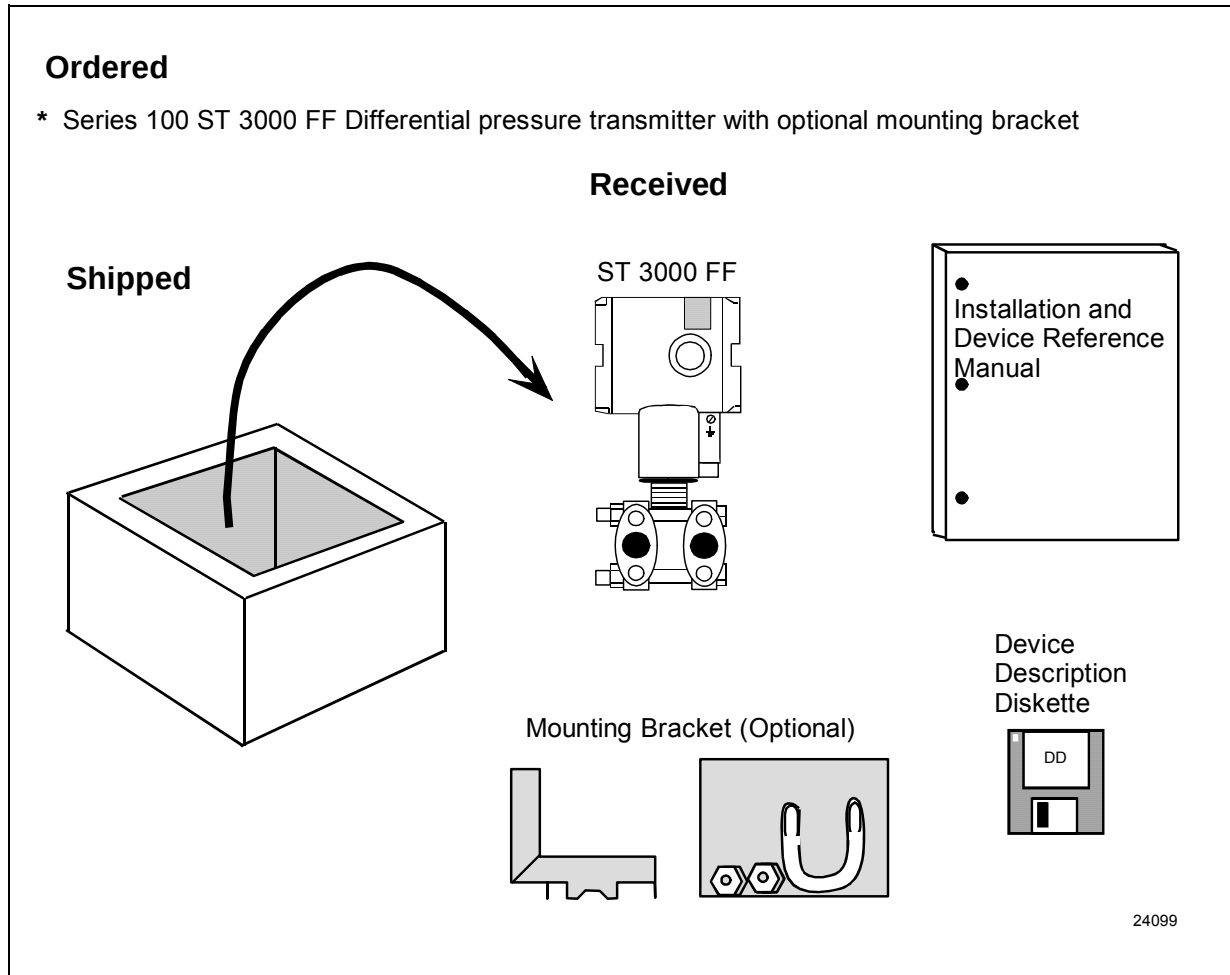
1.5 Transmitter Order

Order Components

Figure 6 shows the components that would be shipped and received for a typical ST 3000 FF transmitter.

Figure 6

Typical ST 3000 FF Transmitter Order Components.



About Documentation

ST 3000 FF Transmitter Installation and Device Reference Manual, 34-ST-25-15 provides information for checking, installing, wiring and configuring the ST 3000 FF transmitter for operation. Also, a Software Release Guide is included with the transmitter which contains additional operational information for a specific software revision.

Device Description Diskette

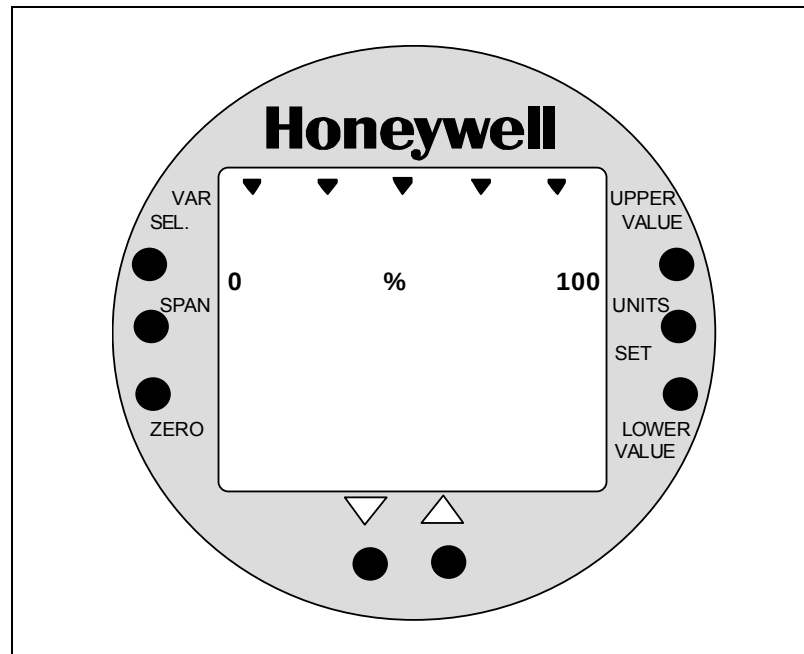
Also, a diskette is shipped with the transmitter containing the device description and standard dictionary files for the transmitter. These files, when used in conjunction with the PC-based fieldbus configuration application, provide an on-line description and displays of the transmitter operation. See Device Description in Section 8.

1.6 Local Meter Option

Option Availability

The ST 3000 FF can be equipped with a Local Meter option as shown in Figure 7. The local meter provides read-only output value of the Analog Input block OUT parameter in both % of span and in actual engineering units. See Section 7.4 for additional details of the meter. (See Section 7.5 for the procedure to select engineering units for the local meter display).

Figure 7 Typical Local Meter Faceplate



Local Meter Panel Pushbuttons

The ZERO pushbutton on the meter panel can be used to perform a zero-correction to the transmitter. See Section 10, Calibration for the procedure.

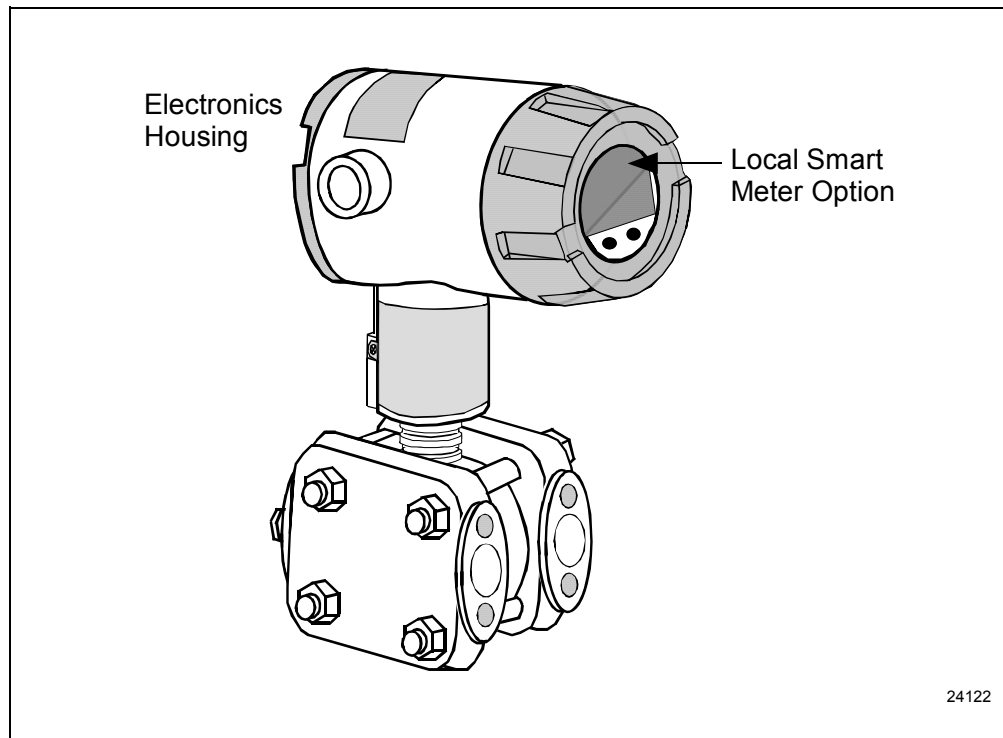
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1.6 Local Meter Option Continued

About the option

The Local Meter is a separate assembly that is designed to snap fit on the transmitter's electronics module. The option assembly includes a cable and plug assembly for mating with a connector on the transmitter's transducer electronics board. A meter end-cap which includes a window is supplied on the electronics side of the transmitter's housing so you can view the meter display with the end cap installed. See Figure 8.

Figure 8 ST 3000 FF with Local Meter Option.



Section 2 — Installation Overview

2.1 Introduction

Section Contents

This section includes these topics:

Section	Topic	See Page
2.1	Introduction	13
2.2	Advanced Diagnostics	14
2.3	Installation Components	16
2.4	Installation/Operation Tasks	18

About this Section

This section provides a list of components needed to install and operate the ST 3000 FF transmitter. Also provided is a list of typical start-up tasks and places where you can find detailed information about performing the tasks.

2.2 Advanced Diagnostics

See table below for Advanced Diagnostic availability in your instrument. Use National Instruments or other configurator to obtain revision information from the resource block's REVISION_ARRAY, DEV_REV and DD_REV parameters and use that information to pick appropriate revision combination column 1 thru 4 in table below.

Use designation and notes from the appropriate column to determine level of availability of each Advanced Diagnostic feature. The notes at end of the table explain situations where a feature is only partially available.

Table 1 Advanced Diagnostics Availability

Table 1 – Advanced Diagnostic Feature Availability by Firmware/Hardware Revision Combination						
	Revision Combination →	1	2	3	4	
#	RS Block: REVISION_ARRAY[0] → RS Block: REVISION_ARRAY[2] → RS Block: DEV_REV, DD_REV → Advanced Diagnostic Feature ↓	0402 + below 0103 + below 08,02 + below	0501 + above 0103 + below 09,01 + above	0501 + above 0104 + above 09,01 + above	0501 + above 0105 + above 09,01 + above	Type
1	INSTALL_DATE	N/A	F/F	F/F	F/F	Parameter
2	TIME_IN_SERVICE	N/A	F/F	F/F	F/F	Parameter
3	POWER_CYCLES	N/A	F/F	F/F	F/F	Parameter
4	POWER_CYCLES_DATE	N/A	F/F	F/F	F/F	Parameter
5	VOLTAGE	N/A	0.0 Note 6	0.0 Note 6	F/F	Parameter
6	VOLTAGE_MIN	N/A	0.0 Note 6	0.0 Note 6	F/F	Parameter
7	VOLTAGE_MIN_DATE	N/A	1/1/72 Note 6	1/1/72 Note 6	F/F	Parameter
8	EL_TEMPERATURE	N/A	0.0 Note 6	0.0 Note 6	F/F	Parameter
	Electronics Temperature Tracking:					
9	EL_TEMP_OVER_RNG_CTR	N/A	0 Note 6	0 Note 6	F/F	Parameter
10	EL_TEMP_OVER_RNG_DATE	N/A	1/1/72 Note 6	1/1/72 Note 6	F/F	Parameter
11	EL_TEMP_UNDER_RNG_CTR	N/A	0 Note 6	0 Note 6	F/F	Parameter
12	EL_TEMP_UNDER_RNG_DATE	N/A	1/1/72 Note 6	1/1/72 Note 6	F/F	Parameter
13	EL_TEMP_MAX	N/A	0.0 Note 6	0.0 Note 6	F/F	Parameter
14	EL_TEMP_MIN	N/A	0.0 Note 6	0.0 Note 6	F/F	Parameter
15	MSG_KEY_NUMBER	N/A	Note 2	F/F	F/F	Parameter
16	MSG_METER_BODY	N/A	Note 2	F/F	F/F	Parameter
17	MSG_FLANGE	N/A	Note 2	F/F	F/F	Parameter
18	MSG_OPTIONS_1	N/A	Note 2	F/F	F/F	Parameter
19	MSG_OPTIONS_2	N/A	Note 2	F/F	F/F	Parameter
20	Device SW Revisions	N/A	F/F	F/F	F/F	Method
21	Device RS Block Information	N/A	F/F	F/F	F/F	Method
	Materials of Construction:					
22	Model Number:	N/A	Note 2	F/F	F/F	Method
23	Device Key Number and Meter Body Information	N/A	Note 2	F/F	F/F	Method
24	Device Flange Assembly Information	N/A	Note 2	F/F	F/F	Method

Table 1 – Advanced Diagnostic Feature Availability by Firmware/Hardware Revision Combination – Continued						
	Revision Combination →	1	2	3	4	
#	RS Block: REVISION_ARRAY[0] → RS Block: REVISION_ARRAY[2] → RS Block: DEV_REV, DD_REV → Advanced Diagnostic Feature ↓	0402 + below 0103 + below 08,02 + below	0501 + above 0103 + below 09,01 + above	0501 + above 0104 + above 09,01 + above	0501 + above 0105 + above 09,01 + above	Type
	Process Variable Tracking:					
25	PV_MAX	N/A	F/F	F/F	F/F	Parameter
26	PV_MIN	N/A	F/F	F/F	F/F	Parameter
27	AI Block Information	N/A	F/F	F/F	F/F	Method
28	PV_OVER_RNG_CTR	N/A	F/F	F/F	F/F	Parameter
29	PV_OVER_RNG_DATE	N/A	F/F	F/F	F/F	Parameter
30	PV_UNDER_RNG_CTR	N/A	F/F	F/F	F/F	Parameter
31	PV_UNDER_RNG_DATE	N/A	F/F	F/F	F/F	Parameter
	Meter Body Temperature Tracking:					
32	TEMP_OVER_RNG_CTR	N/A	F/F	F/F	F/F	Parameter
33	TEMP_OVER_RNG_DATE	N/A	F/F	F/F	F/F	Parameter
34	TEMP_UNDER_RNG_CTR	N/A	F/F	F/F	F/F	Parameter
35	TEMP_UNDER_RNG_DATE	N/A	F/F	F/F	F/F	Parameter
36	TEMP_MAX	N/A	F/F	F/F	F/F	Parameter
37	TEMP_MIN	N/A	F/F	F/F	F/F	Parameter
38	ST_PR	N/A	0.0 Note 6	Note 5	Note 5	Parameter
	Static Pressure Tracking:					
39	ST_PR_MAX	N/A	0.0 Note 6	Note 5	Note 5	Parameter
40	ST_PR_OVER_RNG_CTR	N/A	0 Note 6	Note 5	Note 5	Parameter
41	ST_PR_OVER_RNG_DATE	N/A	1/1/72 Note 6	Note 5	Note 5	Parameter
42	STRESS_MONITOR	N/A	Note 3	Note 3	F/F	Parameter
43	SERVICE_LIFE	N/A	Note 4	Note 4	F/F	Parameter
44	CALIB_DATE_LAST_2PT	N/A	F/F	F/F	F/F	Parameter
45	CALIB_DATE_PREV_2PT	N/A	F/F	F/F	F/F	Parameter
46	CALIB_DATE_RESTORE	N/A	F/F	F/F	F/F	Parameter
47	CALIB_DATE_CLEAR	N/A	F/F	F/F	F/F	Parameter
48	CALIB_DATE_ZERO	N/A	F/F	F/F	F/F	Parameter
49	XD Block Information	N/A	F/F	F/F	F/F	Method
50	Two-point Calibration	N/A	F/F	F/F	F/F	Method
51	Restore Calibration	N/A	F/F	F/F	F/F	Method
52	Clear Calibration	N/A	F/F	F/F	F/F	Method
53	Calibration Zero	N/A	F/F	F/F	F/F	Method

N/A = Not Available.

F/F = Feature has full functionality

Note 2: Model number not available data is blank.

Note 3: Feature is functional but missing effect of electronics temperature.

Note 4: Service life calculated as if electronics temperature was constant at 0°C

Note 5: Future Feature to be added for DP meter body types; static pressure is 0.0 for AP and GP type meter bodies.

Note 6: Feature is not functional. The displayed value is fixed at value indicated in table.

2.3 Installation Components

Components Needed for Installation

The ST 3000 FF transmitter contains electronics that enable it to operate using the Fieldbus FOUNDATION™ protocol. This digital interface requires a number of components to provide control and data communications between field devices and the control room environment. Table 1 outlines the basic component parts needed to install and operate the ST 3000 FF on a fieldbus network

Table 2 Components Required for ST 3000 FF Installation

Components	Description
ST 3000 FF Transmitter (Field Device)	Measures process pressure and transmits process data to operator station or host computer.
Power Supply	Furnishes DC power to fieldbus devices.
Power Conditioner	Acts as a filter to prevent the power supply from interfering with the fieldbus signaling. (May be part of a fieldbus power supply.)
Fieldbus Cable	Twisted pair shielded wire used to interconnect fieldbus devices.
Fieldbus Terminators	A signal termination device used to prevent reflected signals (noise) from distorting fieldbus communications.
Fieldbus IS Barriers (For hazardous area installations)	Intrinsic safety wire barriers are required for hazardous location installations.
Fieldbus Wiring Blocks	Wiring blocks allowing easy connection of devices, cable, terminators, surge suppressors and other fieldbus network components.

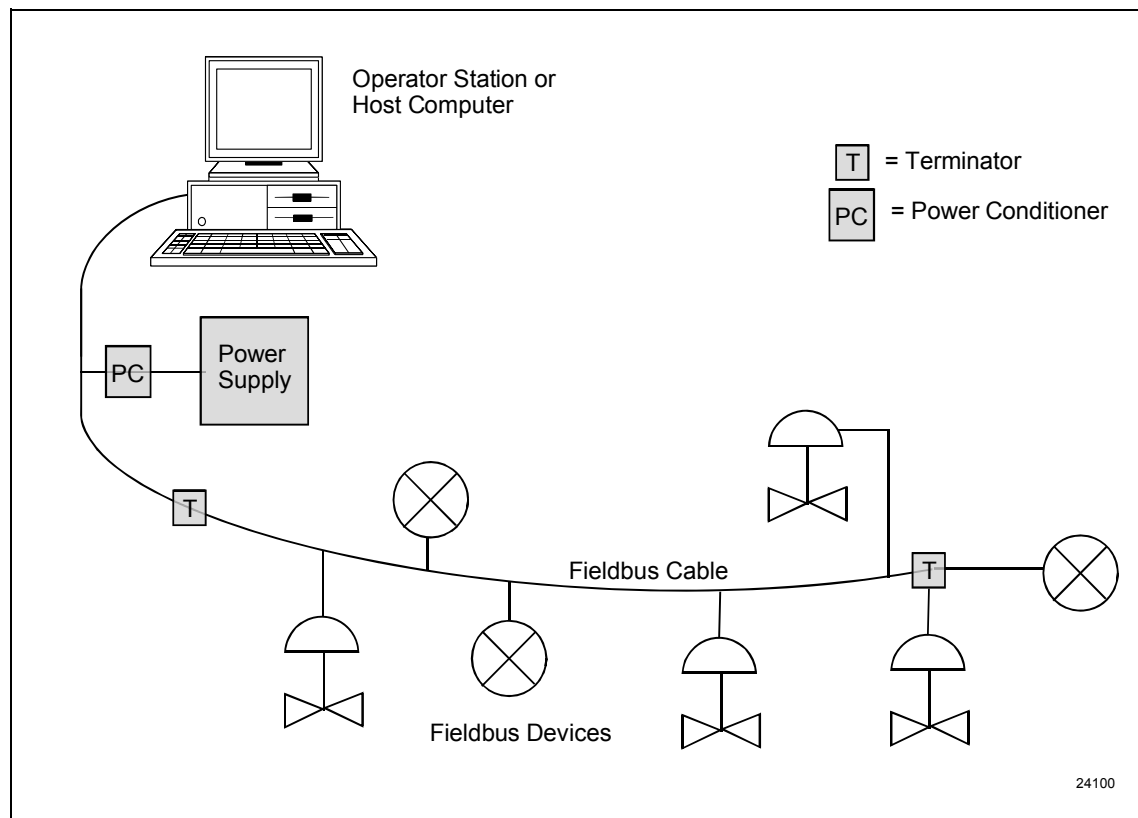
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2.3 Installation Components Continued

Operator Interface

In the control room an operator station, a personal computer or host computer acts as the operator interface to the fieldbus network. Using supervisory control software applications, the field devices on a fieldbus network can be monitored and controlled at the operator interface. Figure 9 shows how these components go together to operate on a fieldbus network.

Figure 9 Fieldbus Network Components



2.4 Installation/Operation Tasks

Installation Tasks

Installation of the ST 3000 FF is not difficult. The tasks for installing and operating the transmitter are outlined in Table 2.

Table 3 Installation/Operation Task Summary

Task	Procedure	Refer to . . .
-	Bench Check (optional) (Off-line configuration)	Section 3
1	Pre-installation Considerations	Section 4
2	Install ST 3000 FF Transmitter • Mounting • Piping • Wiring	Section 5 Section 5.2 Section 5.3 Section 5.4
3	Power Up Transmitter	Section 5.5
4	Establish Communications • Initial checks	Section 6.4
5	Configure ST 3000 FF transmitter	Section 6.5 in this manual and also the user manual supplied with your fieldbus configuration application.
6	Operation	Section 7. Also see supervisory control application documentation.
-	Periodic Maintenance • Cleaning • Calibration	Section 9 Section 9.3 Section 10
-	Troubleshooting (if problems arise)	Section 11
-	Replacement (if needed)	Section 9

Section 3 – Off-line Configuration (Optional)

3.1 Introduction

Section Contents

This section includes these topics

Section	Topic	See Page
3.1	Introduction	17
3.2	Off-line Configuration.....	18

About this Section

The off-line configuration or bench check is an optional procedure for checking out your transmitter. This section provides a procedure for configuring the ST 3000 FF off-line, meaning you can load configuration information into the transmitter before it is connected in a fieldbus network. This enables you to configure the transmitter before installation. Calibration is also possible before the transmitter is installed in the field.

Device Calibration

Your transmitter was factory calibrated to its standard range or a range specified on the purchase order. This means there is no need to recalibrate the transmitter during installation.

If you need to calibrate the transmitter before installation, the setup is the same as for the benchcheck and the calibration procedures can be found in Section 10.

3.2 Off-line Configuration

Configure ST 3000 FF Before Installation

Using the NI-FBUS Configurator software (or other fieldbus device configuration application), you can perform an off-line check of the ST 3000 FF before it is mounted and connected to the process hardware and the fieldbus network. By wiring the transmitter to the fieldbus interface of a PC and using a fieldbus power supply to furnish power to the transmitter, you can read and write parameters in the ST 3000 FF. See Figure 10 and Table 3 for procedure.

Figure 10 Configuration Setup Figure.

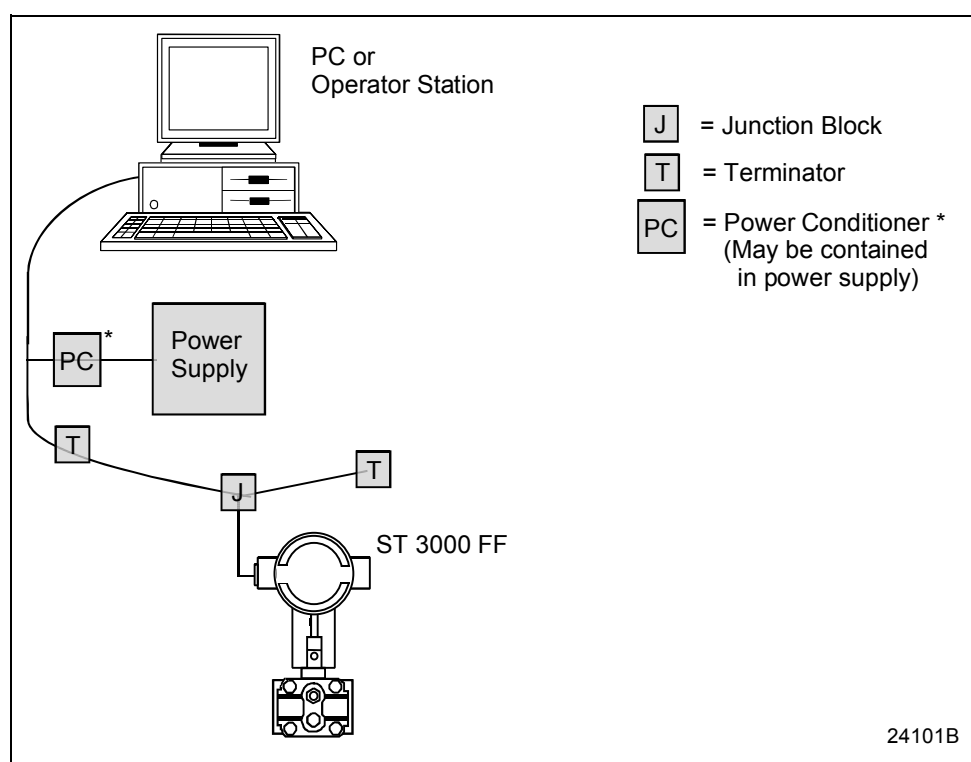


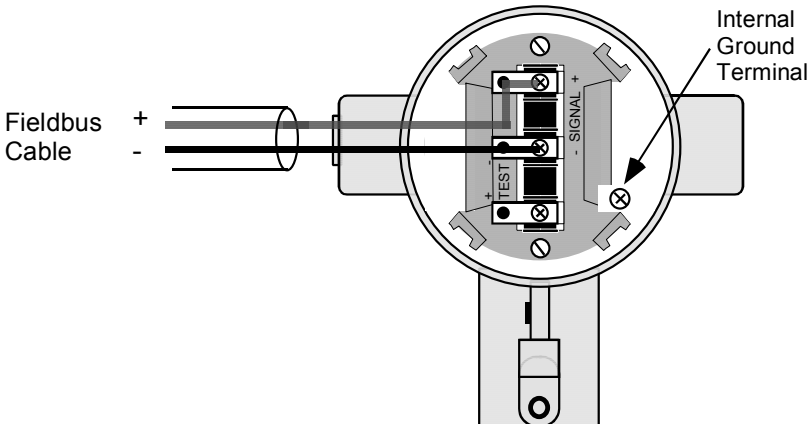
Table 4 Off-line Configuration Wiring Procedure

Step	Action
1	Connect fieldbus cable to junction block and to fieldbus interface card on the PC. Observe polarity of fieldbus cable throughout the network.
2	Loosen end-cap lock and remove end-cap cover from terminal block end of electronics housing.

Continued on next page

3.2 Off-line Configuration Continued

Table 3 Off-line Configuration Wiring procedure, continued

Step	Action
3	Observing polarity, connect positive fieldbus lead to Signal + terminal and negative fieldbus lead to Signal – terminal. Example: Connecting fieldbus to transmitter. 
4	At the junction block, connect a fieldbus terminator in parallel with the transmitter. Refer to Figure 10.
5	Connect a power supply , power conditioner (if needed), and a fieldbus terminator to the fieldbus cable.
6	Turn on PC.
7	Turn on power supply on the fieldbus link.
8	Start fieldbus configuration application on PC.

Establish Communications

Once you have established communications between the transmitter and the PC, you can then check out the transmitter. If the transmitter is not visible in the configurator application window, see Troubleshooting in Section 11.

Continued on next page

3.2 Off-line Configuration Continued

Assign Bus Address and Device Tag

You can check the device ID, sensor ID and SENSOR_SN of the transmitter, assign a network node address to the device and assign tag names to the device.

NOTE: The transmitter is shipped with default node addresses and tag names that appear at start-up. These can be changed to actual network addresses and tag names.

Device Configuration

You can view the various block parameters that make up the transmitter configuration, enter parameter values for your process application and write them to the device.

Section 4 – Pre-Installation Considerations

4.1 Introduction

Section Contents

This section includes these topics:

Section	Topic	See Page
4.1	Introduction	21
4.2	Considerations for ST 3000 FF Transmitter.....	22
4.3	Considerations for Local Meter Option.....	26

About this Section

This section reviews things you should take into consideration before you install the transmitter. Of course, if you are replacing an existing ST 3000 FF transmitter you can skip this section

4.2 Considerations for ST 3000 FF Transmitter

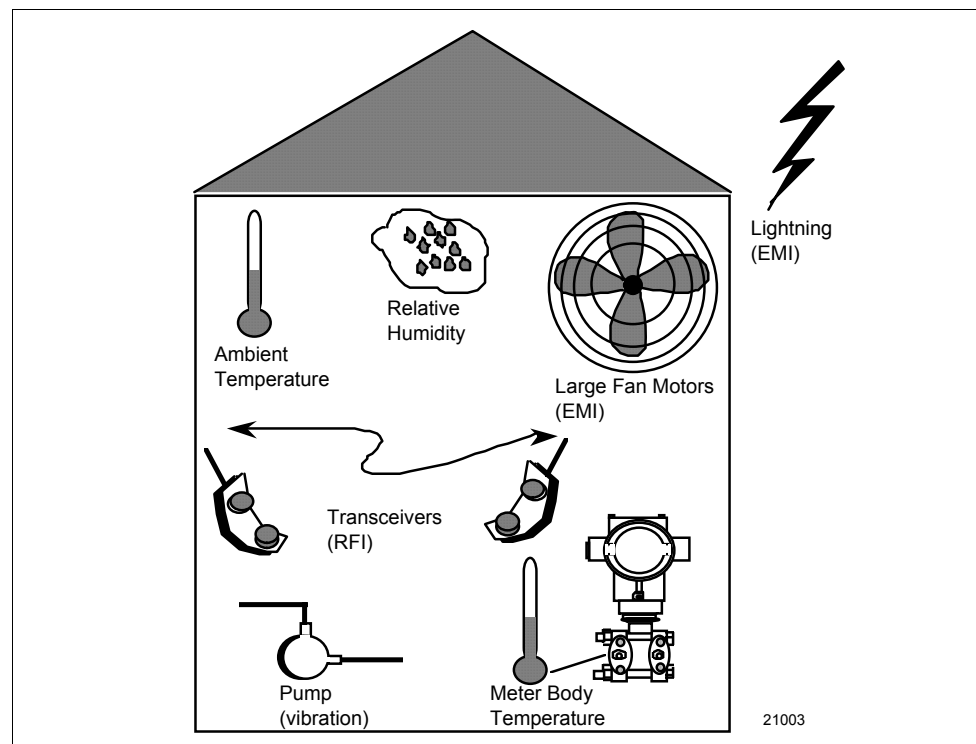
Evaluate Conditions

The ST 3000 FF transmitter is designed to operate in common indoor industrial environments as well as outdoors. To assure optimum performance, evaluate these conditions at the mounting area relative to published transmitter specifications and accepted installation practices for electronic pressure transmitters.

- Environmental conditions
 - Ambient temperature
 - Relative humidity
- Potential noise sources
 - Radio Frequency Interference (RFI)
 - Electromagnetic Interference (EMI)
- Vibration sources
 - Pumps
 - Motorized valves
 - Valve cavitation
- Process characteristics
 - Temperature
 - Maximum pressure rating

Figure 11 illustrates typical mounting area considerations to make before installing a transmitter.

Figure 11 Typical Mounting Area Considerations Prior to Installation



Continued on next page

4.2 Considerations for ST 3000 FF Transmitter Continued

Temperature limits Table 4 lists the operating temperature limits for the various types of transmitters with silicone fill fluids. See transmitter specifications for the temperature limits of transmitters with alternative fill fluids.

Table 5 Operating Temperature Limits (Transmitters with Silicone Fill Fluids)

Transmitter Type and Model	Ambient Temperature		Meter Body	
	°C	°F	°C	°F
<i>Draft Range</i> STD110	-40 to 70	-40 to 158	-40 to 70	-40 to 158
<i>Differential Pressure</i> STD125	-40 to 85	-40 to 185	-40 to 85	-40 to 185
STD120, STD130, STD170	-40 to 93	-40 to 200	-40 to 125	-40 to 257
STD924, STD930, STD974	-40 to 85	-40 to 185	-40 to 125	-40 to 257
<i>Gauge Pressure</i>				
STG140, STG170, STG180, STG14L, STG17L, STG18L	-40 to 93	-40 to 200	-40 to 125	-40 to 257
STG14T	-40 to 93	-40 to 200	-40 to 150 †	-40 to 302 †
STG93P	-15 to 65	5 to 149	-15 to 95 ††	5 to 203 ††
STG944, STG974	-40 to 85	-40 to 185	-40 to 125	-40 to 257
STG94L, STG97L, STG98L	-40 to 85	-40 to 185	-40 to 110	-40 to 230
<i>Absolute Pressure</i> STA122/12L	-40 to 93	-40 to 200	See Specification Sheet	
STA140/14L	-40 to 93	-40 to 200	-40 to 80	-40 to 176
STA922/92L	-40 to 85	-40 to 185	See Specification Sheet	
STA940/94L	-40 to 85	-40 to 185	-40 to 80	-40 to 176
STA17L/97L	-40 to 85	-40 to 185	-40 to 80	-40 to 176
<i>Flange Mounted</i>				
STF128, STF132, STF924, STF932	-40 to 93	-40 to 200	-40 to 175	-40 to 350
<i>Pseudo-Flanged Head</i>				
STF12F, STF13F, STF92F, STF93F	-40 to 93	-40 to 200	-40 to 93	-40 to 200
STF14F	-40 to 85	-40 to 185	-40 to 85	-40 to 185
<i>Gauge Pressure Flange Mount</i>				
STF14T	-40 to 93	-40 to 200	-40 to 150 †	-40 to 302 †
<i>Remote Diaphragm Seals</i>				
STR12D, STR13D, STR14G, STR17G, STR14A	See Specification Sheet		See Specification Sheet	
STR93D, STR94G	-40 to 85	-40 to 185	See Specification Sheet	

† Process temperatures above 125 °C (257 °F) require a reduction in the maximum ambient temperature as follows:

Process Temperature	Ambient Temperature Limit
150 °C (302 °F)	50 °C (122 °F)
140 °C (284 °F)	60 °C (140 °F)
125 °C (257 °F)	85 °C (185 °F)

†† Process temperatures above 65 °C (149 °F) require a 1:1 reduction in maximum ambient temperature.

NOTE: For transmitters with local meter option see Table 7.

NOTE: Transmitters with other fill fluids (CTFE, Neobee, Etc.) have different Operating Temperature Limits. For more specific information, refer to the appropriate Specification and Model Selection Guide or transmitter nameplate.

4.2 Considerations for ST 3000 FF Transmitter Continued

Power Requirements The ST 3000 FF is a bus-powered device, meaning that it receives its power from the dc voltage on a fieldbus wiring segment. There are certain guidelines and limitations regarding the wiring of fieldbus devices. See Section 5.4 for more information on wiring the transmitter.

Table 5 lists the operating power requirements for the ST 3000 FF transmitter.

Table 6 ST 3000 FF Power Requirements

Static Power (at the transmitter terminal block)	Minimum	Maximum
	9 Vdc @ 20mA	32 Vdc @ 20mA

For additional information on power requirements see the Honeywell ST 3000 FF Fieldbus Pressure Transmitter Software Release Guide.

Continued on next page

4.2 Considerations for ST 3000 FF Transmitter Continued

Pressure Ratings

Table 6 lists Maximum Allowable Working Pressure (MAWP) for a given transmitter Upper Range Limit (URL).

The maximum allowable working pressure (MAWP) is the pressure used for the approval body safety calculations.

Table 7 Transmitter Maximum Allowable Working Pressure (MAWP) Ratings

Transmitter Type	Upper Range Limit (URL)	MAWP
Draft Range	10 inches H ₂ O (25 mbar)	50 psi (3.5 bar)
Differential Pressure	400 inches H ₂ O (1 bar)	3,000 psi (210 bar)
	100 psi (7 bar)	3,000 psi (210 bar)
	3,000 psi (210 bar)	3,000 psi (210 bar)
Gauge Pressure	100 psi (7 bar)	100 psi (7 bar)
	300 psi (21 bar)	300 psi (21 bar)
	500 psi (35 bar)	500 psi (35 bar)
	3,000 psi (210 bar)	3,000 psi (210 bar)
	6,000 psi (415 bar)	6,000 psi (415 bar)
	10,000 psi (690 bar)	10,000 psi (690 bar)
Flange Mount	400 inches H ₂ O (1 bar)	Per selected flange and material (ANSI/ASME 150#, 300#, DN PN40)
	100 psi (7 bar)	
Remote Seal	400 inches H ₂ O (1 bar)	Lesser MAWP of either Remote Seal selected or transmitter pressure rating
	100 psi (7 bar)	
Absolute Pressure	780 mmHg Absolute (1 bar)	780 mmHg Absolute (1 bar)
	500 psia (35 bar)	500 psia (35 bar)
	3,000 psia (210 barA)	3,000 psia (210 barA)

NOTE: Maximum Allowable Working Pressure (MAWP) may vary with materials of construction and process temperature. For more specific information, refer to the appropriate Specification and Model Selection Guide or transmitter nameplate

NOTE: To convert bar values to kilopascals (kPa), multiply by 100.
For example, 3.5 bar equals 350 kPa

4.3 Considerations for Local Meter Option

Reference Specifications

Table 7 lists pertinent local meter specifications for reference.

Table 8 Local Meter Specifications.

Operating Conditions		
Parameter	Rated	Extreme, Transportation and Storage
Ambient Temperature	−40 to 176 °F −40 to 80 °C	−58 to 194 °F −50 to 90 °C
Relative Humidity %RH	10 to 90	0 to 100
Design		
Accuracy	No error. Reproduces transmitter signal exactly within its resolution.	
Display Resolution	Shown as: ±0.005 for ±19.99 reading range, 19.99 ±0.05 for ±199.9 reading range, 199.9 ±0.5 for ±1999 reading range, 1999 ±5 for ±19990 reading range, 19.99 K ±50 for ±199900 reading range, 199.9 K ±500 for ±1999000 reading range, 1999 K ±50000 for ±19990000 reading range. 19990 K	
Display Update Rate	Above 32 °F (0 °C): ½ second @ or below 32 °F (0 °C): 1½ seconds.	

Meter Display at High and Low Temperature Extremes

The rated temperature limits for the local meter are listed above and are true in that no damage to the meter will occur over these temperatures, however the readability of the LCD is affected if taken to these temperature extremes:

- The LCD will turn black at some temperature between 80 to 90 °C (176 and 194 °F), rendering the display unreadable. This effect is only temporary, and normally occurs at 90 °C (194 °F).
- At low temperatures, the update rate of the display is lengthened to 1.5 seconds` due to the slower response time of the display. At -20 °C (-4 °F) the display becomes unreadable due to slow response of the LCD. This is also only temporary and normal readability will return when temperature returns above -20 °C (-4 °F).

Section 5 – Transmitter Installation

5.1 Introduction

Section Contents

This section includes these topics:

Section	Topic	See Page
5.1	Introduction	27
5.2	Mounting ST 3000 Transmitter	28
5.3	Piping ST 3000 Transmitter	38
5.4	Wiring ST 3000 FF Transmitter	43
5.5	Power up Transmitter	53

About this Section

This section provides information about the mechanical and electrical installation of the ST 3000 FF transmitter. It includes procedures for mounting, piping and wiring the transmitter for operation.

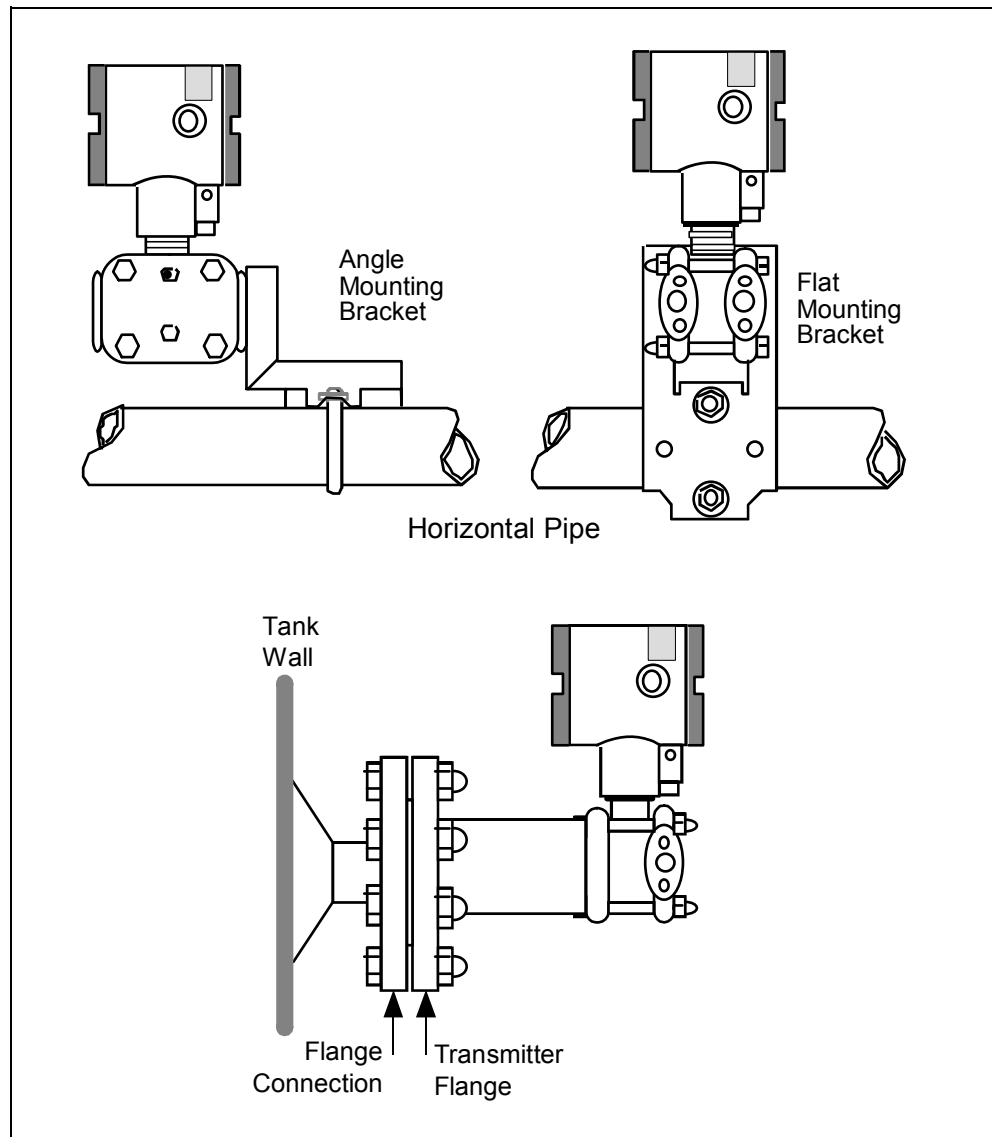
5.2 Mounting ST 3000 Transmitter

Summary

You can mount all transmitter models (except flush mount models and those with integral flanges) to a 2-inch (50 millimeter) vertical or horizontal pipe using our optional angle or flat mounting bracket or a bracket of your own. Flush mount models are mounted directly to the process pipe or tank by a 1-inch weld nipple. Those models with integral flanges are supported by the flange connection.

Figure 12 shows typical bracket and flange mounted transmitter installations for comparison.

Figure 12 Typical Bracket Mounted Installations



Continued on next page

5.2 Mounting ST 3000 Transmitter Continued

Dimensions

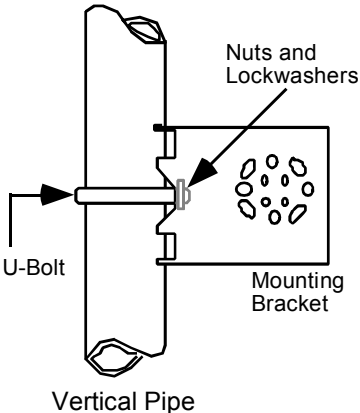
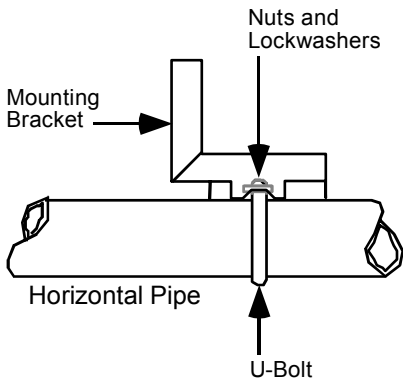
Detailed dimension drawings for given transmitter series and types are listed in Section 13 for reference. Note that abbreviated overall dimensions are also shown in the Specification Sheets for the given transmitter models.

This section assumes that the mounting dimensions have already been taken into account and the mounting area can accommodate the transmitter.

Bracket mounting

Table 8 summarizes typical steps for mounting a transmitter to a bracket.

Table 9 Mounting ST 3000 FF Transmitter to a Bracket

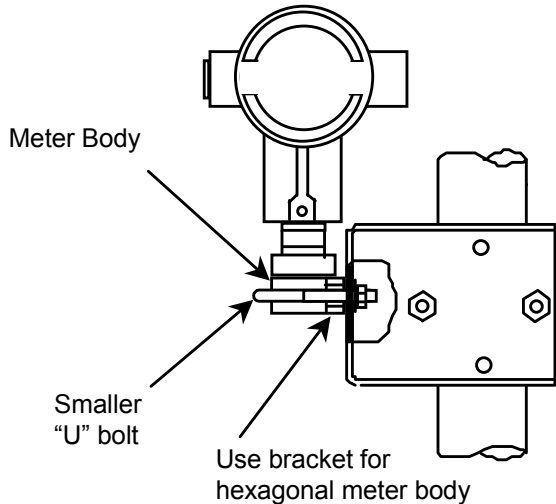
Step	Action						
1	<table><tr><th>If you are using an...</th><th>Then...</th></tr><tr><td>optional mounting bracket</td><td>go to Step 2.</td></tr><tr><td>existing mounting bracket</td><td>go to Step 3.</td></tr></table>	If you are using an...	Then...	optional mounting bracket	go to Step 2.	existing mounting bracket	go to Step 3.
If you are using an...	Then...						
optional mounting bracket	go to Step 2.						
existing mounting bracket	go to Step 3.						
2	Position bracket on 2-inch (50.8 mm) or, and install “U” bolt around pipe and through holes in bracket. Secure with nuts and lockwashers provided. Example - Angle mounting bracket secured to horizontal or vertical pipe. 						

Continued on next page

5.2 Mounting ST 3000 Transmitter Continued

Bracket mounting, continued

Table 8 Mounting ST 3000 FF Transmitter to a Bracket, continued

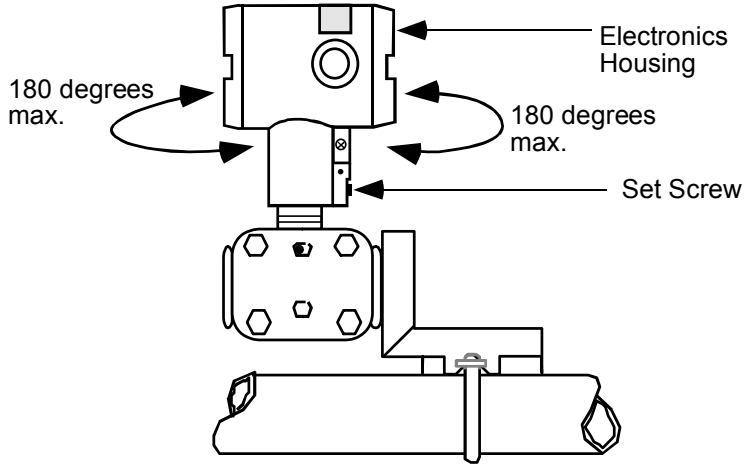
Step	Action										
3	Align appropriate mounting holes in transmitter with holes in bracket and secure with bolts and washers provided. <table border="1"> <thead> <tr> <th>If transmitter is ...</th><th>Then ...</th></tr> </thead> <tbody> <tr> <td>DP type with double-ended process heads and/or remote seals</td><td>use alternate mounting holes in end of heads.</td></tr> <tr> <td>GP and AP with single-ended head</td><td>use mounting holes in side of meter body.</td></tr> <tr> <td>In-line GP and AP</td><td>use smaller "U" bolt provided to attach meter body to bracket. See figure below.</td></tr> <tr> <td>Dual head GP and AP</td><td>use mounting holes in end of process head.</td></tr> </tbody> </table> Inline models  NOTE: If the meter body is hexagonal, you must use the additional bracket supplied. If meter body is round, discard the bracket.	If transmitter is ...	Then ...	DP type with double-ended process heads and/or remote seals	use alternate mounting holes in end of heads.	GP and AP with single-ended head	use mounting holes in side of meter body.	In-line GP and AP	use smaller "U" bolt provided to attach meter body to bracket. See figure below.	Dual head GP and AP	use mounting holes in end of process head.
If transmitter is ...	Then ...										
DP type with double-ended process heads and/or remote seals	use alternate mounting holes in end of heads.										
GP and AP with single-ended head	use mounting holes in side of meter body.										
In-line GP and AP	use smaller "U" bolt provided to attach meter body to bracket. See figure below.										
Dual head GP and AP	use mounting holes in end of process head.										

Continued on next page

5.2 Mounting ST 3000 Transmitter Continued

Bracket mounting, continued

Table 8 Mounting ST 3000 FF Transmitter to a Bracket, continued

Step	Action
4	Loosen 4 mm set screw on outside neck of transmitter one full turn. Rotate electronics housing a maximum of 180 degrees in the left or right direction from center to the position you require and tighten set screw (13 to 15 lb-in/1.46 to 1.68 N·m). Example - Rotating electronics housing.  The diagram illustrates the rotation of the electronics housing. It shows a cross-section of the transmitter assembly mounted on a bracket. The top part is the electronics housing, which is connected to the main body of the transmitter. A set screw is located on the side of the housing. Two curved arrows indicate that the housing can be rotated a maximum of 180 degrees in either direction from its center position. Labels with leader lines identify the 'Electronics Housing' and the 'Set Screw'.

Continued on next page

5.2 Mounting ST 3000 Transmitter Continued



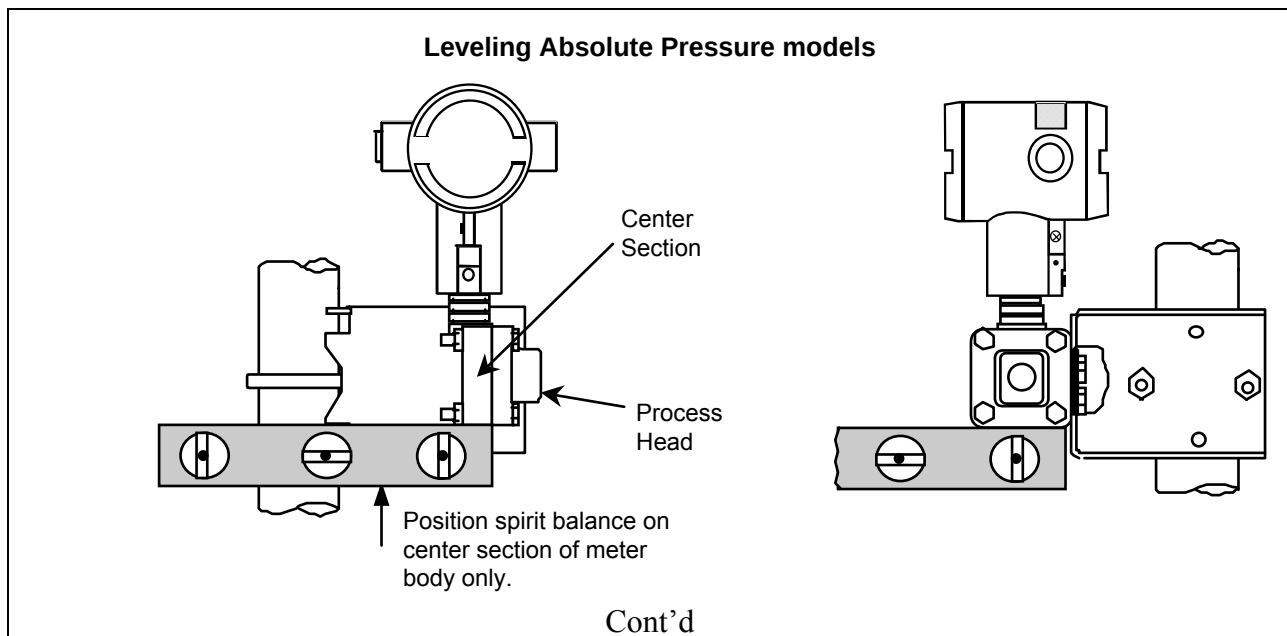
The mounting position of a model STA122, STA922, STA12L or STA922 Absolute Pressure Transmitter or a model STD110 Draft Range Differential Pressure Transmitter is critical as the transmitter spans become smaller. A maximum zero shift of 2.5 mm Hg for an absolute transmitter or 1.5 in H₂O for a draft range transmitter can result from a mounting position which is rotated 90 degrees from vertical. A typical zero shift of 0.12 mm Hg or 0.20 in H₂O can occur for a 5 degree rotation from vertical.

Precautions for Mounting Transmitters with Small Absolute or Differential Pressure Spans

To minimize these positional effects on calibration (zero shift), take the appropriate mounting precautions that follow for the given transmitter model.

For a model STA122 or STA922 transmitter, you must ensure that the transmitter is vertical when mounting it. You do this by leveling the transmitter side-to-side and front-to-back. See Figure 13 for suggestions on how to level the transmitter using a spirit balance.

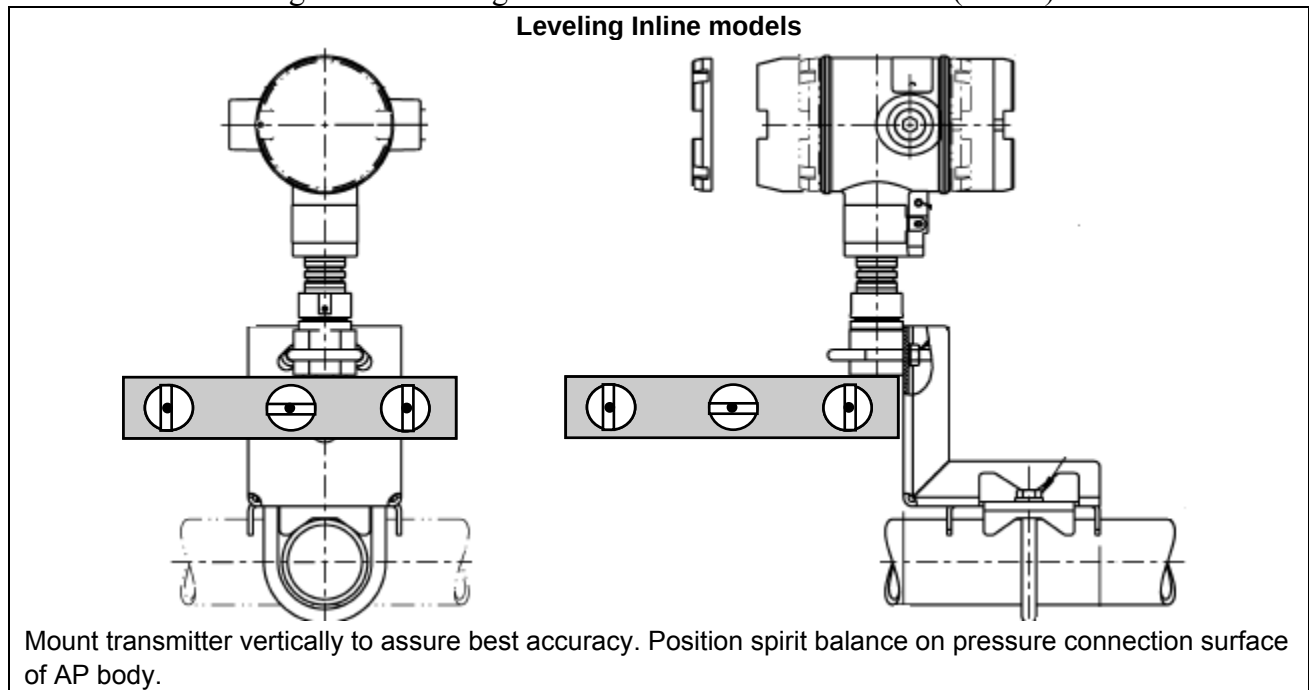
Figure 13 Leveling an Absolute Pressure Transmitter.



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5.2 Mounting ST 3000 Transmitter Continued

Figure 13 Leveling an Absolute Pressure Transmitter (cont'd)



Precautions for Mounting Transmitters with Small Absolute or Differential Pressure Spans, continued

For a transmitter with a small differential pressure span, you must ensure that the transmitter is vertical when mounting it. You do this by leveling the transmitter side-to-side and front-to-back. See Figure 13 for suggestions on how to level the transmitter using a spirit balance. You must also zero the transmitter by following the steps in Table 9 below.

5.2 Mounting ST 3000 Transmitter Continued

Table 10 Zero Corrects Procedure for STD110

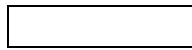
Step	Action
1	Attach the transmitter to the mounting bracket but do not completely tighten the mounting bolts
2	Connect a tube between the input connections in the high pressure (HP) and low pressure (LP) heads to eliminate the affects of any surrounding air currents.
3	Connect an operator interface and transmitter to a fieldbus link and power up the link to read the transmitter's output. See figure.
The diagram illustrates the wiring and mechanical setup for the transmitter. A 'Differential Pressure Type Transmitter' is shown mounted on a bracket. A 'Tube' is connected between the high pressure (HP) and low pressure (LP) input connections. The transmitter's output is connected to a fieldbus link through a 'Junction Block' (J) and 'Terminators' (T). The fieldbus link is powered by a 'Power Supply' and a 'Power Conditioner' (PC). A 'Fieldbus Network Interface' is connected to the fieldbus link. A legend defines the symbols: J = Junction Block, T = Terminator, and PC = Power Conditioner * (May be contained in power supply).	
4	Establish communications with the transmitter. Follow the steps in Table 3, if needed.
5	While reading the transmitter's output (AI block OUT parameter) position the transmitter so the output reading is zero and completely tighten the mounting bolts
6	Perform an input zero correct function to correct for any minor error that may occur after the mounting bolts are tightened. See Calibration, Section 10 for zero correction procedure.
7	Remove the tube from between the input connections and the power to the fieldbus link.
8	Continue with the remaining installation tasks.

Continued on next page

5.2 Mounting ST 3000 Transmitter Continued

Flange mounting

To mount a flange mounted transmitter model, bolt the transmitter's flange to the flange pipe on the wall of the tank.



On insulated tanks, remove enough insulation to accommodate the flange extension.

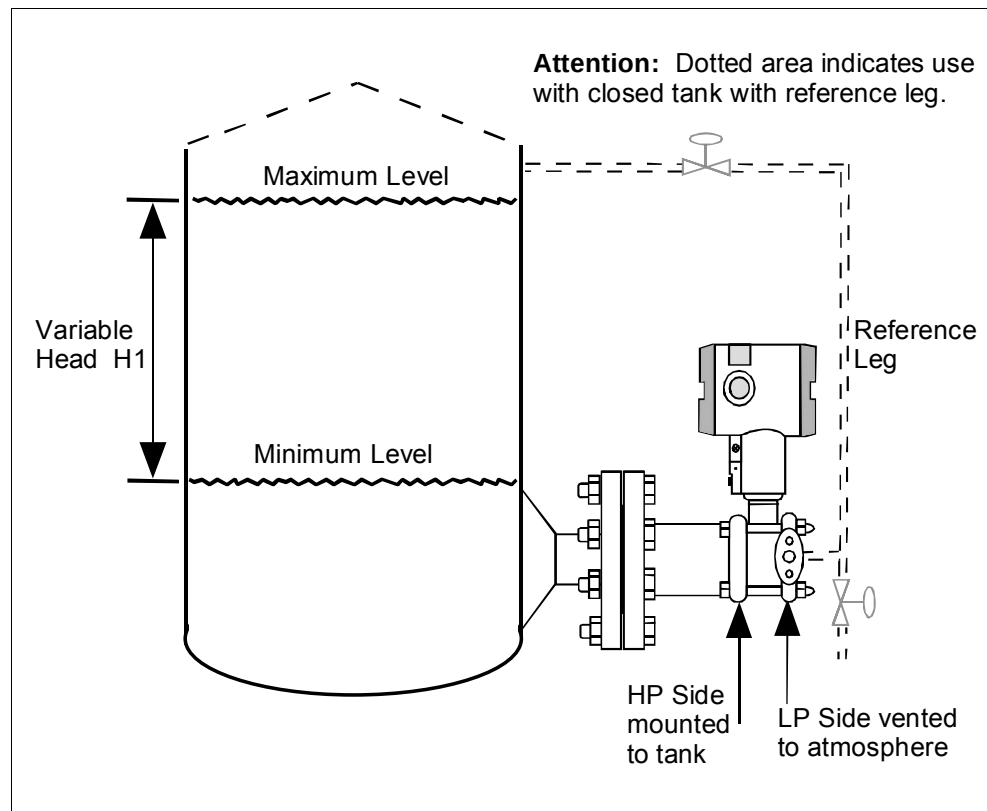
Figure 14 shows a typical installation for a transmitter with the flange on the high pressure (HP) side so the HP diaphragm is in direct contact with the process fluid. The low pressure (LP) side of the transmitter is vented to atmosphere (no connection).

It is the End User's responsibility to provide a flange gasket and mounting hardware that are suitable for the transmitter's service condition.

To prevent degradation of performance in Flush-Mounted Flanged Transmitters, exercise care to ensure that the internal diameter of the flange gasket does not obstruct the sensing diaphragm.

To prevent degradation of performance in Extended Mount Flanged Transmitters, ensure that there is sufficient clearance in front of the sensing diaphragm body.

Figure 14 Typical Flange Mounted Transmitter Installation



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5.2 Mounting ST 3000 Transmitter Continued

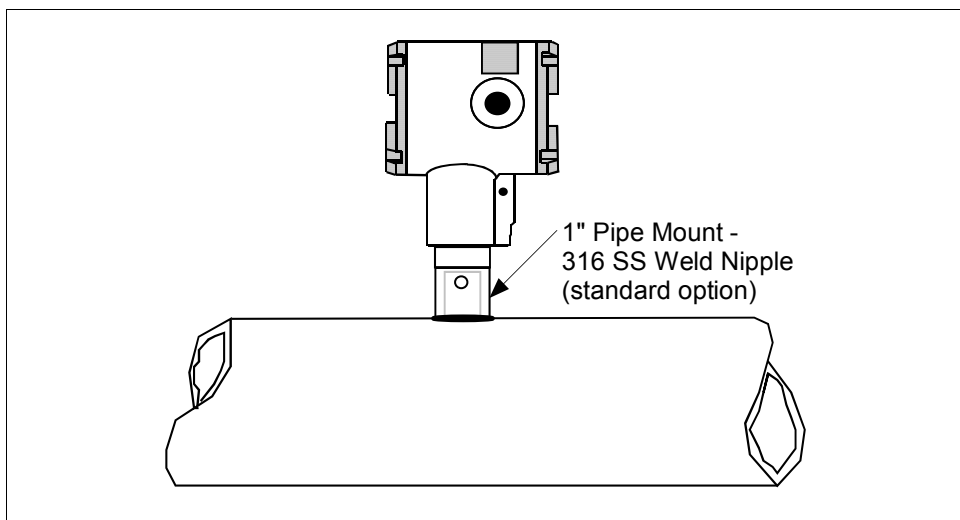
Flush mounting

To mount a flush mounted transmitter model, cut a hole for a 1-inch standard pipe in the tank or pipe where the transmitter is to be mounted. Weld the 1" mounting sleeve to the wall of the tank or to the hole cut on the pipe. Insert the meter body of the transmitter into the mounting sleeve and secure with the locking bolt. Tighten the bolt to a torque of 8.1 to 13.5 N · m (6 to 10 ft-lb). Figure 15 shows a typical installation for a transmitter with a flush mount on a pipe.

Once the transmitter is mounted, the electronics housing can be rotated to the desired position. See Table 8, step 4.

On insulated tanks, remove enough insulation to accommodate the mounting sleeve.

Figure 15 Typical Flush Mounted Transmitter Installation



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5.2 Mounting ST 3000 Transmitter Continued

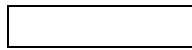
High Temperature Transmitter Mounting

You can mount the High Temperature transmitter directly to the process flange connection or the process piping. Figure 16 shows typical pipe and flange mounted transmitter installations for comparison.

To mount a flange mounted transmitter model, bolt the transmitter's flange to the flange on the wall of the tank or process pipe.

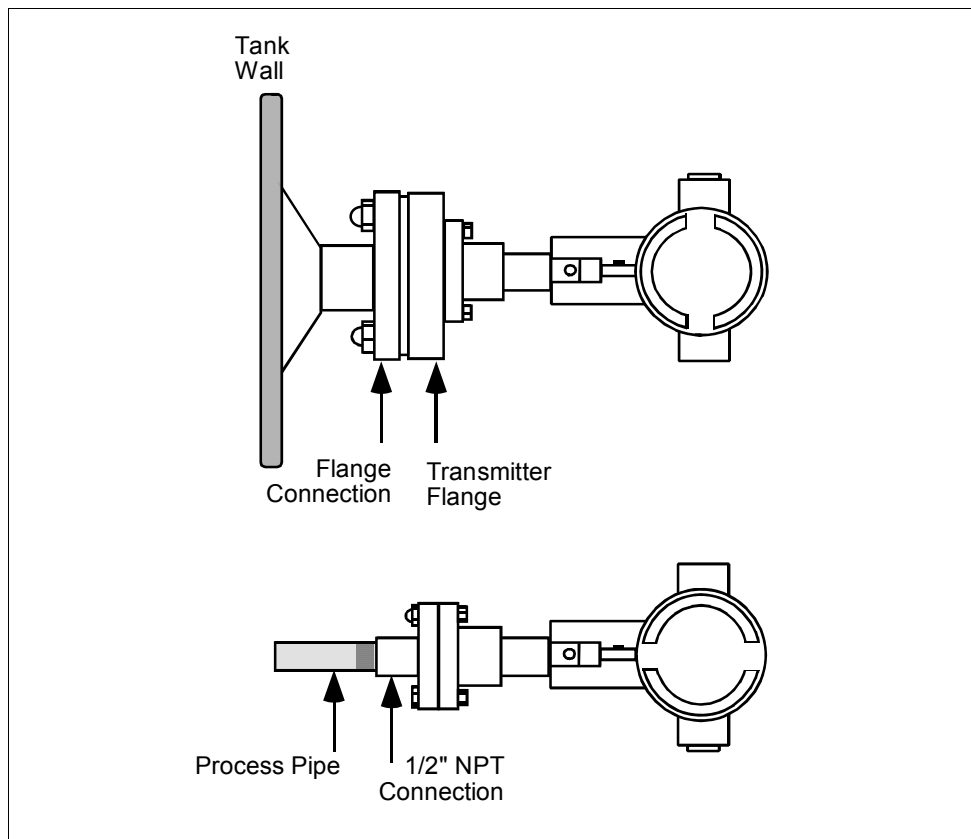
It is the End User's responsibility to provide a flange gasket and mounting hardware that are suitable for the transmitter's service condition.

Once the transmitter is mounted, the electronics housing can be rotated to the desired position. See Table 8, step 4.



On insulated tanks, remove enough insulation to accommodate the flange extension.

Figure 16 Typical Pipe and Flange Mounted Installations



Continued on next page

5.2 Mounting ST 3000 Transmitter Continued

Remote seal mounting

Use the procedure in Table 10 to mount a remote diaphragm seal transmitter model. Figure 17 shows a typical installation for a remote diaphragm seal transmitter for reference.

Mount the transmitter flanges within the limits stated here for the given fill-fluid in the capillary tubes with a tank at one atmosphere.

IF the fill fluid is...	THEN mount the flange...
Silicone DC 200 Oil	no greater than 22 feet (6.7 meters) below the transmitter.
Silicone DC 704 Oil	no greater than 19 feet (5.8 meters) below the transmitter.
Chlorotrifluorethylene (CTFE)	no greater than 11 feet (3.4 meters) below the transmitter.

NOTE: The combination of tank vacuum and high pressure capillary head effect should not exceed 9 psi (300 mm Hg) absolute.

Table 11 Mounting Remote Diaphragm Seal Transmitter

Step	Action						
1	Mount transmitter at a remote distance determined by length of capillary tubing.						
2	<table border="1"> <tr> <th>If Transmitter Model Number is...</th><th>Then Connect Remote Seal on...</th></tr> <tr> <td>STR93D or STR12D</td><td>high pressure (HP) side of transmitter to lower flange mounting on tank wall for variable head H1.</td></tr> <tr> <td>STR13D</td><td>low pressure (LP) side of transmitter to lower flange mounting on tank wall for variable head H1.</td></tr> </table> On insulated tanks, remove enough insulation to accommodate the flange extension.	If Transmitter Model Number is...	Then Connect Remote Seal on...	STR93D or STR12D	high pressure (HP) side of transmitter to lower flange mounting on tank wall for variable head H1.	STR13D	low pressure (LP) side of transmitter to lower flange mounting on tank wall for variable head H1.
If Transmitter Model Number is...	Then Connect Remote Seal on...						
STR93D or STR12D	high pressure (HP) side of transmitter to lower flange mounting on tank wall for variable head H1.						
STR13D	low pressure (LP) side of transmitter to lower flange mounting on tank wall for variable head H1.						

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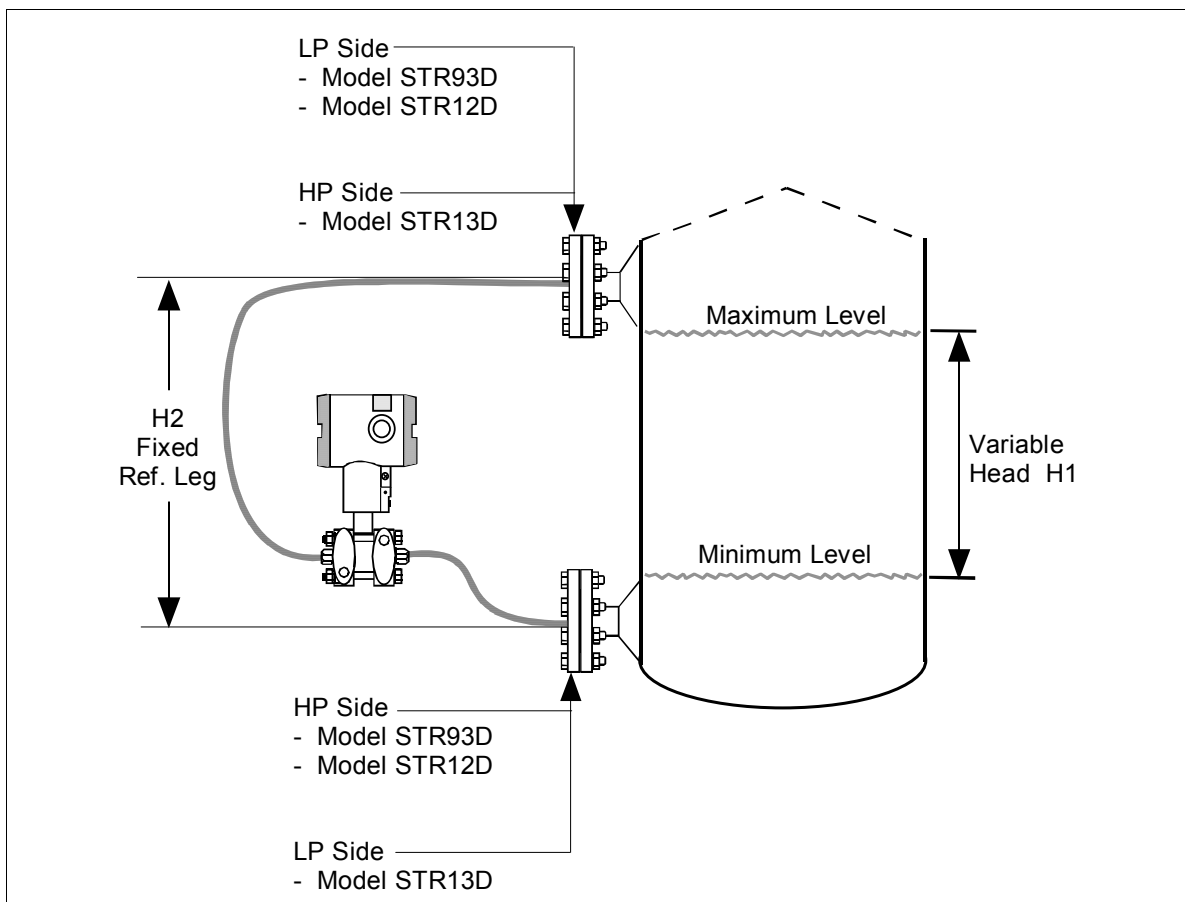
5.2 Mounting ST 3000 Transmitter Continued

Remote seal mounting, continued

Table 10 Mounting Remote Diaphragm Seal Transmitter, Continued

Step	Action						
3	<table><tr><th>If Transmitter Model Number is...</th><th>Then Connect Remote Seal on...</th></tr><tr><td>STR93D or STR12D</td><td>low pressure (LP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.</td></tr><tr><td>STR13D</td><td>high pressure (HP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.</td></tr></table> On insulated tanks, remove enough insulation to accommodate the flange extension.	If Transmitter Model Number is...	Then Connect Remote Seal on...	STR93D or STR12D	low pressure (LP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.	STR13D	high pressure (HP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.
If Transmitter Model Number is...	Then Connect Remote Seal on...						
STR93D or STR12D	low pressure (LP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.						
STR13D	high pressure (HP) side of transmitter to upper flange mounting on tank wall for fixed or constant head H2.						
4	It is the End User's responsibility to provide a flange gasket and mounting hardware that are suitable for the transmitter's service condition						

Figure 17 Typical Remote Diaphragm Seal Transmitter Installation.



5.3 Piping ST 3000 Transmitter

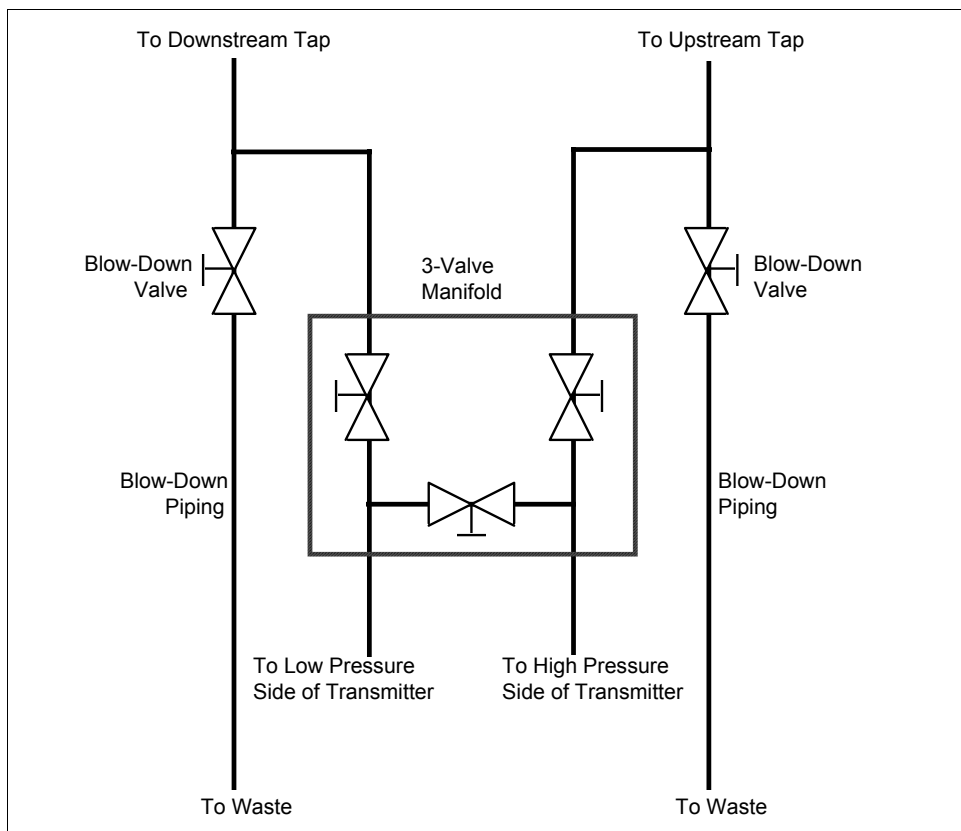
Summary

The actual piping arrangement will vary depending upon the process measurement requirements and the transmitter model. Except for flanged and remote diaphragm seal connections, process connections are made to $\frac{1}{4}$ inch or $\frac{1}{2}$ inch NPT female connections in the process head of the transmitter's meter body. For example, a differential pressure transmitter comes with double-ended process heads with $\frac{1}{4}$ inch NPT connections but they can be modified to accept $\frac{1}{2}$ inch NPT through optional flange adapters. Some gauge pressure transmitters have a $\frac{1}{2}$ inch NPT connection which mounts directly to a process pipe.

The most common type of pipe used is $\frac{1}{2}$ inch schedule 80 steel pipe. Many piping arrangements use a three-valve manifold to connect the process piping to the transmitter. A manifold makes it easy to install and remove a transmitter without interrupting the process. It also accommodates the installation of blow-down valves to clear debris from pressure lines to the transmitter.

Figure 18 shows a diagram of a typical piping arrangement using a three-valve manifold and blow-down lines for a differential pressure transmitter being used to measure flow.

Figure 18 Typical 3-Valve Manifold and Blow-Down Piping Arrangement.

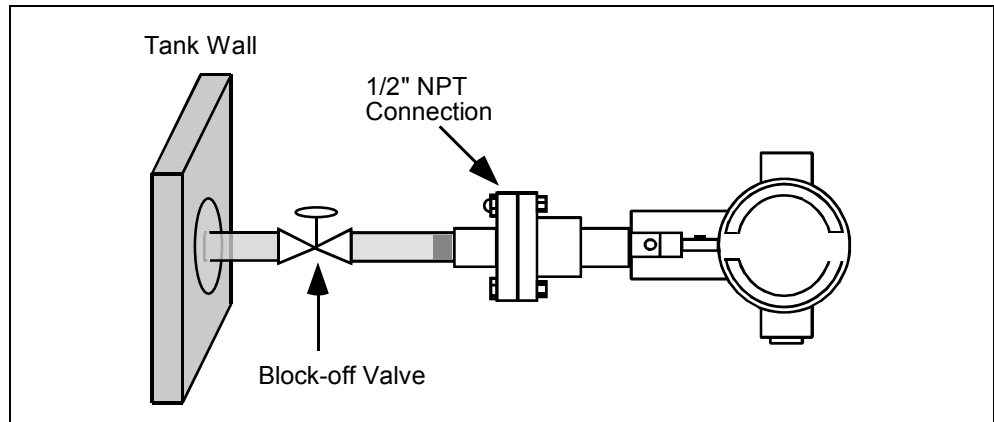


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5.3 Piping ST 3000 Transmitter Continued

Piping Arrangements, continued Another piping arrangement uses a block-off valve and a tee connector in the process piping to the transmitter as shown in Figure 19.

Figure 19 Typical Piping Arrangement for 1/2" NPT Process Connection



Transmitter location Table 11 lists the mounting location for the transmitter depending on the process.

Table 12 Suggested Transmitter Location for Given Process

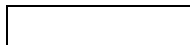
Process	Suggested Location	Explanation
Gases	Above the gas line	The condensate drains away from the transmitter.
Liquids	1. Below but close to the elevation of the process connection. 2. Level with or above the process connection.	1. This minimizes the static head effect of the condensate. 2. This requires a siphon to protect the transmitter from process steam. The siphon retains water as a "fill fluid."

For liquid or steam, the piping should slope a minimum of 25.4 mm (1 inch) per 305 mm (1 foot). Slope the piping down towards the transmitter if the transmitter is below the process connection so the bubbles may rise back into the piping through the liquid. If the transmitter is located above the process connection, the piping should rise vertically above the transmitter; then slope down towards the flowline with a vent valve at the high point. For gas measurement, use a condensate leg and drain at the low point (freeze protection may be required here).

See Appendix C for some suggested freeze protection solutions.

Continued on next page

5.3 Piping ST 3000 Transmitter Continued



Care must be taken when installing transmitters on hot processes. The operating temperature limits for the device (as outlined in Table 4) must not be exceeded. Impulse piping may be used to reduce the temperature of the process that comes into contact with the transmitter meter body. As a general rule there is a 56 degree C drop (100 degree F) in the temperature of the process for every foot of ½-inch uninsulated piping.

Process Connections Table 12 describes typical process connections for a given type of transmitter.

Table 13 Process Connections for Transmitters

Transmitter Type	Process Connection
Differential Pressure	- Process heads with 1/4-inch NPT female connection. - Flange adapters and manifolds with 1/2-inch female connection are optional. - Models with pseudo flange on one side include 2- or 3-inch ANSI class 150 flange.
Gauge Pressure	- Process head with 1/2-inch NPT female connection (Series 100 transmitters). - In-line 1/2-inch NPT female connection (STGxxL). - In-line ½-inch M-NPT, 9/16 AMINCO, DIN19213 - Process heads with 1/4-inch NPT female connection (STG9x4). - Flange adapters and manifolds with 1/2-inch female connections are optional STG9x4). 2-inch Sanitary Tri-Clamp (STG1xT) - Flush mount in 1" weld sleeve, with O-ring and locking bolt.
Absolute Pressure	- Process head with 1/2-inch NPT female connection. (STAx22, x40). - In-line ½-inch M-NPT, 9/16 AMINCO, DIN19213
Flange Mounted Liquid Level	- Small flange 1/2-inch, 1-, 1 ½ - and 2-inch (STFxxT) 2, 3- or 4-inch flange with flush or 2-, 4- or 6-inch extended diaphragm (See Table 13) on high pressure side.* - DN 50, 80, or 100 PN 40 flange with flush or 2, 4 or 6 inch extended diaphragm (See Table 13) on High Pressure Side*.
Remote Diaphragm Seals	See Model Selection Guide for description of available Flanged, Threaded, Chemical Tee, Saddle, and Sanitary process connections.

* Reference side has standard differential pressure process head.

Continued on next page

5.3 Piping ST 3000 Transmitter Continued

Flange descriptions Table 13 describes the available flange connections for flange mounted liquid level transmitters.

Table 14 Flange Description

Transmitter Type	Description
Flush or Extended Diaphragm	2-inch 150# serrated-face flange with 4 holes 19 mm (3/4 in) diameter on 120.7 mm (4.75 in) diameter bolt circle and an outside diameter of 150 mm (5.91 in).
	2-inch 150# serrated-face flange with 8 holes 19 mm (3/4 in) diameter on 127 mm (5.00 in) diameter bolt circle and an outside diameter of 165 mm (6.50 in).
	3-inch 150# serrated-face flange with 4 holes 19 mm (3/4 in) diameter on 152.4 mm (6.00 in) diameter bolt circle and an outside diameter of 190 mm (7.48 in).
	3-inch 300# serrated-face flange with 8 holes 22.2 mm (7/8 in) diameter on 168.3 mm (6.62 in) diameter bolt circle and an outside diameter of 210 mm (8.27 in).
	4-inch 150# serrated-face flange with 4 holes 19 mm (3/4 in) diameter on 190.5 mm (7.50 in) diameter bolt circle and an outside diameter of 230 mm (9.05 in).
	4-inch 300# serrated-face flange with 8 holes 22.2 mm (7/8 in) diameter on 255 mm (10.04 in) diameter bolt circle and an outside diameter of 200 mm (7.87 in).
	DN 50 PN 40 serrated-face flange with 4 holes 18 mm (0.71 in) diameter on 125 mm (4.92 in) diameter bolt circle and an outside diameter of 165 mm (6.50 in).
	DN 80 PN 40 serrated-face flange with 8 holes 18 mm (0.71 in) diameter on 160 mm (6.30 in) diameter bolt circle and an outside diameter of 200 mm (7.87 in).
	DN 100 PN 40 serrated-face flange with 8 holes 22 mm (0.87 in) diameter on 190 mm (7.48 in) diameter bolt circle and an outside diameter of 235 mm (9.25 in).
Pseudo Flange Head	2-inch, 150 lbs serrated-face flange with 4 holes 15.9 mm (5/8 in) diameter on 120.6 mm (4-3/4 in) diameter bolt circle and an outside diameter of 152.4 mm (6 in).
	3-inch, 150 lbs serrated-face flange with 4 holes 19 mm (3/4 in) diameter on 152 mm (6 in) diameter bolt circle and an outside diameter of 190 mm (7-1/2 in).
Flush Mount Gauge STG93P	25.4 mm (1-inch) pipe mount. (316L SS standard option.)

General Piping Guidelines

- When measuring fluids containing suspended solids, install permanent valves at regular intervals to blow-down piping.
- Blow-down all lines on new installations with compressed air or steam and flush them with process fluids (where possible) before connecting these lines to the transmitter's meter body.
- Be sure all the valves in the blow-down lines are closed tight after the initial blow-down procedure and each maintenance procedure after that.

Continued on next page

5.3 Piping ST 3000 Transmitter Continued

Installing Flange Adapter

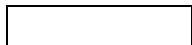
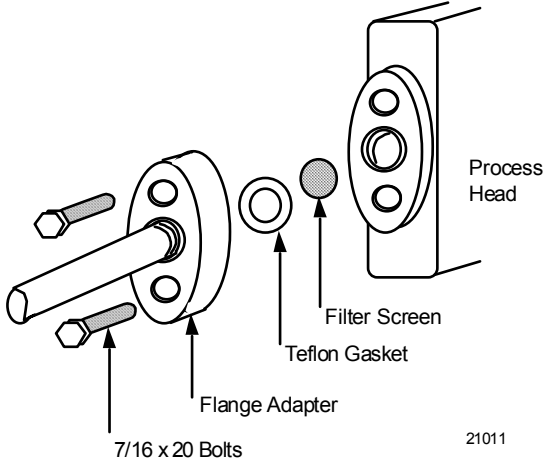
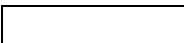


Table 14 gives the steps for an optional flange adapter on the process head.

Slightly deforming the gasket supplied with the adapter before you insert it into the adapter may aid in retaining the gasket in the groove while you align the adapter to the process head. To deform the gasket, submerge it in hot water for a few minutes then firmly press it into its recessed mounting groove in the adapter.

Table 15 Installing Flange Adapter

Step	Action
1	Insert filter screen (if supplied) into inlet cavity of process head.
2	Carefully seat Teflon (white) gasket into adapter groove.
3	Thread adapter onto 1/2-inch process pipe and align mounting holes in adapter with holes in end of process head as required.
4	Secure adapter to process head by hand tightening 7/16-20 hex-head bolts. Example - Installing adapter on process head.
	 21011
	 Apply an anti-seize compound on the stainless steel bolts prior to threading them into the process head.
5	Evenly torque flange adapter bolts to a torque of 27,1 Nm +/- 1,4 Nm (20 ft lbs +/- 1.0 ft lbs)

5.4 Wiring ST 3000 FF Transmitter

Wiring the Transmitter to a Fieldbus Network

The ST 3000 FF transmitter is designed to operate in a two-wire fieldbus network. Although wiring the transmitter to a fieldbus network is a simple procedure, there are a number of rules that should be followed when constructing and wiring a network. This section provides general guidelines that should be considered when wiring the transmitter to a fieldbus network segment. A procedure is given in this section for properly wiring the transmitter.

For Detailed Fieldbus Wiring Information

Refer to Foundation™ Fieldbus document AG-140, *Wiring and Installation 31.25 kbit/s, Voltage Mode, Wire Medium Application Guide* for complete information on wiring fieldbus devices and building fieldbus networks.

Fieldbus Device Profile Type

The ST 3000 FF is identified as either of the following Fieldbus Device Profile Types in Table 15, (as per Fieldbus document #FF-816):

Table 16 Foundation™ Fieldbus Profile Types

Device Profile Type:		Characteristic
111	113	
X	X	Uses standard-power signaling to communicate on a fieldbus network.
X	X	Is a bus-powered device. (The transmitter does not have an internal power supply and so it receives its dc power from the fieldbus.)
X		Is acceptable for intrinsically safe (I.S.) applications
	X	Is acceptable for non I.S. applications

Fieldbus Network Components

There are a number of basic components used in constructing a fieldbus network. These items can include:

- Fieldbus cable - Consists of a shielded, twisted pair made to fieldbus specifications. (Although existing two-wire cable can be used in some installations, fieldbus cable is recommended for new installations.)
- Fieldbus power supply.
- Power conditioner is a fieldbus component that provides impedance matching between the power supply and the fieldbus segment. (This may be included as part of a fieldbus power supply.)

Continued on next page

5.4 Wiring ST 3000 FF Transmitter Continued

Fieldbus Network Components, Continued

- Fieldbus terminators - This component acts as a signal termination. Two are required for each fieldbus segment. One is connected at or near each end of a network segment.
- Junction block - This is a terminal block used as a junction point for fieldbus cable leads to individual devices.
- Fieldbus I.S. barriers - Limits the available power to the fieldbus segment to eliminate explosion hazards. (Barriers must be designed for fieldbus networks.)

Fieldbus Network Wiring Schemes

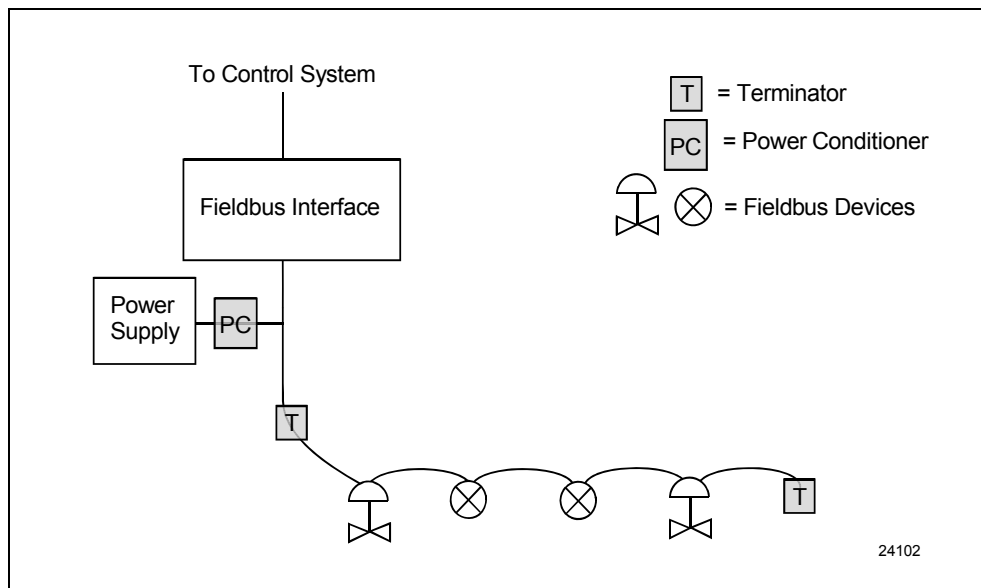
There are various schemes that can be used to wire devices in a fieldbus network. Devices can be connected:

- In a daisy-chain, (in parallel)
- To a bus, where the devices are attached in a multidrop scheme
- In a tree fashion, where devices are connected to a network segment via a common junction block.

Daisy-Chain Wiring

The fieldbus cable is routed from device to device in parallel along a bus segment. The cable is interconnected at the terminals of each field device. (This installation must be powered down to modify or replace transmitter.) This scheme is illustrated in Figure 20.

Figure 20 Daisy-Chain Wiring Scheme



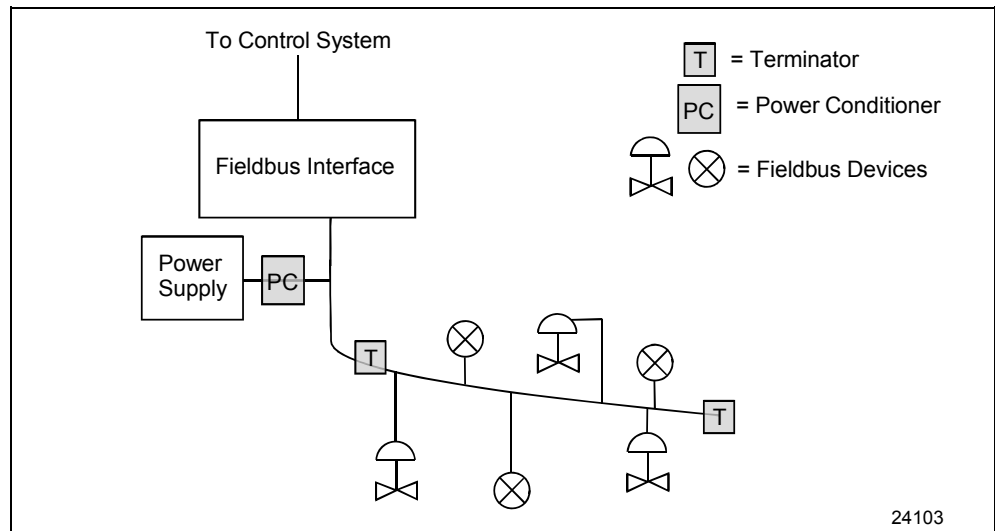
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5.4 Wiring ST 3000 FF Transmitter Continued

Bus with Spurs Wiring

In this scheme, field devices are connected to a bus by a length of fieldbus cable called a spur (or drop). The spur can vary in length from 1 meter (3.28 ft.) to 120 m (394 ft.). Figure 21 shows devices and spurs connected to a bus segment.

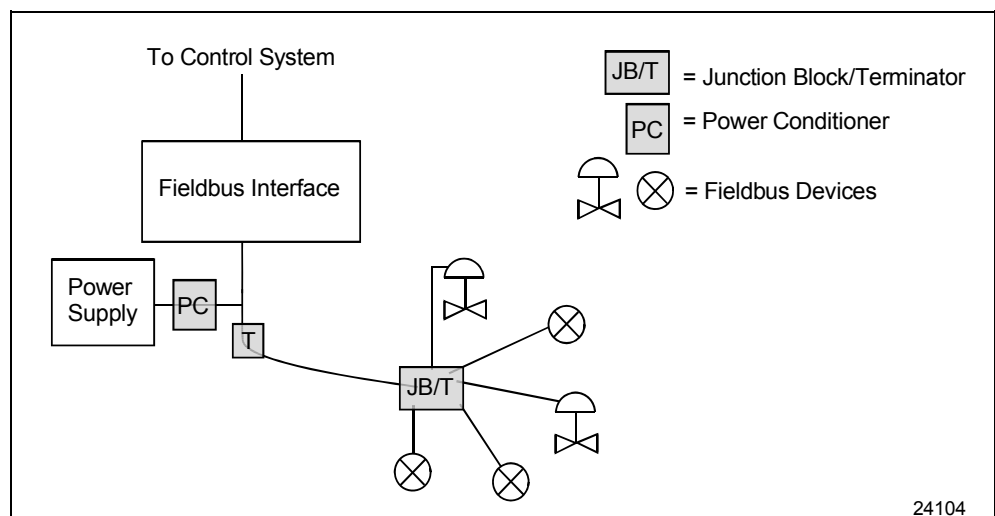
Figure 21 Bus with Spurs Wiring



Tree Wiring Scheme

In this scheme, field devices are connected to a single fieldbus segment via a spur cable to a common junction block, terminal, or marshalling panel. This scheme is practical if devices on the segment are well separated, but in the general area of the same junction block. Figure 22 shows the tree wiring scheme.

Figure 22 Fieldbus Network using Tree Wiring Scheme



5.4 Wiring ST 3000 FF Transmitter Continued

Fieldbus Network Limitations

A number of factors limit the size of a fieldbus network:

1. The cable type used in the wiring system limits the length of a network segment. (See Fieldbus Cable Types.)
2. The number of field devices connected on a segment is limited depending on:
 - voltage of the power supply,
 - resistance of the cable and
 - current drawn by each device.
 (See Voltage, Resistance and Current.)
3. Attenuation and distortion of the signal on the fieldbus due to:
 - resistance of the cable,
 - varying characteristic impedance along the cable,
 - signal reflections from spur connections, and
 - other factors that limit the size of a network segment.

Fieldbus Cable Types

Various types of cable are useable for fieldbus network wiring. Table 16 lists the cable types. Please note that Type A is the preferred cable to use for fieldbus; then type B, etc.

Table 17 Fieldbus Cable Types

Fieldbus Cable Type		Construction			
Type A ⇒		Shielded, twisted pair			↓
Type B ⇒		Multi-twisted pair, with shield			↓
Type C ⇒		Multi-twisted pair, without shield			↓
Type D ⇒		Multi-core, without twisted pairs and having an overall shield			↓
Parameter	Conditions	D	C	B	A
Characteristic Impedance - Ohms	31.25 kHz	*	*	70-130	80-120
Maximum DC resistance - Ohms/km	per conductor	20	132	56	24
Maximum attenuation - db/km	39 kHz	8	8	5	3
Wire Size - AWG #		16	26	22	18
Wire cross sectional area - mm ²		1,25	0,13	0.32	0.8
Maximum Capacitive unbalance - pf	1 kilometer length	*	*	2000	2000

* Not specified

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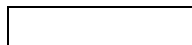
5.4 Wiring ST 3000 FF Transmitter Continued

Voltage, Resistance and Current

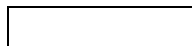
Power supply output voltage, cable resistance and device current requirements limit the number of devices on a network segment.

1. The output voltage of the power supply must be considered when building a fieldbus segment. Typical fieldbus devices require a minimum of 9 volts to operate. (See power requirements for the ST 3000 FF in Section 4.2.)
2. Resistance of the fieldbus cable produces a voltage drop along a segment and must also be considered.
3. The device startup current as well as the operating current must be considered, because some devices require considerably more current when they are first powered up and begin to operate. (The ST 3000 FF does not require extra current at start up.)

The power calculation for a network segment should allow for these factors (voltage, current and resistance), otherwise the network may not start up when power is first applied.



Refer to Wiring Diagram #51309440 in Section 13 for current/resistance wiring recommendations for the ST 3000 FF.



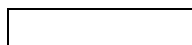
The operating power required by fieldbus devices varies by device type and manufacturer. Please check the device specifications for the device power requirements.

Number of Devices and Spur Length

For the bus with spurs and tree wiring schemes, there are guidelines for the length of spurs and the number of devices that can be connected on these spurs. The guidelines established are only recommendations for the maximum cable length to assure adequate signal quality. Spur length depends upon:

- Cable type/characteristics/wire gauge, (cable types A, B, C, or D)
- Wiring scheme, (bus with spurs or trees)
- Number and type of devices, (are devices bus or self-powered and are they suitable for I.S. applications).

In any fieldbus segment there may be a variety of cable and the quality of existing cable may vary, therefore you should try to use the shortest cable length possible.



If you are installing intrinsically safe field devices in hazardous areas, there are additional things to consider. See Intrinsically Safe Applications section.

Continued on next page

5.4 Wiring ST 3000 FF Transmitter Continued

ST 3000 FF Wire Connections

Fieldbus signal communications and DC power are supplied to the transmitter using the same fieldbus twisted-pair cable.

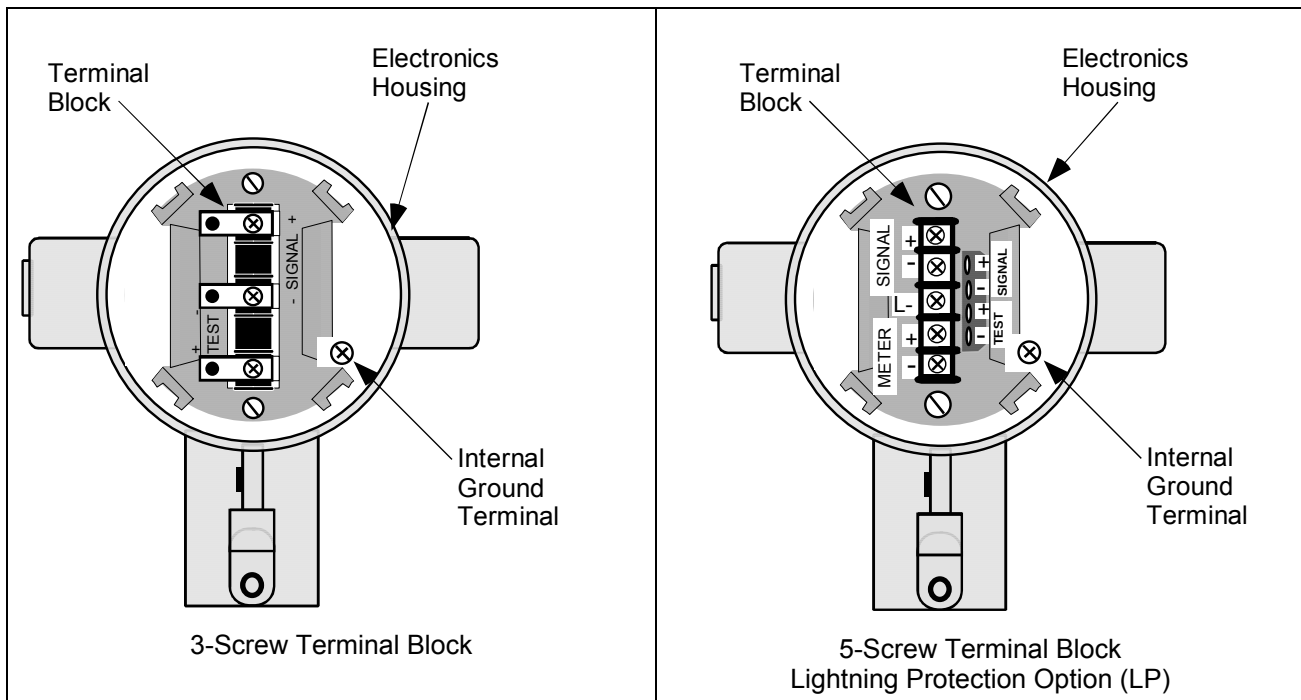
Inside the electronics housing of the transmitter is the terminal block for connecting external wiring as shown in Figure 23. Table 17 explains the usage of the wiring terminals for fieldbus use.

Each transmitter includes an internal ground terminal to connect the transmitter to earth ground. A ground terminal can be optionally added to the outside of the electronics housing. While it is not necessary to ground the transmitter for proper operation, we suggest that you do so to minimize the possible effects of “noise” on the output signal and provide additional protection against lightning and static discharge damage.

Note that grounding may be required to meet optional approval body certification. Refer to section 3.2 CE Conformity (Europe) Notice for special conditions.

Optional lightning protection (option LP) can be ordered for transmitters that will be installed in areas highly susceptible to lightning strikes. Figure 23 shows the 5-screw terminal block used when the lightning protection option is ordered.

Figure 23 ST 3000 Transmitter Terminal Blocks



Continued on next page

5.4 Wiring ST 3000 FF Transmitter Continued

Table 18 ST 3000 FF Wiring Terminals

Wiring Terminal		Use
Screw terminals	SIGNAL + and -	Fieldbus cable connections
	TEST + and -	Not used

Internal Ground Connection

An internal ground terminal is available next to the terminal block. See Figure 23. The terminal can be used to connect the transmitter to earth ground.

External Ground Connections

While it is not necessary to ground the transmitter for proper operation, an external ground terminal on the outside of the electronics housing provides additional noise suppression as well as protection against lightning and static discharge damage. Note that grounding may be required to meet optional approval body certification.

Transmitters are available with additional lightning protection if they will be used in areas highly susceptible to lightning strikes.

Intrinsically Safe Applications

Fieldbus barriers should be installed per manufacturer's instructions for transmitters to be used in Intrinsically Safe (I.S.) applications.

The number of field devices on a segment may be limited due to power limitations in hazardous area installations. Special fieldbus barriers and special terminators may be required. Also the amount of cable may be limited due to its capacitance or inductance per unit length.

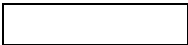
Refer to Foundation™ Fieldbus document AG-163, *31.25 kbit/s Intrinsically Safe Systems Application Guide* for detailed information on connecting fieldbus devices for I.S. applications.

Transmitter Wiring Procedure

The procedure in Table 18 shows the steps for connecting fieldbus cable to the transmitter. For external wiring diagrams, refer to the installation drawings presented in Section 13. Detailed drawings are provided for transmitter installation in non-intrinsically safe areas and for intrinsically safe loops in hazardous area locations.

Continued on next page

5.4 Wiring ST 3000 FF Transmitter Continued



All wiring must comply with local codes, regulations, and ordinances.

Table 19 Wiring the Transmitter

Step	Action
1	Loosen end-cap lock and remove end-cap cover from terminal block end of electronics housing.
2	Feed fieldbus cable through one of conduit entrances on either side of electronics housing. Plug whichever entrance you do not use. The transmitter accepts up to 16 AWG (1.5 mm diameter) wire.
3	Observing polarity, connect positive fieldbus lead to Signal + terminal and negative fieldbus lead to Signal – terminal. 3-Screw terminal block 5-Screw terminal block (Option LP)
NOTE: Check to make sure that the correct polarity is observed on the fieldbus cable connection to the transmitter terminal block. If the polarity is reversed, no damage will result, the device simply will not work.	

5.4 Wiring ST 3000 FF Transmitter Continued

Table 18 Wiring the Transmitter, continued

Step	Action
4	Connect the fieldbus cable shield to the other cable shields in the fieldbus segment. (See NOTE.)
NOTE: Fieldbus Cable Shield Connection. Normal practice for grounding a fieldbus cable segment is that the cable shield should be grounded in only one place - preferably a ground point at the power supply, I.S. barrier or near the fieldbus interface. Be sure that the shield does not contact the transmitter housing.	
5	Replace end-cap, and tighten end-cap lock.
6	Connect a flat-braided wire to the external ground screw of the transmitter housing. The diagram illustrates the grounding connection for the transmitter. It shows the 'Electronics Housing' at the top, which is connected to a terminal block. A flat-braided wire is connected to the terminal block and then to a ground symbol. An arrow points to the connection point with the label 'Connect to Earth Ground'.
7	Using the shortest length possible, connect the other end of the braided wire to a suitable earth ground.

Continued on next page

5.4 Wiring ST 3000 FF Transmitter Continued

Approval Body Requirements

Information on hazardous location standards and approval options are found in Appendix A. Some approvals are pending.

Lightning Protection

When your transmitter is equipped with optional lightning protection, you must connect a wire from the transmitter to ground as shown in Step 6 of Table 18 to make the protection effective.

Process Sealing

The St 3000, Series 100, 100e, 600, and 900, Smart Pressure Transmitters are CSA certified as **“Dual Seal”** devices in accordance with **ANSI/ISA-12.27.01-2003**, Requirements for Process Sealing between Electrical Systems and Flammable or Combustible Process Fluids..

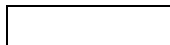
Explosionproof Conduit Seal

Transmitters installed as explosionproof in a Class I, Division 1, Group A Hazardous (Classified) Location in accordance with ANSI/NFPA 70, the US National Electrical Code (NEC), require a “LISTED” explosionproof seal to be installed in the conduit, within 18 inches of the transmitter.

Crouse-Hinds® type EYS/EYD or EYSX/EYDX are examples of “LISTED” explosionproof seals that meets this requirement.

Transmitters installed as explosionproof in a Class I, Division 1, Group B, C or D Hazardous (Classified) Locations do not require an explosionproof seal to be installed in the conduit.

NOTE: Installation should conform to all national and local electrical code requirements.



When installed as explosionproof in a Division 1 Hazardous Location, keep covers tight while the transmitter is energized. Disconnect power to the transmitter in the non-hazardous area prior to removing end caps for service.

When installed as nonincendive equipment in a Division 2 Hazardous Location, disconnect power to the transmitter in the non-hazardous area, or determine that the location is non-hazardous prior to disconnecting or connecting the transmitter wires.

5.5 Power Up Transmitter

Prepower Checklist

Before applying power to the fieldbus network you should make the following checks:

- Verify that the ST 3000 FF transmitter has been properly mounted and connected to a system.
- The transmitter has been properly wired to a fieldbus network.
- The transmitter housing has been properly connected to a suitable earth ground.
- The operator station or host computer has been installed and connected to the fieldbus network.

NOTE: If you want to enable the write protect feature or change the operating mode of the transmitter to simulation input, you must change hardware jumpers on the internal electronics boards. This requires that the power be removed from the transmitter. See Sections 6.6 (Setting Write Protect Feature) and 11.10 (Simulation Parameter) for details.

Power Up Procedure

To apply power to the fieldbus network, perform the steps in Table 19:

Table 20 Transmitter Power Up Procedure

Step	Action
1	Turn on all power supplies that furnish DC power to the fieldbus network.
2	Use a digital voltmeter and measure the DC voltage across the + and - SIGNAL terminals of the ST 3000 FF transmitter.
3	Verify that the polarity at the transmitter terminals is correct.
4	Verify that the voltage at the transmitter terminals is within the limits as listed in Table 5 in Section 4.

Section 6 —Transmitter Start-up

6.1 Introduction

This section includes these topics:

Section	Topic	See Page
6.1	Introduction	55
6.2	ST 3000 FF Communications	56
6.3	Checking Out the Transmitter	57
6.4	Verify Communications with Transmitter	59
6.5	Function Block Application Process	61
6.6	Setting Write Protect Feature.....	64

About this Section

This section explains the tasks to establish communications, configure and check operation of the ST 3000 FF Transmitter for the process application. An overview is given of the configuration tasks using the NI-FBUS Configurator application as an example. Detailed information on using your configurator application is found in the user manual supplied with the software.

Before proceeding with the tasks in this section it is assumed that the ST 3000 FF transmitter has been installed and wired correctly. It also assumes that you are somewhat familiar with using a fieldbus configuration application (such as the NI-FBUS Configurator).

If the transmitter has not been installed and wired, or if you are not familiar with device configuration, and/or you do not know if the transmitter is configured, please read the other sections of this manual before configuring your transmitter.

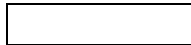
6.2 ST 3000 FF Communications

Communications and Control

All communications with the ST 3000 FF is through an operator station or host computer running supervisory control and monitoring applications. These applications provide the operator interface to fieldbus devices on the fieldbus network.

Configuration Applications

Configuration of the transmitter for your process application also is performed through the operator interface, (operator station or PC) running a fieldbus configuration software application.



There are various applications available for you to configure fieldbus devices. The examples presented in this manual refer to the NI-FBUS Configurator application. For further details on fieldbus configuration solutions see your Honeywell Sales Representative.

6.3 Checking Out the Transmitter

Verifying Transmitter Once the transmitter is installed and powered up, you can then verify communications with it and other field devices on the network . Table 20 outlines the steps for identifying and checking out the transmitter on a fieldbus network.

Table 21 Transmitter Checkout Tasks

Task	Description	Comment
Verify device location	Check that the device is installed in the correct physical location.	
Verify device ID	Match the device ID with the physical location. The device serial number is the PROM ID which is stamped on the transmitter housing nameplate.	
Verify connection with host computer to device	At the operator interface, establish communications with the device on the fieldbus network.	See Subsection 6.4, "Verifying Communications with Transmitter"
Verify or assign device tag and address	Verify that the device tag and node address are set. If not, assign the device tag and the correct node address. The device tag and address can be set and viewed using the fieldbus device configurator application. Use a device tag name (up to eight characters) that does not contain spaces.	See "Changing Device Tags" below.
Configure device(s)	Using a fieldbus configuration program, create a function block application as part of the device configuration and process control strategy.	See Subsection 6.5, "Function Block Application Process"
Verify device operation	Bring the network on-line, verify operation, tune loops, etc.	

Continued on next page

6.3 Checking Out the Transmitter Continued

Changing Device Tags

Note that when a device tag is changed using the NI configurator, the ST 3000 FF function block schedule is cleared by the configurator application (i.e. the function blocks will not execute), and all link objects and VCR's are also cleared by the device, essentially clearing the links between input and output parameters. The NI configurator screen will still show the previous configuration, even though the configuration is no longer loaded into the device that had its device tag changed.

To restart function block execution and restore the link objects, you must download a configuration to the ST 3000 FF using the Download Configuration menu selection.

6.4 Verify Communications with Transmitter

Establish Communications with Device

At the operator interface, establish communications with the device on the fieldbus network.

If the device is not visible on the network, check to make sure that the correct polarity is observed on the fieldbus cable connection to the transmitter terminal block. If the polarity is reversed, no damage will result, the device simply will not work. Also see Troubleshooting, Section 11.

Identify the Transmitter

Verify the device ID of the transmitter by checking a number of device parameters. These parameters contain the following information:

- transmitter type, (pressure transmitter, temperature transmitter, flow transmitter)
- device tag, (tag description of the transmitter)
- sensor serial number
- firmware revision level, (revision level of the firmware elements)

Check the following transmitter parameters listed in Table 21 and note the values to identify the transmitter.

NOTE: We suggest that you verify that the correct version of the Device Description files are present on the host computer. (Look in the READ ME.TXT file on the diskette shipped with the transmitter.) This enables you to see the correct parameter names and descriptions when viewing the device parameters.

Table 22 Transmitter Identification.

Look at this Parameter	To Verify
Resource Block DEV_TYPE	That the transmitter is the proper device type. For all ST 3000 type pressure transmitters, the value is = 0002

Continued on next page

6.4 Verify Communications with Transmitter Continued

Table 21 Transmitter Identification, continued

Look at this Parameter	To Verify
Resource Block REVISION_ARRAY REVISION_ARRAY [0] REVISION_ARRAY [1] REVISION_ARRAY [2]	The firmware revision number of the: - Stack board firmware _____ - Stack board boot code _____ - Transducer board firmware _____ Note: These numbers are helpful when troubleshooting the device. The numbers, when viewed as hexadecimal numbers, are in the format “MMmm”. Where, MM is the major revision number and mm is the minor revision number.
Device Tag (Physical device tag name of the transmitter) Note: The device tag name can be set and viewed using the fieldbus device configurator application. Use a device tag name (up to eight characters) that does not contain spaces. See also “Tag Name Assignments” below.	The device tag is correct. Device Tag name _____
Transducer Block SENSOR_SN =	Sensor serial # _____ The SENSOR_SN value, when viewed as a hexadecimal number, is the same number as the first 8 digits of the PROM ID stamped on the transmitter housing nameplate. See NOTE.

NOTE: The 8-digit serial number in the SENSOR_SN parameter does not show the last two digits of the PROM ID stamped on the nameplate of the transmitter housing. The Device ID does contain the full 10-digit PROM ID.

Tag Name Assignments

If device or block tags have not been assigned to a device, the NI-FBUS Configurator will automatically assign a default tag name. This is done so that the devices are visible on the network. You can then change tag names according to your process requirements. Use a block tag name (up to eight characters) that does not contain spaces.

The ST 3000 FF may contain default tag names which consist of the following form:

Block Type - first seven digits of the device PROM ID, for example:
AI-1234567 or **AI-DEF1234**

6.5 Function Block Application Process

Function Block Application Process

All fieldbus devices contain one or more Function Block Application Processes (FBAP) as part of their device configuration. The Function Block Application Process in the ST 3000 FF is a software application that defines the particular characteristics of the transmitter. The FBAP comprises function blocks, a transducer block, and a resource block, plus other functions which support these blocks. Each function block contains a set of operating parameters (some of which are user-configurable) that define the operating characteristics of the transmitter.

Function blocks perform (or execute) their specific functions according to a schedule. This schedule provides the sequence and timing of events which occur within a device and also between other fieldbus devices. This schedule is coordinated with the function block execution schedules in the device and other fieldbus devices on the network.

Additional information on the FBAP contained in the ST 3000 FF is found in Section 8, Function Block Application Description.

Default FBAP Configuration

An FBAP containing default configuration parameters is resident in the firmware of the transmitter and is loaded on power up. By using the NI-FBUS configurator (or other fieldbus configuration) application, you can create or make changes to a FBAP for the transmitter's process application.

Device Configuration

Configuring the ST 3000 FF results in:

- Function blocks that execute according to a user-defined schedule
 - Measurements that are processed according to various user-configurable parameters found within the function blocks
 - An output "published" on the fieldbus network according to a user-defined publishing schedule. The output then is available to other fieldbus devices and function blocks.
-

Device Configuration Example

Sample printout of a typical device configuration for ST 3000 FF transmitters is given in Appendix B.

Continued on next page

6.5 Function Block Application Process Continued

Fieldbus Configuration Application

The ST 3000 FF transmitter is configured using a fieldbus configuration application running on a operator station, PC or host computer. (The NI-FBUS configurator actually provides the means for you to configure the FBAPs of fieldbus devices.) This configuration tool allows you to:

- Connect function block inputs and outputs according to the process requirements
- Make changes to function block parameters according to the process requirements
- Make changes to the schedule of function block execution.
- Write the FBAP changes to the device.
- Save the FBAP file.

Creating a New FBAP

Again, all fieldbus devices contain one or more Function Block Application Processes as part of their device configuration. Some or all of a device's function blocks may be used as a part of an FBAP. Also, function blocks from a number of field devices may be connected as part of an FBAP. Using a fieldbus configuration application you can create and make changes to a FBAP according to your process application requirements. The procedure in Table 22 outlines the tasks for creating a typical FBAP file.

Table 23 Creating an FBAP file.

Step	Task
1	Connect configurator/builder to network. Load and startup the fieldbus configuration program on the host computer, PC or other operator interface.
2	Connect fieldbus devices to the network. The configurator program will display all active devices.
3	Create a new FBAP or window. Drag appropriate function blocks into the application area. Select function blocks to be used and drag them into the function block application graphic area.
4	Interconnect function blocks. Use the configurator program's tools to connect the function blocks to one another.
5	Interconnect trend and alert objects.
6	Review schedule for both function blocks and publishing. Break up strategy into sub-schedules if desired.

Continued on next page

6.5 Function Block Application Process Continued

Creating a FBAP, continued

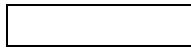
Table 22 Creating an FBAP file, continued

Step	Task
7	Assign processing order to function blocks, if default assignments are not desired.
8	Download application to the field devices.
9	Review errors and correct.
10	Upload the network configuration.
11	Save application file.
12	Tune loops.

6.6 Setting Write Protect Feature

Write Protect Feature

ST 3000 transmitters are available with a “Write Protect feature.” The feature consists of a hardware jumper located on the transmitter’s electronics board and a software switch that can be set to enable or disable the read and write access to the transmitter configuration. The feature is available when the “WP” option is ordered with the transmitter. Without ordering the “WP” option access to the transmitter’s configuration is set to read and write.



When write protect option is ordered, the jumper is factory set for read only access (write protected) “R” position. See Figure 24 for the location of the write protect jumper. Changes to jumper position take effect only upon power-up.

NOTE: The write protect jumper is used in conjunction with the FEATURE_SEL parameter (in the resource block) and it is explained below.

Refer to Table 23 to set the write protect jumper.

Table 24 How to Set Write Protect Jumper

Step	Action
1	Remove power to transmitter.
2	Loosen end cap lock and unscrew end cap from electronics side of housing.
3	If applicable, carefully turn Local Meter counterclockwise to remove it from electronics module and unplug cable from connector on back of meter assembly.
	We recommend that you use a ground strap or ionizer when handling the electronics module, since electrostatic discharges can damage certain circuit components.

Continued on next page

6.6 Setting Write Protect Feature Continued

Table 23 How to Set Write Protect Jumper, continued

Step	Action
4	Note orientation of electronics module in housing. Loosen two retaining screws and carefully pull the electronics module from housing.
5	Set Write Protect Jumper to the appropriate position on the electronics board. (See Figure 24 and Table 25.) Note that the HARD_W_LOCK must also be set to the proper value to obtain desired condition of either Read/Write or Read-only access to the transmitter's configuration. (See Table 26.)
6	Insert the electronics module back into the housing and assemble transmitter by reversing the steps in this procedure. Changes to jumper position are recognized upon power-up.

Figure 24 Write Protect Jumper Location on Transducer Board

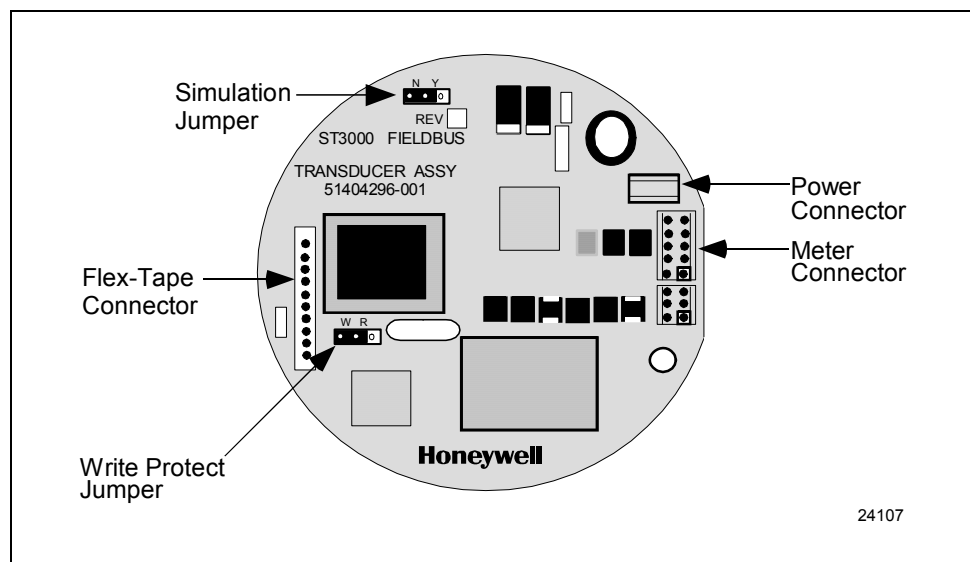


Table 25 Write Protect Jumper Settings

To	Set the Jumper to:
Enable read and write access to the transmitter's configuration.	"W" position on the Transducer board. 
Enable read only (Write Protect) access to transmitter's configuration. (Factory set default)	"R" position on the Transducer board.* 

* FEATURE_SEL parameter must also be set accordingly to enable write protect.

Continued on next page

6.6 Setting Write Protect Feature Continued

Enabling Write Protect Feature

The Write Protect Feature is enabled when two conditions are met: 1) the Jumper is set to the “R” Position at power-up and 2) the HARD_W_LOCK is set to 1 (yes). Operations required to meet the two conditions can be performed in any order. For a complete summary of the combinations for Jumper Settings and HARD_W_LOCK Settings and resulting enabled or disabled condition for Write Protect, refer to Table 26 Write Protect Truth Table.

Note that once the transmitter is write-protected, the hardware jumper must be set to the “W” Position (Read/Write Position) at power-up to enable write access.

HARD_W_LOCK parameter

HARD_W_LOCK element of the FEATURE_SEL parameter acts as a switch to prevent changes to the transmitter configuration. When the write protect jumper is set to the “R” position and HARD_W_LOCK is set, any value stored in the transmitter’s non-volatile memory cannot be changed. You can only read the parameter values from the device. Normal block execution continues.

Table 26 Write Protect Feature Truth Table

Jumper is in this position at power-up ¹	HARD_W_LOCK is set to ² :	
	0 (No)	1 (Yes)
“W” Position (Read/Write)	Write Protect Disabled (Read/Write)	Write Protect Disabled (Read/Write)
“R” Position (Read Only)	Write Protect Disabled (Read/Write)	Write Protect Enabled (Read Only)
¹ Changes to jumper position are not activated until power-up. ² HARD_W_LOCK feature can only be changed from write protect enabled (read only) to write protect disabled (read/write) when the jumper has been enabled for read/write.		

Simulation Jumper

There is a second hardware jumper also on the transducer board which is used for debugging communication problems independent of sensor function. See Figure 24.

A simulation parameter in the AI block is used to aid in system debug if the process is not running. A hardware jumper is provided to enable or disable the simulate parameter. See Section 11.10 for details on setting the simulation jumper.

Section 7 —Operation

7.1 Introduction

Section Contents

This section includes these topics:

Section	Topic	See Page
7.1	Introduction	67
7.2	Operation Tasks	68
7.3	Monitoring Local Smart Meter Display.....	68
7.4	Changing Local Smart Meter Display	73

About this Section

This section outlines the tasks for operating and monitoring the ST 3000 FF transmitter on a fieldbus network and as part of distributed process control system.

7.2 Operation Tasks

Fieldbus Device Operations

Once the ST 3000 FF is checked out, it is ready for operation. The tasks listed in Table 26 outline the steps to startup and monitor transmitter operation. Note that the task list serves as a typical example using the NI-FBUS configuration application and Honeywell's SCAN 3000 supervisory system control applications.

Depending on your control system and operator interface and the supervisory control applications that you use, the tasks involved for operation and control of fieldbus devices will vary.

Table 27 ST 3000 FF Operating Task List

Task	Procedure	Result
1	Start NIFB.exe process application.	Loads the communication drivers in the operator station memory.
2	Start SCAN 3000 system application.	Blank screen.
3	Select controller to fieldbus network.	A window showing a list of configured data points for the network.
4	Select point detail for ST 3000 FF transmitter.	Point detail display shows current status and operating values.
5	Verify range values and operating values.	Correct, calibrate or troubleshoot if necessary.

7.3 Operation Considerations

Operation Considerations

There are a number of considerations you should note when configuring an ST 3000 FF to operate in a fieldbus network.

LAS Capability

The ST 3000 FF is capable of operating as the Link Active Scheduler (LAS). The LAS is a fieldbus device which controls traffic on the network, such as controlling token-rotation and coordinating data publishing. This fieldbus function is active in only one device at any given time on a network. Devices which can be designated as the LAS may be an operator station or a field device. The ST 3000 FF can be designated as a LAS so that, in the event of a failure of the *primary* LAS, control in the field could continue.

Please note that the ST 3000 FF does not support being configured as the *primary* LAS, and therefore the LAS capability in the transmitter is regarded as a "backup" LAS.

Special Non-volatile parameters and NVM Wear-out

All function block parameters designated as Non-Volatile (N) in the FF specifications are updated to non-volatile memory (NVM) on a periodic basis. NV_CYCLE_T parameter in the resource block specifies this update interval.

To provide predictable restart behavior in the transmitter, the following Non-Volatile parameters are updated to NVM each time they are written over the fieldbus.

- MODE.TARGET for all blocks
- SP.VALUE for the PID block

Since these are user-written parameters, these additional updates to NVM contribute negligibly to NVM wear out. However, user's are cautioned to not construct control configurations where the above parameters are written continuously (via a computer application for example) or at rates greater than the NV_CYCLE_T interval. This consideration will help minimize the possibility of NVM wear-out.

In the case of MODE this should not be a problem. When users wish to provide set-points to the PID block via a computer application, users should use RCAS mode with its corresponding setpoint value RCAS_IN. RCAS_IN is updated only at the NV_CYCLE_T update rate and this mode supports full shedding functionality and PID initialization necessary for a robust application.

7.3 Operation Considerations Continued

Mode Restricted Writes to Parameters

Some block parameters have restrictions on having write access to them. These are specified in the FF specifications. Writing to certain AI block and PID block parameters is restricted based on the block's Target and/or Actual mode. The listing of these parameters are given in the AI block description and PID block descriptions in Section 8.

7.4 Monitoring Local Meter Display

Local Meter Display Description

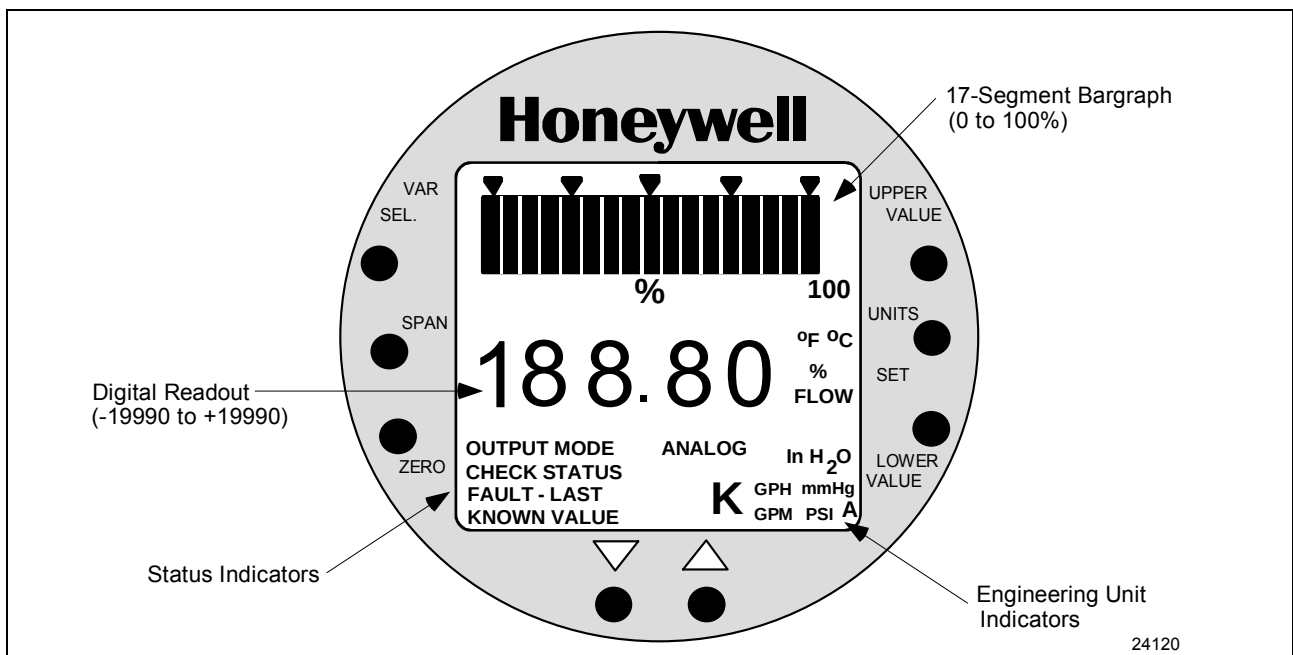
The Local Meter provides a means of monitoring the transmitter process values at the transmitter. The display shows the read-only output of the transmitter, specifically the value and status of the AI block OUT parameter. The value is shown as % of range (shown on the meter bargraph segments) and user-selected engineering units (shown on the numeric display). Status on the display is shown using a number of status indicators and/or segments of the digital readout.

When showing engineering units, the values are auto-ranged for the most precision available within the limits of the display. The units are shown as configured in the transmitter and are determined by setting the OUT_SCALE parameter (in the AI block). If the engineering units are not supported by the meter, or if the units are unknown, the display shows no units indication. Stick-on labels can be applied to the display to indicate units that are not supported by the meter. See Table 27. (See Subsection 8.6 for additional details on local meter display values.)

Display Self-test

The meter runs a brief self-test whenever power is applied to the transmitter. You can check the status of all the indicators on the local meter LCD display by cycling power to the transmitter. All the display indicators are lit for two seconds during the self-test. Figure 25 shows a local meter display with all display indicators lit. Table 27 gives a brief description of all the possible indicators when in operation.

Figure 25 Smart Meter Display.



Continued on next page

7.4 Monitoring Local Meter Display Continued

Display Description, continued

Table 28 Description of Display Indicators Shown in Figure 25

Display Indicator	What It Means When Lit
17-Segment Bargraph	Gives a gross indication of the AI block OUT parameter from 0 to 100%. Bargraph range indicates the same range as defined in the OUT_SCALE parameter (or XD_SCALE if L_TPYE = Direct). A percent (%) symbol located between 0 and 100 on the display is part of the bargraph scale.
Digital Readout (See Table 7 for sample display readouts)	Gives a precise indication of the transmitter's AI block OUT parameter in either percent of span or actual engineering units. The display range is $\pm 19,990,000$ and it is automatically ranged to provide the best precision possible within the limits of the display. A second decimal place expands the precision of range values within ± 19.99 to 1/100th of a unit.
%	The percent sign appears when the digital readout represents output in percent of range.
OUTPUT MODE	Transmitter AI block is in MAN mode or simulate feature is enabled.
CHECK STATUS	Status message appears when a critical device fault occurs.
inH2O	Inches of Water is selected engineering units for digital readout. This is the default engineering units selection.
K	Multiplies digital reading by 1,000. Turns on automatically when reading exceeds 1999.
GPH	Gallons per hour is selected engineering units for digital readout. (Note that the FLOW indicator must also be lit to allow this selection.)
GPM	Gallons per minute is selected engineering units for digital readout. (Note that the FLOW indicator must also be lit to allow this selection.)
mmHg	Millimeters of Mercury is selected engineering units for digital readout.
PSI	Pounds per Square Inch is selected engineering units for digital readout.
A	Transmitter is absolute pressure type. Digital readout represents absolute values.
Stick-On Label (not shown) Honeywell drawing number 30756918-001.	Labels of selected engineering units can be applied to the display to indicate one of the following units: Kpa = Kilopascals Mpa = Megapascals mbar = Millibar bar = Bar g/cm ² = Grams per Square Centimeter Kg/cm ² = Kilograms per Square Centimeter mmH ₂ O = Millimeters of Water inHg = Inches of Mercury

7.4 Monitoring Local Meter Display Continued

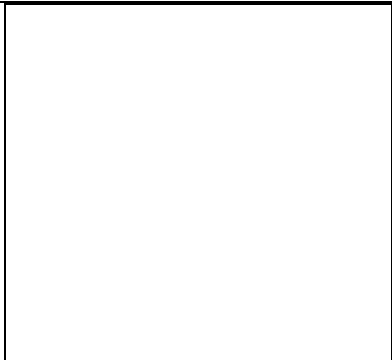
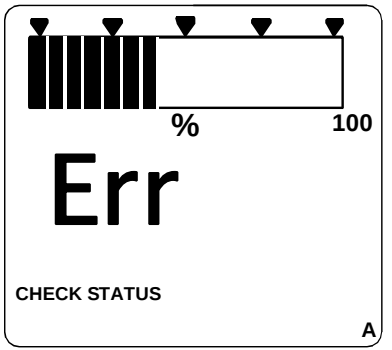
Local Meter Pushbuttons

The ZERO and Down arrow pushbuttons located on the front of the local meter face allow you to perform a zero correction function. See Calibration, Section 10 for details and procedure. The remaining meter pushbuttons are non-functional.

Typical Operation Indications

Table 28 summarizes typical Local Smart Meter indications. Note that other combinations of status messages are possible.

Table 29 Summary of Typical Local Smart Meter Indications.

Meter Indication	What It Means
	No power applied.
	Normal display for transmitter. Digital readout is gallons per minute with 1000 multiplier (K).
	Example of a critical error indication.

7.4 Monitoring Local Meter Display Continued

Fault Indications

When a fault is detected in the transmitter, these indications can appear on the meter display as described in Table 29.

Table 30 Local Meter Fault Indications

Meter Display	How Displayed	Meaning
Err	Flashes No value displayed.	A Critical fault has occurred. Such as background diagnostics fault. See Section 11, Troubleshooting, for fault identification and corrective actions. OR Local zero correction failed. See Calibration, Section 10 for details on procedure.
unc	Alternates with transmitter OUT parameter value.	AI block output status is Uncertain (uncalibrated) See Section 10, Calibration
O_S	Alternates with transmitter OUT parameter value.	AI block or Transducer block is in Out of Service mode.
No Sch	“no” and “sch” alternate on display.	No function blocks are executing because they are not in the current FB schedule.
Pid	Flashes No value displayed.	Only PID block is executing in the FB schedule.

7.5 Changing Local Meter Display

Changing Output Display

The local meter display can be changed to display output in user-selected engineering units. Table 30 lists the steps to select the engineering units for your process application. A block diagram of the AI block is shown in Figure 28 in Section 8.6 which may aid in performing the procedure.

Table 31 Changing Local Meter Display Units

Step	Action
1	At the operator station, access the device tag of the transmitter.
2	Set the AI block MODE_BLK parameter to O/S (Out Of Service).
3	Set the OUT_SCALE.UNITS_INDEX to the desired engineering unit to be shown on the meter display.
4	Set parameters OUT_SCALE.EU_100 and OUT_SCALE.EU_0 to a range for the unit selected in step 3.
5	Set parameter L_TYPE to INDIRECT This allows the OUT_SCALE parameter values to be shown on the meter display. Also, setting L_TYPE to INDIRECT/SQRT allows you select flow units for display.
6	Set the following parameters to values which do not exceed the OUT_SCALE.EU_100 and .EU_0 parameter values: HI_HI_LIM HI_LIM LO_LO_LIM LO_LIM For example, If OUT_SCALE.EU_100 = 400 and OUT_SCALE.EU_0 = 0 Then: HI_HI_LIM and HI_LIM must be ≤ 400 and LO_LO_LIM and LO_LIM must be ≥ 0 .
7	Write the changes to the transmitter.
8	Change AI block parameter MODE_BLK.ACTUAL = Auto
9	At the transmitter, verify that the display shows the proper engineering units. NOTE: Depending on the selected engineering units, you may need to attach the appropriate stick-on label to the display faceplate (Honeywell drawing number 30756918-001).

Section 8 —Function Block Application Description

8.1 Introduction

Section Contents

This section includes these topics

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About this Section

This section provides information about the construction and contents of the ST 3000 FF Function Block Application Process (FBAP); (This is the application that defines transmitter function and operation in the process application.) This information is provided to give some understanding of the elements that make up the configuration of the device application.

For More Information on FBAP

FBAP elements are described as they apply to the ST 3000 FF transmitter in the following sections. More detailed information can be found in Foundation™ Fieldbus documents, FF-890 and FF-891 *Foundation™ Specification Function Block Application Process Parts 1 and 2*.

8.2 Function Block Application Process (FBAP)

Function Block Application Process (FBAP)

The Function Block Application Process (FBAP) (or application) comprises a set of elementary functions which are modeled as function blocks (block objects). These block objects provide a general structure for defining different types of device functions (such as analog inputs, analog outputs and proportional integral derivative (PID) control).

The FBAP also contains other objects that provide other device functions, such as furnishing alarm information, historical data, and links to other blocks for transferring data.

FBAP Elements

The key elements of the FBAP are device objects which are of the following object types:

- Block objects and their parameters
(consisting of the following block types)
 - Resource blocks
 - Transducer blocks
 - Function blocks
 - Link Objects
 - Alert Objects
 - Trend Objects
 - View Objects
 - Domain Objects
-

Device Objects

Link objects allow the transfer of process data from one block to another. View, Alert and Trend objects provide a way of handling function block parameters for operator interface of views, alarms and events, and historical data. A brief description of these objects is presented in the following sections.

8.3 Block Description

Block Objects

Blocks are some of the key elements that make up the FBAP. The blocks contain data, (block objects and parameters) which define the application, such as the inputs and outputs, signal processing and connections to other applications. The ST 3000 FF transmitter application contains the following block objects:

- Resource block
- Transducer block
- Two Function blocks
 - Analog Input (AI) function block
 - Proportional Integral Derivative (PID) Controller function block

Table 31 briefly describes the operation of these blocks.

Table 32 Function Block Application Process Elements

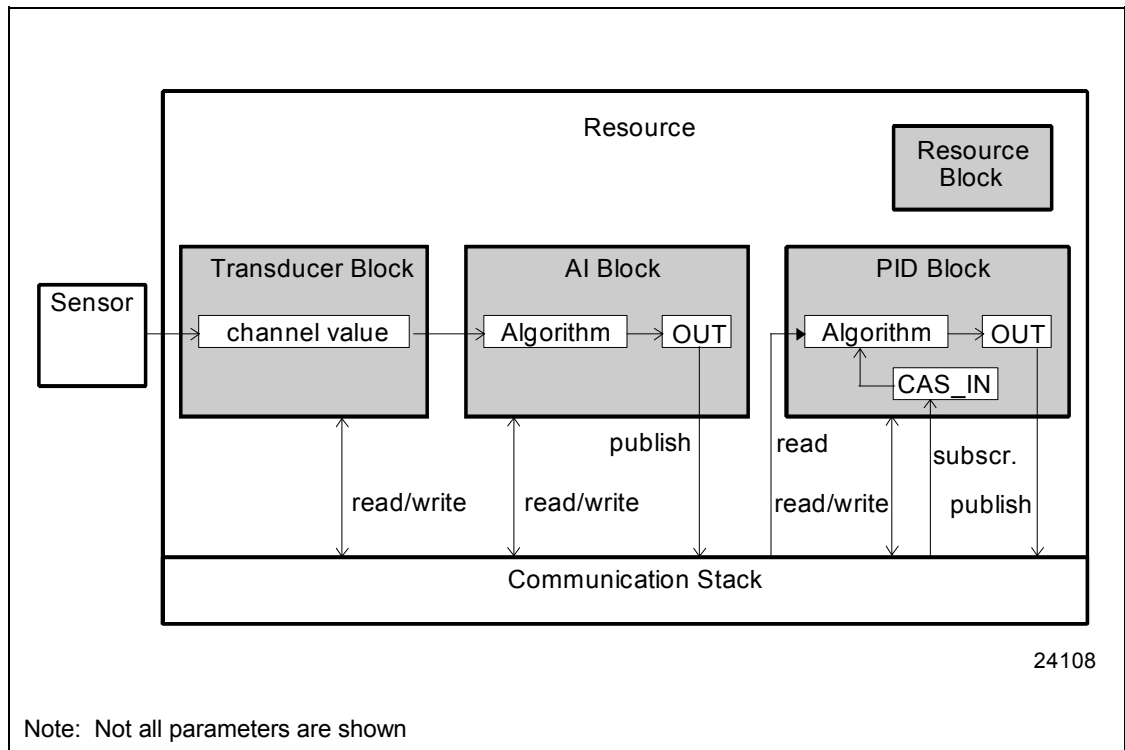
Block Type	Function
Resource	Contains data which describes the hardware (physical) characteristics of the device. Such as : MANUFAC_ID DEV_TYPE Device firmware revision Information The resource block does not perform any action, but contains parameters which support application downloads.
Transducer	De-couples the function blocks from I/O devices such as sensors, actuators and switches. The transducer block interfaces with the sensor hardware and provides either a direct pressure measurement or a calculated value to the AI function block. This block also contains sensor-specific parameters for calibration and diagnostics.
Function Blocks	In general, function blocks perform basic automation functions that are integral to automated control and processing operations. The ST 3000 contains two function blocks, one Analog Input and one PID block.
Analog Input (AI)	The analog input function block performs engineering units scaling, square root, alarming, and publishing of the PV on the bus.
PID Controller	Performs standard or robust proportional integral derivative algorithm used in closed loop processing.

Continued on next page

8.3 Block Description Continued

FBAP Block Diagram Figure 26 shows the important elements of the ST 3000 FBAP.

Figure 26 FBAP Block Diagram



Each of these blocks contain parameters which are standard Foundation™ Fieldbus -defined parameters. In other words, the parameters are pre-defined as part of the FF protocol for all fieldbus devices. Additionally, there are parameters which are defined by Honeywell and are specific to the ST 3000 FF transmitter.

The following pages provide descriptions of the block objects in the ST 3000 FF along with a complete listing of the parameters contained in each block. The block description lists the predefined fieldbus parameters as well as the Honeywell-defined extension parameters. A summary of the Honeywell parameters is provided also. For a complete description of the FF parameters, see the Foundation™ Fieldbus document FF-891, *Foundation™ Specification Function Block Application Process Part 2*.

Continued on next page

8.3 Block Description Continued

Block Parameter Column Descriptions

Tables on the following pages list all of the block parameters contained in each of the block objects. Table 32 explains the column headings for the parameter listings.

Table 33 Block Parameter List Column Description

Column Name	Description
Index	A number which corresponds to the sequence of the parameter in the block parameter segment of the object dictionary. See Object Dictionary, Section 8.16.
Name	The mnemonic character designation for the parameter.
Data Type /Structure	Data Type or Structure for the parameter value: Data Types consist of simple variables or arrays and are: Unsigned8, Unsigned16 Unsigned32 - An unsigned variable of 8, 16 or 32 bits. Floating point - Floating point variable. Visible string - Visible string variable. Octet string - Octet string variable. Bit string - Bit string variable. Data Structures consist of a record which may be: Value and Status - float - Value and status of a floating point parameter. Scaling - Static data used to scale floating point values for display purposes. Mode - Bit strings for target, actual, permitted and normal modes. Access permissions - Access control flags for access to block parameters. Alarm - float - Data that describes floating point alarms. Alarm - discrete - Data that describes discrete alarms. Event - update - Data that describes a static revision alarm. Alarm - summary - Data that summarizes 16 alerts. Simulate - Float - Simulate and transducer floating point value and status, and a simulate enable/disable discrete. Test - Function block test read/write data.
Store	Indicates the type of memory where the parameter is stored: S - Static. Writing to the parameter changes the static revision counter parameter ST_REV. N - Non-volatile. Non-volatile parameters are stored internally to actual non-volatile memory on periodic basis to protect the life of the memory. This interval is set by the resource block parameter NV_CYCLE_T at 15 minutes (displayed as 28800000 in 1/32 milliseconds). It cannot be changed by the user. Parameter must be retained during a power cycle. D - Dynamic. The value is calculated by the block, or read from another block.
Default Value	Default values for the configurable block parameters. These are the values that are used when: - the FBAP is initialized for the first time, or - selecting "restart with defaults" of the resource block parameter RESTART.

8.4 Resource Block

Resource Block Function

The resource block contains data and parameters related to overall operation of the device and the FBAP. Parameters that describe the hardware specific characteristics of the device and support application download operations make up the resource block.

Resource Block Parameters

Table 33 lists the FF and Honeywell-defined parameters and their default values contained in the resource block.

Table 34 Resource Block Parameters

Index	Name	Data Type/Structure	Store	Default Value
1	ST_REV	Unsigned16	S	
2	TAG_DESC	Octet string	S	all blanks
3	STRATEGY	Unsigned16	S	0
4	ALERT_KEY	Unsigned8	S	1
5	MODE_BLK	Mode	mix	TARGET = O/S
6	BLOCK_ERR	Bit string	D	
7	RS_STATE	Unsigned8	D	
8	TEST_RW	Test	D	
9	DD_RESOURCE	Visible string	S	
10	MANUFAC_ID	Unsigned32	S	48574C *
11	DEV_TYPE	Unsigned16	S	0002 *
12	DEV_REV	Unsigned8	S	
13	DD_REV	Unsigned8	S	
14	GRANT_DENY	Access permissions	N	
15	HARD_TYPES	Bit string	S	
16	RESTART	Unsigned8	D	
17	FEATURES	Bit string	S	
18	FEATURE_SEL	Bit string	S	
19	CYCLE_TYPE	Bit string	S	
20	CYCLE_SEL	Bit string	S	scheduled
21	MIN_CYCLE_T	Unsigned32	S	
22	MEMORY_SIZE	Unsigned16	S	
23	NV_CYCLE_T	Unsigned32	S	
24	FREE_SPACE	Floating point	D	
25	FREE_TIME	Floating point	D	
26	SHED_RCAS	Unsigned32	S	32000
27	SHED_ROUT	Unsigned32	S	8000

* Read only parameter

Continued on next page

8.4 Resource Block Continued

Table 33 Resource Block Parameters, continued

Index	Name	Data Type/Structure	Store	Default Value
28	FAULT_STATE	Unsigned8	N	
29	SET_FSTATE	Unsigned8	D	
30	CLR_FSTATE	Unsigned8	D	
31	MAX_NOTIFY	Unsigned8	S	
32	LIM_NOTIFY	Unsigned8	S	8
33	CONFIRM_TIME	Unsigned32	S	32000
34	WRITE_LOCK	Unsigned8	S	
35	UPDATE_EVT	Event - update	D	
36	BLOCK_ALM	Alarm - discrete	D	
37	ALARM_SUM	Alarm - summary	D	all disabled
38	ACK_OPTION	Bit string	S	0
39	WRITE_PRI	Unsigned8	S	0
40	WRITE_ALM	Alarm - discrete	D	
41	ITK_VER	Unsigned16	S	
Honeywell Parameters				
42	DL_CMD1	Unsigned8	D	
43	DL_CMD2	Unsigned8	D	
44	DL_APPSTATE	Unsigned16	S	
45	DL_SIZE	Unsigned32	S	
46	DL_CHECKSUM	Unsigned16	S	
47	REVISION_ARRAY	Unsigned32	S	
48	BLOCK_TEST	Unsigned8	D	
49	ERROR_DETAIL	Unsigned16	D	
50	AUX_FEATURES	Unsigned16	D	
Honeywell Diagnostic Parameters				
51	INSTALL_DATE	Unsigned32	N	
52	TIME_IN_SERVICE	Unsigned32	N	
53	POWER_CYCLES	Unsigned16	N	
54	POWER_CYCLES_DATE	Unsigned32	N	
55	VOLTAGE	Floating point	D	
56	VOLTAGE_MIN	Floating point	N	
57	VOLTAGE_MIN_DATE	Unsigned32	N	
58	EL_TEMPERATURE	Floating point	D	
59	EL_TEMP_OVER_RNG_CTR	Unsigned32	N	
60	EL_TEMP_OVER_RNG_DATE	Unsigned32	N	
61	EL_TEMP_UNDER_RNG_CTR	Unsigned32	N	
62	EL_TEMP_UNDER_RNG_DATE	Unsigned32	N	

Index	Name	Data Type/Structure	Store	Default Value
63	EL_TEMP_MAX	Floating point	N	
64	EL_TEMP_MIN	Floating point	N	
65	MSG_KEY_NUMBER	Visible string	N	
66	MSG_METER_BODY	Visible string	N	
67	MSG_FLANGE	Visible string	N	
68	MSG_OPTIONS_1	Visible string	N	
69	MSG_OPTIONS_2	Visible string	N	

8.4 Resource Block Continued

Resource Block Honeywell-defined Parameters

Table 34 describes the Honeywell-defined parameters in the resource block which are used during the application download procedure.

Table 35 Resource Block Parameter Descriptions

Name	Description or Parameter Contents
DL_CMD1 DL_CMD2	Used to "unlock" or access the domain (flash memory area) of the ST 3000 FF for download. Entering a series of values in these two parameters changes the internal state of the device so that it will accept the downloaded application software. The download cannot begin until the device is put into the correct internal state. The internal state of the device is read in the DL_APPSTATE parameter.
DL_APPSTATE	Contains the state of the downloaded(ing) application.
DL_SIZE	Contains the size of the downloaded application. (This will always be an even number.)
DL_CHECKSUM	Contains the 16-bit checksum of the downloaded application.
REVISION_ARRAY	A read only parameter that contains the application firmware revision level for: 1. Stack board application 2. Stack board boot code 3. Transducer board application. See Section 6.4 also.
BLOCK_TEST	An internal Honeywell test parameter. See Section 11.7 and 11.8 for more details.
ERROR_DETAIL	Contains data indicating the cause of device-critical errors. Parameter contains three sub-elements: 1. Error Type 2. Location 3. Sub-type Only Error Type element contains information meaningful to users. A description of this parameter is found in Section 11, Troubleshooting.
AUX_FEATURES	For future use.
INSTALL DATE	Time and date of device installation.
TIME_IN_SERVICE	Summation of time in minutes that power has been applied to the device since leaving the factory.
POWER_CYCLES	Total number of power-ups experienced by the unit.
POWER_CYCLES_DATE	Displays date and time of the last power-up.
VOLTAGE	Supply operating voltage available at device terminals.

VOLTAGE_MIN	Minimum operating voltage experienced by device at terminals since last reset of operating voltage parameters via method.
VOLTAGE_MIN_DATE	Displays date and time that last minimum operating voltage event occurred. User can reset as desired using method
EL_TEMPERATURE	Electronics Temperature – temperature inside the electronics housing.
EL_TEMP_OVER_RANGE_CTR	Accumulation of minutes that device's electronics temperature has been above the value of maximum specification limit less 10% of range. (Example: $85^{\circ}\text{C} - 12.5^{\circ}\text{C} = 72.5^{\circ}\text{C}$).
EL_TEMP_OVER_RANGE_DATE	Date and time when electronics temperature last passed below the value of maximum specification limit less 10% of range. (Example: $85^{\circ}\text{C} - 12.5^{\circ}\text{C} = 72.5^{\circ}\text{C}$).
EL_TEMP_UNDER_RANGE_CTR	Accumulation of minutes that device's electronics temperature has been below the value of minimum specification limit plus 10% of range. (Example: $-40^{\circ}\text{C} + 12.5^{\circ}\text{C} = -27.5^{\circ}\text{C}$).
EL_TEMP_UNDER_RANGE_DATE	Date and time when electronics temperature last passed above the value of minimum specification limit plus 10% of range. (Example: $-40^{\circ}\text{C} + 12.5^{\circ}\text{C} = -27.5^{\circ}\text{C}$).
EL_TEMP_MAX	Maximum electronics temperature reached in lifetime of the device.
EL_TEMP_MIN	Minimum electronics temperature in lifetime of the device.
MSG_KEY_NUMBER	Model Selection Guide Key Number which specifies span and working pressure rating.
MSG_METER_BODY	Model Selection Guide Table I which specifies meter body materials of construction, fill fluid and process head configuration.
MSG_FLANGE	Model Selection Guide Table II which specifies flange type and remote seals if included.
MSG_OPTIONS_1	Model Selection Guide Table III which specifies options that were purchased with the unit.
MSG_OPTIONS_2	Continuation of Model Selection Guide Table III which specifies options that were purchased with the unit.

8.5 Transducer Block

Transducer Block Function

The transducer block de-couples (or insulates) function blocks from local I/O devices, such as sensors or actuators. In the ST 3000 FF, the transducer block takes the sensor measurements from the signal processing software, performs a two-point linearization, and if selected, executes additional math functions. The transducer block also contains parameters used for transmitter calibration.

Transducer Block Parameters

Table 35 lists the FF and Honeywell-defined parameters and their default values in the transducer block.

Table 36 Transducer Block Parameters

Index	Name	Data Type/Structure	Store	Default Value
1	ST_REV	Unsigned16	S	
2	TAG_DESC	Octet string	S	all blanks
3	STRATEGY	Unsigned16	S	0
4	ALERT_KEY	Unsigned8	S	1
5	MODE_BLK	Mode	mix	TARGET = O/S *
6	BLOCK_ERR	Bit string	D	
7	UPDATE_EVT	Event - update	D	
8	ALARM_SUM	Alarm - summary	D	all disabled
9	BLOCK_ALARM	Alarm - discrete	D	
Honeywell Parameters				
10	PRIMARY_VALUE	Value and Status - float	D	
11	CALC_VAL	Value and Status - float	D	
12	SENSOR_TEMP	Value and Status - float	D	
13	SENSOR_TEMP_UNIT	Unsigned16	S	deg. C (1001)
14	LEVEL_COEFF	Floating point	S	all 0
15	PRIMARY_VALUE_RANGE	Scaling	S	
16	CAL_CMD	Unsigned8	D	
17	CAL_POINT_HI	Floating point	S	0
18	CAL_POINT_LO	Floating point	S	0
19	CAL_STATUS	Unsigned8	D	
20	CAL_SOURCE	Unsigned8	D	

* O/S = Out of Service

Continued on next page

8.5 Transducer Block Continued

Table 35 Transducer Block Parameters, continued

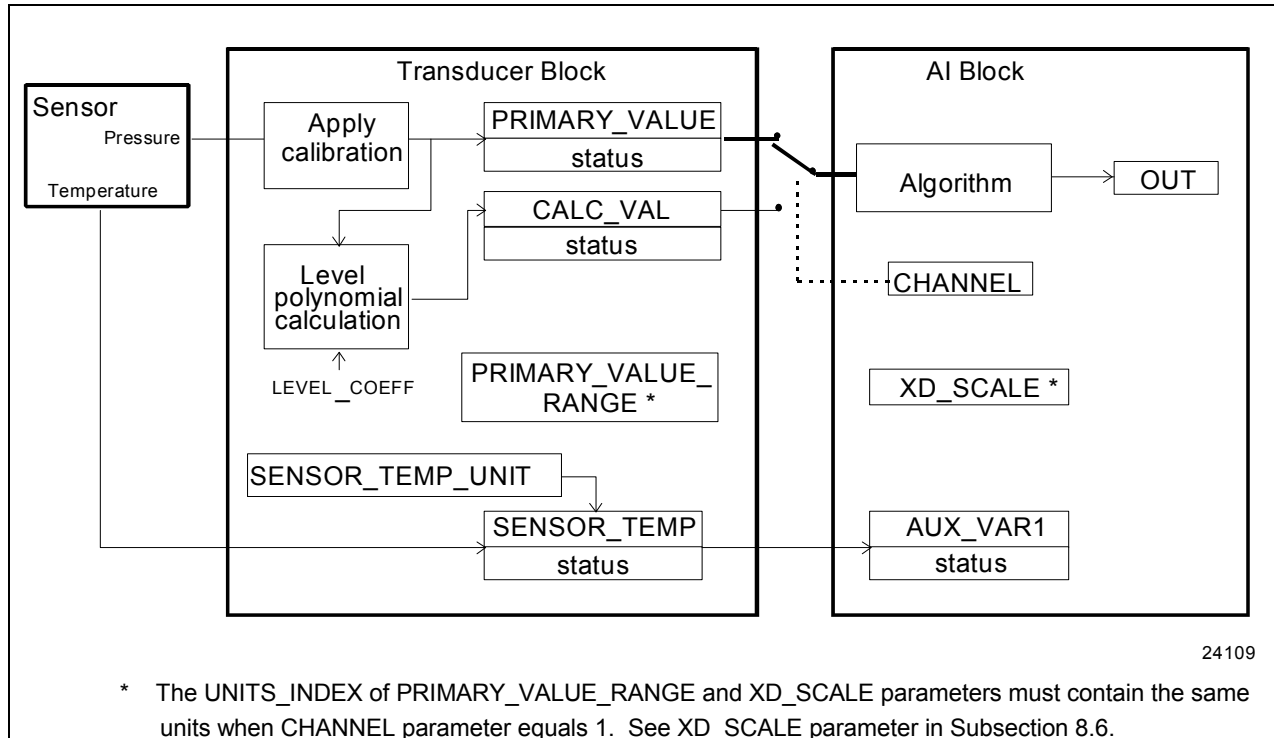
Index	Name	Data Type/Structure	Store	Default Value
21	CAL_UNIT	Unsigned16	S	inches of water @ 4 deg. C (1147)
22	XD_DIAG_DETAIL	Bit String		
23	SENSOR_RANGE	Scaling	S	
24	SENSOR_SN	Unsigned32	S	
25	SENSOR_MAX_SP **	Scaling	S	
26	SENSOR_MAX_OVP **	Floating point	S	
27	TANK_RANGE	Floating point	S	0-400
28	BLOCK_TEST	Unsigned8	D	
Honeywell Diagnostic Parameters				
30	PV_OVER_RNG_DATE	Unsigned32	N	
31	PV_UNDER_RNG_CTR	Unsigned32	N	
32	PV_UNDER_RNG_DATE	Unsigned32	N	
33	TEMP_OVER_RNG_CTR	Unsigned32	N	
34	TEMP_OVER_RNG_DATE	Unsigned32	N	
35	TEMP_UNDER_RNG_CTR	Unsigned32	N	
36	TEMP_UNDER_RNG_DATE	Unsigned32	N	
37	TEMP_MAX	Floating point	N	
38	TEMP_MIN	Floating point	N	
39	STATIC_PRESSURE	Floating point	D	
40	SP_MAX	Floating point	N	
41	SP_OVER_RNG_CTR	Unsigned32	N	
42	SP_OVER_RNG_DATE	Unsigned32	N	
43	STRESS_MONITOR	Floating point	N	
44	SERVICE_LIFE	Floating point	N	
45	CALIB_DATE_LAST_2PT	Unsigned32	N	
46	CALIB_DATE_PREV_2PT	Unsigned32	N	
47	CALIB_DATE_RESTORE	Unsigned32	N	
48	CALIB_DATE_CLEAR	Unsigned32	N	
49	CALIB_DATE_ZERO	Unsigned32	N	

** Please read CAUTION about these parameters on page 88.

Transducer Block Diagram

Figure 27 is a block diagram showing the basic components of the Transducer block.

Figure 27 Transducer Block Diagram



Continued on next page

8.5 Transducer Block Continued

Transducer Block Honeywell-defined Parameters

Table 36 describes the Honeywell parameters included in the transducer block.

Table 37 Transducer Block Parameter Descriptions

Name	Description or Parameter Contents
PRIMARY_VALUE	Contains the direct pressure measurement of the sensor and is updated continuously when the block is in Auto mode.
CALC_VAL	Contains either a calculated value or 0.0, depending upon the following conditions: - If CALC_VAL is selected by the CHANNEL parameter of the AI block (CHANNEL = 2), the pressure measurement is put through a level polynomial calculation and then placed in CALC_VAL and passed to the AI block. (CALC_VAL contains the result of the level polynomial calculation.) - If CALC_VAL is not selected, then no calculation is performed and CALC_VAL contains a value of 0.0 with a status of <i>Bad:: . . .::NonSpecific</i>, (AI parameter CHANNEL = 1).
SENSOR_TEMP	Contains the sensor temperature, in degrees Celsius, which is provided to the AI block.
SENSOR_TEMP_UNIT	Allows user-selected units to be displayed in SENSOR_TEMP.
LEVEL_COEFF	An array that contains the coefficients for the level polynomial calculation. See Level Calculation below for a description.
PRIMARY_VALUE_RANGE	Contains the 4 attributes selected for the value reported in PRIMARY_VALUE. These are: 1 = Upper range and 2 = Lower range (for display purposes) 3 = Engineering units 4 = Decimal places (for display purposes)
CAL_CMD **	The calibration command parameter which is a one byte value that selects the calibration operation to be performed.
CAL_POINT_HI **	The upper calibration trim point.
CAL_POINT_LO **	The lower calibration trim point.
CAL_STATUS **	The status of the selected calibration command (in-progress, success, or failed).
CAL_SOURCE **	The source of the device calibration (none, factory, user).
CAL_UNIT 8	The engineering units used in the calibration.

** See Section 10, Calibration for details on these parameters.

Continued on next page

8.5 Transducer Block Continued

Table 36 Transducer Block Parameter Descriptions, continued

Name	Description or Parameter Contents
XD_DIAG_DETAIL †	Contains various status indicators relating to calibration, the pressure measurement software, and the sensor.
SENSOR_RANGE	A read only parameter that shows the rated range of the sensor and the engineering units of the defined range.
SENSOR_SN	The serial number of the sensor. This value is read directly from the sensor. When viewed in hexadecimal format, it displays the same value as the PROM ID on the device nameplate.
SENSOR_MAX_SP ††	Contains the maximum allowable sensor static pressure.
SENSOR_MAX_OVP ††	Contains the maximum sensor over-pressure.
TANK_RANGE	Contains the upper and lower range of pressure measurement of a tank. Used primarily in level applications - specifically for the polynomial calculation.
BLOCK_TEST	An internal Honeywell test parameter. See Section 11.7 and 11.8 for more details.
PV_OVER_RNG_CTR	Accumulation of minutes that device's PV pressure has been above the value of maximum specification limit less 10% of range. (Example: 800 inH2O – 160 inH2O = 640 inH2O).
PV_OVER_RNG_DATE	Date and time when PV pressure last passed below the value of maximum specification limit less 10% of range. (Example: 800 inH2O – 160 inH2O = 640 inH2O).
PV_UNDER_RNG_CTR	Accumulation of minutes that device's PV pressure has been below the value of minimum specification limit plus 10% of range. (Example: 800 inH2O + 160 inH2O = -640 inH2O).
PV_UNDER_RNG_DATE	Date and time when PV pressure last passed above the value of minimum specification limit plus 10% of range. (Example: 800 inH2O + 160 inH2O = -640 inH2O).
TEMP_OVER_RNG_CTR	Accumulation of minutes that device's meter body (process) temperature has been above the value of maximum specification limit less 10% of range. (Example: 125°C - 16.5°C = 108.5°C).
TEMP_OVER_RNG_DATE	Date and time when meter body (process) temperature last passed below the value of maximum specification limit less 10% of range. (Example: 125°C - 16.5°C = 108.5°C).
TEMP_UNDER_RNG_CTR	Accumulation of minutes that device's meter body (process) temperature has been below the value of minimum specification limit plus 10% of range. (Example: -40°C + 16.5°C = -23.5°C).
TEMP_UNDER_RNG_DATE	Date and time when meter body (process) temperature last passed above the value of minimum specification limit plus 10% of range. (Example: -40°C + 16.5°C = -23.5°C).
TEMP_MIN	Minimum meter body (process) temperature value that the device has experienced during it's service life.

ST_PR	Working pressure also known as pressure on high side of the device for DP (Differential Pressure) devices. Units are always PSI (pounds per square inch). SP value for AP (Absolute Pressure) or GP (Gage Pressure) type devices is always 0.
ST_PR_MAX	Highest Static Pressure ever experienced by the device. Units are always PSI (pounds per square inch).
ST_PR_OVER_RNG_CTR	Accumulation of minutes that device's static pressure has been above the upper specification limit less 10% of static pressure range. (Example: 4500 psi – 450 psi = 4050 psi).
ST_PR_OVER_RNG_DATE	Time that has passed since device's static pressure has passed below the upper specification limit less 10% of static pressure range. (Example: 4500 psi – 450 psi = 4050 psi).
STRESS_MONITOR	Percent of service life spent in stressful conditions. Indicates the % of service life where one or more of PV, static pressure, meter body temperature or electronics temperature are within 10% of respective range limits.
SERVICE_LIFE	Value is based on electronics temperature. Service life accumulates faster at higher temperatures with an exponential relationship. At 25 degrees C service life is expected to be around 27 years.
CALIB_DATE_LAST_2PT	Date and time when the Two-point Calibration method was last run.
CALIB_DATE_PREV_2PT	Date and time when the Two-point Calibration method was run prior to last time.
CALIB_DATE_RESTORE	Date and time when the Restore Calibration method was last run.
CALIB_DATE_CLEAR	Date and time when the Clear Calibration method was last run.
CALIB_DATE_ZERO	Date and time when the Calibration Zero

† See Section 11, Troubleshooting for details on this parameter.

†† **CAUTION**

Maximum Values for SENSOR_MAX_SP & SENSOR_MAX_OVP

These values are for the sensor only! The maximum pressure allowed to any transmitter with remote seals, flange, or fittings must be limited to either the pressure rating of the transmitter sensor or the pressure rating of the remote seals, flange, and fittings, whichever is lower.

Level Calculation

The ST 3000 FF has the ability to put the measured pressure value through a fifth order polynomial equation. This calculation allows the transmitter to closely approximate the level of an irregularly shaped tank or vessel. The following page describe the level calculation along with an example of its use.

Enabling the Level Calculation

The CHANNEL parameter in the Analog Input block is used to select the measurement value from the transducer block (which is either PRIMARY_VALUE or CALC_VAL).

- When CHANNEL = 1, PRIMARY_VALUE is selected as input to the AI block.
- When CHANNEL = 2, the level calculation is enabled and CALC_VAL is the selected input to the AI block which is the direct pressure measurement value from the sensor.

Therefore, if you wish to use the level calculation, you set the AI block CHANNEL parameter to equal 2.

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8.5 Transducer Block Continued

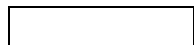
Parameters used in the Level Calculation

The following parameters are used do the level calculation and these values are derived from your particular application:

- LEVEL_COEFF contains an array of floating point values (coefficients) to be used in the equation.
 - TANK_RANGE contains the upper and lower ranges of the tank measurements (i.e. for a full and empty tank) and the engineering units
-

LEVEL_COEFF Parameter

The LEVEL_COEFF parameter will contain coefficients used in the polynomial level equation. These coefficients must generated by you for your application. Also these values must be such that the result of the calculation is expressed in percent.



If the AI block's XD_SCALE is not configured with the engineering units in percent value (and CHANNEL = 2), then a block configuration error will be generated in the AI block and it will remain in Out of Service (O/S) mode.

The polynomial can also be used for measuring flow,
Where flow = f (Δp).

TANK_RANGE Parameter

The TANK_RANGE parameter is configured with the upper and lower range values of the pressure coming from the tank measurement. This must also take into account the head pressure of any fill fluid in remote seal tubing (wet legs).

Level Calculation Formula

The level is calculated in the following way:

$$V = 100 \cdot [C_0 + (C_1 \cdot H^1) + (C_2 \cdot H^2) + (C_3 \cdot H^3) + (C_4 \cdot H^4) + (C_5 \cdot H^5)]$$

where: V = Volume (%)

H = height of process tank fluid, in fraction (0.0 - 1.0)
of TANK_RANGE

$C_i = \text{LEVEL_COEFF}[i]$

NOTE: You must provide the coefficients for this equation, as the transmitter has no knowledge of the shape of the tank.

The result of the calculation, V is placed in CALC_VAL and passed to the AI block. The engineering units are always expressed in percent (%).

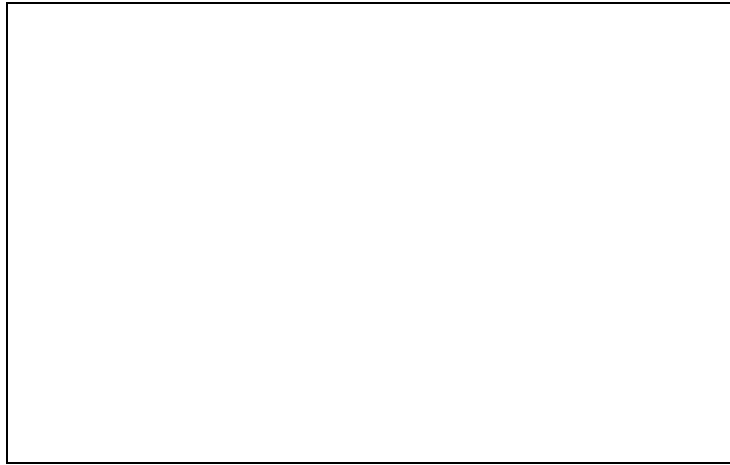
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8.5 Transducer Block Continued

Example for Using Level Calculation

The following paragraphs describe, using an example, how to determine the values used to configure LEVEL_COEFF and TANK_RANGE. Following the example are some measurement examples.

- Step 1** Given the vessel shown below, determine the measurements of the vessel and calculate the theoretical polynomial coefficients. To do this use a height of “1” for the vertical distance, rather than the actual distance, representing the pressure range to be configured in TANK_RANGE. Remember that the polynomial calculates volume, not simply vessel shape, as a function of level.



The actual vessel measurements are: A = 20 ft., B = 30 ft., C = 40 ft.

The theoretical coefficients, using a height of “1”, are derived to be:

$$\begin{aligned}C_0 &= 0 \\C_1 &= B \cdot C = 1200 \\C_2 &= -0.5 \cdot B \cdot C = -600 \\C_3, C_4, C_5 &= 0\end{aligned}$$

- Step 2** Divide all theoretical coefficients by the maximum volume of the vessel, *again using the height of ”1” in the calculations*. These become the *actual coefficients*.

$$\begin{aligned}\text{Maximum volume} &= 0.5 \cdot \text{”1”} \cdot B \cdot C = 600 \\ \text{So, the actual coefficients are:} \\ C_1 &= 1200/600 = 2 \\ C_2 &= -600/600 = -1\end{aligned}$$

Continued on next page

8.5 Transducer Block Continued

Step 3 Configure the transducer block parameters LEVEL_COEFF and TANK_RANGE.

So, LEVEL_COEFF is configured with the coefficients calculated above in Step 2.

TANK_RANGE may be configured as described below, where
TANK_RANGE.EU_0 = actual pressure when tank is empty
(P_{empty})
TANK_RANGE.EU_100 = actual pressure when tank is full
(P_{full})
TANK_RANGE.UNITS_INDEX = pressure units used

Configuring TANK_RANGE.EU_0 -

The lower range (pressure measurement when tank is empty) is configured in TANK_RANGE.EU_0 and can be either of the following:

- Actual measured pressure when tank is empty, or
- $H2 \cdot S_f \cdot -1$

Where,

H2 = Height of fixed reference leg (vertical height between upper and lower tank connections), in units configured in SENSOR_RANGE subindex 3 (units index)

S_f = Specific gravity of fill fluid
(e.g. S_f of silicon "DC200" = 0.94)

Configuring TANK_RANGE.EU_100 -

The upper range (pressure measurement when tank is full) is configured in TANK_RANGE.EU_100 and can be either of the following:

- Actual measured pressure when tank is full, or
- $H1 \cdot S_L$

Where,

H1 = Height of variable head, in units configured in SENSOR_RANGE subindex 3 (units index)

S_L = Specific gravity of measured liquid
(e.g. S_L of water at 60 °F is 1.00)

Continued on next page

8.5 Transducer Block Continued

Step 4 If desired, configure the AI block to convert the percentage (%) value coming from the transducer block to engineering units. For example, if you want to see the value in gallons rather than percent, configure the following parameters as described below:

XD_SCALE.EU_0 = 0
XD_SCALE.EU_100 = 100
XD_SCALE.UNITS_INDEX = Percent

OUT_SCALE.EU_0 = 0
OUT_SCALE.EU_100 = Volume of the tank representing 100%
OUT_SCALE.UNITS_INDEX = Desired output engineering units

CHANNEL = 2
L_TYPE = Indirect (2)

If total vessel volume = $0.5 \cdot A \cdot B \cdot C = 12000$ cu. ft. = 89766 gallons,

Then configure

XD_SCALE - as described above
OUT_SCALE.EU_0 = 0
OUT_SCALE.EU_100 = 89766
OUT_SCALE.UNITS_INDEX = gallons

Measurement Examples

Given: $P_{\text{empty}} = 0$
 $P_{\text{full}} = 100$ PSI

If: Input pressure = 50 PSI

Then: $V = 100 \cdot [(2 \cdot 50/100) + (-1 \cdot (50/100)^2)]$
= 75 %

and: AI.OUT = 67324.5 gallons

If: Input pressure = 25 PSI

Then: $V = 100 \times [(2 \cdot 25/100) + (-1 \cdot (25/100)^2)]$
= 43.75 %

and: AI.OUT = 39272.625 gallons

8.6 Analog Input Function Block

Analog Input Block Function

The Analog Input function block takes the output signal from the transducer block and makes it available to other function blocks as its output.

Input to AI Block

Two values from the transducer block are supplied as inputs to the AI block:

Values from Transducer Block	Input to AI Block
PRIMARY_VALUE or CALC_VAL (Selected by the CHANNEL parameter value, see below.)	FIELD_VAL
SENSOR_TEMP	AUX_VAR1

CHANNEL Parameter

The CHANNEL parameter in the AI block selects the input from the transducer block (which is either PRIMARY_VALUE or CALC_VAL).

When CHANNEL equals	Value Selected (from Transducer Block) is . . .
1	PRIMARY_VALUE which is the direct pressure measurement value from the sensor.
2	CALC_VAL which is the result of the level calculation. See Level Calculation Formula in the previous subsection 8.5.
Other	An Error - the AI block remains in out of service (O/S) mode

XD_SCALE parameter

XD_SCALE is a user-defined parameter and depending on the CHANNEL parameter value, the XD_SCALE parameter must be set to the following values:

When CHANNEL equals	Set XD_SCALE parameter to . . .
1	XD_SCALE.UNITS_INDEX must contain the same units as PRIMARY_VALUE_RANGE.UNITS_INDEX in the transducer block. If not, the AI block remains in the O/S mode. XD_SCALE range limits (EU_100 and EU_0) must be configured according to your application.
2	The XD_SCALE.UNITS_INDEX parameter must be set to engineering units of percent.

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8.6 Analog Input Function Block Continued

AUX_VAR1 parameter Contains the same temperature measurement as the SENSOR_TEMP parameter of the transducer block, but may be converted to different engineering units before being placed in AUX_VAR1. The parameter SENSOR_TEMP_UNIT (in the transducer block) contains the user-defined unit value that will be shown in AUX_VAR1.

AI Block Parameter List Table 37 lists the block parameters and default values for the AI function block.

Table 38 AI Function Block Parameter List

Index	Name	Data Type/Structure	Store	Default Value
1	ST_REV	Unsigned16	S	
2	TAG_DESC	Octet string	S	all blanks
3	STRATEGY	Unsigned16	S	0
4	ALERT_KEY	Unsigned8	S	0
5	MODE_BLK	Mode	mix	TARGET = O/S
6	BLOCK_ERR	Bit string	D	
7	PV	Value and Status - float	D	
8	OUT	Value and Status - float	N	
9	SIMULATE	Simulate - float	D	
10	XD_SCALE	Scaling	S	scale = 0-400 units = 1147 decimal places = 0
11	OUT_SCALE	Scaling	S	scale = 0-400 units = 1147 decimal places = 0
12	GRANT_DENY	Access permissions	N	0,0
13	IO_OPTS	Bit string	S	0
14	STATUS_OPTS	Bit string	S	0
15	CHANNEL	Unsigned16	S	1
16	L_TYPE	Unsigned8	S	0
17	LOW_CUT	Floating point	S	0
18	PV_FTIME	Floating point	S	0
19	FIELD_VAL	Value and Status - discrete	D	
20	UPDATE_EVT	Event - update	D	

* O/S = Out of Service

Continued on next page

8.6 Analog Input Function Block Continued

Table 37 AI Function Block Parameter List, continued

Index	Name	Data Type/Structure	Store	Default Value
21	BLOCK_ALM	Alarm - discrete	D	
22	ALARM_SUM	Alarm - summary	D	all disabled
23	ACK_OPTION	Bit string	S	0
24	ALARM_HYS	Floating point	S	0.5
25	HI_HI_PRI	Unsigned8	S	0
26	HI_HI_LIM	Floating point	S	+INF
27	HI_PRI	Unsigned8	S	0
28	HI_LIM	Floating point	S	+INF
29	LO_PRI	Unsigned8	S	0
30	LO_LIM	Floating point	S	-INF
31	LO_LO_PRI	Unsigned8	S	0
32	LO_LO_LIM	Floating point	S	-INF
33	HI_HI_ALM	Alarm - float	D	
34	HI_ALM	Alarm - float	D	
35	LO_ALM	Alarm - float	D	
36	LO_LO_ALM	Alarm - float	D	
Honeywell Parameters				
37	AUX_VAR1	Floating point	D	
38	BLOCK_TEST	Unsigned8	D	
Honeywell Diagnostic Parameters				
39	MAXIMUM_PV	Floating point	N	
40	MINIMUM_PV	Floating point	N	

AI Block Honeywell-defined Parameters

Table 38 describes the Honeywell parameters included in the AI block.

Table 39 AI Block Parameter Descriptions

Parameter Name	Description/Parameter Contents
AUX_VAR1	AUX_VAR1 is the secondary variable of the block. In the ST 3000 FF it contains the same value as the SENSOR_TEMP parameter of the transducer block. The parameter contains an FF status byte that reflects the condition of the value. The transducer block parameter SENSOR_TEMP_UNIT selects the engineering units for this temperature.
BLOCK_TEST	An internal Honeywell test parameter. See Section 11.7 and 11.8 for more details.
MAXIMUM_PV	Maximum PV pressure value that the device has experienced during it's service life. (Must be in Auto Mode)
MINIMUM_PV	Minimum PV pressure value that the device has experienced during it's service life. (Must be in Auto Mode)

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8.6 Analog Input Function Block Continued

Transmitter Output Signal and Status

Viewing certain parameters and their values in the transmitter and understanding their relationship to each other are helpful in understanding transmitter output signal and status. The following paragraphs and tables describe transducer and AI block parameters which directly determine the way the transmitter output is presented. Refer to Tables 39 and 40 and the AI block diagram for the following discussion.

Pressure Sensor Signal

The characterized ST pressure signal is developed in the transducer block as PRIMARY_VALUE. This signal uses the elements in PRIMARY_VALUE_RANGE in determining the engineering units, the decimal places for display and the high and low scale of the value.

This signal becomes PV value in the AI block and uses the elements of OUT_SCALE in determining the units, decimal places and the high and low scale values for PV. The signal exits the AI block as OUT value which also uses the elements of OUT_SCALE.

Table 40 Transducer Block Parameters

This Parameter	Contains . . .
PRIMARY_VALUE	The status and value of the pressure sensor measurement.
PRIMARY_VALUE_RANGE	Elements used to display the PRIMARY_VALUE parameter. The elements are: • High and low scale values (EU_100 and EU_0). • Engineering units used to display the value (UNITS_INDEX). • Decimal places used to display the value (DECIMAL).

PRIMARY_VALUE Status

The high and low scale values of PRIMARY_VALUE_RANGE (EU_100 and EU_0) should be set to the maximum allowable range of the pressure sensor signal. So, that

- When a properly calibrated transmitter produces the pressure sensor signal within the range of PRIMARY_VALUE_RANGE, the PRIMARY_VALUE status is *Good Non Cascade::[alarm status]:Not Limited*.
- When the signal exceeds the range of PRIMARY_VALUE_RANGE, the PRIMARY_VALUE status becomes *Uncertain::[alarm status]:Engineering Units Range Violation, & High or Low Limited*.

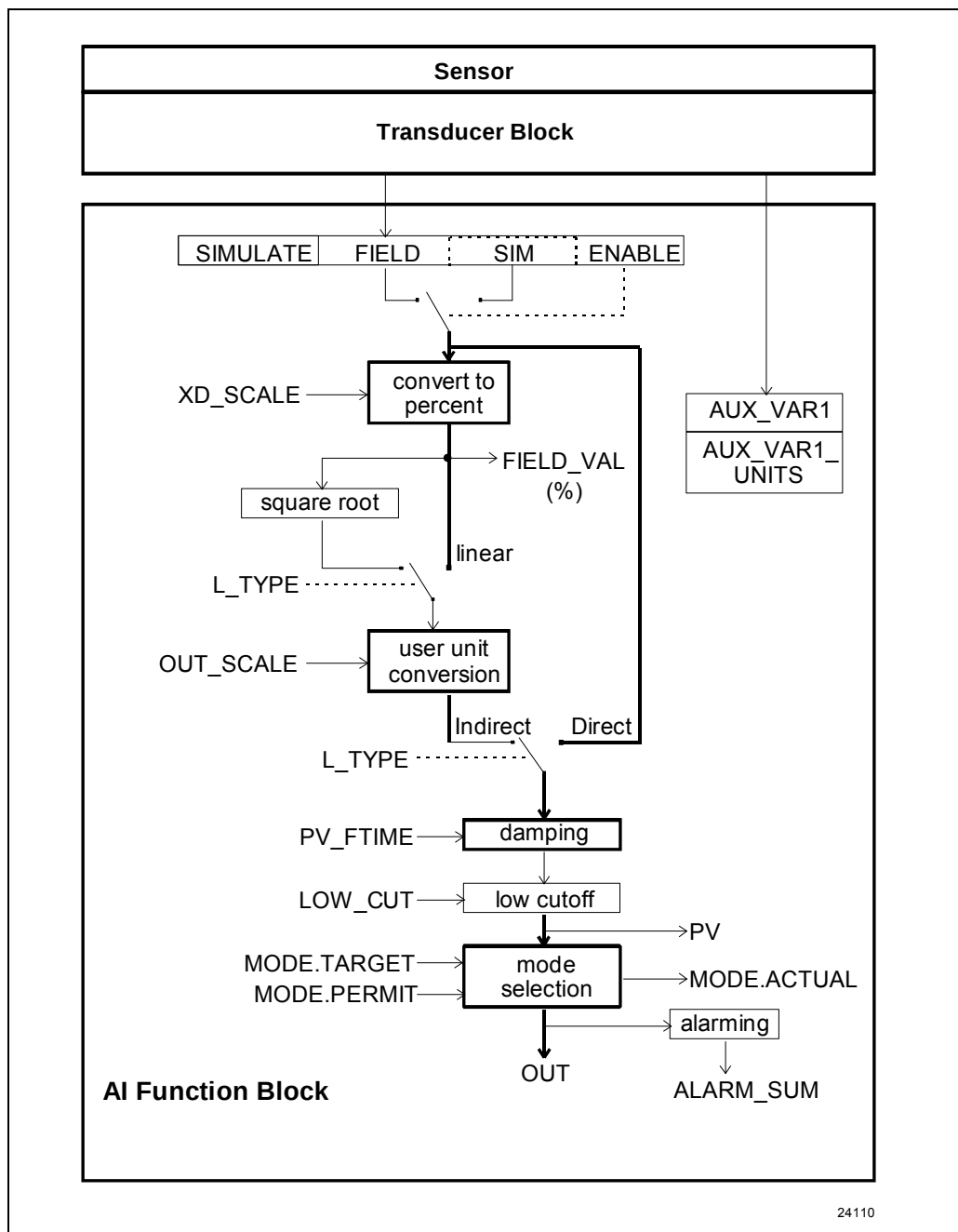
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8.6 Analog Input Function Block Continued

AI Block Diagram

Figure 28 is a block diagram showing the key components of the AI function block.

Figure 28 AI Block Diagram



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8.6 Analog Input Function Block Continued

Table 41 AI Block Parameters

This Parameter	Contains . . .
OUT	The status and value of output from the AI block.
OUT_SCALE	Elements used to display the OUT parameter. The elements are: • High and low scale values (EU_100 and EU_0). • Engineering units used to display the value (UNITS_INDEX). • Decimal places used to display the value (DECIMAL).
PV	The status and value of PV. This is usually the same as OUT and the same value as PRIMARY_VALUE in the transducer block.
XD_SCALE	Elements used to display the value obtained from the transducer block. The elements are: • High and low scale values (EU_100 and EU_0). • Engineering units to display the value (UNITS_INDEX) • Decimal places to display the value (DECIMAL). NOTE: When CHANNEL = 1, XD_SCALE.UNITS_INDEX must contain the same units as PRIMARY_VALUE_RANGE.UNITS_INDEX in the transducer block. When CHANNEL = 2, the XD_SCALE.UNITS_INDEX must be set to engineering units of percent.
L_TYPE	The state (Direct or Indirect) which values are passed from the transducer block to the AI block. • When L_TYPE = Direct. Values are passed directly from the transducer block to the AI block. (No units conversion.) • When L_TYPE = Indirect. Values from the transducer block are in different units, and must be converted either linearly (Indirect) or in square root (Ind Sqr Root) using the range defined by the transducer and the OUT_SCALE range.

Continued on next page

8.6 Analog Input Function Block Continued

XD_SCALE Range

In the AI block, XD_SCALE values are used when L_TYPE is set to Indirect which converts the signal to other units. (See L_TYPE in Table 39.) The high and low scale values of XD_SCALE (EU_100 and EU_0) define the range over which the AI OUT will show *Good* status.

- When L_TYPE is set to either Indirect or Direct, XD_SCALE units must match the transducer PRIMARY_VALUE_RANGE units (CHANNEL = 1).
Therefore, the high and low scale values of XD_SCALE would normally be set equal to or within the transducer PRIMARY_VALUE_RANGE range.
- When L_TYPE is set to Direct, it is recommended that XD_SCALE and OUT_SCALE should contain the same values

PV Value

The AI block PV value is the same as the transducer block PRIMARY_VALUE

AI OUT

AI in Manual Mode - When the AI block is in manual mode, OUT can be written as a fixed value between -10% and +110% of the OUT_SCALE range. OUT values between 0 and 100% will show a status of *Good*. OUT values outside the range will show a status of *Uncertain*. The “limited” field will be marked as *Constant* for all values.

PV shows the live pressure signal in manual mode.

AI in Auto Mode - L_TYPE determines whether the signal is taken directly from the transducer block and passed to the AI block output (L_TYPE = Direct) or converted into different units before it is passed to the AI block output (L_TYPE = Indirect or Ind Sqr Root). OUT_SCALE determines the units conversion of the signal presented to the output.

- When L_TYPE equals Direct, OUT is the same as the value passed from the transducer block.
- When L_TYPE equals Indirect, the PRIMARY_VALUE is converted to percent of XD_SCALE and that value is set equal to percent of OUT (FIELD_VAL = %). The OUT in % is re-ranged to a value using the OUT_SCALE.

Continued on next page

8.6 Analog Input Function Block Continued

OUT Status

The following table provides the resulting status of AI block OUT for a given status of PRIMARY_VALUE in the transducer block.

If . . .	Then . . .
PRIMARY_VALUE status = <i>Good::[alarm status]:Not Limited</i>	OUT value is tested against OUT_SCALE range values: If OUT value is within the OUT_SCALE range, then OUT status = <i>Good Non Cascade::[alarm status]:Not Limited</i> If OUT exceeds OUT_SCALE range, then OUT status = <i>Uncertain:: Engineering Units Range Violation:& High or Low Limited</i>
PRIMARY_VALUE status = <i>Uncertain</i>	OUT status = <i>Uncertain</i>
2 nd field in the PRIMARY_VALUE status = <i>Non Specific</i>	OUT status = <i>Non Specific</i>
PRIMARY_VALUE status = <i>High or Low</i>	OUT status = <i>High or Low</i>

Local Meter Display

The local meter display shows both the value and status of the AI block OUT parameter. Normally, the OUT parameter is shown in engineering units. If the engineering units are not supported by the meter or if the units are unknown, then the display shows no indication of units.

The bar graph is scaled from the high and low scale values of XD_SCALE.

- When L_TYPE equals Direct, the units indication will be the units of XD_SCALE.
- When L_TYPE equals Indirect the units indication will be the units of OUT_SCALE.

If the status is Bad, then an error condition is shown on the display. See Subsection 7.4 for more details of the local meter display option.

Continued on next page

8.6 Analog Input Function Block Continued

Mode Restricted Writes to AI Parameters

Writing to the following AI block parameters are restricted by the block's ACTUAL mode. The MODE_BLK parameter must equal one of the modes in the mode column below before you can write values to the parameters listed in Table 41.

Table 42 AI Block Mode Restricted Parameters

Parameter	ACTUAL Mode Restricted
OUT	Man or O/S modes
XD_SCALE	Man or O/S modes
OUT_SCALE	Man or O/S modes
IO_OPTS	O/S mode only
STATUS_OPTS	O/S mode only
CHANNEL	O/S mode only
L_TYPE	Man or O/S modes

8.7 PID Function Block

PID Block Description The PID Function block provides you with the choice of selecting either a standard PID control equation (Ideal), or a robust PID which is defined in Table 43.

PID Block Parameter List Table 42 lists the block parameters and default values for the PID function block.

Table 43 PID Control Function Block Parameters

Index	Name	Data Type/Structure	Store	Default Value
1	ST_REV	Unsigned16	S	
2	TAG_DESC	Octet string	S	all blanks
3	STRATEGY	Unsigned16	S	0
4	ALERT_KEY	Unsigned8	S	0
5	MODE_BLK	Mode	mix	Target = O/S
6	BLOCK_ERR	Bit string	D	
7	PV	Value and Status - float	D	
8	SP	Value and Status - float	N *	
9	OUT	Value and Status - float	N	
10	PV_SCALE	Scaling	S	0 - 100
11	OUT_SCALE	Scaling	S	0 - 100
12	GRANT_DENY	Access permissions	N	0
13	CONTROL_OPTS	Bit string	S	0
14	STATUS_OPTS	Bit string	S	0
15	IN	Value and Status - float	N	
16	PV_FTIME	Floating point	S	0
17	BYPASS	Unsigned8	S	0
18	CAS_IN	Value and Status - float	N	
19	SP_RATE_DN	Floating point	S	+INF
20	SP_RATE_UP	Floating point	S	+INF
21	SP_HI_LIM	Floating point	S	100
22	SP_LO_LIM	Floating point	S	0
23	GAIN	Floating point	S	0
24	RESET	Floating point	S	+INF
25	BAL_TIME	Floating point	S	0
26	RATE	Floating point	S	0
27	BKCAL_IN	Value and Status - float	N	

* This is a special non-volatile parameter which is updated to the internal non-volatile memory on write.

Continued on next page

8.7 PID Function Block Continued

Table 42 PID Control Function Block Parameters, continued

Index	Name	Data Type/Structure	Store	Default Value
28	OUT_HI_LIM	Floating point	S	100
29	OUT_LO_LIM	Floating point	S	0
30	BKCAL_HYS	Floating point	S	0.5
31	BKCAL_OUT	Value and Status - float	D	
32	RCAS_IN	Value and Status - float	N	
33	ROUT_IN	Value and Status - float	D	
34	SHED_OPT	Unsigned8	S	0
35	RCAS_OUT	Value and Status - float	D	
36	ROUT_OUT	Value and Status - float	D	
37	TRK_SCALE	Scaling	S	0 - 100
38	TRK_IN_D	Value and Status - discrete	N	
39	TRK_VAL	Value and Status - float	N	
40	FF_VAL	Value and Status - float	N	
41	FF_SCALE	Scaling	S	0 - 100
42	FF_GAIN	Floating point	S	0
43	UPDATE_EVT	Event - update	D	
44	BLOCK_ALM	Alarm - discrete	D	
45	ALARM_SUM	Alarm - summary	D	0
46	ACK_OPTION	Bit string	S	0
47	ALARM_HYS	Floating point	S	0.5
48	HI_HI_PRI	Unsigned8	S	0
49	HI_HI_LIM	Floating point	S	+INF
50	HI_PRI	Unsigned8	S	0
51	HI_LIM	Floating point	S	+INF
52	LO_PRI	Unsigned8	S	0
53	LO_LIM	Floating point	S	-INF
54	LO_LO_PRI	Unsigned8	S	0
55	LO_LO_LIM	Floating point	S	-INF
56	DV_HI_PRI	Unsigned8	S	0
57	DV_HI_LIM	Floating point	S	+INF
58	DV_LO_PRI	Unsigned8	S	0
59	DV_LO_LIM	Floating point	S	-INF
60	HI_HI_ALM	Alarm - float	D	
61	HI_ALM	Alarm - float	D	
62	LO_ALM	Alarm - float	D	
63	LO_LO_ALM	Alarm - float	D	
64	DV_HI_ALM	Alarm - float	D	
65	DV_LO_ALM	Alarm - float	D	

Continued on next page

8.7 PID Function Block Continued

Table 42 PID Control Function Block Parameters, continued

Honeywell Parameters				
Index	Name	Data Type/Structure	Store	Default Value
66	PID_FORM	Unsigned8	S	Ideal (1)
67	ALGO_TYPE	Unsigned8	S	0
68	OUT_LAG	Floating point	S	0
69	GAIN_NLIN	Floating point	S	0
70	GAIN_COMP	Floating point	D	
71	ERROR_ABS	Floating point	D	
72	WSP	Value and Status - float	D	
73	BLOCK_TEST	Unsigned8	D	

Honeywell-defined PID Parameters

The Honeywell defined parameters provide a robust PID algorithm. A description of these parameters is in Table 43.

Table 44 Honeywell PID Parameters

Parameter Name	Description/Parameter Contents
PID_FORM	Configuration parameter specifies the IDEAL or ROBUST PID equation to be used: • IDEAL PID (default). Non-Interactive form of a three mode control equation that provides Proportional, Integral and Derivative control action. Linear and non-linear gain parameters are available. • ROBUST PID. The same as Ideal PID. Additionally, the equation supports a user-configurable lag filter applied to calculated output value. (See OUT_LAG parameter.) Linear and non-linear gain parameters are available.
ALGO_TYPE	Configuration parameter specifies algorithm type which can be A, B, or C: • Type “A” equation where Proportional, Integral and Derivative act on ERROR. • Type “B” equation where Proportional and Integral act on ERROR and Derivative acts on PV. • Type “C” equation where Integral acts on ERROR and Proportional and Derivative act on PV.
OUT_LAG	Time constant of single exponential LAG filter applied to the OUT parameter (primary output). Units (in seconds). For Ideal PID equation the lag filter is fixed at 1/16 and is not configurable.

Continued on next page

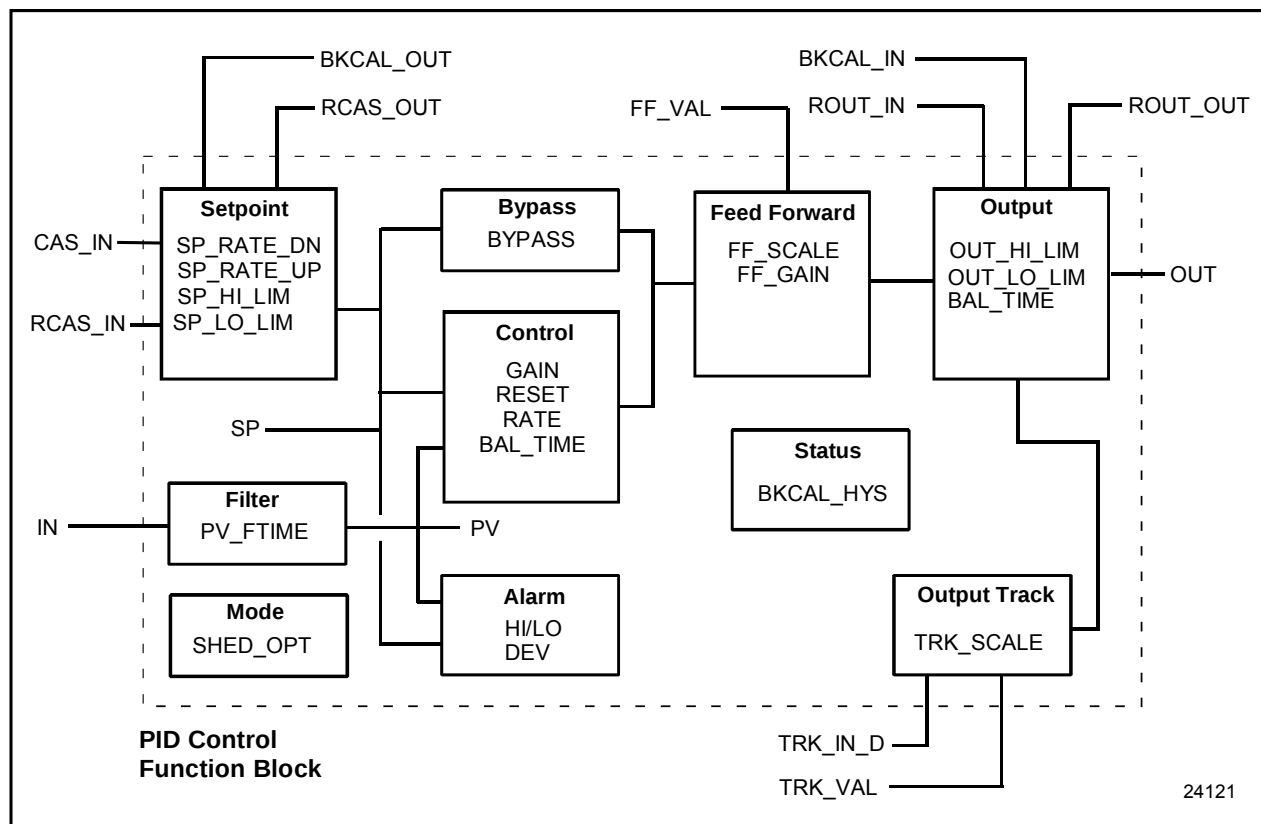
8.7 PID Function Block Continued

Table 43 Honeywell PID Parameters, continued

Parameter Name	Description/Parameter Contents
GAIN_NLIN	Dimensionless gain factor. When the gain factor is multiplied by absolute value of the error and added to the linear GAIN, the result is a gain response which is proportional to the deviation. Default is zero resulting in no response due to non-linear gain action.
GAIN_COMP	The composite gain quantity including both linear and non-linear gain parameters. Read only parameter.
ERROR_ABS	Absolute value of the difference between PV and working setpoint. Read only parameter.
WSP	Working setpoint. This is the setpoint value after absolute and rate limits have been applied. Deviation alarms are computed on this value. Read only parameter.
BLOCK_TEST	An internal Honeywell test parameter. See Section 11.7 and 11.8 for more details.

PID Block Diagram Figure 29 is a block diagram showing the key components of the PID Control function block.

Figure 29 PID Control Block Diagram



8.7 PID Function Block Continued

PID Block Description PID Control Function Block is an algorithm that produces an output signal in response to the measured variable and the setpoint. The PID function block allows you to choose either a standard PID control equation (Ideal) or a robust PID equation defined by Honeywell. This selection is defined in the PID_FORM parameter.

The output has three terms: Proportional, Integral and Derivative. The output is adjusted by tuning constants. There are three tuning constants in the Ideal PID equation. The robust PID uses four tuning constants.

1. GAIN is the tuning constant of the Proportional term.
2. RESET is the tuning constant of the Integral.
3. RATE is the tuning constant of the Derivative. RATE is usually modified by a lag, which is set at some fixed ratio higher than the rate time, to create a rate gain. There is no lag with the rate in this implementation.
4. OUT_LAG is the fourth tuning constant used in the robust PID, it adds roll off to the output response. The action is similar to PID with rate gain.

PID Ideal and PID Robust

The Ideal equation is a parallel or non-interacting implementation of PID control using three tuning constants. It automatically fixes OUT_LAG to 16 times the RATE time constant. This produces response characteristics equivalent to the algorithms used in TPS products.

The Robust equation is the same parallel implementation of ideal PID control but allows the engineer to set the OUT_LAG and effectively change the rate gain.

ALGO_TYPE is a configuration parameter that contains one of three selected algorithm types, A, B, or C.

Where:

- A - RATE, GAIN and RESET all act on the error between set point and measured variable.
 - B - RATE acts on the measured variable only, GAIN and RESET use the error.
 - C - RATE and GAIN act on the measured variable only, and RESET uses the error.
-

8.7 PID Function Block Continued

PID Tuning Parameters

Table 44 lists the valid ranges for the tuning parameters for the PID block. Note that OUT_LAG parameter is not configurable when Ideal PID is selected (PID_FORM = 1) and can be configured when Robust PID is selected (PID_FORM = 2).

The values given for these tuning parameters are valid under the following conditions:

- The values assume that the minimum configurable PID function block execution period (T_s) is 0.125 seconds.
- Algorithm type setting (i.e. A, B, or C) has no effect on the validation of these tuning parameters.
- The PID function block will reject all values outside these ranges.

Table 45 PID Tuning Parameter Values

Parameter	Initial Value	Minimum Value	Maximum Value	Comment
PV_FTIME	0	0	200	units: seconds.
GAIN	0	.004	250	
GAIN_NLIN	0	.004	250	
RATE (sec.)	0	$32 \cdot T_s$	7500	The value of ZERO is permitted to turn off rate action.
RESET (sec.)	+INF	$2 \cdot T_s$	7500	The value of +INF is permitted to turn off reset action. (Some versions of NI configurator program cannot set +/- INF)
OUT_LAG <i>Ideal PID</i>	N/A	N/A	N/A	Fixed for Ideal PID form - not configurable.
<i>Robust PID</i>	0	$2 \cdot T_s$	7500	Zero permitted which implies no output lag.
BAL_TIME	0	N/A	N/A	Not used in Honeywell Implementation.

8.7 PID Function Block Continued

Mode Restricted Writes to PID Parameters

Writing to the following PID block parameters are restricted by the block's TARGET and/or ACTUAL mode. The MODE_BLK.TARGET or MODE_BLK.ACTUAL parameter must equal one of the modes in the TARGET or ACTUAL columns below before you can write values to the parameters listed in Table 45.

Table 46 PID Block Mode Restricted Parameters

Parameter	TARGET mode restricted	ACTUAL mode restricted	Notes and other Validation
SP	AUTO or MAN	n/a	+/- 10% of PV_SCALE, Tracking not operative. Note: For SP Mode restriction follows target mode. All cascades will be broken when SP is written.
OUT	O/S or MAN	n/a	ROUT cascade initialization cannot be in progress.
CONTROL_OPTS	O/S	O/S	
STATUS_OPTS	O/S	O/S	
BYPASS	n/a	O/S or MAN	Bypass must be enabled in control_opts to set ON.
PID_FORM ALGO-TYPE	n/a	O/S or MAN	Limited to range of respective enumeration.
FF_GAIN FF_SCALE TRK_SCALE OUT_SCALE PV_SCALE	n/a	O/S or MAN	
HI_HI_LIM HI_LIM LO_LIM LO_LO_LIM	n/a	O/S	Enforces implied rank order
OUT_HI_LIM OUT_LO_LIM	n/a	O/S	Enforces implied rank order. Note: OUT will be forced within range limits when limits are changed.

8.8 Block Parameter Summary

Table Description Table 46 provides a description of the block parameter attributes that are presented in the Block Parameter Summary, Tables 47 through 50.

Table 47 Table Description for Block Parameter Summary

Column Title Attribute	Meaning
Obj Type Object Type	Object type for the parameter value: S - Simple Variable R - Record A - Array of simple variables
Data Type/Structure	Data Type or Structure for the parameter value: 1. Data Types consist of a simple variable or array and are: Unsigned8, Unsigned16 Unsigned32 - An unsigned variable of 8, 16 or 32 bits. Float - Floating point variable. 2. Data Structures consist of a record which may be: Value and Status - float - Value and status of a floating point parameter. Scaling - Static data used to scale floating point values for display purposes.
Use/Model Use and Model Reference (The letter for use is separated by a slash from the model name.)	The manner in which the parameter will participate in inter-device communications. Use is defined as: I - Function block Input. The input may be connected to a function block output or used as a constant. O - Function block Output. An output may be referenced by other function block inputs. C - Parameter value Contained in the block, available for interface (operation, diagnostic) and/or configuration. Model is: The name of the parameter. In this case, the attribute indicates that it is a contained parameter and may not be referenced by link objects for use as an input to function blocks.
Store	Indicates the type of memory where the parameter is stored: S - Static. Writing to the parameter changes the static revision counter ST_REV N - Non-volatile. Non-volatile. Non-volatile parameters are stored internally to actual non-volatile memory on periodic basis to protect the life of the memory. This interval is set by the resource block parameter NV_CYCLE_T at 15 minutes (displayed as 28800000 in 1/32 milliseconds). It cannot be changed by the user. Parameter must be retained during a power cycle. D - Dynamic. The value is calculated by the block, or read from another block.

Continued on next page

8.8 Block Parameter Summary Continued

Table 46 Table Description for Block Parameter Summary, continued

Column Title Attribute	Meaning
Size	The number of octets.
Valid Range	Range of valid values the parameter is restricted to for use in the function block. For bit strings: 0 (zero) is always valid as the state of a bit and is the inverse of the described value. For enumeration: 0 (zero) means that the value is invalid. This is required for initialization of an unconfigured block. Plus or minus infinity (+INF or -INF) may be included in the valid range to indicate that it is permissible to use them to turn off a limit comparison, such as an alarm limit.
Initial Value	The default value inserted when the device is restarted with defaults. All limits are set to plus or minus infinity (+INF or -INF), which is the same as no limit. All dynamic values are initialized to zero. (See RESTART parameter.)
Perm. Permission	Defines the setting of the GRANT_DENY parameter that allows write access to the parameter, for interface devices that obey this parameter.
Mode	Indicates the lowest priority target mode required to allow a change to the parameter. The actual mode must match the target mode, so that the block is not in another mode than that chosen by the operator. Scaling changes are protected by mode because the block may be using scaling to calculate its output.
Other	DD handling for: • Positive • Ordered and • Read only. NOTE: For parameters that are inputs: If it is linked, it is read only If it is not linked, it can be written to.
Range Check	Flag to check that the value is within the valid range given in the table.

Continued on next page

8.8 Block Parameter Summary Continued

Parameter Summary Tables 47 through 50 provide a summary of the Honeywell-defined block parameters contained in the ST 3000 FF. Table 46 describes the parameter attributes which are the column headings in each table.

A summary of the Foundation™ Fieldbus -defined parameters can be found in FF-890 and FF-891 *Foundation™ Specification Function Block Application Process Parts 1 and 2*.

Table 48 Transducer Block Parameter Summary

Parameter Mnemonic	Obj. Type	Data Type/ Structure	Use/Model	Store	Size	Valid Range	Initial Value	
PRIMARY_VALUE	R	Value and Status - float	C/Contained	D	5			⇒
CALC_VAL	R	Value and Status - float	C/Contained	D	5			⇒
SENSOR_TEMP	R	Value and Status - float	C/Contained	D	4			⇒
SENSOR_TEMP_UNIT	S	Unsigned16	C/Contained	S	2	temp. units	deg. C	⇒
LEVEL_COEFF	A[6]	Float	C/Contained	S	24		all 0's	⇒
PRIMARY_VALUE_RANGE	R	Scaling	C/Contained	S	11		0-400 in. H ₂ O @ 4 deg. C	⇒
CAL_CMD	S	Unsigned8	C/Contained	D	1	1-5	0	⇒
CAL_POINT_HI	S	Float	C/Contained	S	4	sensor-range		⇒
CAL_POINT_LO	S	Float	C/Contained	S	4	sensor-range		⇒
CAL_STATUS	S	Unsigned8	C/Contained	D	1	1-3		⇒
CAL_SOURCE	S	Unsigned8	C/Contained	D	1	1-3	un-calibrated	⇒
CAL_UNIT	S	Unsigned16	C/Contained	S	2	pressure units	in.H ₂ O @ 4 deg. C	⇒
XD_DIAG_DETAIL	S	Bit String	C/Contained	D	2			
SENSOR_RANGE	R	Scaling	C/Contained	S	11			⇒
SENSOR_SN	S	Unsigned32	C/Contained	S	4			⇒
TANK_RANGE	R	Scaling	C/Contained	S	11			⇒
SENSOR_MAX_SP *	S	Float	C/Contained	S	4			⇒
SENSOR_MAX_OVP *	S	Float	C/Contained	S	4			⇒
BLOCK_TEST	A [8]	Unsigned8	C/Contained	D	4			⇒

* Please read CAUTION about these parameters on page 88.

Continued on next page

8.8 Block Parameter Summary Continued

Parameter Summary, Continued

Table 47 Transducer Block Parameter Summary, continued

Parameter Mnemonic	Units	Perm.	Mode	Other	Range Check
PRIMARY_VALUE	in. H2O @ 4 deg. C			Read only	
CALC_VAL	%			Read only	
SENSOR_TEMP	user-config			Read only	
SENSOR_TEMP_UNIT					yes
LEVEL_COEFF			O/S		
PRIMARY_VALUE_RANGE			O/S		
CAL_CMD			O/S		yes
CAL_POINT_HI	user-select		O/S		yes
CAL_POINT_LO	user-select		O/S		yes
CAL_STATUS				Read only	
CAL_SOURCE				Read only	
CAL_UNIT			O/S		yes
XD_DIAG_DETAIL				Read only	
SENSOR_RANGE	in. H2O @ 4 deg. C			Read only	
SENSOR_SN				Read only	
TANK_RANGE				Read only	
SENSOR_MAX_SP *	in. H2O @ 4 deg. C			Read only	
SENSOR_MAX_OVP *	in. H2O @ 4 deg. C			Read only	
BLOCK_TEST					

* Please read CAUTION about these parameters on page 88.

Continued on next page

8.8 Block Parameter Summary Continued

Parameter Summary, Continued

Table 49 Resource Block Parameter Summary

Parameter Mnemonic	Obj. Type	Data Type/ Structure	Use/Model	Store	Size	Valid Range	Initial Value	⇒
DL_CMD1	S	Unsigned8	C/Contained	D	1	enum.		⇒
DL_CMD2	S	Unsigned8	C/Contained	D	1	enum.		⇒
DL_APPSTATE	S	Unsigned16	C/Contained	S	2	enum.		⇒
DL_SIZE	S	Unsigned32	C/Contained	S	4	enum.		⇒
DL_CHECKSUM	S	Unsigned16	C/Contained	S	2	enum.		⇒
REVISION_ARRAY	S	Unsigned32	C/Contained	S	2	enum.		⇒
BLOCK_TEST	A [8]	Unsigned8	C/Contained	D	4			⇒
ERROR_DETAIL	A[3]	Unsigned16	C/Contained	D	6		0,0,0	⇒
AUX_FEATURES	S	Unsigned16	C/Contained	D	2	enum.	0	

Table 50 Analog Input Function Block Parameter Summary

Parameter Mnemonic	Obj. Type	Data Type/ Structure	Use/Model	Store	Size	Valid Range	Initial Value	⇒
AUX_VAR1	S	Float	C/Contained	D	4			⇒
BLOCK_TEST	A [8]	Unsigned8	C/Contained	D	4			⇒

Table 51 PID Function Block Parameter Summary

Parameter Mnemonic	Obj. Type	Data Type/ Structure	Use/Model	Store	Size	Valid Range	Initial Value	⇒
PID_FORM	S	Unsigned8	C/Contained	S	2	1: Ideal 2: Robust	1	⇒
ALGO_TYPE	S	Unsigned8	C/Contained	S	2	1: A, 2: B 3: C	0	⇒
OUT_LAG	S	Float	C/Contained	S	4	$2 \cdot T_s^* - 7500$	0	⇒
GAIN_NLIN	S	Float	C/Contained	S	4	.004 - 250	0	⇒
GAIN_COMP	S	Float	C/Contained	D	4		0	⇒
ERROR_ABS	S	Float	C/Contained	D	4	PV Scale	0	⇒
WSP	R	Value and Status - float	C/Contained	D	5	PV Scale	0	⇒
BLOCK_TEST	A [8]	Unsigned8	C/Contained	D	4			⇒

* T_s = PID function block execution time

Continued on next page

8.8 Block Parameter Summary Continued

Parameter Summary, Continued

Table 48 Resource Block Parameter Summary, continued

Parameter Mnemonic	Units	Perm.	Mode	Other	Range Check
DL_CMD1			O/S	written sequentially	
DL_CMD2			O/S	written sequentially	
DL_APPSTATE				Read-only	
DL_SIZE				Read-only	
DL_CHECKSUM				Read-only	
REVISION_ARRAY				Read-only	
BLOCK_TEST					
ERROR_DETAIL				Read-only	
AUX_FEATURES					

Table 49 Analog Input Function Block Parameter Summary, continued

Parameter Mnemonic	Units	Perm.	Mode	Other	Range Check
AUX_VAR1	user-select				
BLOCK_TEST					

Table 50 PID Function Block Parameter Summary, continued

Parameter Mnemonic	Units	Perm.	Mode	Other	Range Check
PID_FORM	enum		MAN		
ALGO_TYPE	enum		MAN		
OUT_LAG	sec.	TUNE	MAN	Positive	
GAIN_NLIN		TUNE	MAN		
GAIN_COMP				Read only	
ERROR_ABS	PV			Read only	
WSP	PV			Read only	
BLOCK_TEST					

8.9 Link Objects

Background

The function blocks configured to control a process are linked, or connected by objects within the devices. These links allow you to transfer process and event data from one block to another. These links are defined through link objects.

Link Object Description

Link objects define Virtual Communication Relationships (VCRs) which are used to communicate between blocks. Link objects contain information needed to define communication links between function blocks and interface devices and other field devices. This information may be read by an interface device that will access information in field devices.

Example

For example, link objects may be used to link the output parameter of one function block to the input of another block, or a trend object, or alert object.

ST 3000 Link Objects

Link objects are used for alarms and events, function block linking and trending. In the ST 3000 FF there are links objects defined for:

- The PID block (6 input parameters)
- The PID and AI blocks (3 output parameters)
- Every alert object
- Every trend object

Table 51 lists the link objects defined in the ST 3000 FF

Table 52 Link Objects Defined for ST 3000 FF

Link Object for	Parameter or Number of Objects
Input parameters	PID function block: BKCAL_IN CAS_IN FF_VAL IN TRK_IN_D TRK_VAL
Output parameters	AI function block: OUT PID function block: BKCAL_OUT OUT
Alert objects	3
Trend objects	2
TOTAL	14 objects

8.10 View Objects

Description

View objects define a grouping of parameters that can be read over fieldbus using a single message. Typically, view objects are used by a host device to retrieve certain data efficiently for display, without loading down the network. Some host systems may be capable of being "tuned" during configuration by using the knowledge by which parameters may be accessed in the same view object group.

At least four view objects (View1, View2, View3 and View4.) are defined for each resource block, function block, and transducer block in a device (for a total of 16 views.) Block parameters can be grouped and displayed depending on how the data is to be used. Four standard view objects (groups) are defined for accessing the following types of information:

1. View1 - used to display dynamic operation data
2. View2 - used to display static operation data
3. View3 - used to display all dynamic data
4. View4 - used to display other static data.

ST 3000 View Objects

In the ST 3000 FF, four view objects are defined for each of the four blocks - for a total of 16 view objects. Some parameters are accessible in all four views, while others are available in one view. Tables 52 through 55 list all the parameter objects in the transmitter.

- A number in the View columns of the table indicates the number of view(s) in which a parameter is visible, (only if a number is shown in the column for that parameter.)
- The number indicates the number of bytes of data which is shown for that parameter in a view.
- The TOTAL line in each table shows the size of each view in bytes.

8.10 View Objects Continued

Table 53 View List for Resource Block Parameters

Index	Name	View1	View2	View3	View 3_2	View4
1	ST_REV	2	2	2		2
2	TAG_DESC					
3	STRATEGY					2
4	ALERT_KEY					1
5	MODE_BLK	4		4		
6	BLOCK_ERR	2		2		
7	RS_STATE	1		1		
8	TEST_RW					
9	DD_RESOURCE					
10	MANUFAC_ID					4
11	DEV_TYPE					2
12	DEV_REV					1
13	DD_REV					1
14	GRANT_DENY		2			
15	HARD_TYPES					2
16	RESTART					
17	FEATURES					2
18	FEATURE_SEL		2			
19	CYCLE_TYPE					1
20	CYCLE_SEL		2			
21	MIN_CYCLE_T					4
22	MEMORY_SIZE					2
23	NV_CYCLE_T		4			
24	FREE_SPACE		4			
25	FREE_TIME	4		4		
26	SHED_RCAS		4			
27	SHED_ROUT		4			
28	FAULT_STATE	1		1		
29	SET_FSTATE					
30	CLR_FSTATE					
31	MAX_NOTIFY					1
32	LIM_NOTIFY		1			
33	CONFIRM_TIME		4			
34	WRITE_LOCK		1			
35	UPDATE_EVT					
36	BLOCK_ALM					
37	ALARM_SUM	8		8		
38	ACK_OPTION					2
39	WRITE_PRI					1
40	WRITE_ALM					
41	ITK_VER					2

Continued on next page

8.10 View Objects Continued

Table 52 View List for Resource Block Parameters, continued

Honeywell Parameters						
Index	Name	View1	View2	View3	View3_2	View4
42	DL_CMD1					
43	DL_CMD2					
44	DL_APPSTATE			2		
45	DL_SIZE			4		
46	DL_CHECKSUM			2		
47	REVISION_ARRAY					6
48	BLOCK_TEST			8		
49	ERROR_DETAIL			6		
50	AUX_FEATURES					
Honeywell Diagnostic Parameters						
Index	Name	View1	View2	View3	View3_2	View4
51	INSTALL_DATE			8		
52	TIME_IN_SERVICE			4		
53	POWER_CYCLES			2		
54	POWER_CYCLES_DATE			8		
55	VOLTAGE			4		
56	VOLTAGE_MIN			4		
57	VOLTAGE_MIN_DATE			8		
58	EL_TEMPERATURE			4		
59	EL_TEMP_OVER_RNG_CTR			4		
60	EL_TEMP_OVER_RNG_DATE			8		
61	EL_TEMP_UNDER_RNG_CTR			4		
62	EL_TEMP_UNDER_RNG_DATE			8		
63	EL_TEMP_MAX			4		
64	EL_TEMP_MIN			4		
65	MSG_KEY_NUMBER				8	
66	MSG_METER_BODY				4	
67	MSG_FLANGE				14	
68	MSG_OPTIONS_1				30	
69	MSG_OPTIONS_2				30	
	TOTAL	22	30	118	81	37

Note:

A View object can have a maximum of 123 octets.

8.10 View Objects Continued

Table 54 View List for Transducer Block Parameters

Index	Name	View1	View2	View3	View3_2	View4
1	ST_REV	2	2	2		2
2	TAG_DESC					
3	STRATEGY					2
4	ALERT_KEY					1
5	MODE_BLK	4		4		
6	BLOCK_ERR	2		2		
7	UPDATE_EVT					
8	ALARM_SUM	8				
9	BLOCK_ALARM					
Honeywell Parameters						
10	PRIMARY_VALUE	5		5		
11	CALC_VAL	5		5		
12	SENSOR_TEMP	4		4		
13	SENSOR_TEMP_UNIT		2			
14	LEVEL_COEF		24			
15	VALUE_SCALE		11			
16	CAL_CMD			1		
17	CAL_POINT_HI					4
18	CAL_POINT_LO					4
19	CAL_STATUS			1		
20	CAL_SOURCE			1		
21	CAL_UNIT					2
22	XD_DIAG_DETAIL	2		2		
23	SENSOR_RANGE					11
24	SENSOR_SN					4
25	SENSOR_MAX_SP *					4
26	SENSOR_MAX_OVP *					4
27	TANK_RANGE		11			
28	BLOCK_TEST			8		
Honeywell Diagnostic Parameters						
29	PV_OVER_RNG_CTR			4		
30	PV_OVER_RNG_DATE			8		
31	PV_UNDER_RNG_CTR			4		
32	PV_UNDER_RNG_DATE			8		
33	TEMP_OVER_RNG_CTR			4		
34	TEMP_OVER_RNG_DATE			8		
35	TEMP_UNDER_RNG_CTR			4		
36	TEMP_UNDER_RNG_DATE			8		
37	TEMP_MAX			4		
38	TEMP_MIN			4		

Continued on next page

8.10 View Objects Continued

Table 53 View List for Resource Block Parameters, continued

Honeywell Diagnostic Parameters (continued)						
Index	Name	View1	View2	View3	View3_2	View4
39	STATIC_PRESSURE				4	
40	SP_MAX				4	
41	SP_OVER_RNG_CTR				4	
42	SP_OVER_RNG_DATE				8	
43	STRESS_MONITOR				4	
44	SERVICE_LIFE				4	
45	CALIB_DATE_LAST_2PT				8	
46	CALIB_DATE_PREV_2PT				8	
47	CALIB_DATE_RESTORE				8	
48	CALIB_DATE_CLEAR				8	
49	CALIB_DATE_ZERO				8	
	TOTAL	32	39	99	70	38

Notes:

A View object can have a maximum of 123 octets.

*Please read CAUTION about these parameters on page 88.

8.10 View Objects Continued

Table 55 View List for AI Function Block Parameters

Index	Name	View1	View2	View3	View4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	OUT	5		5	
9	SIMULATE				
10	XD_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	IO_OPTS				2
14	STATUS_OPTS				2
15	CHANNEL				2
16	L_TYPE				1
17	LOW_CUT				4
18	PV_FTIME				4
19	FIELD_VAL	5		5	
20	UPDATE_EVT				
21	BLOCK_ALM				
22	ALARM_SUM	8		8	
23	ACK_OPTION				2
24	ALARM_HYS				4
25	HI_HI_PRI				1
26	HI_HI_LIM				4
27	HI_PRI				1
28	HI_LIM				4
29	LO_PRI				1
30	LO_LIM				4
31	LO_LO_PRI				1
32	LO_LO_LIM				4
33	HI_HI_ALM				
34	HI_ALM				
35	LO_ALM				
36	LO_LO_ALM				
Honeywell Parameters					
37	AUX_VAR1	4		4	
38	BLOCK_TEST			8	
Honeywell Diagnostic Parameters					
39	HIGHEST_PV			4	
40	LOWEST_PV			4	
TOTAL		35	26	51	46

8.10 View Objects Continued

Table 56 View List for PID Control Function Block Parameters

Index	Name	View1	View2	View3	View4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	SP	5		5	
9	OUT	5		5	
10	PV_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	CONTROL_OPTS				2
14	STATUS_OPTS				2
15	IN			5	
16	PV_FTIME				4
17	BYPASS		1		
18	CAS_IN	5		5	
19	SP_RATE_DN				4
20	SP_RATE_UP				4
21	SP_HI_LIM		4		
22	SP_LO_LIM		4		
23	GAIN				4
24	RESET				4
25	BAL_TIME				4
26	RATE				4
27	BKCAL_IN			5	
28	OUT_HI_LIM		4		
29	OUT_LO_LIM		4		
30	BKCAL_HYS				4
31	BKCAL_OUT			5	
32	RCAS_IN			5	
33	ROUT_IN			5	
34	SHED_OPT				1
35	RCAS_OUT			5	
36	ROUT_OUT			5	
37	TRK_SCALE				11
38	TRK_IN_D	2		2	
39	TRK_VAL	5		5	
40	FF_VAL			5	
41	FF_SCALE				11
42	FF_GAIN				4

Continued on next page

8.10 View Objects Continued

Table 55 View List for PID Control Function Block Parameters,
continued

Index	Name	View1	View2	View3	View4
43	UPDATE_EVT				
44	BLOCK_ALM				
45	ALARM_SUM	8		8	
46	ACK_OPTION				2
47	ALARM_HYS				4
48	HI_HI_PRI				1
49	HI_HI_LIM				4
50	HI_PRI				1
51	HI_LIM				4
52	LO_PRI				1
53	LO_LIM				4
54	LO_LO_PRI				1
55	LO_LO_LIM				4
56	DV_HI_PRI				1
57	DV_HI_LIM				4
58	DV_LO_PRI				1
59	DV_LO_LIM				4
60	HI_HI_ALM				
61	HI_ALM				
62	LO_ALM				
63	LO_LO_ALM				
64	DV_HI_ALM				
65	DV_LO_ALM				
Honeywell Parameters					
Index	Name	View1	View2	View3	View4
66	PID_FORM		1		
67	ALGO_TYPE		1		
68	OUT_LAG		4		
69	GAIN_NLIN		4		
70	GAIN_COMP	4		4	
71	ERROR_ABS	4		4	
72	WSP	5		5	
73	BLOCK_TEST			8	
	TOTAL	56	53	104	104

8.11 Alert Objects

Description

Alert objects support the reporting of alarms and update events to operator interface devices and other field devices. Alert objects are used to communicate notification messages when alarms or events are detected. These objects are defined in the function block application.

Alert objects contain:

- The value of the data
- Block index (a number)
- Alert key (parameter)
- Time stamp
- Priority

ST 3000 Alert Objects

Three alert objects are defined in the ST 3000 FF for event and alarm reporting.

- 1 for events (used for static parameter update events)
 - 1 for discrete alarms (used for block alarms)
 - 1 for analog alarms
-

8.12 Alarm and Event Reporting

Alarms, Events and Alert Objects

Alarms are generated when a block leaves or returns from a particular state. (A function block changes state and generates an alarm that indicates high tank pressure.)

Events are instantaneous occurrences that are significant to block execution or operation of a process. (For example, a change in the state of a variable generates an event message.)

Alarms and event messages are communicated to operator interfaces and other devices using alert objects.

Alarm Messages

- Alarm messages contain a:
 - Time stamp
 - Snapshot of the data
 - Specified priority
 - Alarms must be confirmed; otherwise the block will continually report the alarm.
 - Another alarm is generated when alarm conditions clear.
 - Acknowledgment of alarms may be necessary to satisfy operation requirements
-

Event Messages

- Event messages contain a time stamp
 - Events also must be confirmed; otherwise the block will continually report the event.
 - Acknowledgment of event may be necessary to satisfy operation requirements
-

8.13 Trend Objects

Description

Trend objects support the management and control of function blocks by providing user access to history information. Trend objects provide for short term history data to be collected and stored within a resource. The collected data may be input and output parameters, and status information from selected function blocks. Trend objects are available anytime for you to view.

Trend Data Types

Trend record data may include one of these types of data -

- analog
- discrete or (not used in ST 3000 FF)
- bit string (not used in ST 3000 FF).

It is important that the proper trend data type be chosen to match the data type being recorded. Trend information may be used in support of trending in interface devices or by function block objects that require historical information.

Trend Objects

Trend objects:

- Provide short term history data
 - Track both values and status
 - Track and hold the last 16 values
 - Allow user-defined sampling rate
 - Allow efficient transfer of large amounts of data.
-

ST 3000 Trend Objects

The ST 3000 FF has two defined trend objects for analog data:

- one for the AI function block
- one for the PID function block.

8.14 Domain Objects

Description

Domain objects support download services which are used to download applications to a device. Standard generic download services (defined by Foundation™ Fieldbus) are used in the domain object of the ST 3000 FF.

8.15 Device Description (DD)

Overview

Standardized definitions are used to support and describe application process objects. Two of these standardized "tools" used to describe these objects are the Object Dictionary (OD) and the Device Description (DD).

The Object Dictionary and the Device Descriptions define and describe the network visible objects of a device, such as function blocks and block parameters. These "tools" try to provide a consistency in understanding and describing these objects in device applications. See also Object Dictionary description in the following section.

Device Description Contents

A typical DD contains information about the device parameters and operation, such as:

- Attributes, like coding, name, engineering unit, write protection, how to display, etc.
 - The menu structure for listing parameters, including names of menus and submenus.
 - The relationship of one parameter to others
 - Information about help text and help procedures
 - Maintenance, calibration and other necessary operation information.
-

Standard and Device-Specific DD

Standard DD descriptions for function blocks and transducer blocks are maintained by the Foundation™ Fieldbus. These descriptions can be used as part of a field device DD by manufacturers to describe the standard features of their devices. Device-specific descriptions are developed by manufacturers to describe custom features which are unique to that particular device.

These two types of DDs (the standard and device-specific) can then be combined to provide a complete DD for the field device.

Device Descriptions and ODs

A Device Description provides a clear and structured text description of a field device. The descriptions found in a DD supplement the object dictionary definitions of device applications. So, an OD description used in conjunction with the DD will provide a complete detailed description of the device operation.

Continued on next page

8.15 Device Description (DD) Continued

Access to Field Device DD

DDs can be loaded into the device that it describes, or stored on an external medium, such as a floppy disk or CD. You then can access this information through an operator station and read the DD directly from the device or from the floppy disk.

You can use the DD to determine what information is available from the device, what rules must be applied when accessing the information and how the information can be displayed to you.

Standardized Descriptions and Interoperability

The use of standardized descriptions and definitions to describe device application processes promotes the interoperability of fieldbus devices.

8.16 Object Dictionary (OD)

Overview

The Object Dictionary (OD) is one of a number of standardized “tools” used to describe and define Application Process (AP) objects, (function blocks, block parameters, alert objects, etc.). The OD is used in conjunction with standard and device-specific Device Descriptions (DD) to provide a complete description of the device’s application process.

Device Descriptions contain standard and device-specific text descriptions of function blocks and block parameters in device applications. See Device Description also in the previous section.

Object Dictionary Description

AP objects are described in the Object Dictionary (OD). The OD is comprises a series of entries, each describing an individual AP object and its message data. The message data may consist of a number of characteristics defined for that particular object.

The OD allows the FBAP of a device to be visible to the fieldbus communications system.

OD Entries

OD entries are assigned an index by the AP. The index serves as a means of identification and location of individual objects. The entries in the Application Process OD are organized as follows:

Index 0 - Object Dictionary Description - Describes overall structure of the OD.

Index 1-255 - Reserved for descriptions of data types and data structures used by the AP. (There are a number of standard data types and data structures already defined as part of Foundation™ Fieldbus specifications.)

Index starting at 256 - Entries for AP objects defined by the application. These entries contain the records and parameters for the various blocks that make up the AP. Also included are alert, trend, view, link, and domain objects which are defined by the AP.

Continued on next page

8.16 Object Dictionary (OD) Continued

ST 3000 FF Object Dictionary

Table 56 shows the indexes of object descriptions within the object dictionary for the ST 3000 FF.

Table 57 ST 3000 FF Object Dictionary

OD Index	Object(s)
0	OD Description (ODES)
1-255	Data types (standard)
256	Directory Object
257	AI block record
258-297	AI block parameters
298-309	<i>spare</i>
310	PID block record
310-383	PID block parameters
384-399	<i>spare</i>
400	Resource block record
400-469	Resource block parameters
0	<i>spare</i>
470	Transducer block record
470-519	Transducer block parameters
520-549	<i>spare</i>
550	Domain Object
551-553	Alert Objects (3)
554-555	<i>spare</i>
556-557	Trend Objects (2)
558-560	<i>spare</i>
561-574	Link Objects (14)
575-579	<i>spare</i>
580-583	AI View objects (4)
584-587	PID View objects (4)
588-592	Resource View objects (5)
593-597	Transducer View objects (5)

Continued on next page

8.16 Object Dictionary (OD) Continued

To Calculate Index number of an Object

To calculate the index of any block parameter or object, add the index in the block's parameter (or object) list to the index of the block's record in the list above. For example:

OUT: Index of 8 in the AI block parameter list, (Table 31)
AI's block record is at index 257 in the OD (Table 41)
Therefore, OUT of the AI block is at index $257 + 8 = 265$ in the OD.

ST 3000 FF Block Parameter Index

Table 57 lists the index numbers for all block parameters defined in the FBAP for ST 3000 FF.

Table 58 Block Parameter Index Table

	AI Block		PID Block (cont'd)		Resource Block		Resource Block(cont'd)
257	BLOCK	327	BYPASS	400	BLOCK	460	EL_TEMP_OVER_RNG_DATE
258	ST_REV	328	CAS_IN	401	ST_REV	461	EL_TEMP_UNDER_RNG_CTR
259	TAG_DESC	329	SP_RATE_DN	402	TAG_DESC	462	EL_TEMP_UNDER_RNG_DATE
260	STRATEGY	330	SP_RATE_UP	403	STRATEGY	463	EL_TEMP_MAX
261	ALERT_KEY	331	SP_HI_LIM	404	ALERT_KEY	464	EL_TEMP_MIN
262	MODE_BLK	332	SP_LO_LIM	405	MODE_BLK	465	MSG_KEY_NUMBER
263	BLOCK_ERR	333	GAIN	406	BLOCK_ERR	466	MSG_METER_BODY
264	PV	334	RESET	407	RS_STATE	467	MSG_FLANGE
265	OUT	335	BAL_TIME	408	TEST_RW	468	MSG_OPTIONS_1
266	SIMULATE	336	RATE	409	DD_RESOURCE	469	MSG_OPTIONS_2
267	XD_SCALE	337	BKCAL_IN	410	MANUFAC_ID		Transducer Block
268	OUT_SCALE	338	OUT_HI_LIM	411	DEV_TYPE	470	BLOCK
269	GRANT_DENY	339	OUT_LO_LIM	412	DEV_REV	471	ST_REV
270	IO_OPTS	340	BKCAL_HYS	413	DD_REV	472	TAG_DESC
271	STATUS_OPTS	341	BKCAL_OUT	414	GRANT_DENY	473	STRATEGY
272	CHANNEL	342	RCAS_IN	415	HARD_TYPES	474	ALERT_KEY
273	L_TYPE	343	ROUT_IN	416	RESTART	475	MODE_BLK
274	LOW_CUT	344	SHED_OPT	417	FEATURES	476	BLOCK_ERR
275	PV_FTIME	345	RCAS_OUT	418	FEATURE_SEL	477	UPDATE_EVT
276	FIELD_VAL	346	ROUT_OUT	419	CYCLE_TYPE	478	ALARM_SUM
277	UPDATE_EVT	347	TRK_SCALE	420	CYCLE_SEL	479	BLOCK_ALM
278	BLOCK_ALM	348	TRK_IN_D	421	MIN_CYCLE_T	480	PRIMARY_VALUE
279	ALARM_SUM	349	TRK_VAL	422	MEMORY_SIZE	481	CALC_VAL
280	ACK_OPTION	350	FF_VAL	423	NV_CYCLE_T	482	SENSOR_TEMP
281	ALARM_HYS	351	FF_SCALE	424	FREE_SPACE	483	SENSOR_TEMP_UNIT
282	HI_HI_PRI	352	FF_GAIN	425	FREE_TIME	484	LEVEL_COEFF

Continued next page

8.16 Object Dictionary (OD) Continued

Table 57 Block Parameter Index Table, continued

* Please read CAUTION about these parameters on page 88.

	AI Block		PID Block (cont'd)		Resource Block		Resource Block(cont'd)
283	HI_HI_LIM	353	UPDATE_EVT	426	SHED_RCAS	485	PRIMARY_VALUE_RANGE
284	HI_PRI	354	BLOCK_ALM	427	SHED_ROUT	486	CAL_CMD
285	HI_LIM	355	ALARM_SUM	428	FAULT_STATE	487	CAL_POINT_HI
286	LO_PRI	356	ACK_OPTION	429	SET_FSAFE	488	CAL_POINT_LO
287	LO_LIM	357	ALARM_HYS	430	CLR_FSAFE	489	CAL_STATUS
288	LO_LO_PRI	358	HI_HI_PRI	431	MAX_NOTIFY	490	CAL_SOURCE
289	LO_LO_LIM	359	HI_HI_LIM	432	LIM_NOTIFY	491	CAL_UNIT
290	HI_HI_ALM	360	HI_PRI	433	CONFIRM_TIME	492	XD_DIAG_DETAIL
291	HI_ALM	361	HI_LIM	434	WRITE_LOCK	493	SENSOR_RANGE
292	LO_ALM	362	LO_PRI	435	UPDATE_EVT	494	SENSOR_SN
293	LO_LO_ALM	363	LO_LIM	436	BLOCK_ALM	495	SENS_MAX_SP
294	AUX_VAR1	364	LO_LO_PRI	437	ALARM_SUM	496	SENS_MAX_OVP
295	BLOCK_TEST	365	LO_LO_LIM	438	ACK_OPTION	497	TANK_RANGE
296	HIGHEST_PV	366	DV_HI_PRI	439	WRITE_PRI	498	BLOCK_TEST
297	LOWEST_PV	367	DV_HI_LIM	440	WRITE_ALM	499	PV_OVER_RNG_CTR
		368	DV_LO_PRI (more)	441	ITK_VER	500	PV_OVER_RNG_DATE
	PID Block	369	DV_LO_LIM	442	DL_CMD1	501	PV_UNDER_RNG_CTR
310	BLOCK	370	HI_HI_ALM	443	DL_CMD2	502	PV_UNDER_RNG_DATE
311	ST_REV	371	HI_ALM	444	DL_APPSTATE	503	TEMP_OVER_RNG_CTR
312	TAG_DESC	372	LO_ALM	445	DL_SIZE	504	TEMP_OVER_RNG_DATE
313	STRATEGY	373	LO_LO_ALM	446	DL_CHECKSUM	505	TEMP_UNDER_RNG_CTR
314	ALERT_KEY	374	DV_HI_ALM	447	REVISION_ARRAY	506	TEMP_UNDER_RNG_DATE
315	MODE_BLK	375	DV_LO_ALM	448	BLOCK_TEST	507	TEMP_MAX
316	BLOCK_ERR	376	PID_FORM	449	ERROR_DETAIL	508	TEMP_MIN
317	PV	377	ALGO_TYPE	450	AUX_FEATURES	509	STATIC_PRESSURE
318	SP	378	OUT_LAG	451	INSTALL_DATE	510	SP_MAX
319	OUT	379	GAIN_NLIN	452	TIME_IN_SERVICE	511	SP_OVER_RNG_CTR
320	PV_SCALE	380	GAIN_COMP	453	POWER_CYCLES	512	SP_OVER_RNG_DATE
321	OUT_SCALE	381	ERROR_ABS	454	POWER_CYCLES_DATE	513	STRESS_MONITOR
322	GRANT_DENY	382	WSP	455	VOLTAGE	514	SERVICE_LIFE
323	CONTROL_OPTS	383	BLOCK_TEST	456	VOLTAGE_MIN	515	CALIB_DATE_LAST_2PT
324	STATUS_OPTS			457	VOLTAGE_MIN_DATE	516	CALIB_DATE_PREV_2PT
325	IN			458	EL_TEMPERATURE	517	CALIB_DATE_RESTORE
326	PV_FTIME			459	EL_TEMP_OVER_RNG_CTR	518	CALIB_DATE_CLEAR
						519	CALIB_DATE_ZERO

8.17 Management Virtual Field Device (VFD)

VFD Description

There is one VFD for both System Management and Network Management. This is called the Management VFD.

VendorName: Honeywell
ModelName: ST 3000 Fieldbus
Revision: as per revision
Profile number: 0x4D47 ('MG')

The VendorName, ModelName and Revision are defined by the manufacturer. The Profile number is a standard value defined by fieldbus specifications.

VFD Contents

The VFD contains all objects and object descriptions which may be used by you. The VFD contains a single Object Dictionary.

8.18 System Management (SM)

Description

System Management (SM) operates on special objects in the System Management Information Base (SMIB) which is part of the Management Virtual Field Device (VFD).

System Management Key Features

The key features of system management operation:

- Provide system application clock time synchronization
 - Provide scheduling of function blocks
 - Manage automatic device address assignment
 - Provide tag search service
-

System Management Information Base (SMIB)

The SMIB contains various objects that are associated with system management operation. Table 58 shows a listing of the SMIB object dictionary. Groups of objects (along with their starting index number) are included in the SMIB for the ST 3000 FF. The numbers in parenthesis (n) indicate the number of objects.

Table 59 ST 3000 FF SMIB Object Dictionary

Dictionary Index	Object
Header	Reserved
	Directory of Revision Number (1)
	Number of Directory Objects (1)
	Total Number of Directory Entries (5)
	Directory Index of First Composite List Reference (0)
	Number of Composite List References (0)
258	System Management Agent Starting OD Index
	Number of System Management Agent Objects (4)
262	Sync and Scheduling Starting OD Index
	Number of Sync and Scheduling Objects (8)
270	Address Assignment Starting OD Index
	Number of Address Assignment Objects (3)
273	VFD List Starting OD Index
	Number of VFD List Objects (2)
275	FB Schedule Starting OD Index
	Number of FB Schedule Objects (2)

Continued on next page

8.18 System Management (SM) Continued

Supported Features

The features supported by system management include the key features listed above as well as the ones designated in Table 59. The object SM_SUPPORT indicates which features are supported by system management in the FBAP. The features are mapped to the bits in the bit string shown below.

Table 60 System Management Supported Features

SM_SUPPORT bit	Feature	Supported ?
0	Set physical device tag (agent)	yes
1	Set field device address (agent)	yes
2	Clear address (agent)	yes
3	Identify (agent)	yes
4	Locating function blocks (agent)	yes
5	Set physical device tag (mgr.)	no
6	Set field device address (mgr.)	no
7	Clear address (mgr.)	no
8	Identify (mgr.)	no
9	Locating function blocks (mgr.)	no
10	FMS server role	yes
11	Application clock synch (time slave)	yes
12	Scheduling function block	yes
13	Application clock synch (time publisher)	no
14 to 31	<i>Reserved for future use.</i>	no

SM_SUPPORT Bits

Any bit (of the object SM_SUPPORT) will be set which corresponds to a supported feature in the table above.
The resulting value in the object SM_SUPPORT is 1C1F (hex).

Continued on next page

8.18 System Management (SM) Continued

SM Agent Objects

Four SM agent objects are contained in the SMIB object dictionary. One object, SM_SUPPORT, was described previously. The three other objects are timers associated with SM operations. Table 60 identifies the SM Agent objects with their object directory index and default values.

Table 61 SM Agent Objects

Object	Description	OD Index	Default value
SM_SUPPORT	Variable which indicates the features supported by SM in this device. See Table 58.	258	0x1C1F
T1	Value of the SM step timer in 1/32 of a millisecond ticks.	259	96,000 * (3 seconds)
T2	Value of the SM set address sequence timer in 1/32 of a millisecond ticks.	260	1,920,000 * (60 seconds)
T3	Value of the SM set address wait timer in 1/32 of a millisecond ticks.	261	480,000 * (15 seconds)

* The default value is specified by the communications profile for the application area.

Continued on next page

8.18 System Management (SM) Continued

System Application Clock Time Synchronization

Each link in a fieldbus network contains an Application Clock Time Publisher responsible for distributing Application Time on the link. A clock synchronization message is periodically sent by the time publisher to all fieldbus devices. The application clock time is independently maintained in each device based on its own internal crystal clock.

Clock synchronization provides the capability for devices to time stamp data (events and alarms when they occur).

Sync and Scheduling Objects

These objects are used by system management to provide application clock synchronization and macrocycle scheduling for the device. Table 61 identifies the sync and scheduling objects with their object directory index and default values.

Table 62 SM Sync and Scheduling Objects

Object	Description	OD index	Default Value
CURRENT_TIME	The current application clock time.	262	Dynamic
LOCAL_TIME_DIFF	Used to calculate local time from CURRENT_TIME.	263	0
AP_CLOCK_SYNC_INTERVAL	The interval in seconds between time messages on the link (bus).	264	Set by SM (mgr.) during address assignment
TIME_LAST_RCVD	The application clock time contained in the last clock message.	265	Dynamic
PRIMARY_AP_TIME_PUBLISHER	The node address of the primary time publisher for the local link (bus).	266	Set by SM (mgr.) during address assignment
TIME_PUBLISHER_ADDR	The node address of the device which sent the last clock message.	267	Dynamic
<i>Unused</i>		268	
MACROCYCLE_DURATION	The length of the macrocycle in 1/32 of a millisecond ticks.	269	Set by SM (mgr.) during address assignment

Continued on next page

8.18 System Management (SM) Continued

Device ID, Tag Name and Device Address

Each fieldbus device on the network is uniquely identified by:

- Device ID which is set by the manufacturer to identify the device.
 - Device Name (Tag) - set by you to identify operation.
 - Device Address - a unique numerical address on the fieldbus segment. Address may be set automatically by system management.
-

Automatic Device Address Management

Assignment of physical device addresses is performed automatically by system management.

1. The sequence for assigning a physical address to a new device is:
 2. A physical device address is assigned to a new device. This may be done off-line before the device is installed on the fieldbus network. (The address can be preconfigured at the factory or set by you.)
 3. The device is connected to the bus and uses default address 248 to 251. If no physical device name is set, the manufacturer's device ID is used.
 4. System management assigns an unused address to the new device. Assignment is done automatically or by you.
-

Address Assignment Objects

Table 62 is a description of the Address Assignment objects with their object directory index and default values

Table 63 SM Address Assignment Objects

Object	Description	OD index	Default Value
DEV_ID	The device ID set by the manufacturer.	270	48574C0002-HWL-ST3000-xxxxxxxx (PROM ID)
PD_TAG	The physical device tag to be set using SET_PD_TAG service.	271	ST-xxxxxxx (1 st seven digits of PROM ID)
OPERATIONAL_POWERUP	Controls the state of SM of the device upon power-up.	272	TRUE (SM goes operational after powerup)

Tag Search Services

There are three SM services (functions) available to set the physical tag of the device, give it a permanent node address and search the network for a given tag name.

Continued on next page

8.18 System Management (SM) Continued

Set Physical Tag

Using a configuration program, a request to set PD_TAG parameter is sent to the new device function block. If device tag is clear, then a device tag is assigned to the function block at the device address.

Set Permanent Address

After a physical tag has been assigned to a new device, a request can be made to give the device a permanent address using the configurator program.

Tag Locator

Also, a find tag query service searches for a given function block tag among the fieldbus devices and returns the device address and object dictionary index for that tag if found.

Virtual Field Device (VFD) List Objects

There are two (2) objects that identify the VFD's in the device.

OD Index	VFD_REF	VFD_TAG
273	1	'MIB'
274	2	'Resource'

Continued on next page

8.18 System Management (SM) Continued

Function Block Scheduling

The SMIB contains a schedule, called the Function Block Schedule, that indicates when that device's function blocks are to be executed. System Management schedules the start of each function block relative to the macrocycle of the device. The macrocycle represents one complete cycle of the function block schedule in a device. The macrocycles of all devices on the link are synchronized so that function block executions and their corresponding data transfers are synchronized in time.

Using the configurator software, the device's function block schedule can be configured.

Function Block Scheduling Objects

There are four scheduling objects defined in the ST 3000 FF. Any function block can be configured in one or more scheduling objects. By default, the first scheduling object is assigned to the AI block and the second is assigned to the PID block. Table 63 lists the function block scheduling objects with their object directory index and default values.

Table 64 Function Block Scheduling Objects

Object	Description	OD Index	Default Value
VERSION_OF_SCHEDULE	The version number of the function block schedule.	275	0
FB Schedule Entry #1	By default, the entry which defines the AI function block execution schedule.	276	START_TIME_OFFSET - 0 FB_OBJECT_INDEX - 257 (AI block) VFD_REF - 2
FB Schedule Entry #2	By default, the entry which defines the PID function block execution schedule.	277	START_TIME_OFFSET - 16000 FB_OBJECT_INDEX - 301 (PID block) VFD_REF - 2
FB Schedule Entry #3, 4		278 - 279	START_TIME_OFFSET - 0xFFFFFFFF FB_OBJECT_INDEX - 0 VFD_REF - 0

8.19 Network Management

Description

Network Management provides for the management of a device's communication system by an external network manager application.

Network Management operates on special objects in the Network Management Information Base (NMIB) which is part of the Management Virtual Field Device (VFD).

Network Management Features

- Network Management provides the following features:
- Loading a Virtual Communication Relationship (VCR), which may be a list or a single entry. See VCR List Objects.
 - Loading/changing the communication stack configuration
 - Loading the Link Active Schedule (LAS)
 - Performance monitoring
 - Fault detection monitoring

Network Management Objects



Normally, most of the network management objects appear transparent to you. In other words, the parameters and objects used for network management are not normally viewed or changed as part of device configuration.

The network management objects in the ST 3000 FF FBAP are listed in the following paragraphs, although most, (if not all) of these objects are not directly user-configurable.

Continued on next page

8.19 Network Management Continued

Network Management Information Base (NMIB)

The NMIB contains various objects that are associated with network management operation. Table 64 lists the NMIB object dictionary. The groups of network management objects (along with their index starting numbers) are included in the NMIB for the ST 3000 FF. The numbers in parenthesis (n) indicate the number of objects

Table 65 ST 3000 FF NMIB Object Dictionary

Dictionary Index	Object
Header	Reserved
	Directory of Revision Number
	Number of Directory Objects
	Total Number of Directory Entries
	Directory Index of First Composite List Reference
	Number of Composite List References
290	Stack Management OD Index
	Number of Objects in Stack Management (1)
291	VCR List OD Index
	Number of Objects in VCR List (5)
330	DLL Basic OD Index
	Number of Objects in DLL Basic (3)
332	DLL Link Master OD Index
	Number of Objects in DLL Link Master (7)
340	Link Schedule OD Index
	Number of Objects in Link Schedule
<i>Not Used</i>	DLL Bridge OD Index
	Number of Objects in DLL Bridge
337	Phy LME OD Index
	Number of Objects in Phy LME (2)

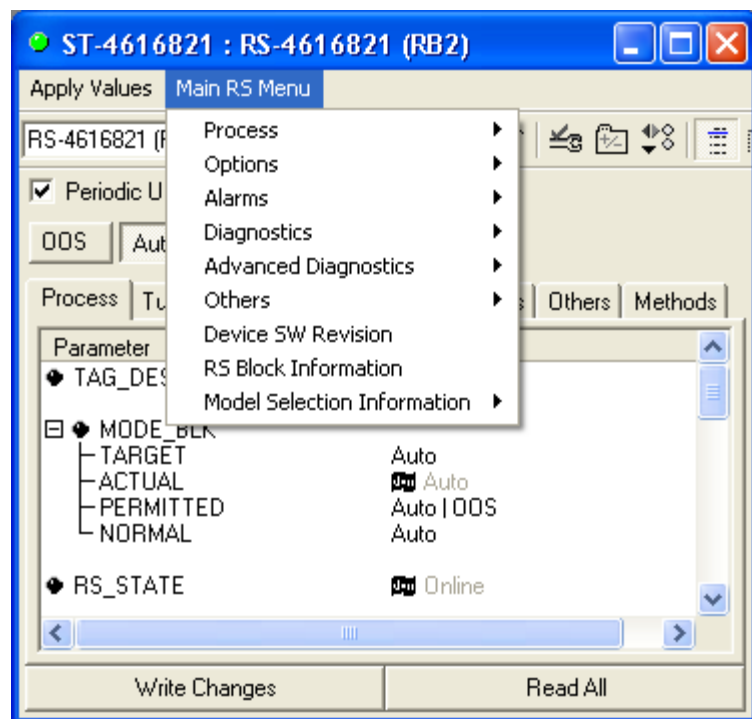
Virtual Communications Reference (VCR) Objects

The objects listed above contain parameters which define network management operations. These operations include communications between applications in different field devices (or field devices and operator interface). In order for this communication to take place, a “communications relationship” must be set up using the network management objects and parameters. The parameters for this communication relationship are stored in a Virtual Communications Reference (VCR) object.

8.20 Resource Block Methods

The Main RS Menu tab was added to the Resource Block to provide additional access both parameters and methods. The parameters provide access data similar to that contained in the block parameters while the methods provide access to data provided by multi block parameters or a means to automate a procedure (such as calibration) or manage data (reset) certain diagnostic data.

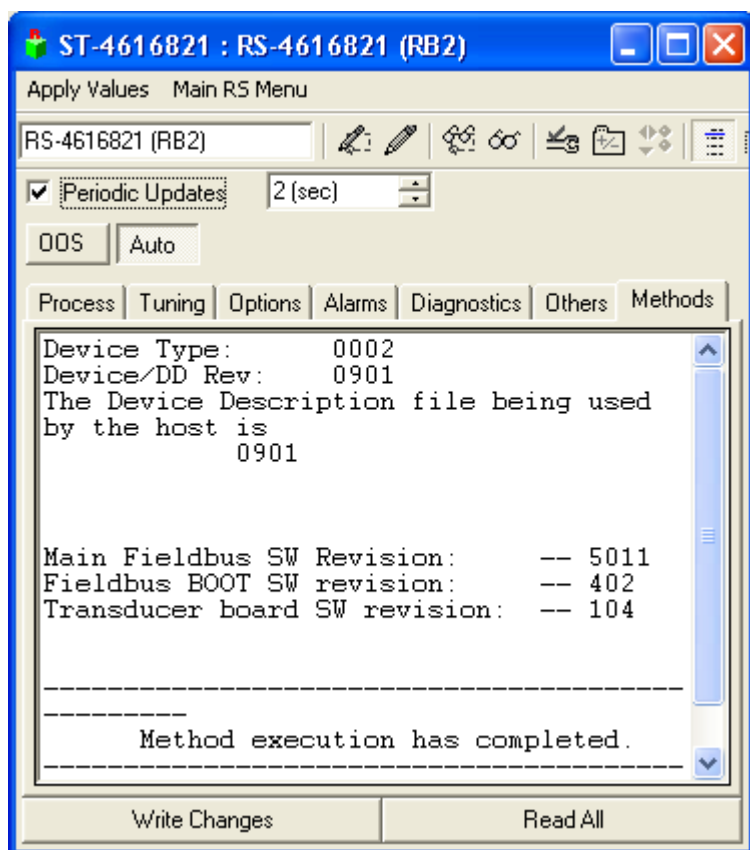
The **Main RS Menu** contains both Parameter and Method items. These are shown below:



The Parameter items are contained in the first 6 selections from Process through Others selections. These provide access to the data previously presented in Section 8.4 Resource Block. Methods are provided by the next three selections which are: Device SW revision, RS Block Information and Model selection Information. Information provided by these methods follows:

8.20 Resource Block Methods Continued

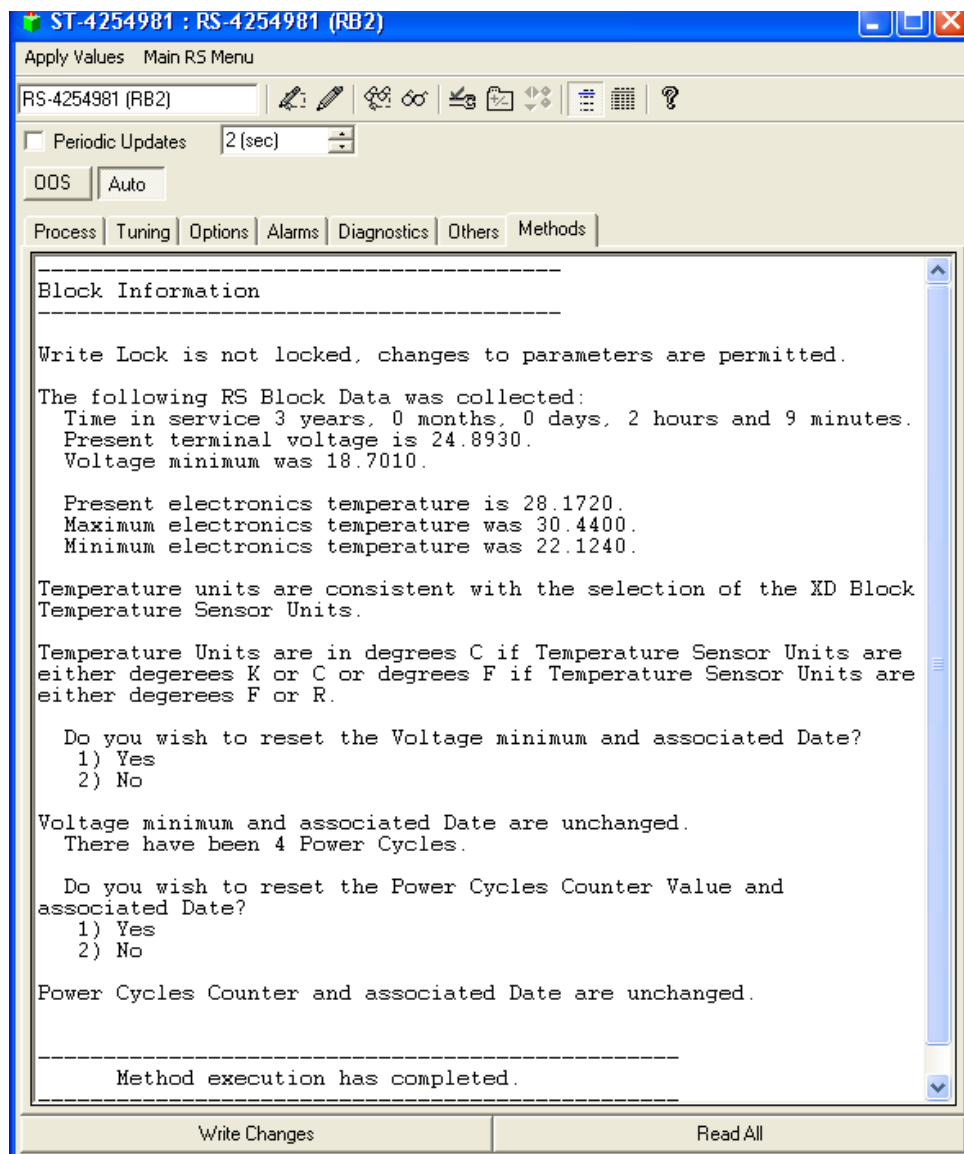
The Device SW Revision Method provides data for the device and DD revision.



8.20 Resource Block Methods Continued

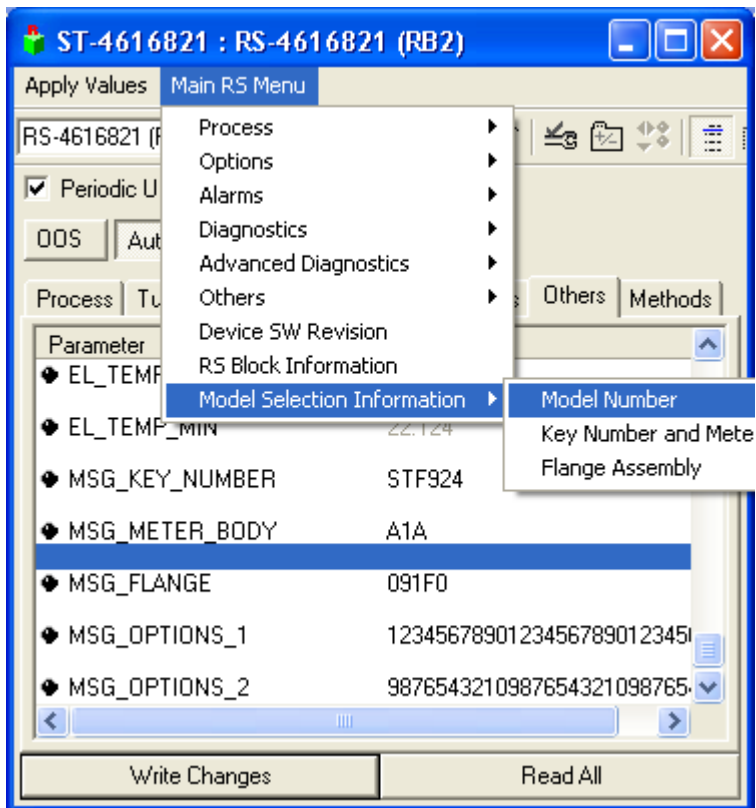
The Block Information Method gives information and ability to reset certain parameters.:

- Write Lock jumper
- Time in Service converted to years, months, days, hours and minutes
- Present Terminal Voltage
- Minimum Terminal Voltage
- Present Electronics Temperature
- Maximum and minimum Electronics Temperature. Temperature units are either C or F.
- Number of Power Cycles
- Ability to reset the minimum terminal Voltage and associated date
- Ability to reset Power Cycles and associated date



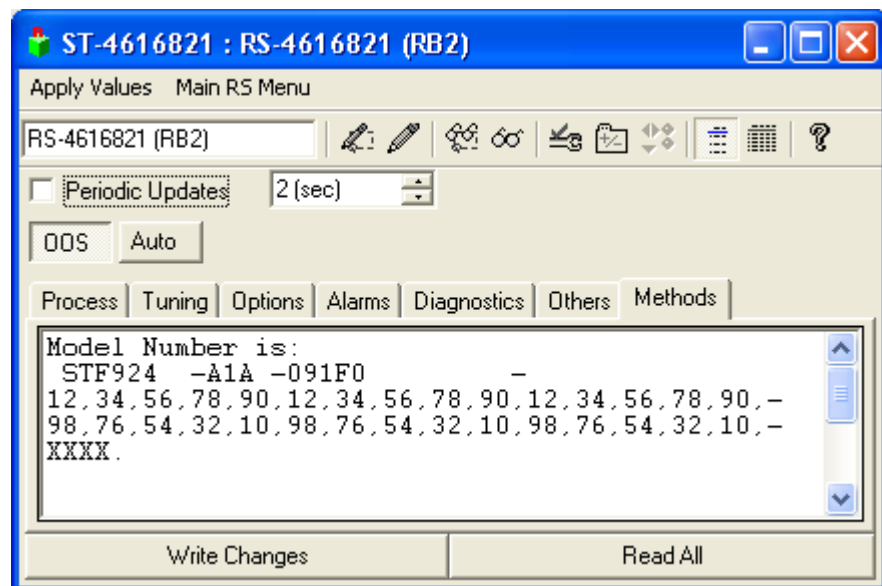
8.20 Resource Block Methods Continued

The Model Selection Information provides data for the Model selection Number, Key Number and Meter Body type and Flange Assembly. Selection is shown below:

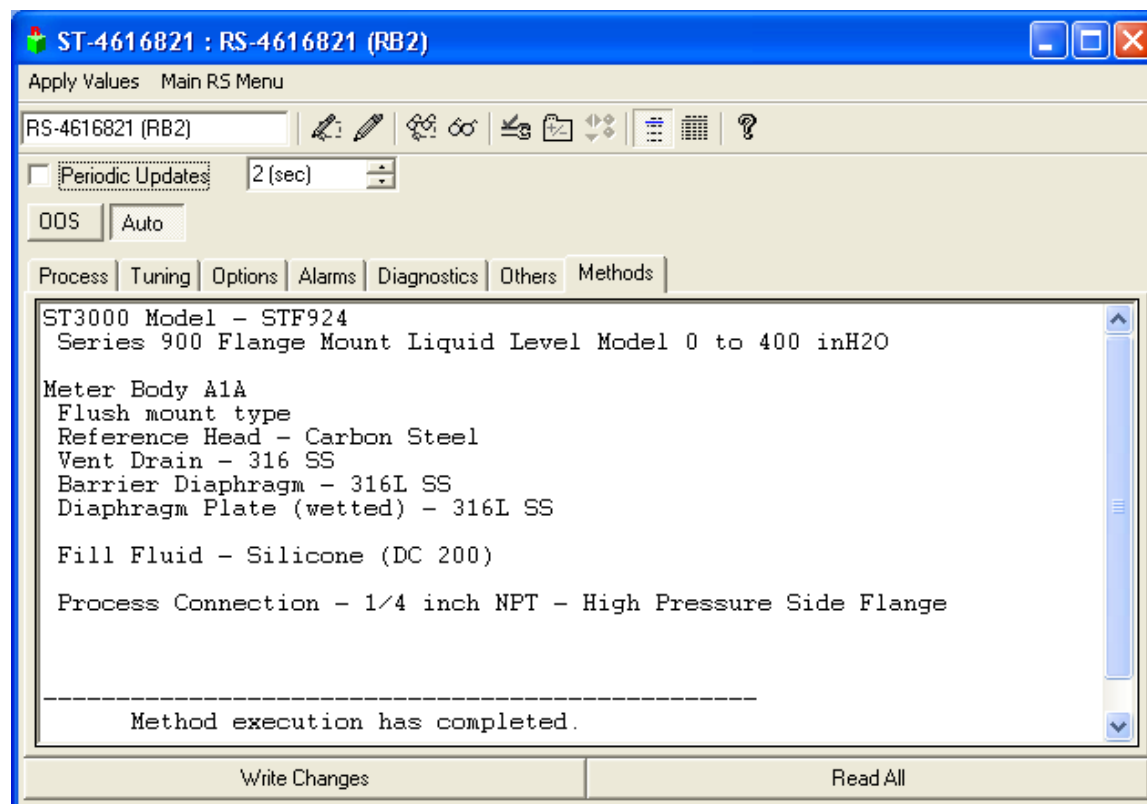


8.20 Resource Block Methods Continued

Model Number data :

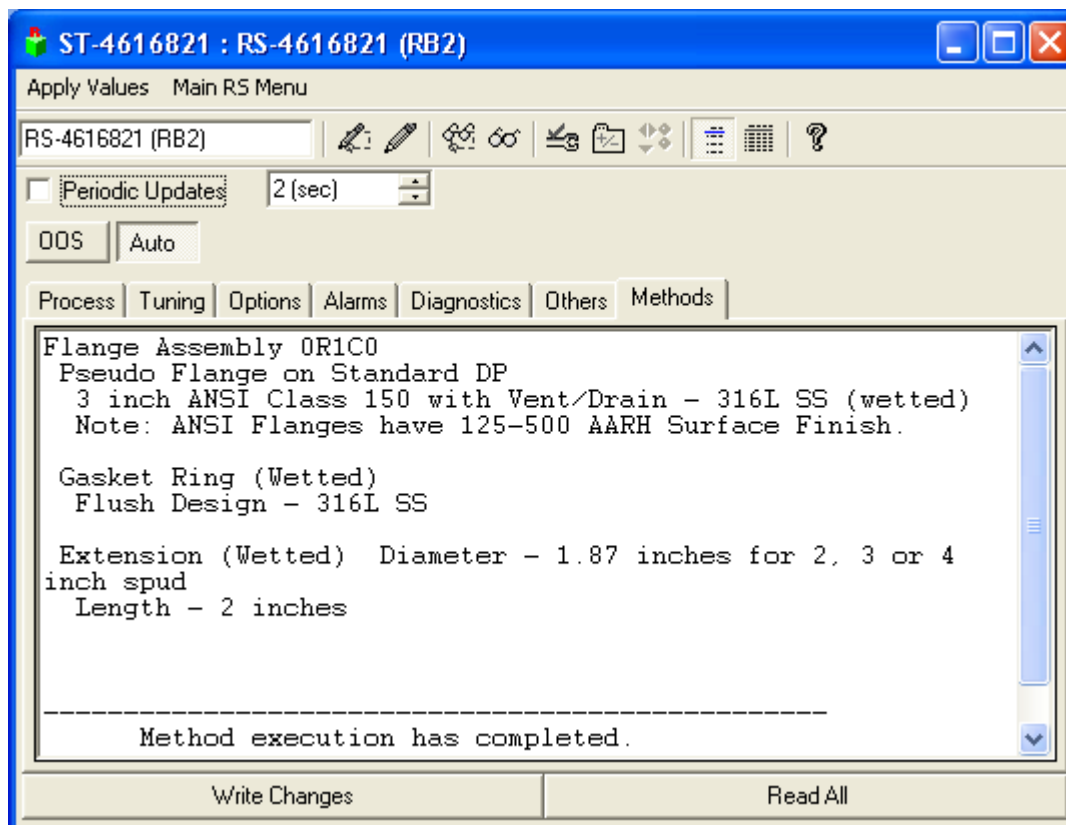


Key Number and Meter Body Data:



8.20 Resource Block Methods Continued

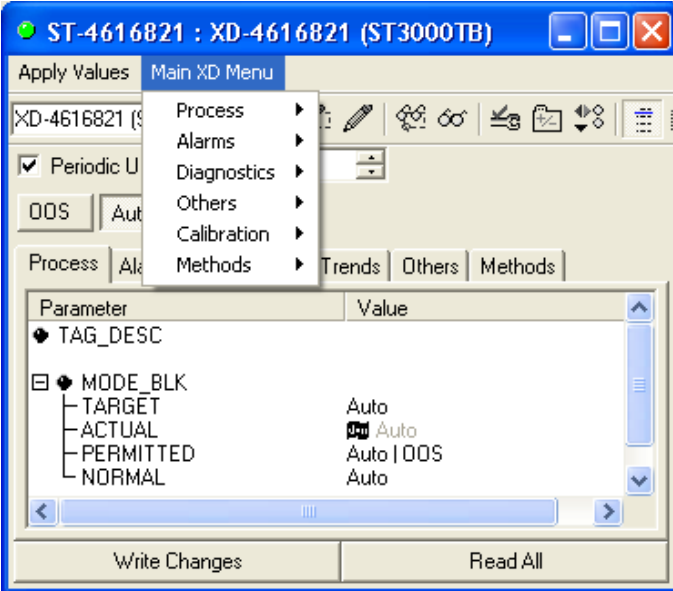
Flange Assembly:



8.21 Transducer Block Methods

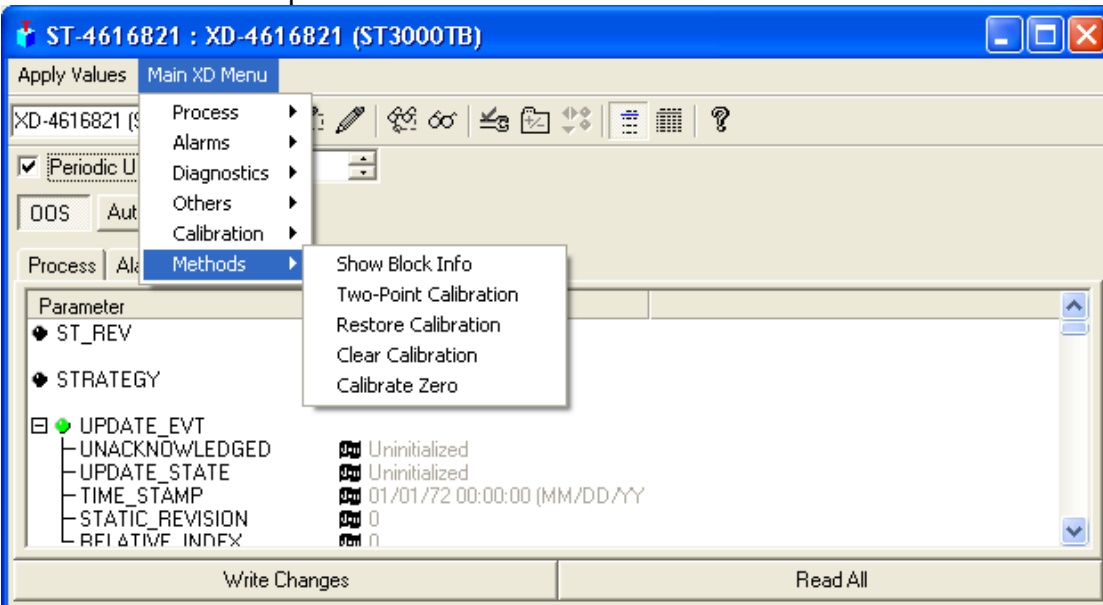
The Main XD Menu tab was added to the Transducer Block to provide additional access both parameters and methods. The parameters provide access data similar to that contained in the block parameters while the methods provide access to data provided by multi block parameters or a means to automate a procedure (such as calibration) or manage data (reset) certain diagnostic data.

The **Main XD Menu** contains both Parameter and Method items. These are shown below:



The Parameter items are contained in the first 5 selections from Process through Calibration. These give read/write access to all parameters were previously presented in Section 8.5 Transducer Block.

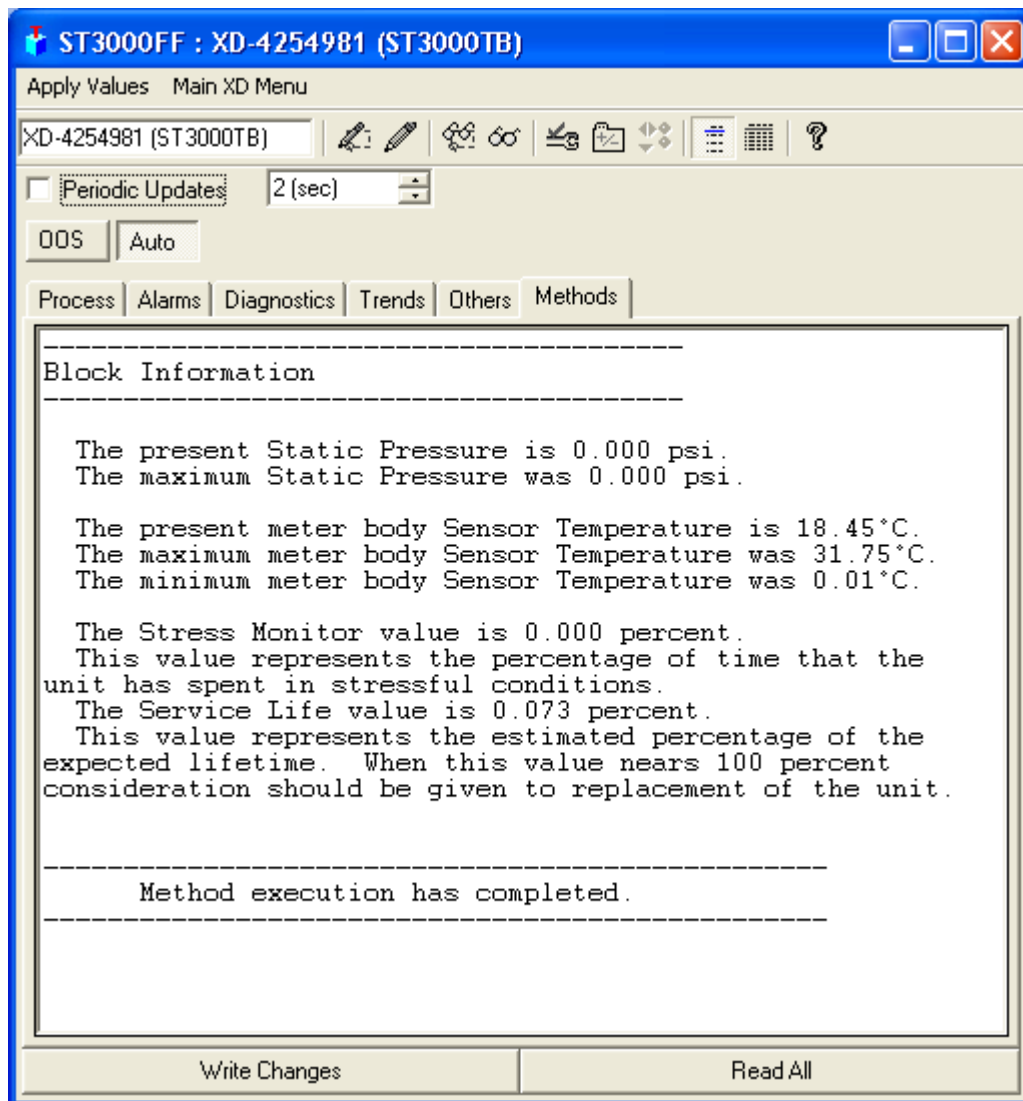
A Methods item is listed after the parameter items. The methods include data information and automated calibration procedures. These are shown below:



8.21 Transducer Block Methods Continued

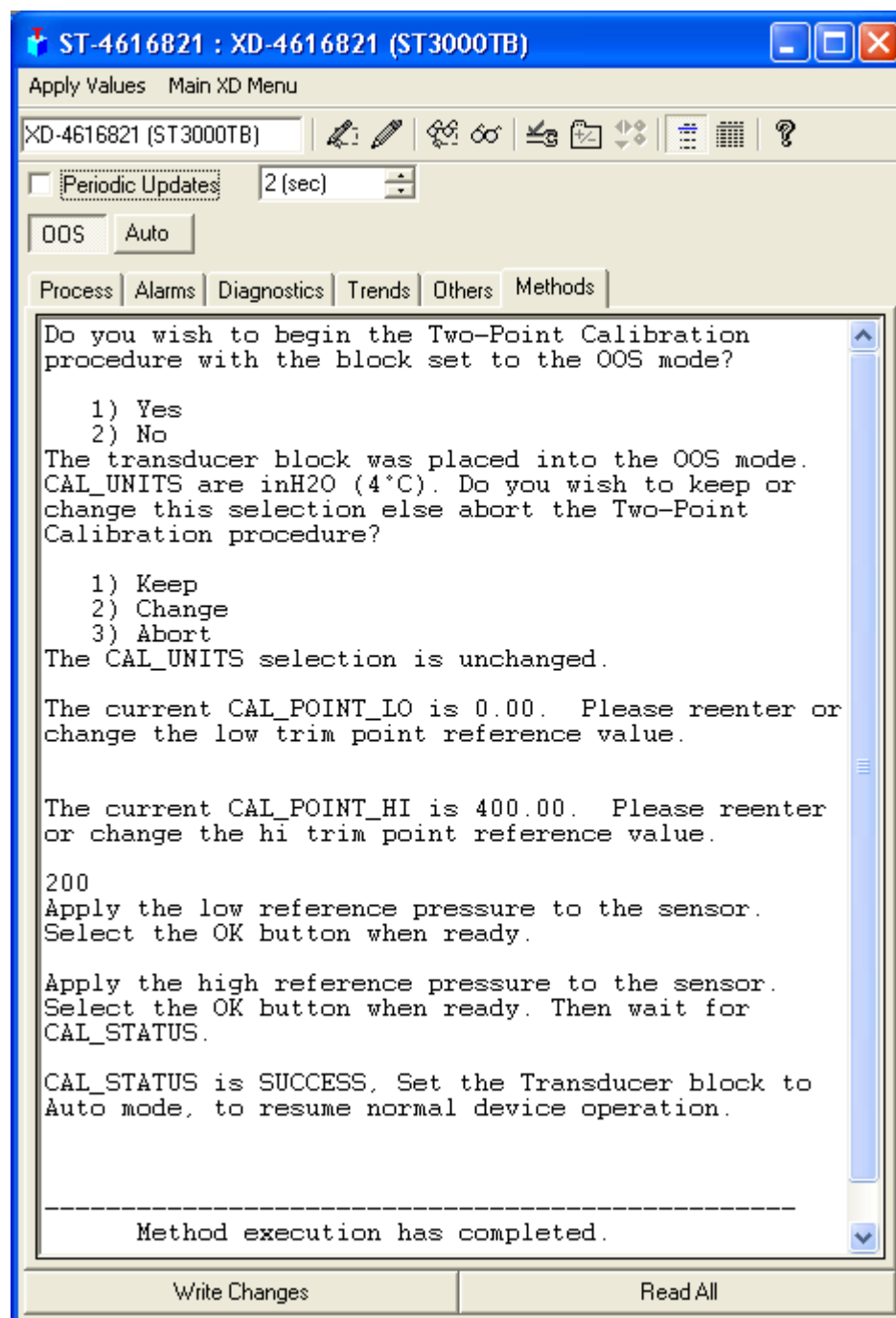
The Show Block Method Info details information for:

- Present Static Pressure
- Maximum Static Pressure
- Present meter body Sensor Temperature
- Maximum meter body Sensor Temperature
- Minimum meter body Sensor Temperature
- Stress Monitor Calculation
- Service Life Calculation



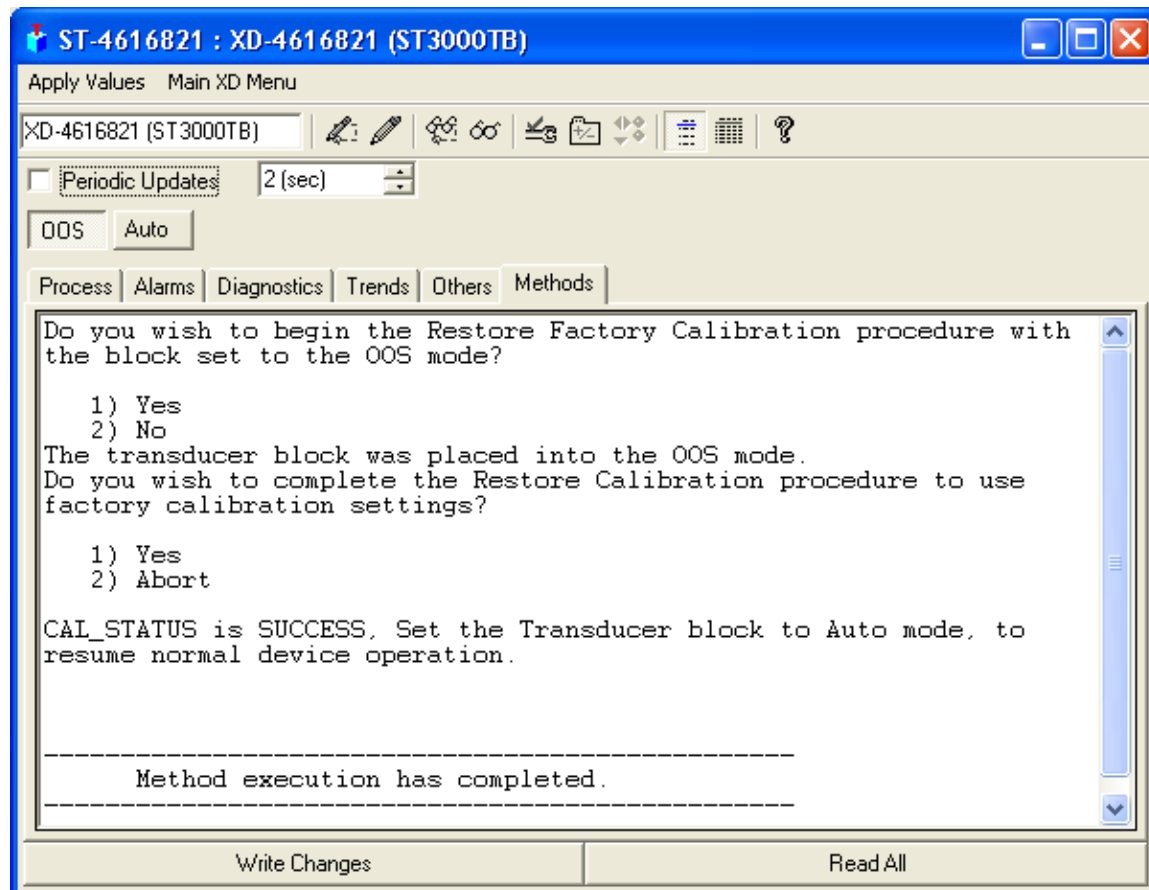
8.21 Transducer Block Methods Continued

The Two-Point Calibration method provides an automated procedure to perform the Two-point calibration as outlined in Section 10.3 Calibration.



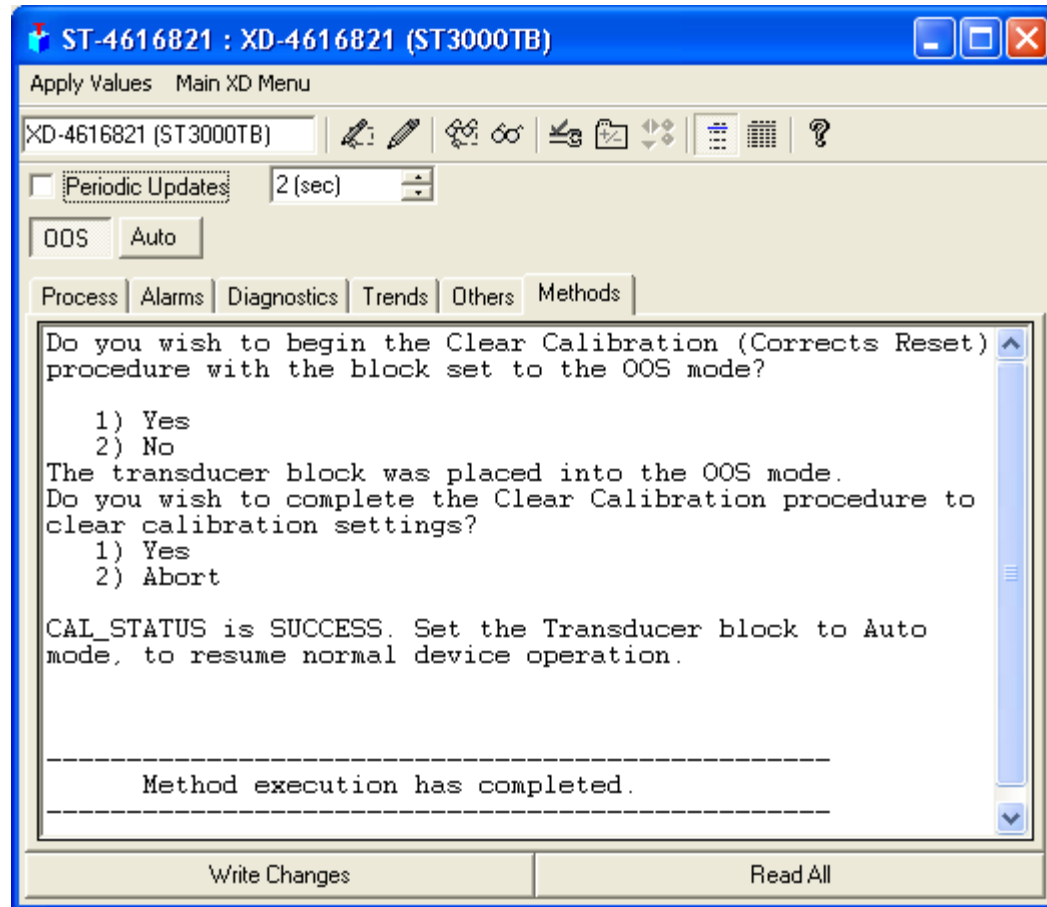
8.21 Transducer Block Methods Continued

This Restore Calibration Method provides an automated procedure to perform Restore to the factory calibration. This method uses the calibration procedure as outlined in Section 10.3 Calibration.



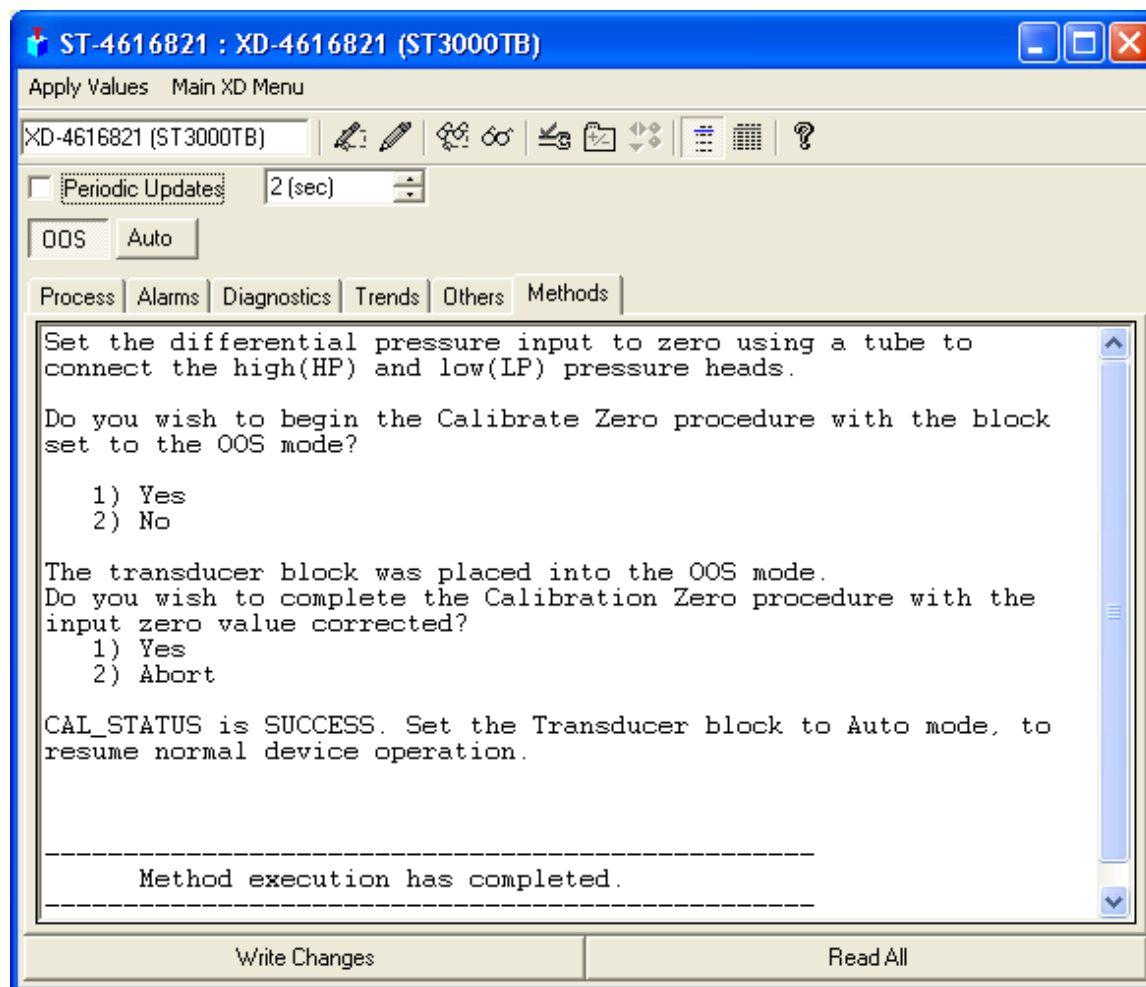
8.21 Transducer Block Methods Continued

The Clear Calibration (Corrects Reset) Method provides an automated procedure to allow the transmitter to operate using characterization constants only. This method uses the calibration procedure as outlined in section 10.3 Calibration.



8.21 Transducer Block Methods Continued

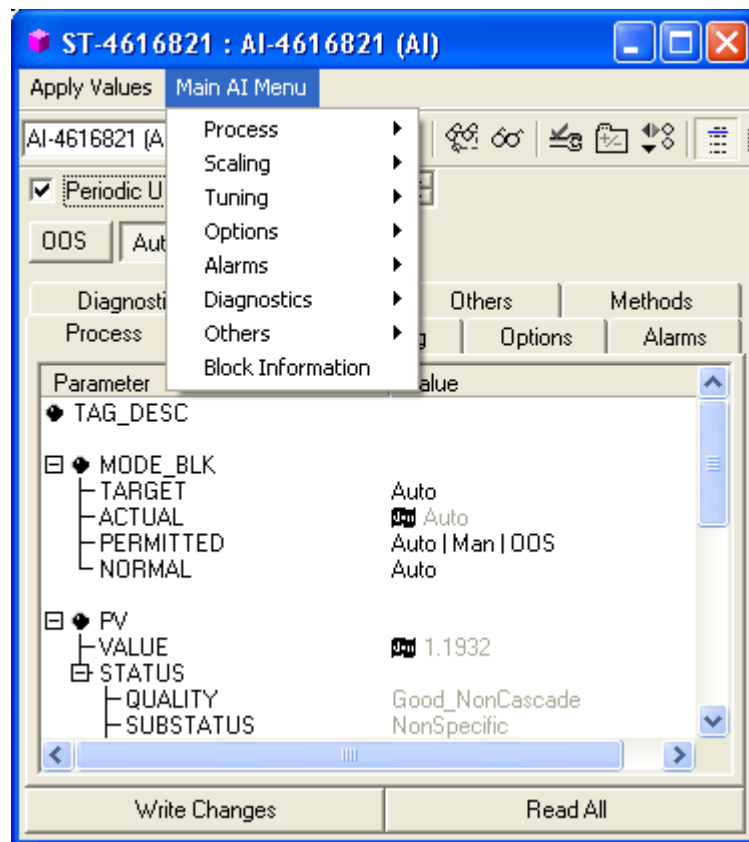
The Calibrate Zero (Input Zero) Method provides an automated procedure to calibrate the sensor to correct the input measurement due to fill fluid and transmitter position effects once the transmitter is installed and operating under process conditions. This method uses the calibration procedure as outlined in Section 10.3 Calibration.



8.22 Analog Input Block Methods

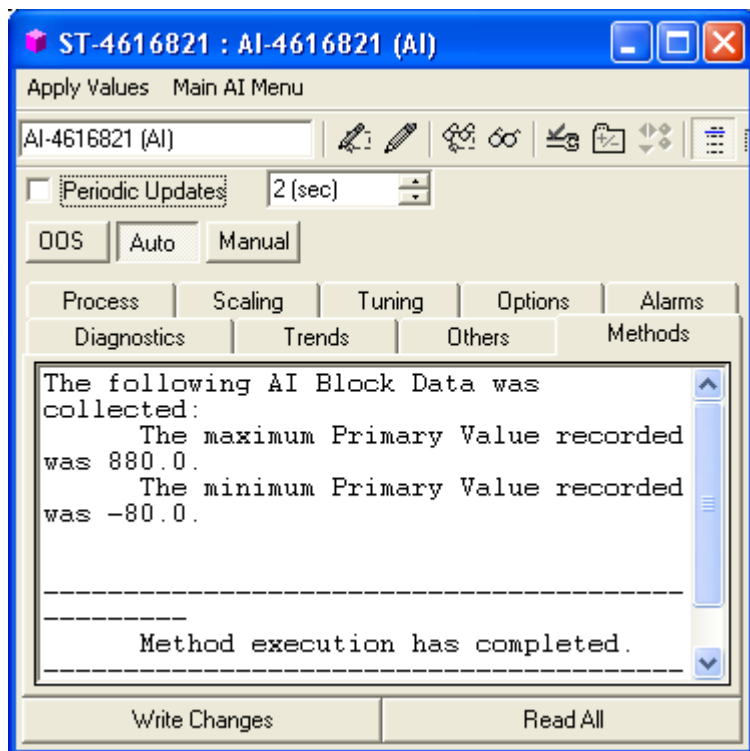
The Main AI Menu tab was added to the Analog Input Block to provide additional access both parameters and methods. The parameters provide access data similar to that contained in the block parameters while the methods provide access to data provided by multi block parameters or a means to automate a procedure (such as calibration) or manage data (reset) certain diagnostic data.

The **Main AI Menu** contains both Parameter and Method items. These are shown below:



8.22 Analog Input Block Methods Continued

The Block Information Method shows the maximum and minimum PV values detected over the life of the product. This data is gathered in Auto Mode operation only.



Section 9 —Maintenance

9.1 Introduction

Section Contents

This section includes these topics

Section	Topic	See Page
9.1	Introduction.....	143
9.2	Preventive Maintenance.....	144
9.3	Inspecting and Cleaning Barrier Diaphragms.....	145
9.4	Replacing Transmitter Electronics.....	149
9.5	Replacing Meter Body	154
9.6	Code Download	158

About this Section

This section provides information about preventive maintenance routines, cleaning barrier diaphragms, and replacing damaged parts.

9.2 Preventive Maintenance

Maintenance Routines and Schedules

The ST 3000 transmitter itself does not require any specific maintenance routine at regularly scheduled intervals. However, you should consider carrying out these typical inspection and maintenance routines on a schedule that is dictated by the characteristics of the process medium being measured and whether blow-down facilities or purge systems are being used.

- Check piping for leaks
 - Clear the piping of sediment or other foreign matter
 - Clean the transmitter's pressure chambers including the barrier diaphragms
-

9.3 Inspecting and Cleaning Barrier Diaphragms

Background

Depending on the characteristics of the process medium being measured, sediment or other foreign particles may collect in the process head cavity/chamber and cause faulty measurement. In addition, the barrier diaphragm or diaphragms in the transmitter's meter body may become coated with a residue from the process medium. The latter is also true for external diaphragms on flange mount and remote seal type transmitters.

In most cases, you can readily remove the process head or heads from the transmitter's meter body to clean the process head cavity and inspect the barrier diaphragm or diaphragms. For flange mount and remote seal diaphragms, you may only need to run a purge line in the tank to rinse off the face of the diaphragm.

Procedure

The procedure in Table 65 outlines the general steps for inspecting and cleaning barrier diaphragms. You may have to modify the steps to meet your particular process or transmitter model requirements. Figure 30 shows an exploded view of a DP transmitter's meter body for reference.

Table 65 Inspecting and Cleaning Barrier Diaphragms

Step	Action
1	Close all valves and isolate transmitter from process. Open vent in process head to drain fluid from transmitter's meter body, if required.  We recommend that you remove the transmitter from service and move it to a clean area before taking it apart.
2	Remove nuts from bolts that hold process head or heads to meter body. Remove process heads and bolts. See Figure 30.
3	Remove O-ring and clean interior of process head using soft bristle brush and suitable solvent.
4	Inspect barrier diaphragm for any signs of deterioration or corrosion. Look for possible residue and clean if necessary. NOTE: If diaphragm is dented, has distorted convolutions or radial wrinkles, performance may be affected. Contact TAC for assistance.

Continued on next page

9.3 Inspecting and Cleaning Barrier Diaphragms Continued

Procedure, continued

Table 65 Inspecting and Cleaning Barrier Diaphragms, Continued

Step	Action
5	Replace O-ring. - We recommend that you install a new O-ring whenever a process head is removed for cleaning. - The process head for a GP or AP transmitter with single-head design has two O-ring grooves. A large one which is 2 in (50.8 mm) in diameter and a small one which is 1.3 in (33 mm) in diameter as shown in the following illustration. For high-pressure applications, be sure to use a small O-ring in the smaller/inner groove. On other models of GP or AP transmitters, use a large O-ring in the larger/outer groove. Never use both O-rings together. GP/AP Process Head 22518 - For process heads of a GP or AP transmitter with dual-head design, see detail illustration for differential pressure transmitters in Figure 30.
6	Coat threads on process head bolts with anti-seize compound such as "Neverseize" or equivalent.
7	Replace process head or heads and bolts. Finger tighten nuts.

Continued on next page

9.3 Inspecting and Cleaning Barrier Diaphragms Continued

Procedure, continued

Table 65 Inspecting and Cleaning Barrier Diaphragms, Continued

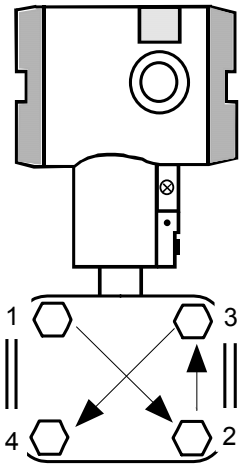
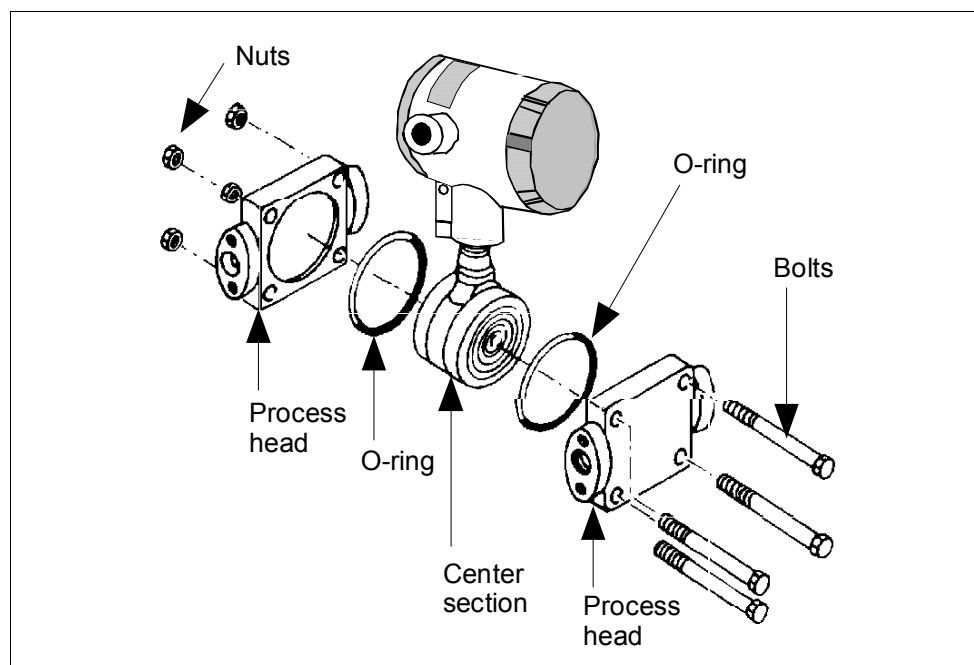
Step	Action
8	Use a torque wrench to gradually tighten nuts to torque rating shown in Table 68 in sequence shown in following illustration. Tighten head bolts in stages of 1/3 full torque, 2/3 full torque, and then full torque. Always tighten head bolts in sequence shown and in these stages: 1. 1/3 full torque 2. 2/3 full torque 3. Full torque 
9	Return transmitter to service.  Do not exceed the overload rating when placing the transmitter back into service or during cleaning operations. See Overpressure ratings in Section 4 of this manual.

Figure 30 Disassembly of DP Transmitter Process Heads from Meter Body



9.3 Inspecting and Cleaning Barrier Diaphragms Continued

Torque ratings

Table 66 lists process head bolt torque ratings for given transmitter type.

Table 66 Process Head Bolt Torque Ratings

Meter Body Type	Process Head Bolting Size	Bolting Type			
		Carbon Steel – Standard; no option specified	B7M Bolting ["B7" Option]	Stainless Steel NACE ["CR" Option]	316 Stainless Steel Non-NACE ["SS" Option]
Draft Range Transmitter	7/16 x 14 UNC	20,3 N-m +/- 1,0 N-m [15,0 Lb-Ft +/- 0.8 Lb-Ft]	20,3 N-m +/- 1,0 N-m [15,0 Lb-Ft +/- 0.8 Lb-Ft]	20,3 N-m +/- 1,0 N-m [15,0 Lb-Ft +/- 0.8 Lb-Ft]	20,3 N-m +/- 1,0 N-m [15,0 Lb-Ft +/- 0.8 Lb-Ft]
	7/16 x 20 UNF	NA	NA	25,8 N-m +/- 1,3 N-m [19,0 Lb-Ft +/- 1.0 Lb-Ft]	NA
	M12 x 1.75	25,8 N-m +/- 1,3 N-m [19,0 Lb-Ft +/- 1.0 Lb-Ft]	NA	NA	NA
All Other DP, GP and AP Transmitters	M12 x 1.75	63,7 N-m +/- 3,2 N-m [47,0 Lb-Ft +/- 2.4 Lb-Ft]	NA	NA	NA
	7/16 x 20 UNF	NA	NA	63,7 N-m +/- 3,2 N-m [47,0 Lb-Ft +/- 2.4 Lb-Ft]	NA
	7/16 x 14 UNC	67,8 N-m +/- 3,4 N-m [50,0 Lb-Ft +/- 2.5 Lb-Ft]	48,8 N-m +/- 2,4 N-m [36,0 Lb-Ft +/- 1.8 Lb-Ft]	56,9 N-m +/- 2,8 N-m [42,0 Lb-Ft +/- 2.1 Lb-Ft]	56,9 N-m +/- 2,8 N-m [42,0 Lb-Ft +/- 2.1 Lb-Ft]
	3/8 x 16 UNC	39,3 N-m +/- 2,0 N-m [29 Lb-Ft +/- 1.5 Lb-Ft]	NA	39,3 N-m +/- 2,0 N-m [29 Lb-Ft +/- 1.5 Lb-Ft]	39,3 N-m +/- 2,0 N-m [29 Lb-Ft +/- 1.5 Lb-Ft]
	M8 x 1.25	27,1 N-m +/- 1,4 N-m [20,0 Lb-Ft +/- 1.0 Lb-Ft]	NA	NA	NA
	5/16 x 18 UNC	NA	NA	20,3 N-m +/- 1,0 N-m [15,0 Lb-Ft +/- 0.8 Lb-Ft]	20,3 N-m +/- 1,0 N-m [15,0 Lb-Ft +/- 0.8 Lb-Ft]

9.4 Replacing Transmitter Electronics

ST 3000 FF Electronics

The electronics of the ST 3000 FF transmitter exists on two Printed Wiring Assemblies (PWAs) and the optional local smart meter assembly.

The PWAs are:

1. Transducer board PWA
2. Stack board PWA.

The Transducer board and Stack board PWAs are connected together in a mounting bracket to make the electronics module assembly. The electronics module is the recommended replacement unit for the electronics boards.

Procedure

The procedure in Table 67 details the steps for replacing the smart meter option assembly and the electronics module that holds the transducer board and stack board PWAs within the transmitter.



ATTENTION

We recommend that you use a ground strap or ionizer when handling the electronics module, since electrostatic discharges can damage certain circuit components.



CAUTION

When servicing devices in a hazardous location, keep covers tight while the transmitter is energized. Disconnect power to the analyzer in the non-hazardous area prior to opening transmitter housing for service, or determine that the location is non-hazardous prior to disconnecting or connecting the transmitter wires.

Table 67 Replacing Smart Meter and Electronics Module.

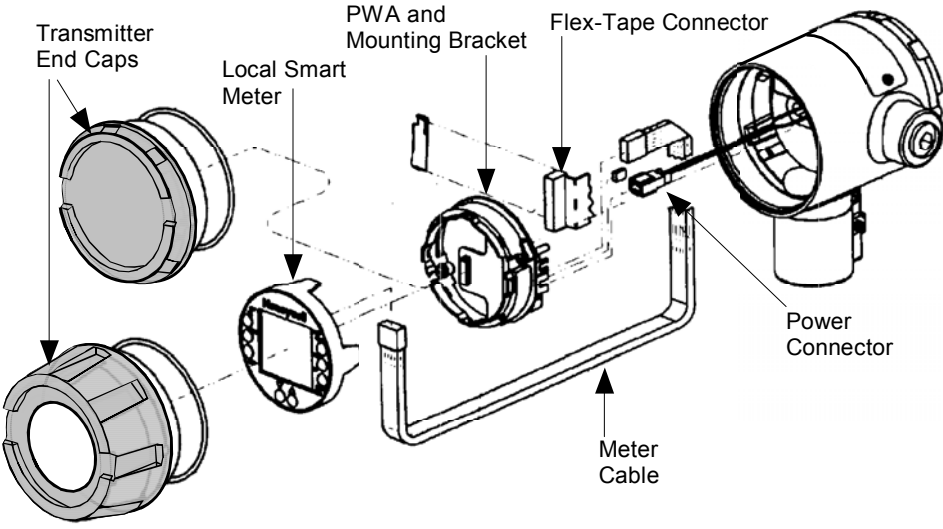
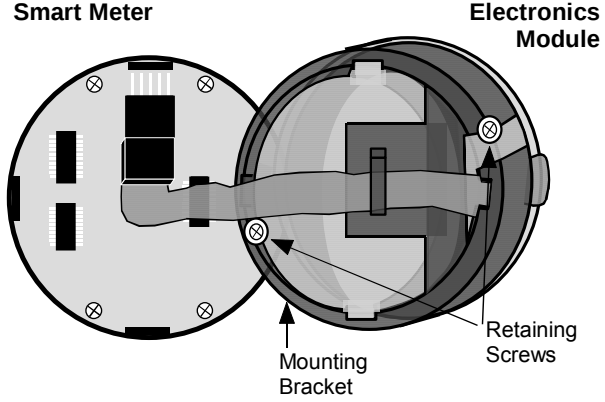
Step	Action
1	Loosen end cap lock screw using supplied Allen key and unscrew end cap from terminal side of transmitter housing.
2	Remove power to the transmitter by disconnecting the Signal + and Signal - wires from the transmitter terminal block. We recommend that you remove the transmitter from service and move it to a clean area before taking it apart.

Continued on next page

9.4 Replacing Transmitter Electronics Continued

Procedure, continued

Table 67 Replacing Smart Meter and Electronics Module, continued

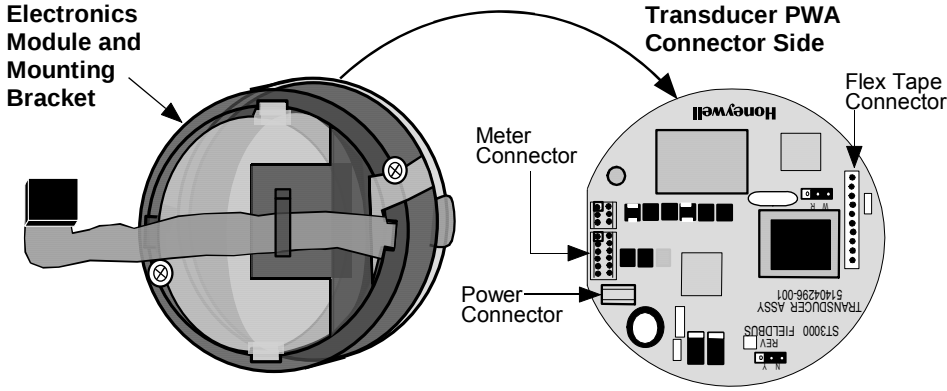
Step	Action
3	Loosen end cap lock screw using the Allen key and unscrew end cap from electronics side of housing. See figure for exploded view of transmitter components. 
4 	If transmitter is equipped with a local smart meter: Carefully turn smart meter counterclockwise to disconnect it from electronics module. We recommend that you use a ground strap or ionizer when handling the electronics module, since electrostatic discharges can damage certain circuit components.
5	Note orientation of electronics module in housing. Move the meter to the side and loosen two retaining screws and carefully pull the electronics module out of the housing. 

Continued on next page

9.4 Replacing Transmitter Electronics Continued

Procedure, continued

Table 67 Replacing Smart Meter and Electronics Module, continued

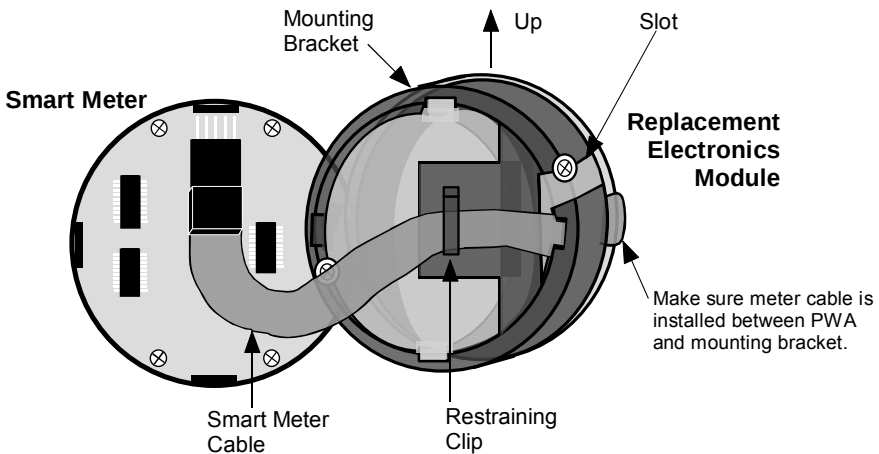
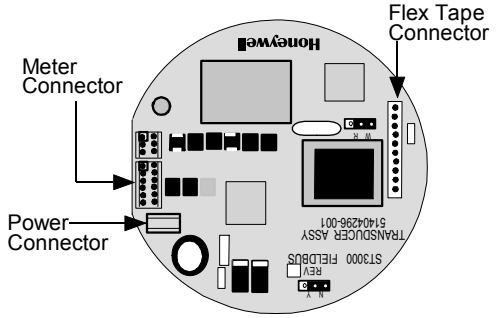
Step	Action						
6	Note routing of meter cable to mounting bracket. Remove the smart meter cable wires from the slot on the mounting bracket and unplug the smart meter cable from the Transducer board.						
7	<table border="1"> <thead> <tr> <th>If you are...</th><th>Then...</th></tr> </thead> <tbody> <tr> <td>Replacing the local smart meter only</td><td>go to Step 10.</td></tr> <tr> <td>Replacing the electronics module</td><td>go to Step 8.</td></tr> </tbody> </table>	If you are...	Then...	Replacing the local smart meter only	go to Step 10.	Replacing the electronics module	go to Step 8.
If you are...	Then...						
Replacing the local smart meter only	go to Step 10.						
Replacing the electronics module	go to Step 8.						
8	Remove retaining clip from PWA and flex-tape connector, unplug flex tape, and power cables from component side of Transducer PWA, and then remove the electronics module.						
							
9	Remove the replacement electronics module from its protective wrapping. Re-use the protective envelope to package the old electronics module for return shipment.						

Continued on next page

9.4 Replacing Transmitter Electronics Continued

Procedure, continued

Table 67 Replacing Smart Meter and Electronics Module, continued

Step	Action
10	If equipped with (or if you are replacing the) smart meter: Plug the smart meter cable on to the meter connector of the Transducer board and carefully route the smart meter wires underneath the clip on the mounting bracket. 
11	Locate the replacement electronics module at the transmitter housing.
12	Plug the flex tape cable into the connector on Transducer Board PWA. Plug power cable in to the connector on Transducer Board PWA. Place retaining clip over the flex tape and power connectors. 
13	Correctly orient and insert the electronics module back into the transmitter housing. Secure module in the transmitter housing with the two retaining screws.

Continued on next page

9.4 Replacing Transmitter Electronics Continued

Procedure, continued

Table 67 Replacing Smart Meter and Electronics Module, continued

Step	Action
14	If equipped with smart meter: Rotate meter to the desired orientation for viewing and attach the meter to mounting bracket assembly using a clockwise turn. (You can rotate the meter mounting orientation in 90-degree increments.)
15	Lubricate end-cap O-ring with silicon grease such as Dow Corning #33 or equivalent and replace end cap.
16	Reinstall the transmitter and restore power by reconnecting the fieldbus cable to the SIGNAL + and - terminals of the transmitter.
17	Perform application download to transmitter. Reconfigure transmitter as required.
18	Recalibrate transmitter. Refer to Section 10. If recalibration is not possible, the transmitter can be returned to default calibration by following the procedure in Section 10.3, Clear Calibration. Do not use CAL_RESTORE for recalibration.
19	Return transmitter to service.

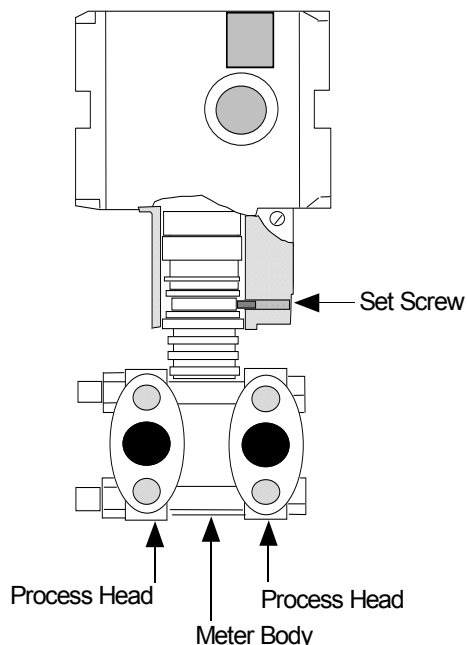
9.5 Replacing Meter Body

Procedure

You can replace the complete meter body including process heads or only the meter body on selected DP, GP and AP transmitters by using the existing process head(s).

Use the procedure in Table 68 to install a meter body only.

Table 68 Replacing Meter Body Only

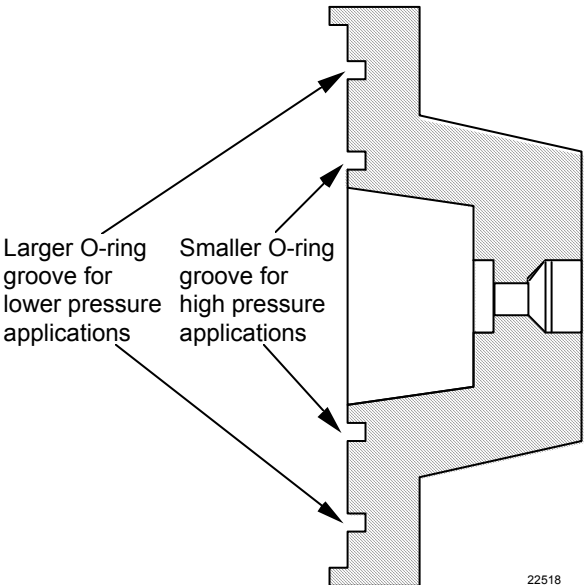
Step	Action
1	Complete first 8 Steps in Table 67, as applicable, to remove electronics module.
2	Use 4 mm size hex wrench to completely loosen set screw outside housing.  The diagram shows a cross-section of the meter assembly. At the top is the electronics housing. Below it is the meter body, which is secured by a set screw. Two process heads are attached to the meter body. Labels with arrows point to the 'Set Screw', 'Process Head', and 'Meter Body'.
3	Carefully turn complete meter body counterclockwise to unscrew it from electronics housing.
4	Remove nuts from bolts that hold process head or heads to center section. Remove process heads and bolts

Continued on next page

9.5 Replacing Meter Body Continued

Procedure, continued

Table 68 Replacing Meter Body Only, continued

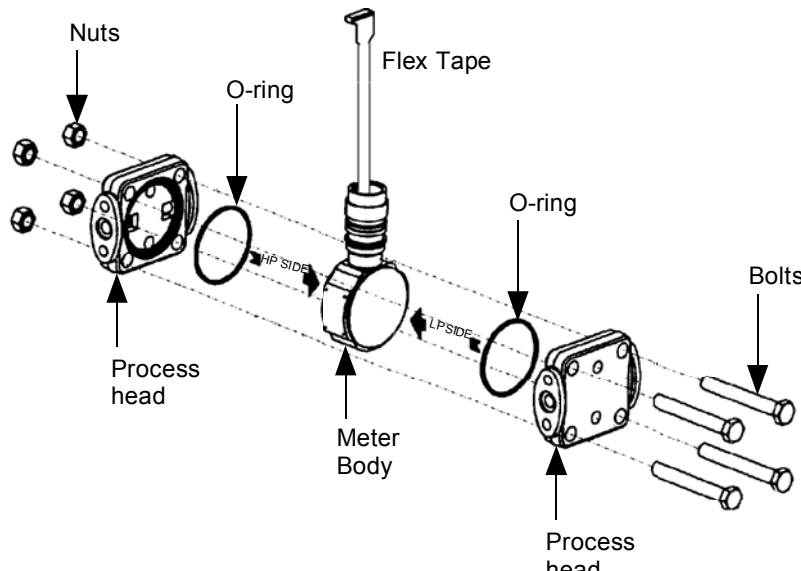
Step	Action
5	Remove O-ring and clean interior of process head using soft bristle brush and suitable solvent.
6	Replace O-ring.  22518 GP/AP Process Head - We recommend that you install a new O-ring whenever a process head is removed for cleaning. - The process head for a GP or AP transmitter with single-head design has two O-ring grooves. A large one which is 2 in (50.8 mm) in diameter and a small one which is 1.3 in (33 mm) in diameter as shown in the following illustration. For high-pressure applications, be sure to use a small O-ring in the smaller/inner groove. On other models of GP or AP transmitters, use a large O-ring in the larger/outer groove. Never use both O-rings together. - For process heads of a GP or AP transmitter with dual-head design, see detail illustration for differential pressure transmitters in step 8.
7	Coat threads on process head bolts with anti-seize compound such as "Neverseize" or equivalent.

Continued on next page

9.5 Replacing Meter Body Continued

Procedure, continued

Table 68 Replacing Meter Body Only, continued

Step	Action
8	Carefully assemble process head or heads and bolts to new center section. Finger tighten nuts. Typical Series 100 DP Transmitter Meter Body 
9	Use a torque wrench to gradually tighten nuts to torque rating shown in Table 68 in sequence shown in following illustration. Tighten head bolts in stages of 1/3 full torque, 2/3 full torque, and then full torque.

Continued on next page

9.5 Replacing Meter Body Continued

Procedure, continued

Table 68 Replacing Meter Body Only, continued

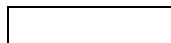
Step	Action
10	Feed flex tape on new meter body through neck of housing and screw new meter body into housing until bottom of header portion of center section is approximately flush with neck of electronics housing.
11	Tighten outside set screw to be sure it is fully seated in slot in header. Loosen set screw half turn, rotate housing to desired position and tighten set screw.
12	Perform Steps 8 through 11 in Table 67.
13	Restore power to transmitter.
14	Verify transmitter's configuration data. Perform configuration download, if applicable.
15	The manufacturer's sensor serial number is located on the tag attached to the meter body. Record the new PROM serial number. _____
16	Recalibrate transmitter. Refer to Section 10. If calibration is not possible, the transmitter can be returned to default calibration by following the procedure in Section 10.3, Clear Calibration. Do not use CAL_RESTORE for recalibration.
17	Return transmitter to service.

9.6 Code Download

Code Download Utility

A code download may be recommended to upgrade the transmitter firmware. A download utility program is used to perform the upgrade. A code download also updates other files necessary for proper operation; specifically, new versions of the Standard Dictionary and Device Description files are loaded on the host computer. These files are compatible with the “new” code.

Table 69 outlines the procedure for code download on a ST 3000 FF transmitter using the “Honeywell FF Products Download Application”.



A code download can be performed on an active live control loop. Prepare the control loop by setting the final control device to a safe state. The transmitter will be off-line for about 30 minutes. When the download is complete, the transmitter will revert to default settings, so before you download save the present configuration.

Table 69 Code Download Procedure

Step	Action
1	Save the current FBAP configuration of the device that you are going to perform a code download.
2	Start NIFB.exe and then DLOAD.exe (the Honeywell download application).
3	Select a device using the “Refresh” button.
4	Enter the code file name, including path, or use the “Browse” button.
5	Press the “Download” button to start the download.
6	After 6 to 8 minutes, a message box displays that the download is complete.
7	Verify the values of DL_SIZE and DL_CHECKSUM in the message box with those in the release guide accompanying the code software. • If both values match, you can choose to ACTIVATE the new software. • If either result does not match, DO NOT ACTIVATE and select “CANCEL”. You can either retry the download or contact Honeywell Technical Assistance Center.
8	If you choose to activate the software, the transmitter will reset and after about 2 minutes reappear on the network.
9	Once the download is complete, the transmitter will contain a default database. You must then download the FBAP configuration saved in step 1 to the transmitter.

Continued on next page

9.6 Code Download Continued

The Effects of a Code Download on a Device

The effects on a device as a result of the download are that all configuration data in the device, with the exception of calibration data is cleared.

This includes:

- Device and block tags
- Block parameters
- The function block schedule
- Link object, trend object, and VCR configurations
- The network schedule

This requires you reconfigure the block tags and the control system and then download the configuration (FBAP file) to the device and other device on the network.

The device ID may appear differently on the network, due to differences between the new and older software versions. The device may appear as a new device since the NI Configuration system uses the device ID as the key identification variable for a device.

Section 10 —Calibration

10.1 Introduction

Section Contents This section includes these topics:

Section	Topic	See Page
10.1	Introduction	161
10.2	Overview	162
10.3	Calibration	163

About this Section This section provides information about calibrating the transmitter’s measurement range. It also covers the procedure for resetting calibration to factory default values as a quick alternative to measurement range calibration.

10.2 Overview

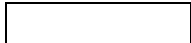
About Calibration

Your transmitter was factory calibrated to its standard range or a range specified on the purchase order. So there should be no need to recalibrate the transmitter during installation.

When recalibration is required, we recommend that you do a bench calibration with the transmitter removed from the process and located in a controlled environment to get the best accuracy.

Calibration Sources

ST 3000 FF transmitter can be calibrated to a number of sources. The calibration values can be set, cleared, restored to original factory settings, or even cleared so that the transmitter will operate using sensor characterization values.



The NI_FBUS Configurator application can be used to perform the calibration procedures. The software application is not a calibrated measurement source. It is a digital diagnostic tool that provides verification of device parameter values.

Calibration Process

In general, calibration procedures follow this process:

1. Prepare the transmitter
2. Write the appropriate parameters
3. Write to CAL_CMD.
4. The results of the calibration procedure are read from the CAL_SOURCE and CAL_STATUS block parameters.

The calibration parameter values and calibration commands are written to and read from the transmitter using a fieldbus configuration application, (such as the NI_FBUS Configurator).

10.3 Calibration

Select Calibration

You can select the calibration source to be used by the transmitter during operation:

Calibration Type	For Procedure See Table #
Two-point calibration - Calibrates the transmitter range using the two-point procedure. This procedure is also used to calibrate the transmitter to operate at a range that is smaller than its full range (Turndown calibration).	72
Restore to factory calibration - Sets the transmitter to operate using the calibration values set at the factory. (The factory calibration is stored in non-volatile memory in the transmitter.)	73
Clear calibration - (Formerly called "Corrects Reset") Resets calibration and allows transmitter to operate using characterization constants only.	74
Calibrate zero - (Formerly called "Input Zero") Calibrates the sensor to correct the input measurement due to fill fluid and transmitter position effects once the transmitter is installed and operating under process conditions.	75
Local zero correction - Calibrates zero point of the sensor using the pushbuttons on the local meter. Performs the same function as calibrate zero procedure.	76

10.3 Calibration Continued

Calibration Parameters

Parameters used for transmitter calibration are located in the transducer block. These parameters define the type of calibration to be performed and provide the status of the transmitter's calibration (whether a calibration was successful or if a failure was detected). Table 70 lists transducer block parameters and their values used in the calibration procedures described on the following pages.

Table 70 Transducer Block Calibration Parameters

Parameter	Description	Value - Meaning	Comments
MODE_BLK	The operating mode of the transducer block	Permitted modes: Auto - Auto (target mode) O/S - Out of Service	The transducer block must be in the O/S mode to perform transmitter calibration.
CAL_CMD	One byte value which selects the calibration operation to be performed.	1 - CAL_LOWER Calibrate at user-defined lower trim point 2 - CAL_UPPER Calibrate at user-defined upper trim point 3 - CAL_ZERO Calibrate zero 4 - CAL_RESTORE Set transmitter to final factory calibration 5 - CAL_CLEAR Clear user calibration adjustments	Calibration and correction commands are executed when the command is written. CAL_CMD resets to zero after being written.
CAL_UNIT	The engineering units used in calibration.	User-selected units.	
CAL_POINT_HI	The upper calibration trim point.	User-selected value	
CAL_POINT_LO	The lower calibration trim point.	User-selected value	

Continued on next page

10.3 Calibration Continued

Table 70 Transducer Block Calibration Parameters, continued

Parameter	Description	Value - Meaning	Comments
CAL_STATUS	The status of the selected calibration command.	1 - Success. 2 - Calibration failed. 3 - Bad factory calibration. 4 - Bad user calibration. 5 - Internal error 6 - Bad units 7 - Bad sensor 8 - Bad trim point 9 - Success/ with excess	Calibration command completed successfully. High and low trim points, or the measurements taken at those points contain equal values. Attempt to calibrate an AP transmitter at a negative trim point. For CAL_RESTORE For saving factory calibration. CAL_UNITS is invalid. Bad pressure reading. CAL_POINT_HI or CAL_POINT_LO is outside of the characterized range for the device (URL . . LRL). Calibration was successful, but resulted in an excess zero or excess span condition. This will be reflected in a status of "uncertain" in the measurement. See "Excess Calibration" below.
CAL_SOURCE	The source of the current device calibration.	1 - None 2 - User 3 - Factory	No calibration. Only sensor characterization is being used. User-selected calibration values used. Factory calibration used.

Excess Calibration (CAL_STATUS = 9)

An excess calibration status exists when one of the following conditions is present:

- Zero correction is greater than 5% of URL, (which is SENSOR_RANGE.EU_100).
- Span correction is greater than 5% of URL, (which is SENSOR_RANGE.EU_100).
- Calibrated range in a compound-characterized device is greater than the full sensor range.

In any of these conditions, the status of the transducer block output will be Uncertain/Inaccurate. Each of these conditions is indicated separately in Bits 0, 1, and 2 of the XD_DIAG_DETAIL parameter (See Section 11, Troubleshooting, Transmitter Faults).

10.3 Calibration Continued

Two-Point Calibration The ST 3000 FF Transmitter has two-point calibration. The calibration is used to correct for any sensor accuracy drift over time. Two-point calibration means you calibrate at two points in the calibration range (the lower and upper trim points) and then all points within that range adjust to that calibration.

Determine Lower and Upper Trim Points The two trim points are not fixed values, therefore you may choose the trim point values which calibrate the transmitter.

- The lower trim point can be zero or a user-selected value for the lower range value.
- The upper trim point can be a user-selected value for the upper range value.

Trim Point Limits Table 71 lists the low and high limit trim point limits for various transmitter types.

Table 71 Low and High Trim Point Limits for ST 3000 FF Transmitters

Device Type	Low Limit	High Limit
DP	Negative of high limit	200% of URL, or maximum overpressure rating (SENSOR_MAX_OVP), whichever is less
GP	-15 inches of water	150% of URL
AP	0	150% of URL

Precision Pressure Source You **must** have a precision pressure source with an accuracy of 0.04% or better to do a range calibration. Note that Honeywell factory calibrates the ST 3000 FF with inches of water ranges using inches of water pressure referenced to a temperature of 39.2 °F (4 °C).

Two-Point and Turndown Calibration Procedure Use the procedure in Table 72 to perform a two-point sensor calibration and turndown calibration using lower and upper trim points.

NOTE: When calibrating both lower and upper trim points, **calibrate the lower trim point first.**

Continued on next page

10.3 Calibration Continued

Two-Point and Turndown Calibration Procedure, continued

Table 72 Two-Point Sensor Calibration Procedure

Step	Action
1	Using a fieldbus configuration application as the operator interface to device, set the Transducer block MODE_BLK parameter to O/S (Out of Service).
2	Write the correct engineering units to parameter CAL_UNITS.
3	Write the low trim point reference value to parameter CAL_POINT_LO.
4	Write the high trim point reference value to parameter CAL_POINT_HI.
5	Apply the low reference pressure to the sensor. †
6	Write to parameter CAL_CMD a value of CAL_LOWER (1).
7	Apply the high reference pressure to the sensor. † Note: The pressure is normally applied to the HIGH side, but for compound-characterized devices where "custom calibrations" require negative inputs the pressure is applied to the LOW side. *
8	Write to parameter CAL_CMD a value of CAL_UPPER (2)
9	If calibration was successful: CAL_STATUS = Success (1) CAL_SOURCE = User (2), Proceed to next step. If calibration failed: CAL_STATUS = a value other than Success (1). (See Table 69 for descriptions of CAL_STATUS values.) CAL_SOURCE = value unchanged Repeat procedure from step 1.
10	When calibration is completed: Set Transducer block to Auto mode, to resume normal device operation.

* Using a negative trim point when calibrating an AP transmitter will result in an error. CAL_STATUS will be set to "2".

† To verify that the transmitter is reading the correct input pressure, you may have to read the PRIMARY_VALUE parameter in the transducer block.

10.3 Calibration Continued

Restore Factory Calibration Procedure

Use the procedure in Table 73 to calibrate the sensor using the final factory calibrated values.

Table 73 Restoring Factory Sensor Calibration Procedure

Step	Action
1	Using a fieldbus configuration application as the operator interface to device, set the Transducer block MODE_BLK parameter to O/S (Out of Service)
2	Write CAL_RESTORE (4) to parameter CAL_CMD to restore factory calibration settings. See Table 70, Calibration Parameters.
3	If calibration was successful: CAL_STATUS = Success (1) CAL_SOURCE = Factory (3), Proceed to next step. If calibration failed: CAL_STATUS = Bad factory calibration (3) (See Table 70 for descriptions of CAL_STATUS values.) CAL_SOURCE = value unchanged
4	When calibration is completed: Set Transducer block to Auto mode, to resume normal device operation.

10.3 Calibration Continued

Clear Calibration to Characterization Values (Also called Corrects Reset)

You can erase incorrect calibration data by clearing (or resetting) the data to default values. The default values return the transmitter calibration to the original factory “characterization” values. Characterization calculates a mathematical model of the performance of the transmitter’s sensors and then stores that data in the transmitter’s memory. Note that this is **not** the “factory calibration” which is done at the end of the process against the ordered range.

While clearing the calibration will return the transmitter to a close approximation of the previous calibration using its stored characterization data, the accuracy of the “reset” transmitter will be lower than the specified factory calibrated accuracy. The calibration is not exact since the transmitter mounting angle may be different than the factory mounting angle. This means that the transmitter is calculating its output based on the characterization equation alone without any compensation for the small residual errors of zero offset and span correction.

Example

A typical zero offset correction is less than 0.1 inH₂O for a 400 inH₂O range and a typical span correction is less than 0.2% regardless of the range (down to the point where specification turndown begins). The typical performance of a 400 inH₂O transmitter after clearing calibration (or a “Corrects Reset” as it is often called) can be expressed as:

$$\text{Accuracy} = 0.2\% + \boxed{} \cdot 100\%$$

By correcting the zero input, the typical performance will be 0.2% or better.

For other transmitter ranges, the initial zero offset will be scaled by the ratio of the Upper Range Limit (URL) to 400 inH₂O at 39.2°F (4°C). Thus, for a 100 psi range, the initial zero offset can be expressed by:

$$\boxed{}$$

Note that these are **typical** values and they may vary. However, our patented characterization method includes several techniques that help to ensure that this level of performance can be achieved.

Continued on next page

10.3 Calibration Continued

Clear Calibration Procedure

Use the procedure in Table 74 to clear the calibration so that the sensor will operate using default characterization values. Also called “Corrects Reset.”

Table 74 Clearing Sensor Calibration Procedure

Step	Action
1	Using a fieldbus configuration application as the operator interface to device, set the Transducer block MODE_BLK parameter to O/S (Out of Service)
2	Write CAL_CLEAR (5) to parameter CAL_CMD to clear calibration settings. See Table 70, Calibration Parameters.
3	If calibration was successful: CAL_STATUS = Success (1) CAL_SOURCE = None (1), Proceed to next step. If calibration failed: CAL_STATUS = a value other than Success (1). (See Table 70 for descriptions of CAL_STATUS values.) Repeat procedure from step 1.
4	When calibration is completed: Set Transducer block to Auto mode, to resume normal device operation.

Note: Using this calibration procedure will cause the local meter display to show “unc” Uncertain status.

10.3 Calibration Continued

Calibrate Zero

This calibration procedure is performed **after** the transmitter is mounted and installed in a process control system. Also called “Input Zero”.

Background

Bench calibration is performed with the device removed from the process and calibrated using reference pressure conditions. Often, when the device is mounted and connected to the process, the input measurement due to fill fluid and position effects cause the measurement to shift. This calibration provides a means of correcting for these effects without changing the calibration.

Correct Zero Calibration Procedure

Use the procedure in Table 74 when calibrating the sensor to correct the input measurement due to fill fluid and transmitter position effects.

NOTE 1: This procedure is not used for calibrating AP transmitters, since it is nearly impossible to measure a true “zero” pressure.

NOTE 2: This procedure can be performed using the local meter. See Table 75 for local zero correction procedure.

Table 75 Correct Zero Sensor Calibration Procedure

Step	Action
1	Set the differential pressure input to zero by connecting a tube between the input connections in the high pressure (HP) and the low pressure (LP) heads.
2	Using a fieldbus configuration application as the operator interface to device, set the Transducer block MODE_BLK parameter to O/S (Out of Service)
3	Write CAL_ZERO (3) to parameter CAL_CMD to calibrate zero. See Table 70, Calibration Parameters. The device will use the average of the last 10 pressure samples to perform the correction.
4	If calibration was successful: CAL_STATUS = Success (1) CAL_SOURCE = User (2), Proceed to next step. If calibration failed: CAL_STATUS = a value other than Success (1). (See Table 70 for descriptions of CAL_STATUS values.) Repeat procedure from step 1.
5	When calibration is completed: Set Transducer block to Auto mode, to resume normal device operation.

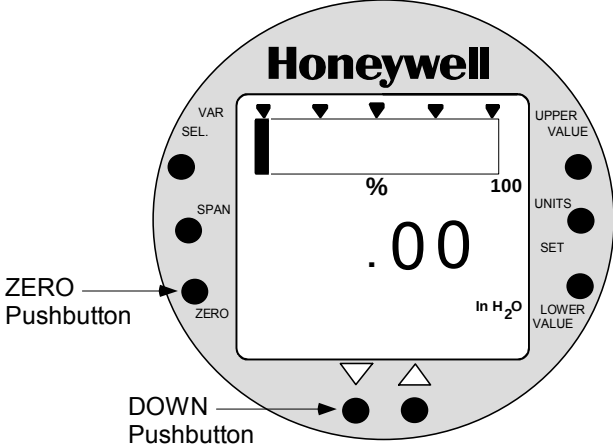
10.3 Calibration Continued

Local Zero Correction This calibration procedure allows you perform a zero correction using the pushbuttons on the local meter. The result is the same as in the previous procedure.

Zero Correction Calibration Procedure

Use the procedure in Table 76 for local zero correction.

Table 76 Local Zero Correction Procedure

Step	Action
1	Connect a tube between the input connections in the high pressure (HP) and the low pressure (LP) heads.
2	Using a fieldbus configuration application as the operator interface to device, set the Transducer block MODE_BLK parameter to O/S (Out of Service)
3	At the local meter, press and hold the ZERO button on the meter. The calibrated pressure measurement is displayed. NOTE: Units of the value displayed is inches of water. 
4	Press and release the DOWN pushbutton on the meter. This will zero correct the transmitter.
5	If calibration was successful: The pressure measurement shows zero on the meter display. CAL_POINT_LO = 0 (zero) CAL_SOURCE = User (2) If correction fails, the meter display will flash "err" for a few seconds and then display the calibrated pressure measurement. NOTE: Calibration will fail if transducer block is not O/S.
6	Release buttons and remove tube from HP and LP inputs.

Section 11 —Troubleshooting

11.1 Introduction

Section Contents

This section includes these topics

Section	Topic	See Page
11.1	Introduction	195
11.2	Overview	197
11.3	Device Troubleshooting	198
11.4	Transmitter Faults	204
11.5	Non-Critical Fault Summary	207
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11.7	Device Diagnostics	209
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11.9	Clearing Block Configuration Errors	215
11.10	Simulation Mode	217

About this section

this section contains information to guide you in identifying device faults and suggested actions to correct them. The approach to troubleshooting is geared toward determining the cause of the fault through definition of the symptoms (such as device not visible on network or not able to write values to parameters).

The information is organized the following way:

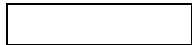
- **Device Troubleshooting** tables list some of the more commonly encountered faults and suggested things to check in order to find out where the problem is and correct it.
- **Transmitter status** tables define some of the conditions that cause critical or non-critical faults in the transmitter. **Critical and non-critical faults** are described and suggestions are given on where to find further information.
- **Device Diagnostics** briefly explains about some of the background diagnostics that are active in the device during normal operation. Device parameters are described, which provide information about hardware and software status within the device.
- **Block Configuration Errors** summarize conditions within the device that may be caused by configuration errors and suggestions on where to look to correct the errors.
- **Simulation Mode** tells you how to set up the transmitter to generate a user-defined simulated input. This feature is useful in debugging the system when the process is not running.

11.2 Overview

Device Status and Faults

ST 3000 transmitter is constantly running internal background diagnostics to monitor the functions and status of device operation. When errors and faults are detected, they are reported in the status bits of certain block parameters, (for example, BLOCK_ERR or ERROR_DETAIL). Other parameters can be viewed which show a status description and/or a value, which may help to identify a fault.

Device status and operational faults are identified by viewing key parameter values or status and then interpreting their meaning using the tables in this section.



Additional diagnostics may be available through supervisory and control applications that monitor and control fieldbus networks. These diagnostics and messages are dependent upon the capabilities of the application and control system you are using.

Troubleshooting with the NI-FBUS Configuration Tool

The diagnostic messages generated by the ST 3000 FF transmitter and block parameters can be accessed and evaluated using the NI-FBUS Configurator. Troubleshooting of some transmitter faults and corrective actions also can be performed using the configurator.

11.3 Device Troubleshooting

Device Not Visible on Network

If you cannot see a device on the fieldbus network, the device may not be powered up or possibly the supervisory or control program is not looking for (or polling) the node address of that device. See Table 77 for possible causes and recommended actions.

Table 77 Device Troubleshooting Table A

Symptom		
• Device not Visible on Network		
⇓		
Possible cause	Things to check	Recommended Action
Device may have a node address that is within the "unpolled range" of addresses.	Look at the following settings: • First Unpolled Node • Number of Unpolled Nodes	Set Number of Unpolled Nodes to "0".
No power to the device.	Measure the DC voltage at the device's SIGNAL terminals. Voltage must be within the limits as shown in Table 5.	If no voltage or voltage is out of operating limits, determine cause and correct.
Incorrect polarity at device terminals.	Check for proper voltage polarity to the device. • Fieldbus wire + to SIGNAL + • Fieldbus wire - to SIGNAL -	Correct the wiring to device terminals, if necessary.
Insufficient current to device	Measure DC current to device. It should be between 17 and 20 mA.	If current is insufficient, determine cause and correct.
More than two or less than two terminators wired to fieldbus link	Check to see that only two terminators are present on link.	Correct, if necessary.
Insufficient signal to device	Measure the peak-to-peak signal amplitude, it should be: • Output 0.75 to 1.0 Vp-p. • Input 0.15 to 1.0 Vp-p. Measure the signal on the + and - SIGNAL terminals and at a frequency of 31.25k Hz.	If signal amplitude is insufficient, determine the cause and correct.

Continued on next page

11.3 Device Troubleshooting Continued

Incorrect or Non-Compatible Tools

If you are using non-compatible versions of fieldbus software tools, such as Standard Dictionary or Device Description (DD) files, or if you are using the incorrect revision level of device firmware, then device objects or some block objects may not be visible or identified by name. See Table 78 for possible causes and recommended actions.

Table 78 Device Troubleshooting Table B

Symptom		
• Device and/or block objects not identified (UNKnown), or, • Parameters are not visible or identified by name, or • Honeywell-defined parameters are not visible.		
↓		
Possible cause	Things to check	Recommended Action
Incorrect Standard Dictionary, Device Description (DD) or Symbols on Host computer	Verify that the Standard Dictionary, the DD or symbols files are correct for the device.	Install the compatible version of Standard Dictionary and DD for the device on the host computer.
Incorrect pathnames to descriptions on host computer.	Check that the pathname to locations of the Standard Dictionary, and DD files on the host computer is correct.	Make sure that the pathname of the Standard Dictionary and DD are in the correct location for the fieldbus software application. (C:\. . . \release\48574C\0002)
Incorrect revision of Device Resource Block firmware	Read the following Resource block parameters: • DEV_REV (contains the revision level of the resource block). • DD_REV (contains the revision level of the resource block).	Perform a code download of the correct device firmware. See Section 9, Maintenance.
Incorrect revision level of the device firmware.	Read the three elements of the REVISION_ARRAY parameter, which are: • Stack board firmware • Stack board boot code • Transducer board firmware NOTE: The numbers, when viewed as hexadecimal numbers, are in the format "MMmm". Where, MM is the major revision number and mm is the minor revision number.	Perform a code download of the correct device firmware. See Section 9, Maintenance.

Continued on next page

11.3 Device Troubleshooting Continued

Non-Functioning Blocks

Device block objects may not be running (executing their function block schedules) or the blocks may be in Out of Service O/S mode. For example, if the AI function block is in O/S mode, the block will not provide updated output values although the AI block may be running. When troubleshooting non-functioning block objects, start with the resource block. For example, if the resource block is in O/S mode all other blocks in the device will also be in O/S mode. See Table 79 for possible causes and recommended actions.

Table 79 Device Troubleshooting Table C

Symptom		
• Device output is not updating.		
↓		
Possible cause	Things to check	Recommended Action
Resource block mode is OOS	Read MODE_BLOCK. ACTUAL of Resource block.	If necessary, Set MODE_BLOCK.TARGET to Auto.
Resource block is not running.	1. Read the first element of BLOCK_TEST. Number should be increasing indicating that block is running. If block is not running, check the 2nd element of BLOCK_TEST. 2. Check BLOCK_ERR for other errors. 3. If an error is present in BLOCK_ERR, then read ERROR_DETAIL.	If 2nd element of BLOCK_TEST is nonzero, write all zeroes to element. See Subsection 11.7 for details on BLOCK_ERR. See Subsection 11.7 for details on ERROR_DETAIL parameter. Set RESTART to Processor (or 4) to soft restart the device.
Incorrect revision of Resource block firmware.	Read DEV_TYPE , DEV_REV, and DD_REV.	See "Incorrect or non-compatible tools" above in Subsection 11.3.
Incorrect revision level of the device firmware.	Read REVISION_ARRAY.	See "Incorrect or non-compatible tools" above in Subsection 11.3.
Transducer block mode is OOS	Read MODE_BLK . ACTUAL.	Set MODE_BLK.TARGET to Auto. NOTE: Transducer block must be in Auto mode for the sensor signal to be passed to AI block.

Continued on next page

11.3 Device Troubleshooting Continued

Non-Functioning Blocks, Continued

Table 79 Device Troubleshooting Table C, continued

Symptom		
Device output is not updating.		
↓		
Possible cause	Things to check	Recommended Action
Transducer block is not producing valid primary data.	1. Read the 1 st element of BLOCK_TEST. Number should be increasing indicating that block is running. If block is not running, check the 2 nd element of BLOCK_TEST.	If 2 nd element of BLOCK_TEST is nonzero, write all zeroes to element.
	2. Read BLOCK_ERR.	See Subsection 11.7 for details on BLOCK_ERR.
	3. Verify parameter PRIMARY_VALUE is not valid STATUS = <i>Good</i> or <i>Uncertain</i> VALUE = active	Isolate transmitter from process and check calibration.
	4. Read SENSOR_TEMP. Should contain the sensor temperature.	Report information to Honeywell.
Analog Input block mode is OOS.	Read MODE_BLK.ACTUAL of AI block.	Set MODE_BLK.TARGET to Auto.
	Read WRITE_LOCK parameter in resource block. Check if device is in Write Protect mode. If WRITE_LOCK = Locked (2)	- Change Write Protect jumper to "W" position. (See Subsection 6.6.) - Reset the device. (Cycle power to transmitter or write "Processor" to RESTART parameter in Resource block.)
	Read CHANNEL parameter. If CHANNEL = 1, then read PRIMARY_VALUE_RANGE UNITS_INDEX = should contain the same units as XD_SCALE UNITS in the AI block. If CHANNEL = 2, then XD_SCALE UNITS and OUT_SCALE UNITS should = same units. When L_TYPE = Direct, XD_SCALE and OUT_SCALE should contain the same range values (EU_0 and EU_100).	

11.3 Device Troubleshooting Continued

Non-Functioning Blocks, Continued

Table 79 Device Troubleshooting Table C, continued

Symptom		
Device output is not updating. ↓		
Possible cause	Things to check	Recommended Action
Analog Input block mode is O/S. AI block is not initialized.	Check the following parameters: - ALERT_KEY. Should ≠ 0 - CHANNEL. Should ≠ 0 - L_TYPE. Should ≠ Uninitialized	The default values of these parameters are configuration errors and they must be set to a valid value. See “Clearing Block Configuration Errors”, Subsection 11.9.
	Read parameters: SIMULATE.ENABLE_DISABLE Should = Disable.	If SIMULATE.ENABLE_DISABLE = Enabled, write disable to parameter.
	Read parameters: - PV - FIELD_VAL Both parameter should be active and with a STATUS of <i>Good</i> or <i>Uncertain</i> .	?
Analog Input block is not running.	- Read the first element of BLOCK_TEST. Number should be increasing indicating that block is running. If block is not running, check the 2nd element of BLOCK_TEST. - Check if BLOCK_ERR bit 3 is set. - Read BLOCK_ERR	If 2 nd element of BLOCK_TEST is nonzero, write all zeroes to element. If bit 3 is set, verify that SIMULATE parameter in AI block is disabled. Verify that simulate jumper is not in simulate position. See Subsection 11.7 for details on BLOCK_ERR. Download a new function block schedule.

Continued on next page

11.3 Device Troubleshooting Continued

Non-Functioning Blocks, Continued

Table 78 Device Troubleshooting Table C, continued

Symptom		
• Device output is not updating. ↓		
Possible cause	Things to check	Recommended Action
PID block mode is O/S	Read MODE_BLK.ACTUAL of PID block.	Set MODE_BLK.TARGET to Auto
PID block is not running.	1. Read the first element of BLOCK_TEST. Number should be increasing indicating that block is running. If block is not running, check the 2 nd element of BLOCK_TEST.	If 2 nd element of BLOCK_TEST is nonzero, write all zeroes to element.
	2. Read BLOCK_ERR.	See Subsection 11.7 for details on BLOCK_ERR.
PID block is not initialized.	Read parameters: BYPASS SHED_OP	The default values of these parameters are configuration errors and they must be set to a valid range. See “Clearing Block Configuration Errors”, Subsection 11.9.
	Read parameters: IN.STATUS Should = <i>Good</i> OUT.STATUS Should = <i>Good</i>	

11.4 Transmitter Faults

Transmitter Diagnostics

Transmitter faults can be grouped into one of these three diagnostic categories and could cause the following results:

1. **Non-Critical Fault** — Transmitter continues to calculate PV output.
2. **Critical Fault** — Transmitter drives PV output to failsafe state.
3. **Block Configuration Errors** — Incorrect parameter values may cause the transmitter to generate a fault, (for example, BLOCK_ERR or MODE_BLK = OS.

A description of each condition in each category is given in the following tables. The condition is described, a probable cause is stated and a recommended corrective action is given for each fault.

XD_DIAG_DETAIL Parameter

The XD_DIAG_DETAIL parameter contains data indicating status relating to calibration, the measurement software in the transducer board and the sensor. See Table 80 for more details of the parameter.

Table 80 XD_DIAG_DETAIL Parameter Bit Mapping

Bit	Status	Category	Meaning	Transducer Status
0	Excess zero calibration	Non-critical	Zero correction factor is outside acceptable limits.	Uncertain/ Inaccurate
1	Excess span calibration	Non-critical	Span correction factor is outside acceptable limits.	
2	Excess calibrated range	Non-critical		
3	Meter body fault	Non-critical Critical	Pressure input is two times greater than Upper Range Limit of transmitter. OR Electronics module and meter body are incompatible.	
4	Characterization PROM fault	Critical	Characterization PROM not functioning properly.	
5	Suspect input	Non-critical	Input data seems wrong. Could be a process problem. Possible meter body or electronics-based problem.	
6	ROM fault	Critical	Memory error.	
7	Sensor over-temperature	Non-critical	Meter body temperature is too high. Accuracy and life span may decrease if it remains high.	Uncertain/ Inaccurate
8	Meter body overload	Non-critical	Pressure input is two times greater than URL of transmitter, or a possible sensor fault	Uncertain/ Inaccurate
9	Meter body overload			

11.4 Transmitter Faults Continued

Identifying Device Faults

Checking the status and values of key block parameters you can identify the type of device fault (critical or non-critical). Table 81 helps you identify the type of device fault and provides corrective action to restore normal operation.

Table 81 Identifying Critical and Non-critical Device Faults.

Block.Parameter	Value or Message *	Fault Type	Action
AI.OUT = STATUS =	Bad/sensor failure	Critical	1. Look in AI.BLOCK_ERR for message. (See Subsection 11.7 for details on BLOCK_ERR.) 2. Look in BLOCK_ERR of all blocks in device for message. 3. See Table 83, "Summary of Critical Faults."
	Bad/device failure	Critical	1. Look in AI.BLOCK_ERR for message. (See Subsection 11.7 for details on BLOCK_ERR.) 2. Look in BLOCK_ERR of all blocks in device for message. 3. See Table 83, "Summary of Critical Faults."
	Good/constant Uncertain	Non-critical	See Table 82, "Summary of Non-critical Faults."
AI.ALARM_SUM CURRENT =	Block alarm	Critical/ Non-critical	Look in BLOCK_ERR of all blocks in the device. See Subsection 11.7 for details on BLOCK_ERR.)
	Process alarm	Non-critical	See Table 82, "Summary of Non-critical Faults."

* Depending on the fieldbus interface application, device operating status and parameter values may appear as text messages. The text in the table is typical of values or messages seen when using the NI-FBUS configurator.

11.4 Transmitter Faults Continued

Table 81 Identifying Critical and Non-critical Device Faults, continued

Block.Parameter	Value or Message * (Bit number)	Fault Type	Action
All Blocks BLOCK_ERR = (See Table 85 for description of BLOCK_ERR messages)	Block Configuration Error (1)	Non-critical	Check the value of all configurable parameters in the block and correct if necessary. See Subsection 11.9 "Clearing Block Configuration Errors."
	Simulation Active (3)	Non-critical	Set "simulate jumper" to "N" on the electronics board, and set the ENABLE_DISABLE field to "1" of the SIMULATE parameter. (See Subsection 11.10)
	Input Failure/Process Variable has Bad Status (7)	Critical	Write Processor (or 4) to RESTART parameter of resource block. If failure is still present, replace meter body.
	Memory Failure (9)	Critical	Set Resource block to O/S Write Processor (or 4) to RESTART parameter. Wait 10 seconds. See Critical Fault NOTE.
	Lost Static Data (10)	Critical	
	Lost NV Data (11)	Critical	
	Readback Check Failed (12)	Critical	
	Out-of-Service (15)	Non-critical	Write proper mode to MODE_BLK parameter.
Unable to write values to valid device parameters		Configuration Error	See Subsection 11.9 "Clearing Block Configuration Errors" and Table 86, "Summary of Configuration Errors."

* Depending on the fieldbus interface application, device operating status and parameter values may appear as text messages. The text in the table is typical of values or messages seen when using the NI-FBUS configurator.

Critical Fault NOTE

In the case of a critical fault due to Memory Failure, Lost NV/Static data, or Readback check failure, you may need to write to the RESTART parameter twice for the transmitter to fully recover from the fault condition. Therefore:

1. Write "4" or "processor" to RESTART parameter of resource block.
2. Wait until communication is established. *
3. If the fault occurs again, Repeat the write to the RESTART parameter.
4. If the fault occurs again, Replace the transmitter electronics module.

* If a ROM error (Memory Failure) occurs in the resource block, it may take up to 10 seconds for the fault to reappear.

11.5 Non-Critical Fault Summary

Non-critical Failures Table 82 summarizes the conditions that could cause a non-critical fault in the ST 3000 FF transmitter along with recommended actions to correct the fault.

Table 82 Summary of Non-critical Faults

Problem/Fault	Probable Cause	Recommended Action
AI block is executing, but status of OUT parameter is:		
<i>Good::[alarm status]:Constant</i>	AI block is in Manual mode.	Write Auto to MODE_BLK parameter of AI block.
<i>Uncertain::[alarm status]:inaccurate</i>	- Transducer block parameter CAL_SOURCE = NONE, or a value of "1" (using default characterization values) - Excess span correction - correction at CAL_POINT_HI is greater than 5% of CAL_POINT_HI - Excess zero correction - correction at CAL_POINT_LO is greater than 5% of the "URL" (characterized range of the sensor) - Meter-body overload - pressure input is greater than two times the rated sensor pressure. - PV value of transducer block is outside range of XD_SCALE. (When AI block CHANNEL = 1) OR OUT value of AI block is outside of OUT_SCALE range.	Recalibrate transmitter. See Section 10. Recalibrate transmitter. See Section 10. Recalibrate transmitter. See Section 10. Reduce pressure at sensor. Check range and, if required, replace transmitter with one that has a wider range. Meter body may have been damaged. Check the transmitter for accuracy and linearity. Replace meter body and recalibrate, if needed.
One of the following AI alarms is active (in ALARM_SUM.CURRENT):	- HI_HI, HI, LO, LO_LO - OUT has crossed the corresponding limit (HI_HI_LIM, HI_LIM, LO_LIM, LO_LO_LIM), and is either still past the limit or is in the hysteresis range. (ALARM_HYS is the percentage of OUT_SCALE that is used for alarm hysteresis.) - Block alarm.	Reduce the value or increase limits. Check BLOCK_ERR for status bit. See Subsection 11.7 for details of BLOCK_ERR parameter.

11.6 Critical Fault Summary

Non-critical Failures Table 83 summarizes the conditions that could cause a critical fault in the ST 3000 FF transmitter along with recommended actions to correct the fault.

Table 83 Summary of Critical Faults

Problem/Fault	Probable Cause	Recommended Action
AI block is executing, but status of output is:		
<i>Bad::[alarm status]: sensor failure</i>	Transducer board generates: 1. Meter body fault 2. Characterization PROM fault 3. Electronics fault 4. Suspect input 5. Sensor over-temperature - sensor temperature is greater than 125 °C (257 °F)	1. and 2. Write "4" or "processor" to RESTART parameter of resource block. If failure is still present, replace meter body. 3. and 4. Write "4" or "processor" to RESTART parameter of resource block. If failure is still present, replace transmitter electronics module. 5. Reduce temperature at sensor. Take steps to insulate meter body from temperature source.
<i>Bad::[alarm status]: device failure</i>	Transducer board has stopped communicating with the stack board.	Write "4" or "processor" to RESTART parameter of resource block. If failure is still present, replace transmitter electronics module.
BLOCK_ALM of the Transducer Block is active	Check BLOCK_ERR for status message.	See Subsection 11.7 for details of BLOCK_ERR parameter.
BLOCK_ALM of the Resource Block is active	Check BLOCK_ERR for status message.	See Subsection 11.7 for details of BLOCK_ERR parameter.

11.7 Device Diagnostics

ST 3000 FF Memory

The ST 3000 FF contains a number of areas of memory. An EEPROM provides a non-volatile memory area for static and non-volatile parameter values. The transmitter also contains areas of RAM and ROM.

Background Diagnostics

Block objects (Resource, Transducer and Function blocks), the communications stack and other device objects each have a designated area of memory where their database resides. Diagnostic routines are performed in the background during device operation which check the integrity of these individual databases. When a failure is detected, a status bit is set in the BLOCK_ERR parameter in the appropriate block object.

Diagnostic checks are performed continuously on the device functional databases of the transmitter application shown in Table 84.

Table 84 Areas of Device Memory Where Data is Stored.

Device Functional Area	Location
Block object database (DB)	RAM and EEPROM
Communication stack database (DB)	EEPROM
Boot ROM	ROM
Program ROM	ROM
Trend and link object databases (DB)	EEPROM

BLOCK_ERR parameter

BLOCK_ERR parameter shows diagnostic faults of hardware and software components within the transmitter. Each block object in the transmitter device application contains a BLOCK_ERR parameter. BLOCK_ERR is actually a bit string which provides a means to show multiple status or error conditions. A status message identifying the fault can be viewed by accessing the parameter. Table 85 shows the bit mapping of the BLOCK_ERR parameter.

Background Diagnostics Execution, BLOCK_TEST parameter

To verify that block and background diagnostics are executing in a particular block:

View the BLOCK_TEST parameter of the block.

- If the first element of the parameter (BLOCK_TEST =) is incrementing, the block is executing and the diagnostics are active.
- If the first element value is not increasing, the block is not executing.

Continued on next page

11.7 Device Diagnostics Continued

Table 85 BLOCK_ERR ParameterBit Mapping

BLOCK_ERR Bit	Value or Message *	Description
0	<i>Not used</i>	(least significant bit) (LSB)
1	Block configuration error	Invalid parameter value in block. See "Clearing Block configuration Errors."
2	<i>Not used</i>	
3	Simulate parameter active	The SIMULATE parameter is being used as the input to the AI block. This occurs if the "simulate jumper" is set to "Y" on the electronics board, and the ENABLE_DISABLE field of the SIMULATE parameter is set to 2. See Subsection 11.10 also.
4	<i>Not used</i>	
5	<i>Not used</i>	
6	<i>Not used</i>	
7	Input failure/process variable has BAD status	Sensor failure
8	<i>Not used</i>	
9	Memory failure	- Block database (DB) error or - ROM failure (Resource block only)
10	Lost static data	- Block Non-Volatile (NV) memory failure - Stack NV memory failure - Link or Trend objects NV memory failure
11	Lost NV data	- EEPROM write to block DB failed - EEPROM write to Stack DB failed (Resource block only) - EEPROM write to Link or Trend DB failed (Resource block only)
12	Readback check failed (Checksum error)	Communication failure to serial EEPROM (Resource block only)
13	<i>Not used</i>	
14	<i>Not used</i>	
15	Out-of-service	Out of Service - The block's actual mode is O/S (most significant bit) (MSB)

* Depending on the fieldbus interface application, device operating status and parameter values may appear as text messages. The text in the table is typical of values or messages seen when using the NI-FBUS configurator.

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11.7 Device Diagnostics Continued

ERROR_DETAIL parameter

ERROR_DETAIL parameter in the resource block contains data that describes the cause of any device-critical error. This category of error will cause the resource block to remain in O/S actual mode regardless of its target mode. This in turn causes all other blocks to remain in O/S actual mode.

ERROR_DETAIL is an array of three unsigned integers, each 16 bits in size. The three sub-elements are generally defined as follows:

- 1 - Error Type
- 2 - Location
- 3 - Sub-type

ERROR_DETAIL Enumeration

Table 86 lists the enumerated values for the Error Type element only. The Location and Sub-type elements have no significant meaning for users.

Table 86 ERROR_DETAIL Parameter Enumeration

ERROR_DETAIL	Message
0	No error
1	HC11 ROM checksum
2	HC16 boot ROM checksum
3	HC16 application ROM checksum
4	Interprocessor error (startup)
5	Interprocessor error (operation)
6	EEPROM corrupt (background diagnostics)
7	EEPROM driver error
8	EEPROM - fieldbus write
9	Sensor error
10	Internal software error
11	Other

Using ERROR_DETAIL for Troubleshooting

If there is a critical error in the resource block you should read and record the ERROR_DETAIL value. Then reset the device (Write RESTART parameter "Processor"). Wait 30 seconds after reset and read ERROR_DETAIL again to check if error cleared and then Call Honeywell Technical Assistance Center.

11.8 Block Configuration Errors

Configuration Errors

Block configuration errors prevent a device block from leaving O/S mode. The BLOCK_ERR parameter (bit 1) shows whether a block configuration error is present. Table 87 summarizes the conditions that may be the result of block configuration errors, which in turn cause a device fault. Follow the recommended actions to correct these errors.

Table 87 Summary of Configuration Errors

Problem/Fault	Probable Cause	Recommended Action
Name of parameters are not visible	Missing or incorrect version of Device Description file on host computer.	1. Check path to Device Description. 2. Load correct version of DD.
Unable to write successfully to MODE_BLK of any block.	Mode not supported in TARGET and/or PERMITTED modes for the given block.	• Verify that the mode being written is supported by the block. • If writing TARGET mode only, then the desired mode must already be set in the PERMITTED field. • If writing the whole MODE_BLK record, then the mode set in TARGET must also be set in the PERMITTED field. Other modes may also be set in the PERMITTED field, but target mode must be set.
Unable to write to a parameter	1. Parameter is read-only. 2. Subindex of the parameter is read-only. Some parameters have fields that are not writeable individually (such as MODE_BLK.ACTUAL). 3. Write-locking is active. Resource block parameter WRITE_LOCK value is 2. 4. Corresponding block is in the wrong mode. Some parameters can only be written to in O/S mode only, or in O/S or Manual modes. 5. Data written to the parameter is out of the valid range for that parameter. 6. Subindex used is invalid for that parameter	1. None 2. None 3. Remove write protect jumper (see Subsection 6.6) 4. Write valid mode to MODE_BLK parameter of block (O/S or MAN modes). See "Mode Restricted Writes to Parameters" in Subsections 8.6 and 8.7. 5. Write valid range values to parameter. 6. Enter valid subindex for parameter.

Continued on next page

11.8 Block Configuration Errors Continued

Table 87 Summary of Configuration Errors, continued

Problem/Fault	Probable Cause	Recommended Action
Unable to change Resource block to Auto mode	The second element of BLOCK_TEST is non-zero.	Write all zeroes to the second element of the BLOCK_TEST parameter.
Unable to change Transducer block to Auto mode	1. Resource block is in O/S mode 2. The second element of BLOCK_TEST is non-zero. 3. There is a configuration error in the block.	1. Write Auto mode to MODE_BLK.TARGET of the Resource block. 2. Write all zeroes to the second element of the BLOCK_TEST parameter. 3. Find and correct any configurable parameter outside its valid range. See "Clearing Block Configuration Errors" in Subsection 11.9.
Unable to change Analog Input block from O/S mode	1. The block has not been configured to execute. It is neither in the function block schedule in the System Management Information Base, nor is it linked to another executing block via the "next block to execute" field in the block record (relative parameter index "0"). 2. Resource block is in O/S mode. 3. Block configuration error.	1. Build and download an execution schedule for the block including links to and from AI block with other function blocks. 2. Write Auto mode to MODE_BLK of resource block. 3. a. Check the parameters ALERT_KEY, CHANNEL, and L_TYPE. All values must be non-zero. b. BLOCK_ERR for Bit 1 set. If set, check all configurable parameters for possible invalid values. See "Clearing Block Configuration Errors" in Subsection 11.9.

Continued on next page

11.8 Block Configuration Errors Continued

Table 87 Summary of Configuration Errors, continued

Problem/Fault	Probable Cause	Recommended Action
Unable to change Analog Input block from O/S mode, <i>Continued</i>	5. XD_SCALE UNITS_INDEX is not equal to the Transducer block output units. 6. The second element of BLOCK_TEST is non-zero.	5. a. If CHANNEL value is 1, then XD_SCALE units must equal the units in transducer block parameter PRIMARY_VALUE_RANGE. b. If CHANNEL value is 2, then the units must equal % (1342). 6. Write all zeroes to the second element of the BLOCK_TEST parameter.
AI Block is in the correct mode but does not seem to be operating	1. Simulation active. 2. The block has not been configured to execute. It is neither in the function block schedule in the System Management Information Base, nor is it linked to another executing block via the "next block to execute" field in the block record (relative parameter index "0"). 3. The second element of BLOCK_TEST is non-zero.	1. Disable simulation. See Subsection 11.10 for procedure. 2. Build and download an execution schedule for the block including links to and from AI block with other function blocks. 3. Write all zeroes to the second element of the BLOCK_TEST parameter.

11.9 Clearing Block Configuration Errors

Clearing Block Configuration Errors

Tables 88 and 89 list the parameters in the AI and PID blocks that can cause the status bit of Block Configuration Error to be set in their respective BLOCK_ERR parameters. The tables also provide the initial values and the valid range for the parameters.

NOTE: Block configuration errors can only be cleared if the function block is being executed (running). One way of determining block execution is by doing a series of two or three reads of the BLOCK_TEST parameter and confirming that the first byte of the parameter is incrementing. This will work if the execute rate is fast relative to the speed of reading BLOCK_TEST. A very slowly executing block may not *appear* to execute because block parameters are updated only when the block executes.

Table 88 AI Block Parameters

Parameter	Initial Value	Valid Range	Corrective Action
ALERT_KEY	0	non-zero	<i>Initial Value is a configuration error</i> Set value to non-zero number.
SIMULATE	1 (disabled)	1-2 (disabled -enabled)	Set value in valid range.
XD_SCALE	0 to 100 inches of water	EU_100 > EU_0, UNITS_INDEX matches output of transducer block	Set values to valid range(s).
OUT_SCALE	0 to 100 inches of water	EU_100 > EU_0	Set values to valid range.
CHANNEL	0	1-2	<i>Initial Value is a configuration error</i> Set value to valid range.
L_TYPE	0 (Uninitialized)	1,2,3 (direct, indirect, sq. root)	<i>Initial Value is a configuration error</i> Set value to valid range.
PV_FTIME	0	0-200	Set value to valid range.
ALARM_HYS	0.5 (%)	0-50 (%)	Set value to valid range.
HI_HI_PRI, HI_PRI, LO_LO_PRI, LO_PRI	0	0-15	Set value to valid range.
HI_HI_LIM, HI_LIM	+INF	+INF or within OUT_SCALE range	Set value to valid range.
LO_LIM, LO_LO_LIM	-INF	-INF or within OUT_SCALE range	Set value to valid range.

11.9 Clearing Block Configuration Errors Continued

Table 89 PID Function Block Parameters

Parameter	Initial Value	Valid Range	Corrective Action
BYPASS	0	1:OFF, 2:ON	<i>Initial value is a configuration error.</i> Set value in valid range.
SHED_OPT	0	1-8 (see Shed Options in the FF specs.)	<i>Initial value is a configuration error.</i> Set value in valid range.
HI_HI_LIM HI_LIM	+INF +INF	PV_SCALE, +INF	Values must be set in rank order. e.g. LO_LIM > LO_LO_LIM but < HI_LIM etc.
LO_LIM LO_LO_LIM	-INF -INF	PV_SCALE, -INF	Values must be set in rank order.
OUT_HI_LIM OUT_LO_LIM	100 0	OUT_SCALE +/- 10%	Verify that OUT_HI_LIM > OUT_LO_LIM.
SP_HI_LIM SP_LO_LIM	100 0	PV_SCALE +/- 10%	Verify that SP_HI_LIM > SP_LO_LIM.

11.10 Simulation Mode

Simulation Mode Jumper

A simulation mode is available in the transmitter that is used to aid in system debug if the process is not running. When simulation mode is enabled, the SIMULATE parameter in the AI block provides a user-selected value as the input to the AI block.

WARNING

Setting Simulation Jumper

A hardware jumper on the transducer board is set to enable or disable the SIMULATE parameter. See Figure 31 for jumper location. Table 90 shows how to set the simulation jumper on the transducer board.

Figure 31 Simulation Jumper Location on Transducer Board

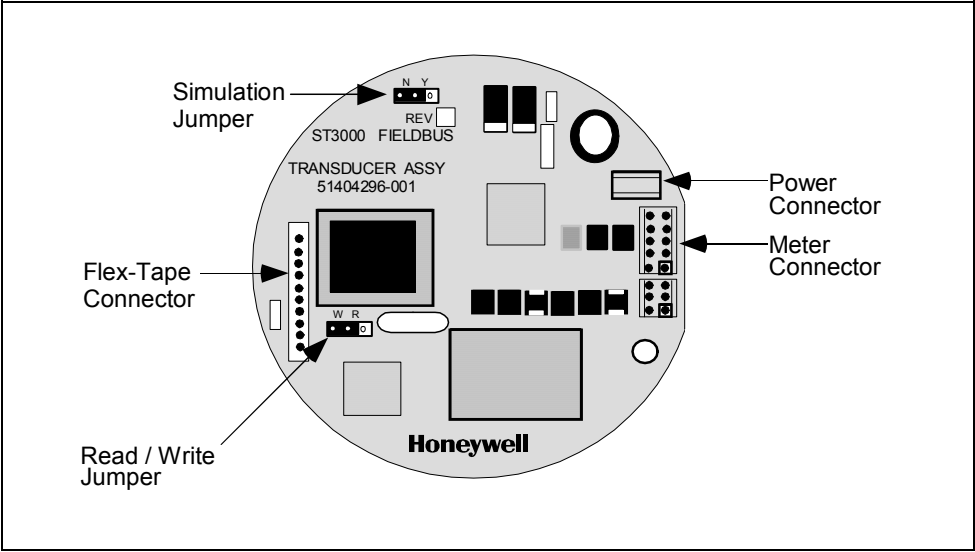


Table 90 Setting the Simulation Jumper.

To	Set the Jumper to:	
Disable the SIMULATE parameter. (Set transmitter for normal operation.)	"N" position on the Transducer board.	N Y
Enable the SIMULATE parameter. (For testing or debugging purposes)	"Y" position on the Transducer board.	N Y

Continued on next page

11.10 Simulation Mode Continued

Enabling Simulation Mode

The SIMULATE parameter is enabled by setting the hardware simulation jumper to the “Y” position.

Additionally, AI block SIMULATE parameter must be set to the following values:

SIMULATE

STATUS = *Good::[alarm status]:constant* (suggested setting)
SIMULATE_VALUE = (supplied by user) Used as the input to the AI block.
ENABLE_DISABLE = Active Enabled

Simulation Mode Truth Table

The truth table in Table 91 shows the states of the simulation jumper and SIMULATE parameter to activate the simulation mode.

Table 91 Simulation Mode Truth Table

When the Simulation Jumper on Transducer board is set to:	— and the SIMULATE Enable_Disable is set to:	
	1 (Disabled)	2 (Active)
“N” Position	Simulation Disabled	Simulation Disabled
“Y” Position	Simulation Disabled	Simulation Active

AI Block Mode

To connect the AI block input to the output, the AI block must be in AUTO mode.

Section 12 —Parts List

12.1 Replacement Parts

Part Identification

- All individually salable parts are indicated in each figure by key number callout. For example, 1, 2, 3, and so on.
- All parts that are supplied in kits are indicated in each Figure by key number callout with the letter “K” prefix. For example, K1, K2, K3, and so on.
- Parts denoted with a “†” are recommended spares. See Table 103 for summary list of recommended spare parts.

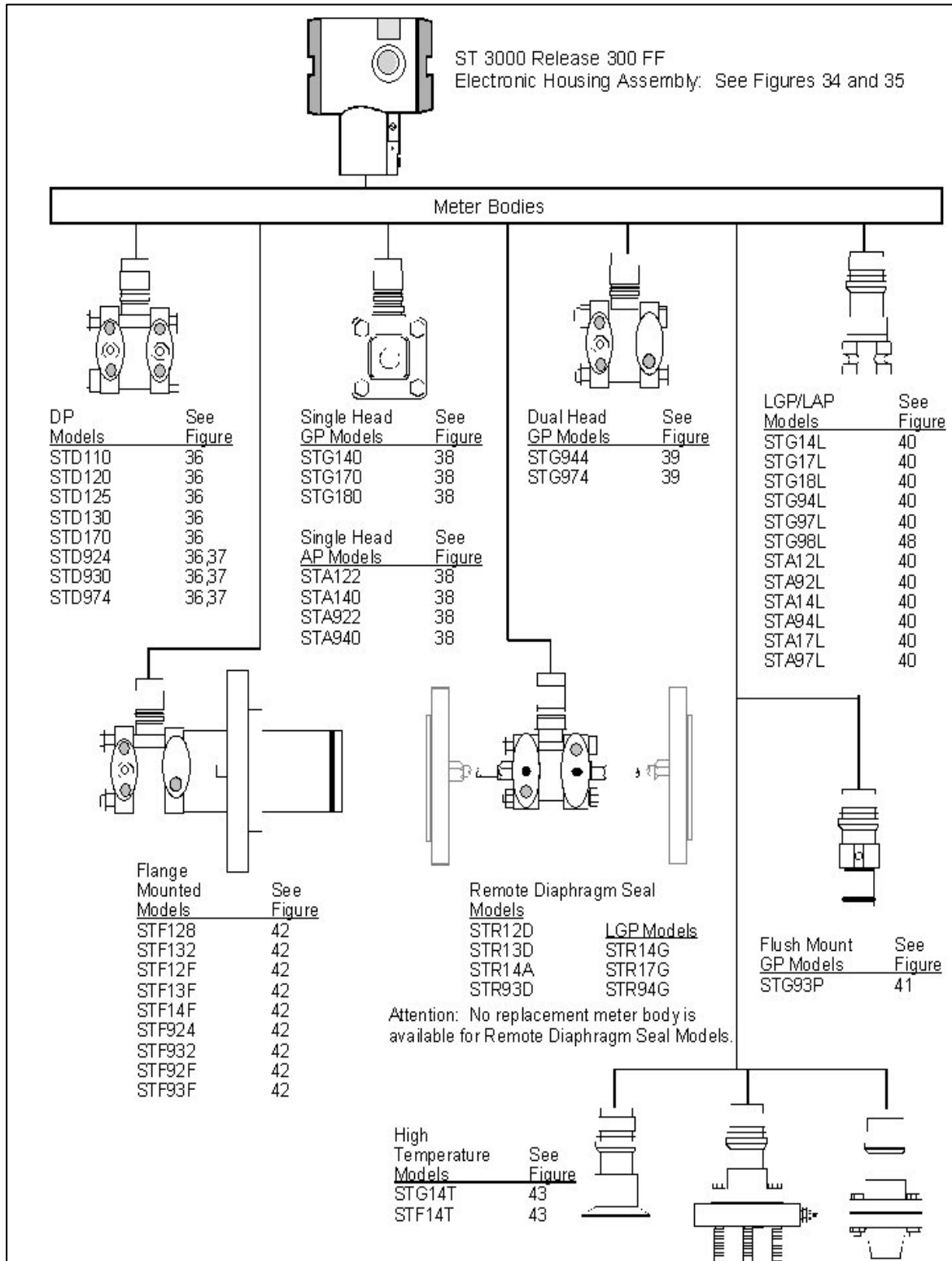
Figure 32 shows major parts for given model with parts list Figure references.

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12.1 Replacement Parts Continued

Figure 32 Major ST 3000 FF Smart Transmitter Parts Reference.

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12.1 Replacement Parts Continued

Figure 33 ST 3000 Mounting Bracket Parts Reference

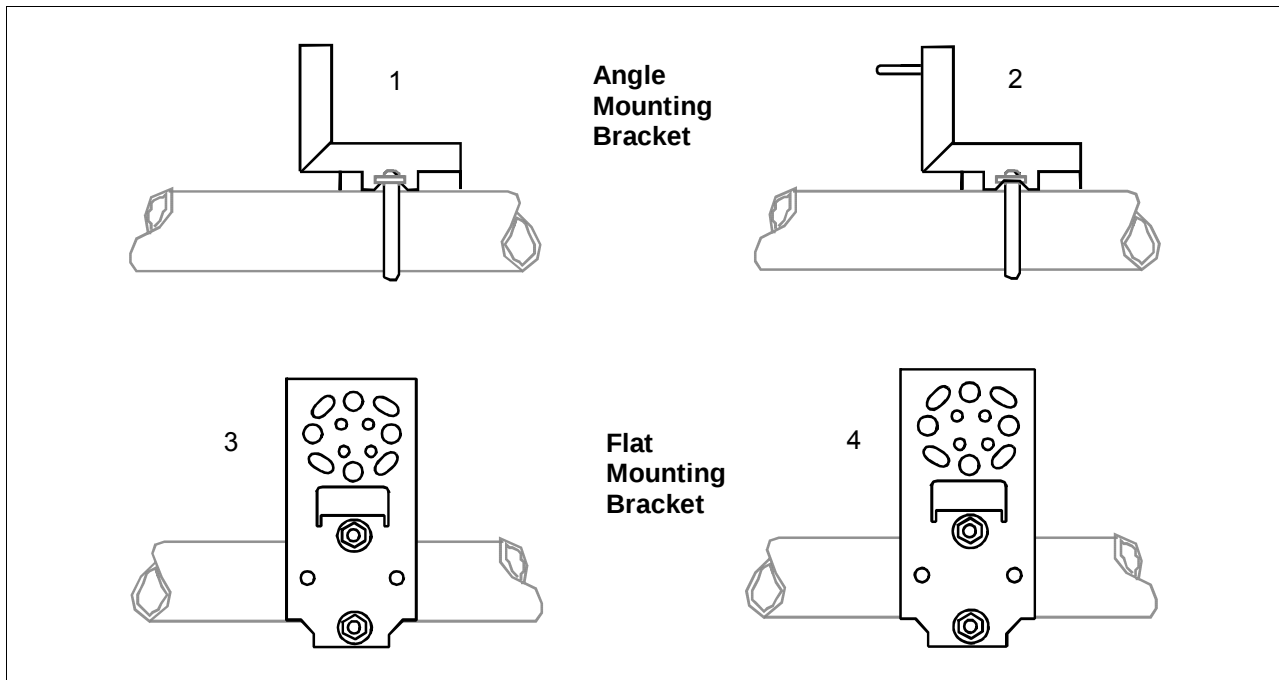


Table 92 ST 3000 Mounting Brackets Parts Reference

Key No.	Part Number	Description	Quantity Per Unit
1	30752770-003	Angle Bracket Mounting Kit for all models except LGP and Flush mount	
2	30752770-004	Angle Bracket Mounting Kit for models LGP, Flush mount, STR14G, STR17G, and STR94G	
3	51196557-001	Flat Bracket Mounting Kit for all models except LGP and Flush Mount	
4	51196557-002	Flat Bracket Mounting Kit for all models LGP, Flush mount, STR14G, STR17G, and STR94G	

12.1 Replacement Parts Continued

Figure 34 Series 100 and 900 Electronics Housing – Electronics/Meter End.

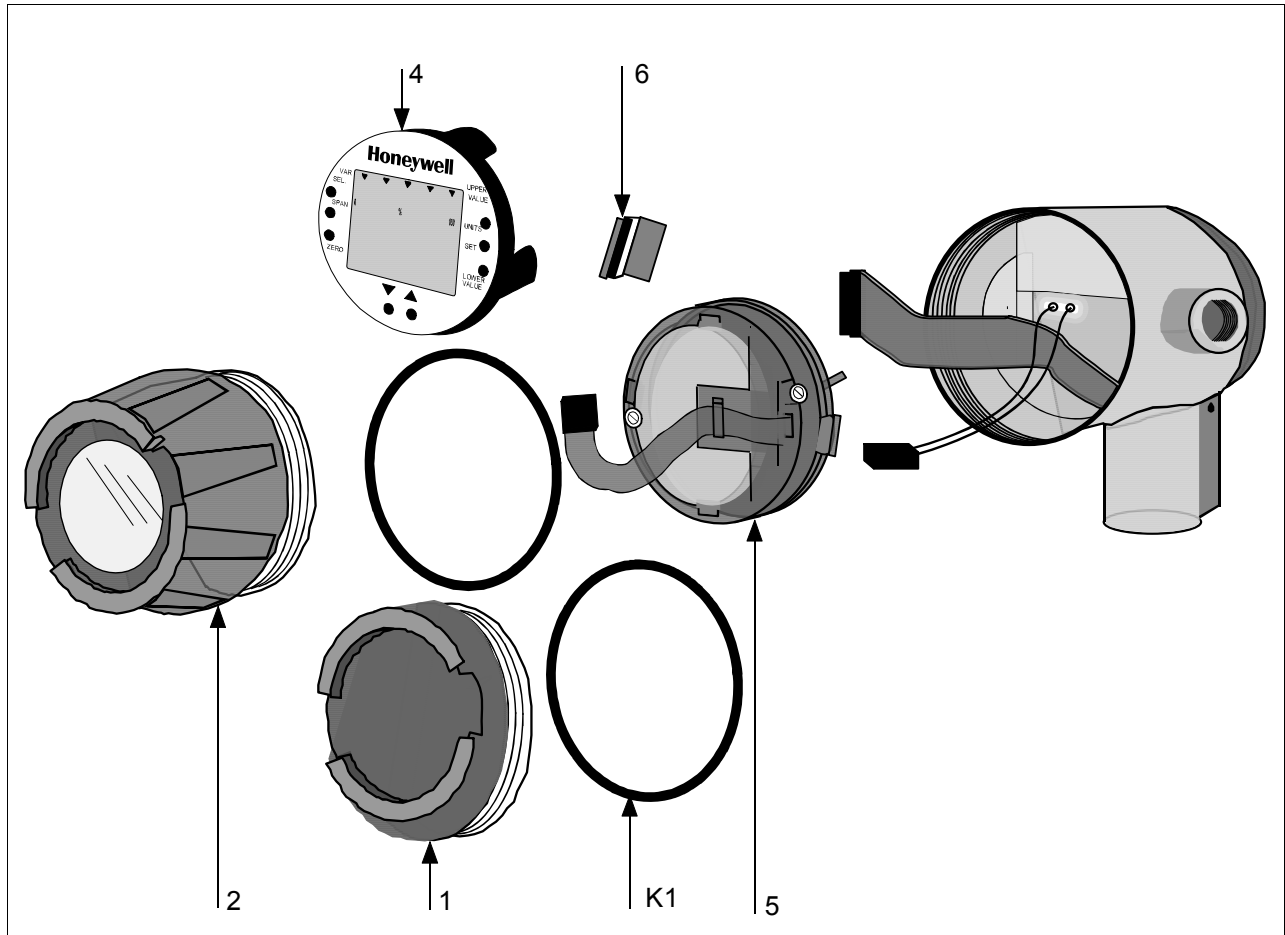
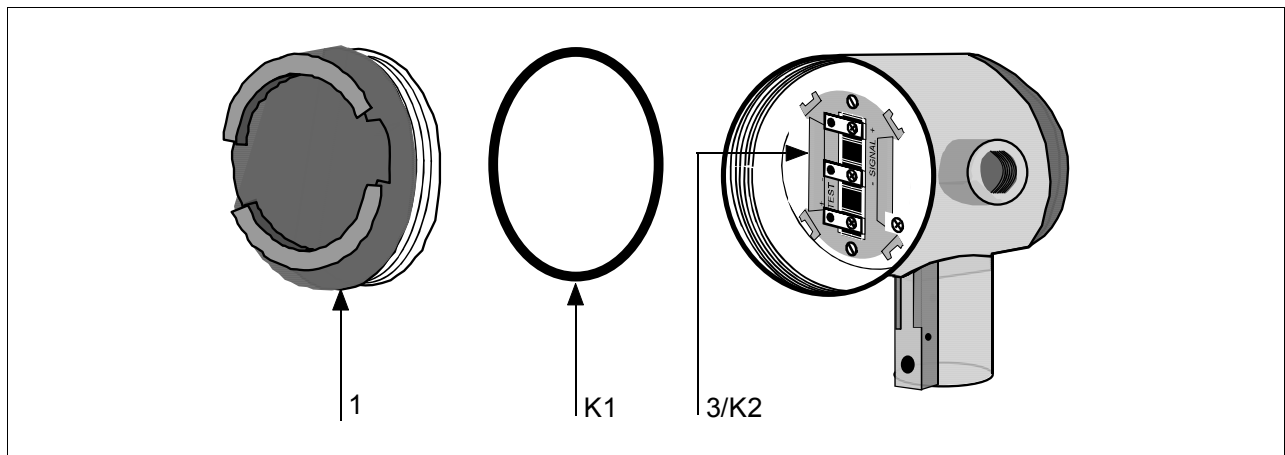


Figure 35 Series 100 and 900 Electronics Housing – Terminal Block End



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12.1 Replacement Parts, Continued

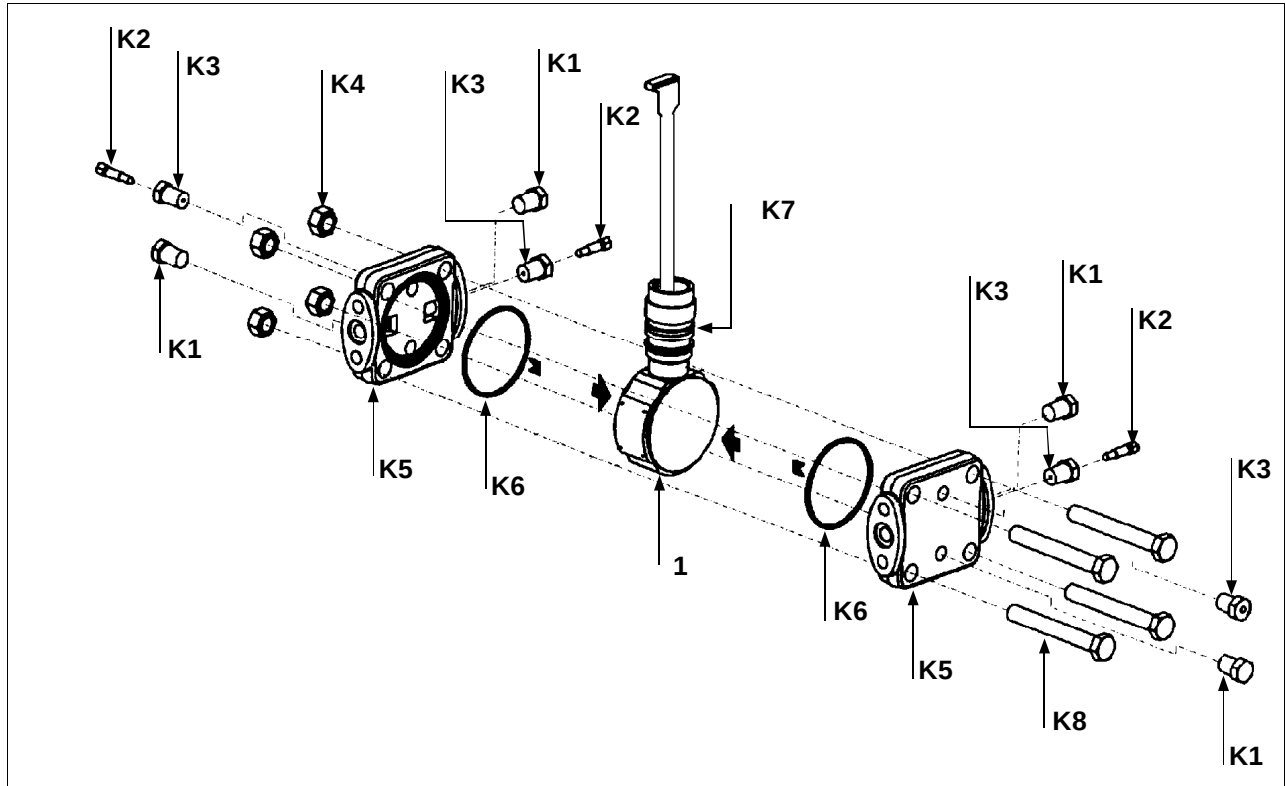
Table 93 Parts Identification for Callouts in Figures 34 and 35

Key No.	Part Number	Description	Quantity Per Unit
1	30756961-501 30756961-502	Cap for Series 900 only Cap for Series 100 only	1
2	30756996-501 30756996-502	Cap, meter for Series 900 only Cap, meter for Series 100 only	1
3	51205897-501† 51404078-502†	Terminal assembly without lightning protection Terminal assembly with lightning protection	1
4	51309441-501	Electronics Module Assembly	1
5	51309389-502 51309389-503	Local Smart Meter Only Local Smart Meter With Zero and Span Adjust	1
6	51204038-001	Retaining Clip	1
K1	30757503-001†	Electronics housing seals kit (includes O-rings)	
K2	51197425-001 51197425-002	Terminal assembly without lightning protection conversion kit (includes screws, cover, and terminal block) Terminal assembly with lightning protection conversion kit (includes screws, cover, and terminal block)	
Not Shown	30757504-001	Electronics housing hardware kit, DP/I, GP/I, LGP/I (includes screws, gasket, plate, washers, cover terminal, and spacers)	

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12.1 Replacement Parts, Continued

Figure 36 Series 100 and Series 900 DP Meter Body for Models STD924 & STD930 C, D, G, H, K, and L and STD974



Continued on next page

12.1 Replacement Parts, Continued

Table 94 Parts Identification for Callouts in Figure 36.

Key No.	Part Number	Description	Quantity Per Unit
1	Specify complete model number from nameplate.	Series 100 replacement meter body without heads	1
	Specify complete model number from nameplate.	Series 900 replacement meter body without heads	1
2	30757104-001	Adapter, meter body to electronics housing	1
	30753790-001	Carbon steel bolts and nuts kit	
	Not Shown	Bolt, hex head, 7/16-20 UNF, 1.375 inches lg., flange adapter	4
K4		Nut, hex, metric, M12, process heads	4
K8		Bolt, hex head, metric, M12, 90mm lg., process heads	4
	30753791-002	A286 SS (NACE) bolts and 302/304 SS (NACE) nuts kit	
	Not Shown	Bolt, hex head, 7/16-20 UNF, 1.375 inches lg., flange adapter	4
K4		Nut, hex, metric, M12, process heads	4
K8		Bolt, hex head, metric, M12, 90mm lg., process heads	4
	30753785-001	St. steel vent/drain and plug kit	
K1		Pipe plug	4
K2		Vent plug (all except model STD110)	2
K3		Vent bushing (all except model STD110)	2
	30753787-001	Monel vent/drain and plug kit	
K1		Pipe plug	4
K2		Vent plug (all except model STD110)	2
K3		Vent bushing (all except model STD110)	2
	30753786-001	Hastelloy C vent/drain and plug kit	
K1		Pipe plug	4
K2		Vent plug (all except model STD110)	2
K3		Vent bushing (all except model STD110)	2
	30753788-003†	Process head gasket kit (PTFE material)	
	30753788-004†	Process head gasket kit for (Viton material)	
K6		Head gasket [For gasket only: 30756445-501 (PTFE, quantity 12) or 30749274-501 (6 Viton head O-rings and 6 Viton flange adapter O-rings)]	6
K7		O-ring	3
K9		Gasket, flange adapter (for gasket only: 30679622-501, 6 Teflon; or 30749274-002, 6 Viton)	6

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12.1 Replacement Parts, Continued

Table 94 Parts Identification for Callouts in Figure 36, continued

Key No.	Part Number	Description	Quantity Per Unit
Optional Flange Adapter Kits (two heads) – Not Shown			
	30754419-002	Flange adapter kit (st. steel flange adapters with carbon steel bolts)	
	30754419-004	Flange adapter kit (Monel flange adapters with carbon steel bolts)	
	30754419-018	Flange adapter kit (st. steel flange adapters with 316 st. steel bolts)	
	30754419-020	Flange adapter kit (Monel flange adapters with 316 st. steel bolts)	
K9	Not Shown	Bolt, hex head, 7/16-20 UNF, 1.375 inches lg., flange adapter	4
K11		Gasket, flange adapter	2
K10		Flange adapter	2
K12		Filter screen	2
	30754419-003	Flange adapter kit (Hastelloy C flange adapters with carbon steel bolts)	
	30754419-019	Flange adapter kit (Hastelloy C flange adapters with 316 st. steel bolts)	
K9	Not Shown	Bolt, hex head, 7/16-20 UNF, 1.375 inches lg., optional flange adapter	4
K11		Gasket, flange adapter	2
K10		Flange adapter	2
Process Head Kits (one head with PTFE head gasket)			
	30753908-001	Process head assembly kit (Hastelloy C head)	
	30753908-002	Process head assembly kit (Hastelloy C DIN head)	
	30753908-003	Process head assembly kit (carbon steel head with side vent/drain)	
	30753908-004	Process head assembly kit (st. steel head with side vent/drain)	
	30753908-005	Process head assembly kit (Monel head)	
	30753908-009	Process head assembly kit (carbon steel head without side vent/drain)	
	30753908-010	Process head assembly kit (stainless steel head without side vent/drain)	
	30753908-011	Process head assembly kit (stainless steel DIN head without side vent/drain)	
	30753908-012	Process head assembly kit (carbon steel head – model STD110 only)	
	30753908-013	Process head assembly kit (st. steel head – model STD110 only)	
	30753908-014	Process head assembly kit (carbon steel DIN head – model STD110 only)	
	30753908-015	Process head assembly kit (st. steel DIN head – model STD110 only)	
K1		Pipe plug	2
K2		Vent plug	1
K3		Vent bushing	1
K5		Process head	1
K6		Gasket (PTFE), process head	1
K11		Gasket (PTFE), optional flange adapter	1

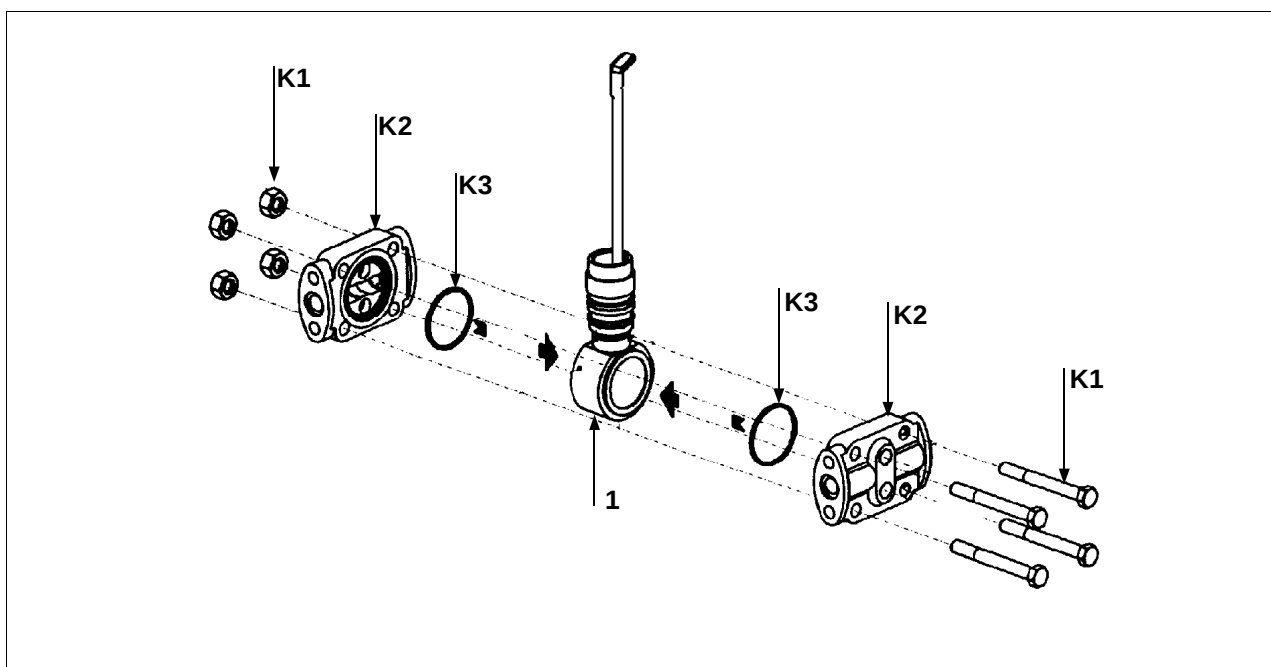
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12.1 Replacement Parts, Continued

Table 94 Parts Identification for Callouts in Figure 36, continued

Key No.	Part Number	Description	Quantity Per Unit
Process Head Kits (one head with Viton head gasket)			
	30753908-101	Process head assembly kit (Hastelloy C head)	
	30753908-102	Process head assembly kit (Hastelloy C DIN head)	
	30753908-103	Process head assembly kit (carbon steel head with side vent/drain)	
	30753908-104	Process head assembly kit (st. steel head with side vent/drain)	
	30753908-105	Process head assembly kit (Monel head)	
	30753908-109	Process head assembly kit (carbon steel head without side vent/drain)	
	30753908-110	Process head assembly kit (stainless steel head without side vent/drain)	
	30753908-111	Process head assembly kit (stainless steel DIN head without side vent/drain)	
	30753908-112	Process head assembly kit (carbon steel head – model STD110 only)	
	30753908-113	Process head assembly kit (st. steel head – model STD110 only)	
	30753908-114	Process head assembly kit (carbon steel DIN head – model STD110 only)	
	30753908-115	Process head assembly kit (st. steel DIN head – model STD110 only)	
K1		Pipe plug	2
K2		Vent plug	1
K3		Vent bushing	1
K6		Gasket (Viton), process head	1
K11		Gasket (PTFE), flange adapter	1
K5		Process head	1

Figure 37 Series 900 DP Meter Body for Models STD924 & STD930 A, B, E, F, and J



Continued on next page

12.1 Replacement Parts, Continued

Table 95 Parts Identification for Callouts in Figure 37

Key No.	Part Number	Description	Quantity Per Unit
1	Specify complete model number from nameplate.	Series 900 replacement meter body without heads	1
K1	30757506-001	Head bolts carbon steel Kit includes: Bolts, Nuts	4
	30757507-001	Head bolts stainless steel/NACE Kit includes: Bolts, Nuts	4
	30757507-002	Process Head Bolting 3/8 UNC 316 SS Non-NACE Kit Includes: Process Head Bolts and Nuts	4
K2	30757147-001†	Replacement heads carbon steel Kit includes: Heads with side vents, Head gaskets Teflon, head gaskets Viton, Plugs, Bushings, Vent plugs, Gaskets	
	30757147-002	Replacement heads carbon steel Kit includes: Heads without side vents, Head gaskets Teflon, head gaskets Viton, Bushings, Vent plugs, Gaskets	
	30757148-001	Replacement heads stainless steel Kit includes: Heads with side vents, Head gaskets Teflon, Head gaskets Viton, Plugs, Bushings, Vent Plugs, Gaskets	
	30757148-002	Replacement heads stainless steel Kit includes: Heads without side vents, Head gaskets Teflon, Head gaskets Viton, Bushings, Vent Plugs, Gaskets	
	30757149-001	Replacement heads Hastelloy Kit includes: Heads with side vents, Head gaskets Teflon, Head gaskets Viton, Plugs, Bushings, Vent plugs, Gaskets	
	30757500-001	Replacement heads Monel Kit includes: Head with side vents, Head gasket Teflon, Head gasket Viton, Plugs, Bushings, Vent plugs, Gaskets	
K3	30757505-001†	Process Head Gasket Kit Kit includes: 6 Teflon head gaskets (30757100-001), 6 Viton head gaskets (30749274-004), and 6 Teflon flange adapter gaskets (30679622-501)	
Optional Flange Adapter and Flange Adapter Gaskets - Not Shown			
	30679622-501	Flange adapter gaskets Teflon	6
	30749274-502	Flange adapter gaskets Viton	6
	30754419-002	Flange adapter kit (st. steel flange adapters with carbon steel bolts)	
	30754419-018	Flange adapter kit (st. steel flange adapters with 316 st. steel NACE bolts)	
K9	Not Shown	Bolt, hex head, 7/16-20 UNF, 1.375 inches lg., flange adapter	4
K11	Not Shown	Gasket, flange adapter	2
K10	Not Shown	Flange adapter	2
K12	Not Shown	Filter screen	2
	30754419-003	Flange adapter kit (Hastelloy C flange adapters with carbon steel bolts)	
	30754419-019	Flange adapter kit (Hastelloy C flange adapters with 316 st. steel NACE bolts)	
K9	Not Shown	Bolt, hex head, 7/16-20 UNF, 1.375 inches lg., optional flange adapter	4
K11	Not Shown	Gasket, flange adapter	2
K10	Not Shown	Flange adapter	2

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12.1 Replacement Parts, Continued

Figure 38 Series 100 GP and AP Meter Bodies and Series 900 AP Meter Body

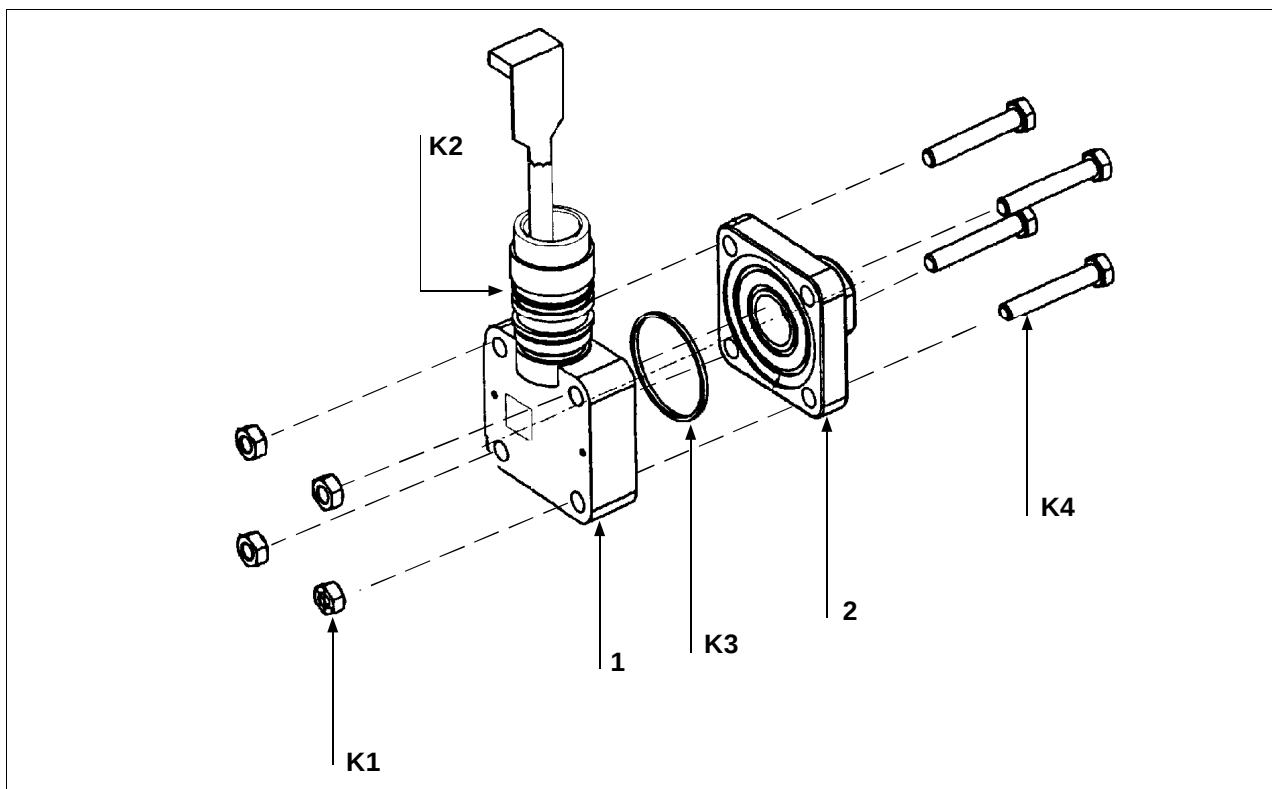


Table 96 Parts Identification for Callouts in Figure 38

Key No.	Part Number	Description	Quantity Per Unit
2	See Table 97.	Process head (GP/AP models)	1
1	Specify complete model number from nameplate.	Series 100 replacement meter body without head (GP/AP Models)	1
	Specify complete model number from nameplate.	Series 900 replacement meter body without head (GP/AP Models)	1
Key No.	Part Number	Description	Quantity Per Kit
	30754154-002†	Head gasket kit for all models with narrow profile meter body except STG180 (3 sets)	
	30754154-003†	Head gasket kit for model STG180 with narrow profile meter body (3 sets)	
K2		O-ring	3

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12.1 Replacement Parts, Continued

Table 96 Parts Identification for Callouts in Figure 38, continued

Key No.	Part Number	Description	Quantity Per Unit
K3		Gasket, Teflon [for gasket only – 30756445-502 (narrow profile L.P), or 30756445-503 (STG180)]	6
		Gasket, Viton [for gasket only – 30756445-504 (narrow profile L.P), or 30756445-505 (STG180)]	6
	30756445-509	Gasket, Graphite (for replacement on existing STX22/STX40 Transmitter with Graphite Gasket only)	6
	30753792-001	Bolts & nuts kit, all models – narrow profile (carbon steel)	
K1		Nut, hex, metric, M8 carbon steel	4
K4		Bolt, hex head, metric, M8, 50 mm long	4
	30753793-002	A286 SS (NACE) Bolts & 304 SS (NACE) nuts kit, all models – narrow profile	
K1		Nut, hex, 5/16 (304 stainless steel)	4
K4		Bolt, hex head, 5/16-18	4
	30753793-003	Process Head Bolting 316 SS Non-NACE Kit Includes: Process Head Bolts and Nuts. Contains:	
K1		5/16 –18 UNC 316 SS Non-NACE Heavy Hex Nuts	4
K4		5/16 –18 UNC 316 SS Non-NACE Hex Cap Screw	4

Table 97 Replacement GP and AP Process Head Part Numbers for Narrow Profile Meter Body

Material	Fitting Size	Models: STA122, STA140, STG140, STG170, STG180, STA922, STA940
Carbon steel (Series 100)	9/16 – 18UNF-2B	30755124-001
Stainless steel (Series 100)	9/16 – 18UNF-2B	30755124-002
Carbon steel	½ in NPT	30755124-005
Stainless steel	½ in NPT	30755124-006
Monel	½ in NPT	30755124-008
Hastelloy C	½ in NPT	30755124-007

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12.1 Replacement Parts, Continued

Figure 39 Series 900 Dual-Head GP Meter Bodies.

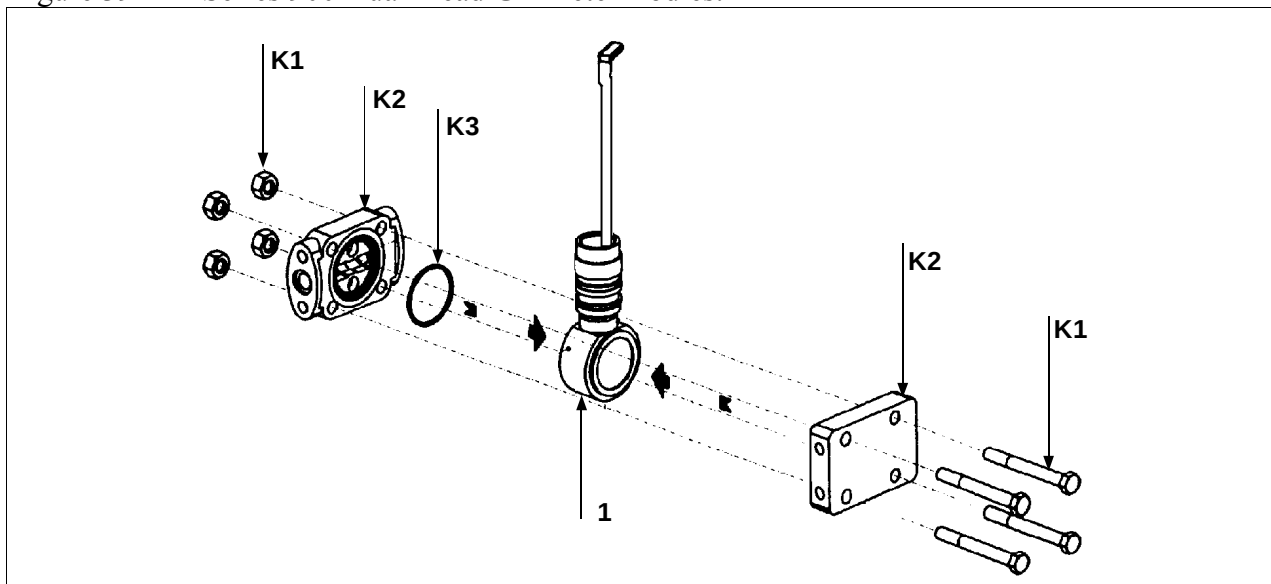


Table 98 Parts Identification for Callouts in Figure 39

Key No.	Part Number	Description	Quantity Per Unit
1	Specify complete model number from nameplate.	Series 900 replacement meter body without heads (GP models)	1
K1	30757506-001	Head bolts carbon steel, 3/8-inch Kit includes: Bolts, Nuts	4
	30757507-001	Head bolts stainless steel/NACE, 3/8-inch Kit includes: Bolts, Nuts	4
	30757507-002	Process Head Bolting 3/8 UNC 316 SS Non-NACE Kit Includes: Process Head Bolts and Nuts	4
K2	30757501-001	Replacement heads carbon steel Kit includes: Head with side vents, Head dummy CS, Head gaskets Teflon, Head gaskets Viton, Plugs, Bushings, Vent Plug, Gasket	
	30757501-002	Replacement heads carbon steel Kit includes: Head without side vents, Head dummy CS, Head gaskets Teflon, Head gaskets Viton, Bushings, Vent Plug, Gasket	
	30757502-001	Replacement heads stainless steel Kit includes: Heads with side vents, Head dummy SS, Head gaskets Teflon, head gaskets Viton, Plugs, Bushings, Vent plugs, Gaskets	
	30757502-002	Replacement heads stainless steel Kit includes: Heads without side vents, Head dummy SS, Head gaskets Teflon, head gaskets Viton, Bushings, Vent plugs, Gaskets	
	30756941-005	Stainless steel blind reference head (HR option)	
K3	30757505-001†	Process head gasket kit Kit includes: 6 Teflon head gaskets (30757100-001), 6 Teflon flange adapter gaskets (30679622-001), 6 Viton head gaskets (30749274-004)	
Optional Flange Adapter – Not Shown			
K4	30679622-501	Flange adapter gaskets Teflon	6
	30749274-502	Flange adapter gaskets Viton	6

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12.1 Replacement Parts, Continued

Figure 40 Series 100 and Series 900 LGP and LAP Meter Body.

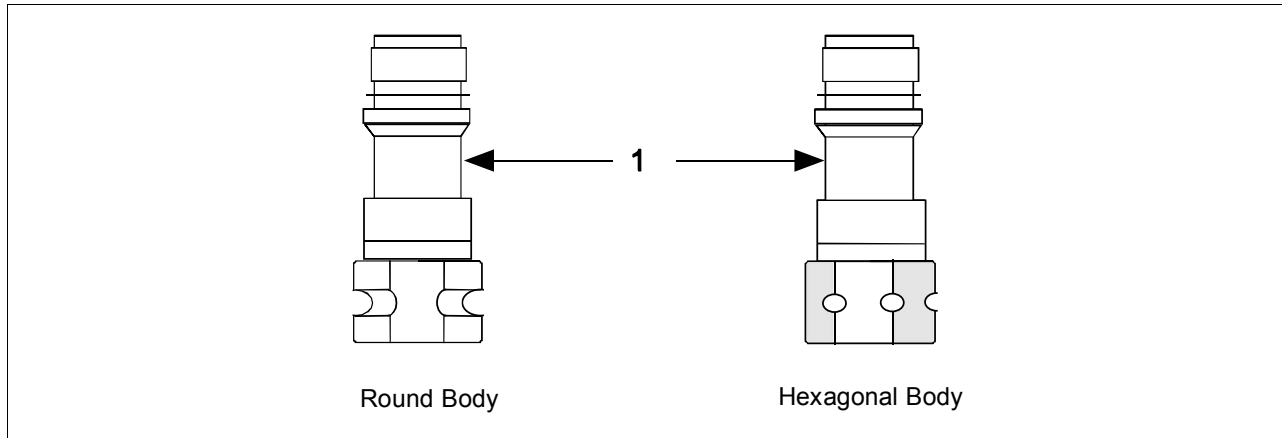


Table 99 Parts Identification for Callouts in Figure 40

Key No.	Part Number	Description	Quantity Per Unit
1	Specify complete model number from nameplate.	Series 100 replacement meter body (LGP model)	1
	Specify complete model number from nameplate.	Series 900 replacement meter body (LGP model)	1

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12.1 Replacement Parts, Continued

Figure 41 Series 900 Flush Mount Meter Body.

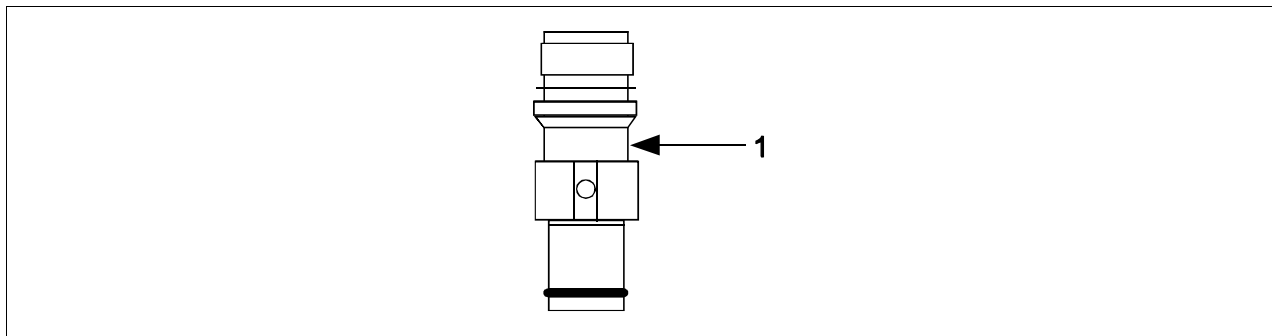


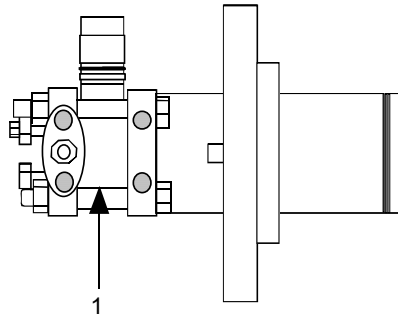
Table 100 Parts Identification for Callouts in Figure 41

Key No.	Part Number	Description	Quantity Per Unit
1	Specify complete model number from nameplate.	Series 900 replacement meter body (Flush Mount model)	1
	30756445-508	Gasket Kit (O-rings)	
	51204496-001	316L SS Mounting Sleeve Kit	
	51204497-001	Calibration Sleeve Kit	

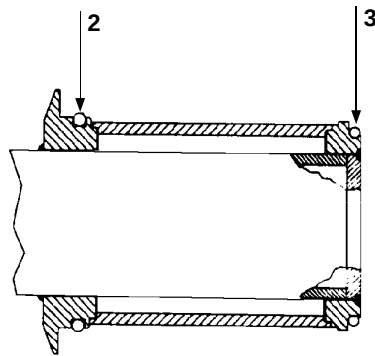
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12.1 Replacement Parts, Continued

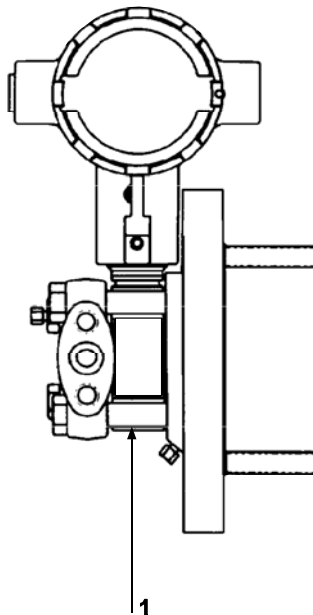
Figure 42 Series 100 and Series 900 Flange Mounted Meter Body.



Extended Flange Design



Extended Sanitary Seal Design



Pseudo Flange Design

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12.1 Replacement Parts, Continued

Table 101 Parts Identification for Callouts in Figure 42

Key No.	Part Number	Description	Quantity Per Unit
1	Specify complete model number from nameplate.	Series 100 replacement meter body	1
	Specify complete model number from nameplate.	Series 900 replacement meter body	1
2	30749372-005	O-ring seal	1
3	30749372-001	O-ring seal	1
Optional Flange Adapter – Not Shown			
K1	30754419-006	Flange adapter kit (st. steel flange adapter with carbon steel bolts)	2
	30754419-008	Flange adapter kit (Monel flange adapter with carbon steel bolts)	
	30754419-022	Flange adapter kit (st. steel flange adapter with 316 st. steel bolts)	
	30754419-024	Flange adapter kit (Monel flange adapter with 316 st. steel bolts)	
		Bolt, hex head, 7/16-20 UNF, 1.375 inches lg.	
		Flange adapter	
K2		Flange adapter	1
K3		Gasket	1
K4		Filter screen	1
	30754419-007	Flange adapter kit (Hastelloy C flange adapter with carbon steel bolts)	
	30754419-023	Flange adapter kit (Hastelloy C flange adapter with 316 st. steel bolts)	
K1		Bolt, hex head, 7/16-20 UNF, 1.375 inches lg.	2
K2		Flange adapter	1
K3		Gasket	1
K5	30757503-001	Housing seal kit	1

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12.1 Replacement Parts, Continued

Figure 43 High Temperature Meter Body.

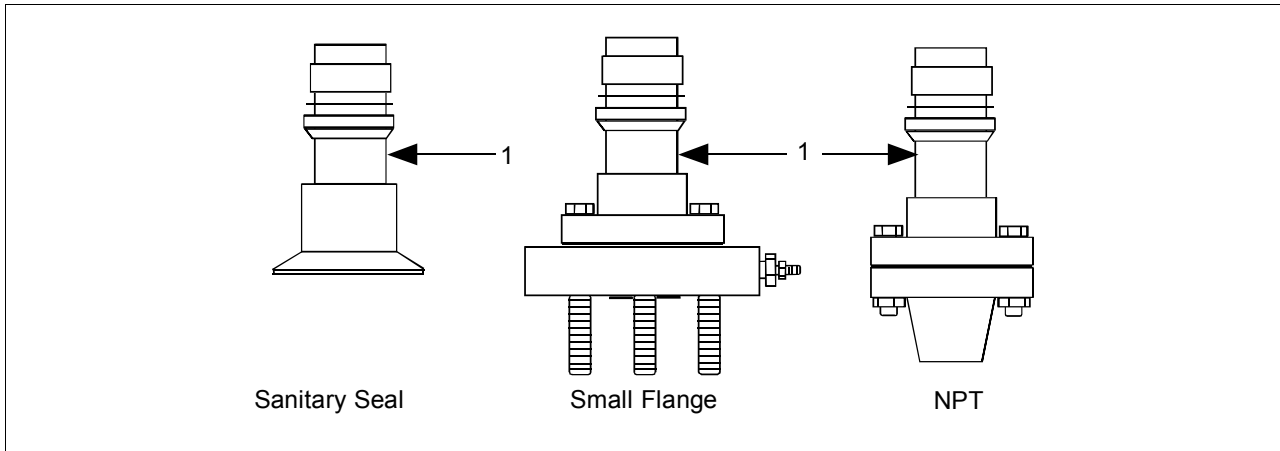


Table 102 Parts Identification for Callouts in Figure 43

Key No.	Part Number	Description	Quantity Per Unit
1	Specify complete model number from nameplate plus R300	Series 100 replacement meter body	1
Sanitary Seal Head and Gasket			
	51204982-001	Sanitary Seal Head GP/I (Stainless Steel Head w/ st.stl. hardware)	
	51204982-003	Sanitary Seal Head GP/I (Stainless Steel Head w/ SS NACE. Hardware)	
	51204982-002	Sanitary Seal Head GP/I (Hastelloy Head w/ st.stl. hardware)	
	51204984-001	Gasket GP/I (includes Teflon gasket and Viton O-ring)	
Flange Adapter – Not Shown			
	51204983-001	Flange adapter kit (½" NPT st. stl. 150# w/ st. stl bolts)	
	51204983-002	Flange adapter kit (½" NPT st. stl. 150# w/ st. stl bolts w/ vent/drain)	
	51204983-017	Flange adapter kit (½" NPT st. stl. 150# w/ SS NACE bolts)	
	51204983-018	Flange adapter kit (½" NPT st. stl. 150# w/ SS NACE bolts w/ vent/drain)	
	51204983-003	Flange adapter kit (½" NPT Hastelloy 150# w/ st. stl bolts)	
	51204983-004	Flange adapter kit (½" NPT Hastelloy 150# w/ st. stl bolts w/ vent/drain)	
	51204983-005	Flange adapter kit (1" NPT st. stl. 150# w/ st. stl bolts)	
	51204983-006	Flange adapter kit (1" NPT st. stl. 150# w/ st. stl bolts w/ vent/drain)	
	51204983-019	Flange adapter kit (1" NPT st. stl. 150# w/ SS NACE bolts)	
	51204983-020	Flange adapter kit (1" NPT st. stl. 150# w/ SS NACE bolts w/ vent/drain)	
	51204983-007	Flange adapter kit (1" NPT Hastelloy 150# w/ st. stl bolts)	
	51204983-008	Flange adapter kit (1" NPT Hastelloy 150# w/ st. stl bolts w/ vent/drain)	

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12.1 Replacement Parts, Continued

Table 102 Parts Identification for Callouts in Figure 43, continued

Key No.	Part Number	Description	Quantity Per Unit
	51204983-013	Flange adapter kit (1" NPT st. stl. 300# w/ st. stl bolts)	
	51204983-014	Flange adapter kit (1" NPT st. stl. 300# w/ st. stl bolts w/ vent/drain)	
	51204983-023	Flange adapter kit (1" NPT st. stl. 300# w/ SS NACE bolts)	
	51204983-024	Flange adapter kit (1" NPT st. stl. 300# w/ SS NACE bolts w/ vent/drain)	
	51204983-015	Flange adapter kit (1" NPT Hastelloy 300# w/ st. stl bolts)	
	51204983-016	Flange adapter kit (1" NPT Hastelloy 300# w/ st. stl bolts w/ vent/drain)	
	51204983-009	Flange adapter kit (1½" NPT st. stl. 150# w/ st. stl bolts)	
	51204983-010	Flange adapter kit (1½" NPT st. stl. 150# w/ st. stl bolts w/ vent/drain)	
	51204983-021	Flange adapter kit (1½" NPT st. stl. 150# w/ SS NACE bolts)	
	51204983-022	Flange adapter kit (1½" NPT st. stl. 150# w/ SS NACE bolts w/ vent/drain)	
	51204983-011	Flange adapter kit (1½" NPT Hastelloy 150# w/ st. stl bolts)	
	51204983-012	Flange adapter kit (1½" NPT Hastelloy 150# w/ st. stl bolts w/ vent/drain)	
	51204983-025	Flange adapter kit (2" st. stl. 150# w/ st. stl bolts)	
	51204983-026	Flange adapter kit (2" st. stl. 150# w/ st. stl bolts w/ vent/drain)	
	51204983-037	Flange adapter kit (2" st. stl. 150# w/ SS NACE bolts)	
	51204983-038	Flange adapter kit (2" st. stl. 150# w/ SS NACE bolts w/ vent/drain)	
	51204983-027	Flange adapter kit (2" Hastelloy 150# w/ st. stl bolts)	
	51204983-028	Flange adapter kit (2" Hastelloy 150# w/ st. stl bolts w/ vent/drain)	
	51204983-029	Flange adapter kit (1½" st. stl. 300# w/ st. stl bolts)	
	51204983-030	Flange adapter kit (1½" st. stl. 300# w/ st. stl bolts w/ vent/drain)	
	51204983-039	Flange adapter kit (1½" st. stl. 300# w/ SS NACE bolts)	
	51204983-040	Flange adapter kit (1½" st. stl. 300# w/ SS NACE bolts w/ vent/drain)	
	51204983-031	Flange adapter kit (1½" Hastelloy 300# w/ st. stl bolts)	
	51204983-032	Flange adapter kit (1½" Hastelloy 300# w/ st. stl bolts w/ vent/drain)	
	51204983-033	Flange adapter kit (2" st. stl. 300# w/ st. stl bolts)	
	51204983-034	Flange adapter kit (2" st. stl. 300# w/ st. stl bolts w/ vent/drain)	
	51204983-041	Flange adapter kit (2" st. stl. 300# w/ SS NACE bolts)	
	51204983-042	Flange adapter kit (2" st. stl. 300# w/ SS NACE bolts w/ vent/drain)	
	51204983-035	Flange adapter kit (2" Hastelloy 300# w/ st. stl bolts)	
	51204983-036	Flange adapter kit (2" Hastelloy 300# w/ st. stl bolts w/ vent/drain)	

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12.1 Replacement Parts, Continued

Table 103 Summary of Recommended Spare Parts

Part Number	Description	Reference		Spares for		
		Figure Number	Key Number	1-10 Units	10-100 Units	100-1000 Units
	Electronics Housing Assembly	Figs.34 &35				
51309441-501	Electronics Module	34	5	1	1-2	2-4
30757503-001	Series 100/900 housing seal kit	34 &35	K1	1	1-2	2-4
51205897-501	Series 100/900 terminal assembly without lightning protection	35	3/K2	1	1	1-2
51404078-502	Series 100/900 terminal assembly with lightning protection					
Process head gasket kit				1	1-4	4-10
30757505-001	For STD924-A, B, E, F, and J; STD930-A, B, E, F, and J; STG944; STG974 models Teflon and Viton	37,39	K3			
30753788-003 30753788-004	For all other Series 100 DP and STD924-C, D, G, H, K, and L; STD930-C, D, G, H, K, and L; and STD974 models Teflon Viton	36	K6			
30754154-002	For STA122, STA140, STA922, STA940, STG140, and STG170 Teflon and Viton	38	K3			
30754154-003	For STG180	38	K3			
Meter Body				1	1-2	2-4
Specify complete model number from nameplate.	Series 100/900 DP Models	36	1			
	Series 900 DP Models	36,37	1			
	Series 100/900 GP/AP Models	38	1			
	Series 900 GP Dual Head Model	39	1			
	Series 100/900 LGP and Series 900 AP Models	40	1			
	Series 900 Flush Mount Model	41	1			
	Series 100/900 Flange Mount Models	42	1			
	Series 100 High Temperature Models	43	1			

Section 13 — Reference Drawings

13.1 Wiring Diagrams

Wiring Drawings

The wiring diagrams for both intrinsically safe and non-intrinsically safe installations are listed in Table 104 and are included in numerical order behind this section for wiring reference.

Table 104 External Wiring Diagrams

ST 3000 FF Pressure Transmitter	Description	Drawing Number	
	For non-intrinsically safe applications	51309440	
	For intrinsically safe applications	For FM approval	51204301-000
		For CSA approval	51204302-000

13.2 Dimension Drawings

Dimension Drawings Table 105 lists the available dimension drawings for reference. If you need a copy of a drawing, please determine the appropriate drawing number from the table and contact your Honeywell Representative to obtain a copy.

Table 105 Dimension Drawings - Series 100 and Series 900

Transmitter Type and Key Number	Table Selections	Mounting				Drawing Number
		Angle Bracket (MB), (SB)		Flat Bracket (FB)		
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Differential Pressure						
STD110, STD120, STD125*, STD130, STD170	See Key Number Column	51205895		51205893		←
			51205894		51205892	←
*STD125	—	Tank HTG				30756435-000
STD904, STD924, STD930, STD974	Table I - C, D, G, H, K, L	51500357		51500355		←
			51500356		51500354	←
STD924, STD930	Table I - A, B, E, F, J	X		X		
			X		X	
Transmitter Type and Key Number	Equipped with A-G manifold part #	Angle Bracket (MB), (SB)		Flat Bracket (FB)		Drawing Number
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Differential Pressure (with Anderson-Greenwood 3-way valve manifold)						
STD110, STD120, STD125*, STD130, STD170	M4AV1	51500426	51500424	51500428	51500422	←
	M4TV1	51500427	51500425	51500429	51500423	←
STD924, STD930	M4AV1	51500431	51500433	51500435	51500437	←
	M4TV1	51500430	51500432	51500434	51500436	←
STD904, STD924, STD930, STD974	M4AV1	51500442	51500440	51500444	51500438	←
	M4TV1	51500443	51500441	51500445	51500439	←

Continued on next page

13.2 Dimension Drawings Continued

Table 105 Dimension Drawings - Series 100 and Series 900, continued

Transmitter Type and Key Number	Table Selections	Mounting				Drawing Number
		Angle Bracket (MB), (SB)		Flat Bracket (FB)		
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Gauge and Absolute Pressure						
STG944, STG974	See Key Number Column	51500411		51500409		⇐
			51500410		51500408	⇐
STG140, STG170, STG180, STA122, STA140	See Key Number Column	51500362		51500360		⇐
			5500361		51500359	⇐
STA922, STA940		51500366		515004364		⇐
			51500365		51500363	⇐
STG14L, STG17L, STG18L, STA12L, STA14L		51500373		51500371		⇐
			51500372		51500370	⇐
STG90L, STG94L, STG97L, STG98L, SAT92L, STA94L		51500377		51500375		⇐
			51500376		51500374	⇐
STG14T (High Temperature)	½ NPT					51404482

Continued on next page

13.2 Dimension Drawings Continued

Table 105 Dimension Drawings - Series 100 and Series 900, continued

Transmitter Type and Key Number	Table Selections	Mounting	Drawing Number
Flange Mount			
STF128, STF132	Table II (Flush) 0_1F0, 0_2F0, 0_3F0	—	51500404
	Table II (Extended) 0_5_0	—	51500405
	Table I Z__ (Sanitary) Table II 0S0_0	—	51500418
STF924, STF932	Table II (Flush) 0_1F0, 0_2F0, 0_3F0	—	51500406
	Table II (Extended) 0_5_0	—	51500407
	Table I Z__ (Sanitary) Table II 0S0_0	—	51500419
STF12F, STF13F	—	—	51500420
STF92F, STF93F	—	—	51500421
STF14F	—	Tank HTG	30756436-000 30755981-000
STF14T (High Temperature)	½, 1, 1 ½, and 2-inch Flange	—	51404481
Flush Mount			
STG93P	—	—	51404716-000

Continued on next page

13.2 Dimension Drawings Continued

Table 105 Dimension Drawings - Series 100 and Series 900, continued

Transmitter Type and Key Number	Table Selections	Mounting				Drawing Number
		Angle Bracket (MB), (SB)		Flat Bracket (FB)		
		Vertical Pipe	Horizontal Pipe	Vertical Pipe	Horizontal Pipe	
Remote Seals						
STR14A**	—	51500415		51500413		⇐
	—		51500414		51500412	⇐
STR12D**, STR13D**	Table I 2__	51500399		51500397		⇐
			51500398		51500396	⇐
	Table I 1__, 3__	51500403		51500401		⇐
			51500402		51500400	⇐
STR12D**	Table I __D	—				51500386
STR93D **	Table I 1__, 3__	51500395		51500393		⇐
			51500394		51500392	⇐
	Table I 2__	51500391		51500389		⇐
			51500390		51500388	⇐
	Table I _2_ or _6_	—				51402418-000
STR14G**, STR17G**	—	51500381		51500379		⇐
	—		51500380		51500378	⇐
STR14G, STR17G, STR94G	Table I _2_ or _6_	—				51402418-000
STR94G**	—	51500385		51500383		⇐
	—		51500384		51500382	⇐
STR94G**	Table I __D	—				51500387

(See next page for ** reference)

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13.2 Dimension Drawings Continued

Table 105 Dimension Drawings - Series 100 and Series 900, continued

Transmitter Type and Key Number	Table Selections	Mounting	Drawing Number
**STR_ _ _	Table II		
Flush Flange 3.5" diaphragm	___A_____	—	51305141-000
Off Line Flange 2.4" diaphragm	___B_____		51305138-000
Off Line Flange 2.9" diaphragm	___C_____		51305139-000
Off Line Flange 4.1" diaphragm	___D_____		51305140-000
Extended Flange 2.9" diaphragm	___E_____		51305137-000
Extended Flange 3.5" diaphragm	___F_____		51305137-000
Pancake Seal	___G_____		51305144-000
Chemical Tee "Taylor" Wedge	___H_____		51305144-000
Threaded Connection 2.4" diaphragm	___J_____		51305148-000
Threaded Connection 2.9" diaphragm	___K_____		51305148-000
Threaded Connection 4.1" diaphragm	___L_____		51305148-000
Sanitary Seal 1.9" diaphragm	___M_____		51305143-000
Sanitary Seal 2.4" diaphragm	___N_____		51305143-000
Sanitary Seal 2.9" diaphragm	___P_____		51305143-000
Sanitary Seal 4.1" diaphragm	___Q_____		51305143-000
Saddle Seal	___R_____		51305142-000

Appendix A — Hazardous Area Classifications

Reference Information

Information is provided to clarify the hazardous location installation requirements in North America and internationally. An explanation of the applicable enclosure classification systems is also provided.

A.1 North American Classification of Hazardous Locations

Electrical Codes

Installation of electrical apparatus within hazardous (classified) locations of the United States is conducted under the provisions of the National Electrical Code (NEC), ANSI/NFPA 70, Article 500; and within Canada, under the provisions of the Canadian Electrical Code (CEC) C22.1, Part 1, Section 18.

Classes

Hazardous (classified) locations, in both the United States and Canada, are categorized into one of these three classes.

Class	Description of Hazardous Location
I	Presence of flammable gases or vapors may be present in quantities sufficient to produce explosive or ignitable mixtures.
II	Presence of combustible dusts, powders or grains.
III	Presence of easily ignitable fibers or flyings.

Divisions

The classes listed above are further categorized based upon the level of risk present.

Division	Description of Risk
1	Locations in which hazardous concentrations of flammable gases or vapors, or combustible dust in suspension are continuously, intermittently or periodically present under normal operating conditions.
2	Locations in which flammable gases or vapors are present, but normally confined within closed containers or systems from which they can escape only under abnormal or fault conditions. Combustible dusts are not normally in suspension nor likely to be thrown into suspension.

Continued on next page

A.1 North American Classification of Hazardous Locations, Continued

Examples

Given the criteria above, the following examples are made:

A **Class III, Division 1** location is a location in which easily ignitable fibers or material processing combustible flyings are handled, manufactured or used.

A **Class III, Division 2** location is a location in which easily ignitable fibers are stored or handled.

Groups

Flammable gases, vapors and ignitable dusts, fibers and flyings are classified into groups according to the energy required to ignite the most easily-ignitable mixture within air. Group classifications are as follows:

Class I Group	Description of Atmosphere
A	Atmospheres containing acetylene.
B	Atmospheres containing hydrogen, fuel and combustible process gases containing more than 30 percent hydrogen by volume, or gases or vapors of equivalent hazard.
C	Atmospheres such as ethyl ether, ethylene, or gasses or vapors of equivalent hazard.
D	Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane or gases or vapors of equivalent hazard.
Class II Group	Description
E	Atmospheres containing combustible metal dusts including aluminum, magnesium, and their commercial alloys, and other metals of similarly hazardous characteristics.
F	Atmospheres containing combustible carbonaceous dusts including carbon black, charcoal, coal or other dusts that have been sensitized by other materials so that they present an explosion hazard.
G	Atmospheres containing combustible dusts not included in Group E or F, including flour wood, grain, and other dusts of similarly hazardous characteristics.

Continued on next page

A.1 North American Classification of Hazardous Locations, Continued

Methods of Protection The following table summarizes available methods of protection for use in given locations.

Protection Concept	Designation	Permitted Use	Principle
Explosionproof	XP	Division 1 & 2	Contains explosion and quenches flame.
Intrinsic Safety	IS	Division 1 & 2	Limit energy of sparks under normal and fault conditions.
Pressurized	Type X and Y	Division 1	Keeps flammable gas out.
Pressurized	Type Z	Division 2	Keeps flammable gas out.
Nonincendive	NI	Division 2	No arcs, sparks or hot surfaces under normal conditions

Temperature Classification

Equipment intended for installation directly within the hazardous (classified) location must also be classified for the maximum surface temperature that can be generated under normal or fault conditions as referenced to either 40°C (104°F) or the maximum operating ambient of the equipment (whichever is greater). The maximum surface temperature must be less than the minimum autoignition temperature of the hazardous atmosphere present. The temperature shall be indicated in identification numbers as listed in the following table.

Maximum Temperature		Temperature
Degrees C	Degrees F	Identification Number
450	842	T1
300	572	T2
280	536	T2A
260	500	T2B
230	446	T2C
215	419	T2D
200	392	T3
180	356	T3A
165	329	T3B
160	320	T3C
135	275	T4
120	248	T4A
100	212	T5
85	185	T6

A.1 North American Classification of Hazardous Locations, Continued

Intrinsically Safe Apparatus Parameters

The **Apparatus Parameters** are defined as follows.

Parameter	Description
V _{max}	Maximum safe voltage that can be applied to the apparatus terminals.
I _{max}	Maximum safe current that can be applied to the apparatus terminals.
C _i	Unprotected capacitance in the apparatus that can be considered present at the terminals.
L _i	Unprotected inductance in the apparatus that can be considered present at the terminals.

Associated Apparatus Parameters

The **Associated Apparatus Parameters** are defined as follows.

Parameter	Description
V _{oc}	Maximum output voltage that can be delivered to the hazardous (classified) location. This voltage is the maximum from a single channel.
I _{sc}	Maximum output current that can be delivered to the hazardous (classified) location. This current is the maximum from a single channel.
*V _t	Maximum output voltage that can be delivered to the hazardous (classified) location. This voltage is the maximum across any combination of terminals of a multiple channel configuration.
*I _t	Maximum output current that can be delivered to the hazardous (classified) location. This current is the maximum through any combination of terminals of a multiple channel configuration.
C _a	Maximum capacitance that can be connected to the apparatus.
L _a	Maximum inductance that can be connected to the apparatus.

*CSA does not recognize these parameters at this time.

Continued on next page

A.1 North American Classification of Hazardous Locations, Continued

Entity Concept

Under entity requirements, the concept allows interconnection of intrinsically safe apparatus to associated apparatus, not specifically examined in such combination. The criteria for interconnection is that the voltage (V_{max}) and current (I_{max}), which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the voltage (V_{oc} or V_t) and current (I_{sc} or I_t) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (C_i) and inductance (L_i) of the intrinsically safe apparatus, including interconnecting wiring, must be less than or equal to the capacitance (C_a) and inductance (L_a) which can be safely connected to the associated apparatus. If these criteria are met, then the combination may be connected and remain intrinsically safe. Both FMRC and CSA define the entity parameters in Tables A-1 and A-2.

Table A-1 Factory Mutual (FM) Entity Parameters

Code	Description
1C	- Explosionproof for Class I, Division 1, Groups A, B, C & D. Dust-Ignitionproof for Class II, Division 1, Groups E, F & G. Suitable for Class III, Division 1. Conduit seals required within 18" of enclosure, Group A only. - Intrinsically Safe for use in Class I, Division 1, Groups A, B, C & D; Class II, Division 1, Groups E, F & G; Class III, Division 1, T4 at 40°C, T3A at 93°C maximum ambient, when connected in accordance with Honeywell drawing 51204301. - Nonincendive for use in Class I, Division 2, Groups A, B, C & D; Suitable for Classes II & III, Division 2, Groups F & G, T4 at 93°C maximum ambient, hazardous locations. 24 Vdc max. - Environmental: Indoor and outdoor hazardous locations (NEMA 4X).

Foundation™ Fieldbus Option FF Entity Parameters ⁽¹⁾	Class I, II, III, Divisions 1 and 2, Groups A - G
$V_{Max} \leq 24 \text{ V}$	
$I_{Max} = 250 \text{ mA}$	
$P_{Max} = 1.2 \text{ W}$	
$C_i = 4.2 \text{ nF}$	
$L_i = 0$	With no integral indicator, or with integral Smart Meter, option SM.
$L_i = 150 \text{ } \mu\text{H}$	With Analog Meter, option ME.

⁽¹⁾ Install in accordance with Honeywell drawing 51204301.

A.1 North American Classification of Hazardous Locations, Continued

Table A-2 CSA Entity Parameters

Code	Description
2J	CSA approval body certification for : • Explosionproof Class I, Division 1, Groups B, C, D • Dust Ignition Proof Class II, III, Division 1, Groups E, F, G. Enclosure Type 4X • Intrinsically Safe Class I, II, III, Division 1, Groups A, B, C, D, E, F, G. Enclosure Type 4X • Non_Incendive Class I, Division 2, Groups A, B, C, D. Enclosure Type 4X

Foundation™ Fieldbus Option FF Entity Parameters ⁽¹⁾	Class I, II, III, Divisions 1 and 2, Groups A - G
$V_{Max} \leq 24 \text{ V}$	
$I_{Max} = 250 \text{ mA}$	
$P_{Max} = 1.2 \text{ W}$	
$C_i = 4.2 \text{ nF}$	
$L_i = 0$	With no integral indicator, or with integral Smart Meter, option SM.
$L_i = 150 \text{ } \mu\text{H}$	With Analog Meter, option ME.

⁽¹⁾ Install in accordance with Honeywell drawing 51204302.

A.1 North American Classification of Hazardous Locations, Continued

FISCO Concept

The FISCO concept allows the interconnection of intrinsically safe apparatus to Associated Apparatus not specifically examined in such combination. The criterion for such interconnection is that the voltage (V_{max} or U_i), the current (I_{max} or I_i), and the power (P_i), which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the voltage (U_o , V_{oc} , V_t), the current (I_o , I_{sc} , I_t), and the power (P_o) which can be provided by the associated apparatus (supply unit). In addition, the maximum unprotected residual capacitance (C_i) and inductance (L_i) of each apparatus (other than the terminators) connected to the Fieldbus must be less than or equal to 5nF and 10μH respectively.

In each I.S. Fieldbus segment only one active source, normally the Associated Apparatus, is allowed to provide the necessary power for the Fieldbus system. The allowed voltage (U_o , V_{oc} , V_t) of the associated apparatus used to supply the bus must be limited to the range of 14Vd.c. to 17.5Vd.c. All other equipment connected to the bus cable has to be passive, meaning that the apparatus is not allowed to provide energy to the system, except to a leakage current of 50μA for each connected device. Separately powered equipment needs a galvanic isolation to insure that the intrinsically safe Fieldbus circuit remains passive.

The cable used to interconnect the devices needs to comply with the following parameters:

Loop resistance R_c : 15Ω/km ...150 Ω/km

Inductance per unit length L_c : 0.4mH/km... 1mH/km

Capacitance per unit length C_c : 45nF/km ...200nF/km

Length of spur cable: 60m maximum

Length of trunk cable: 1km maximum

Terminators

At each end of the trunk cable a fm approved line terminator with the following parameters is suitable:

$R = 90\Omega \dots 102\Omega$

$C = 0 \dots 2.2 \mu F$

1. No revision to drawing without prior fm approval.
2. Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.
3. The FISCO associated apparatus must be fm approved.
4. Control equipment connected to FISCO barrier must not use or generate more than 250Vrms or 250Vdc.
5. Resistance between FISCO ground and earth ground must be less than 1Ω.
6. Installation should be in accordance with ANSI/ISA-RP12.06.01 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the National Electrical Code (ANSI/NFPA 70).
7. The FISCO concept allows interconnection of Fieldbus intrinsically safe apparatus with FISCO associated apparatus when the following is true:

V_{max} or $U_i \geq V_{oc}$, V_t or U_o ;

I_{max} or $I_i \geq I_{sc}$, I_t or I_o ;

P_{max} or $P_i \geq P_o$;

Reference ST 3000FF Control Drawing 51204301 (Attached)

Table 1

Units	ST 3000 FIELDBUS TRANSMITTER		
	Class I, Zone 0, AEx ia IIC, ENTITY / FISCO		
	IS, Class I, Division 1, Groups A, B, C, D, E, F & G ENTITY / FISCO		
	ENTITY – Barrier where $P_o \leq 0.84 \text{ W}$	ENTITY – Barrier where $P_o \leq 1.2 \text{ W}$	Suitable for FISCO systems
Ui	32 VDC	24 VDC	17.5 VDC
Ii	120 mA DC	250 mA DC	380 mA DC
Pi	0.84 W	1.2 W	5.32 W
Li	0	0	0
Ci	4.2 nF	4.2 nF	4.2 nF
T4	Tamb. $\leq 40^\circ\text{C}$	Tamb. $\leq 40^\circ\text{C}$	Tamb. $\leq 40^\circ\text{C}$
T3	Tamb. $\leq 93^\circ\text{C}$	Tamb. $\leq 93^\circ\text{C}$	Tamb. $\leq 93^\circ\text{C}$

Table 2

Units	ST 3000
	Class I, Zone 2, AEx nA IIC, ENTITY / FNICO
	NI, Class I, Division 2, Groups A, B, C & D ENTITY / FNICO
	No barrier
Ui	32 VDC
Li	0
Ci	4.2 nF
T4	Tamb. $\leq 40^\circ\text{C}$
T3	Tamb. $\leq 93^\circ\text{C}$

A.1 North American Classification of Hazardous Locations, Continued

FNICO Concept

(Nonincendive for Class I, Division 2 and Zone Hazardous Locations). Conventional Nonincendive practice does require cable parameters to be calculated, and the voltage and current values of apparatus to be matched. In the case of North American approvals, the V, I, C and L values are stated in the 'nonincendive field wiring parameters', which are part of the approvals listing. The same principle exists for energy-limited approvals for EN 50021, which carry the approvals code EEx n L. This is just like Intrinsic Safety, but note that some North-American NI approvals do not allow live working on the wiring at all, in which case no nonincendive parameters are published.

FNICO is like FISCO in that it eliminates the need to calculate cable parameters, provided the cable complies with a minimum requirement (which is the same as that for FISCO). As far as matching power supplies to field instruments is concerned, FNICO requires only that the voltage values are compatible, and in this case the Vmax for the field device can be taken either from its NI approvals or (if no NI approval is stated) from the Intrinsic Safety approvals. The overall result is that FNICO systems are as easy to design as FISCO, but with the benefit of more field devices per trunk due to the relaxed factor of safety for Division 2 apparatus.

A.2 International Electrotechnical Commission (IEC) Classification of Hazardous Locations

About IEC

The IEC has established a number of recommendations applying to the construction of explosion protected electrical apparatus identified. These recommendations are found within IEC 79-0 through 79-15 and 79-28.

For all EC countries as well as various neighboring countries (CENELEC member states), the European Standards EN 50 014 to EN 50 020 and EN 50 039 apply for the construction of explosion protected electrical apparatus. They were established on the basis of the IEC. However these recommendations are much more detailed by comparison.

Zones

Within IEC7-10, hazardous locations are defined into one of these three zones.

ZONE	Description of Hazardous Location
0	Explosive gas atmosphere is present continuously, or is present for long periods.
1	Explosive gas atmosphere is likely to occur in normal operation.
2	Explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, it will exist for a short period only.

IEC Groups

Flammable gases, vapors and mists are further classified into groups according to the energy required to ignite the most easily-ignitable mixture within air. Apparatus is grouped according to the atmospheres it may be used within as follows:

Group	Description of Atmosphere
IIC	Atmospheres containing acetylene, hydrogen, fuel and combustible process gases or vapors of equivalent hazard.
IIB	Atmospheres such as ethyl ether, ethylene, or gasses or vapors of equivalent hazard.
IIA	Atmospheres such as acetone, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane or gases or vapors of equivalent hazard.

Continued on next page

A.2 International Electrotechnical Commission (IEC) Classification of Hazardous Locations, Continued

IEC Methods of Protection

The following table summarizes available methods of protection for use in given locations.

Protection Concept	Designation	Permitted Use	Principle
Flameproof	d	Zone 1 & 2	Contains explosion and quenches flame.
Intrinsic Safety	ia	Zone 0, 1 & 2	Limits energy of sparks under 2 faults.
Intrinsic Safety	ib	Zone 1 & 2	Limits energy of sparks under 1 fault
Pressurized	p	Zone 1	Keeps flammable gases out.
Encapsulation	m	Zone 1 & 2	Keeps flammable gases out.
Increased Safety	e	Zone 1 & 2	No arcs, sparks or hot surface.
Powder Filled	q	Zone 1 & 2	Contains explosion and quenches flame.
Oil Immersion	o	Zone 1 & 2	Keeps flammable gases out.
Non-sparking	nA	Zone 2	No arcs, sparks or hot surfaces under normal conditions.
Enclosed Break	nC	Zone 2	Contains explosion and quenches flame.
Limited Energy	nA	Zone 2	Limits energy of sparks and surface temperature under normal conditions.
Restricted Breathing	nR	Zone 2	Keeps flammable gases out.

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A.2 International Electrotechnical Commission (IEC) Classification of Hazardous Locations, Continued

IEC Temperature Classification

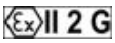
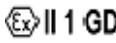
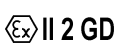
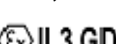
Equipment intended for installation directly within the hazardous location must also be classified for the maximum surface temperature that can be generated under normal or fault conditions as referenced to the maximum operating ambient of the equipment. The maximum surface temperature must be less than the minimum autoignition temperature of the hazardous atmosphere present. The temperature shall be indicated in identification numbers as listed in the following table.

Maximum Temperature		Temperature Identification Number
Degrees C	Degrees F	
450	842	T1
300	572	T2
200	392	T3
135	275	T4
100	212	T5
85	185	T6

continued on next page

Certification and conformity details

If Code is . . .	Then, transmitter option is . . .
1C	FM approval body certification for: - Explosion proof/Flameproof Class I, Division 1, Groups A, B, C, D - Dust Ignition Proof Class II, III, Division 1, Groups E, F, G - Non-Incendive Class I, Division 2, Groups A, B, C, D - Intrinsically Safe Class I, II, III, Division 1, Groups A, B, C, D, E, F, G
2J	CSA approval body certification for : - Explosion proof Class I, Division 1, Groups B, C, D - Dust Ignition Proof Class II, III, Division 1, Groups E, F, G - Intrinsically Safe Class I, II, III, Division 1, Groups A, B, C, D, E, F, G - Non-Incendive Class I, Division 2, Groups A, B, C, D
CA	IECEx approval body certification for : - Flame proof Zone 1: Ex d IIC - Intrinsically Safe Zone 0/1: Ex ia IIC
Z2	SAEx approval body certification for: - Intrinsically Safe Zone 0/1: Ex ia IIC - Flameproof Zone 1: Ex d IIC

ZD ZA (Multiple Marketing)	• Intrinsically Safe Zone 0/1: Ex ia IIC • Flameproof Zone 1: Ex d IIC
3S	ATEX (LCIE) approval body certification for: • Intrinsically Safe Zone 0:  Ex ia II C • Intrinsically Safe Zone 1:  , Ex ia IIC
33	ATEX (LCIE) approval body certification for: • Dust-tight Zone 0:  Ex tD A20 IP6X • Flameproof and Dust-tight Zone 1:  , Ex d IIC, Ex tD A21 IP6X
3N	ATEX (LCIE) approval body certification for: • Non-Sparking, Zone 2:  , Ex nA IIC, Ex tD A22 IP6X
3C (Multiple Marketing)	ATEX (LCIE) approval body certification for: • Intrinsically Safe Zone 0/1:  Ex ia IIC, Ex tD A20 IP6X • Flameproof Zone 1:  , Ex d IIC, Ex tD A21 IP6X • Non-Sparking, Zone 2:  , Ex ia IIC, Ex tD A22 IP6X
6D 6S	CERTUSP INMETRO (Brazil) approval body certification for: • Flameproof Zone 1: BR-Ex d IIC • Intrinsically Safe Zone 0/1: BR-Ex ia IIC
9X	No certification

A.2 International Electrotechnical Commission (IEC) Classification of Hazardous Locations, Continued

Process Sealing

Process Sealing for Classes I, II, and III, Divisions 1 and 2 and Class I, Zone 0, 1, and 2, Explosion proof Electrical Systems

ST 3000, Smart Pressure Transmitters

The ST 3000, Series 100, 100e, 600, and 900, Smart Pressure Transmitters are CSA certified as **“Dual Seal”** devices in accordance with **ANSI/ISA–12.27.01–2003**, Requirements for Process Sealing between Electrical Systems and Flammable or Combustible Process Fluids.

Accordingly, the ST 3000, Series 100, 100e, 600, and 900, Smart Pressure Transmitters comply with the sealing requirements of NEC Chapter 5. Special Occupancies, Article 500 — Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2, Article 501 — Class I Locations, Article 501-15, Sealing and Drainage, (f) Drainage, (3) Canned Pumps, Process or Service Connections, Etc., Article 505 — Class I, Zone 0, 1, and 2 Locations, Article 505-16, Sealing and Drainage, (E) Drainage, (3) Canned Pumps, Process, or Service Connections, and So Forth., and the Canadian Electrical Code rules 18-092, 18-108, 18-158, J18-108 and J18-158.

Annunciation of a primary seal failure per ANSI/ISA–12.27.01 is electronic and is displayed in various forms based on the type of communication used for the particular transmitter. Failure of the primary seal is considered a Critical Failure. Based on testing annunciation of primary seal failure will occur in 7 hours or less. The transmitter’s 4-20 mA output will be driven to the selected failsafe direction – upscale or downscale.

The transmitter’s digital output (DE, HART, Fieldbus) will display any of the following responses which could indicate a primary seal failure as well as other meter body faults.

METER BODY FAULT, MB OVERLOAD, SUSPECT INPUT, SENSOR FAILURE, DEVICE FAILURE.

A.3 Enclosure Ratings

NEMA and IEC Recognition

The NEMA (National Electrical Manufacturer's Association) enclosure classifications are recognized in the US. The IEC Publication 529 Classifications are recognized throughout Europe and those parts of the world that use the IEC standards as a basis for product certifications. The following paragraphs provide a discussion of the Comparison Between NEMA Enclosure Type Numbers and IEC Enclosure Classification Designations.

IEC Classifications

IEC Publication 529, *Classification of Degrees of Protection Provided by Enclosures*, provides a system for specifying the enclosures of electrical equipment on the basis of the degree of protection provided by the enclosure. IEC 529 does not specify degrees of protection against mechanical damage of equipment, risk of explosion, or conditions such as moisture (produced for example by condensation), corrosive vapors, fungus, or vermin.

NEMA Standards

NEMA Standards Publication 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*, does test for environmental conditions such as corrosion, rust, icing, oil, and coolants. For this reason, and because the tests and evaluations for other characteristics are not identical, the IEC enclosure classification designations cannot be exactly equated with NEMA enclosure type numbers.

IEC Designations

Basically, the IEC designation consists of the letters IP followed by two numerals. The first characteristic numeral indicates the degree of protection provided by the enclosure with respect to persons and solid foreign objects entering the enclosure. The second characteristic numeral indicates the degree of protection provided by the enclosure with respect to the harmful ingress of water.

Continued on next page

A.3 Enclosure Ratings, Continued

IEC Designations, continued

Table A-6 provides an approximate conversion from NEMA enclosure type numbers to IEC enclosure classification designations. The NEMA types meet or exceed the test requirements for the associated IEC classifications; **for this reason the Table cannot be used to convert from IEC classifications to NEMA types.**

Table A-6 NEMA Enclosure Type Numbers and Comparable IEC Enclosure Classification

NEMA Enclosure Type Number	IEC Enclosure Classification Designation
1	IP 10
2	IP 11
3	IP 54
3R	IP 14
3S	IP 54
4 and 4X	IP 56
5	IP 52
6 and 6P	IP 67
12 and 12K	IP 52
13	IP 54

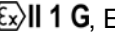
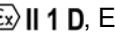
NOTE: This comparison is based on tests specified in IEC Publication 529

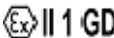
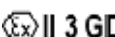
A.4 Table III Options Reference

Codes and Descriptions

Table A-4 lists available ST 3000 FF Table III approval body options alphabetically and numerically by their codes and gives a brief description of the options. Note that restrictions do apply based on other as-built transmitter characteristics and some options are mutually exclusive.

Table A-4 ST 3000 FF Table III Approval Body Options

If Code is . . .	Then, transmitter option is . . .
1C	FM approval body certification for: - Explosionproof/Flameproof Class I, Division 1, Groups A, B, C, D - Dust Ignition Proof Class II, III, Division 1, Groups E, F, G - Non-Incendive Class I, Division 2, Groups A, B, C, D - Intrinsically Safe Class I, II, III, Division 1, Groups A, B, C, D, E, F, G
2J	CSA approval body certification for : - Explosionproof Class I, Division 1, Groups B, C, D - Dust Ignition Proof Class II, III, Division 1, Groups E, F, G - Intrinsically Safe Class I, II, III, Division 1, Groups A, B, C, D, E, F, G - Non_Incendive Class I, Division 2, Groups A, B, C, D
CA	IECEx approval body certification for : - Flameproof Zone 1: Ex d IIC - Intrinsically Safe Zone 0/1: Ex ia IIC
Z2 ZD ZA (Multiple Marketing)	SAEx approval body certification for: - Intrinsically Safe Zone 0/1: Ex ia IIC - Flameproof Zone 1: Ex d IIC - Intrinsically Safe Zone 0/1: Ex ia IIC - Flameproof Zone 1: Ex d IIC
3S	ATEX (LCIE) approval body certification for: - Intrinsically Safe Zone 0: , Ex ia II C - Intrinsically Safe Zone 1: , Ex ia IIC
33	ATEX (LCIE) approval body certification for: - Dust-tight Zone 0: , Ex tD A20 IP6X - Flameproof and Dust-tight Zone 1: , Ex d IIC, Ex tD A21 IP6X

3N	ATEX (LCIE) approval body certification for: • Non-Sparking, Zone 2:  Ex nA IIC, Ex tD A22 IP6X
3C (Multiple Marketing)	ATEX (LCIE) approval body certification for: • Intrinsically Safe Zone 0/1:  Ex ia IIC, Ex tD A20 IP6X • Flameproof Zone 1:  Ex d IIC, Ex tD A21 IP6X • Non-Sparking, Zone 2:  , Ex ia IIC, Ex tD A22 IP6X
6D 6S	CERTUSP INMETRO (Brazil) approval body certification for: • Flameproof Zone 1: BR-Ex d IIC • Intrinsically Safe Zone 0/1: BR-Ex ia IIC
9X	No certification

Appendix B —Sample Configuration Record

Sample Device Configuration

The following pages provide a printout example of the “Function Block Application” portion of a ST 3000 FF device configuration file. The printout was generated using the NI-FBUS configurator application and shows function block parameters and values for a typical control loop. The printout is shown at the left side of the page. Comments and notes on the configuration are given on the righthand side.

Configuration File Data

Notes

ST-4000636 : RS-4000636 (RB) 3

Device tag : Block tagname (Resource block) Page #

RS-4000636 (RB):

Block tagname (Resource block)
(Index) Parameter mnemonic = Value

- (0) BLOCK_INFO =
 - BLOCK_TAG = RS-4000636
 - DD_MEMBER = 0x00000000
 - DD_ITEM = 0x80020310
 - DD_REVIS = 0x0001
 - PROFILE = 0x010b
 - PROFILE_REVISION = 0x0103
 - EXECUTION_TIME = 0x00000000
 - EXECUTION_PERIOD = 0x00000000
 - NUM_OF_PARAMS = 0x0031
 - NEXT_FB_TO_EXECUTE = 0x0000
 - VIEWS_INDEX = 0x01ed
 - NUMBER_VIEW_3 = 0x01
 - NUMBER_VIEW_4 = 0x01
 - (1) ST_REV = 0x0000
 - (2) TAG_DESC =
 - (3) STRATEGY = 0x0000
 - (4) ALERT_KEY = 0x00
 - (5) MODE_BLK =
 - TARGET = Auto
 - ACTUAL = Auto
 - PERMITTED = Auto | OOS
 - NORMAL = Auto
 - (6) BLOCK_ERR = SimulationActive
 - (7) RS_STATE = Online
-

Continued on next page

(Index) Parameter mnemonic = Value

- (8) TEST_RW =
 - VALUE_1 = FALSE
 - VALUE_2 = 0x00
 - VALUE_3 = 0x0000
 - VALUE_4 = 0x00000000
 - VALUE_5 = 0x00
 - VALUE_6 = 0x0000
 - VALUE_7 = 0x00000000
 - VALUE_8 = 0
 - VALUE_9 = (NULL)
 - VALUE_10 = (NULL)
 - VALUE_11 = 01/01/00 00:00:00 (MM/DD/YY HH:MM:SS)
 - VALUE_12 = 01/01/84 00:00:00 (MM/DD/YY HH:MM:SS)
 - VALUE_13 = 0:00:00:00 (DD:HH:MM:SS)
 - VALUE_14 = 0x0000
 - VALUE_15 = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
- (9) DD_RESOURCE = (NULL)
- (10) MANUFAC_ID = 0x0048574cC (Honeywell)
- (11) DEV_TYPE = 0x0002
- (12) DEV_REV = 0x09
- (13) DD_REV = 0x01
- (14) GRANT_DENY =
 - GRANT = 0x00
 - DENY = 0x00
- (15) HARD_TYPES = Scalar Input
- (16) RESTART = Run
- (17) FEATURES = Reports | Hard W Lock
- (18) FEATURE_SEL = 0x0000
- (19) CYCLE_TYPE = Scheduled
- (20) CYCLE_SEL = 0x0000
- (21) MIN_CYCLE_T = 0x0000007dmillisec
- (22) MEMORY_SIZE = 0x0000Kbytes
- (23) NV_CYCLE_T = 0x01b77400millisec
- (24) FREE_SPACE = 0%
- (25) FREE_TIME = 68.493%
- (26) SHED_RCAS = 0x00007d00millisec
- (27) SHED_ROUT = 0x00001f40millisec
- (28) FAULT_STATE = Clear
- (29) SET_FSTATE = OFF
- (30) CLR_FSTATE = Off
- (31) MAX_NOTIFY = 0x08
- (32) LIM_NOTIFY = 0x08
- (33) CONFIRM_TIME = 0x00007d00millisec
- (34) WRITE_LOCK = Not Locked
- (35) UPDATE_EVT =
 - UNACKNOWLEDGED = Uninitialized
 - UPDATE_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - STATIC_REVISION = 0x0000
 - RELATIVE_INDEX = 0x0000

- Constantly increases**

- (58) EL TEMPERATURE = 31.196 Present Electronics Temperature
- (59) EL TEMP OVER RNG CTR = Count of Occurrence
- (60) EL TEMP OVER RNG DATE = 06/01/09 (MM/DD/YY HH:MM:SS) Captured Date of Occurrence
- (61) EL TEMP UNDER RNG CTR = Count of Occurrence
- (62) EL TEMP UNDER RNG DATE = 06/01/09 (MM/DD/YY HH:MM:SS) Captured Date of Occurrence
- (63) EL TEMP MAX = 34.22 Captured Max Value
- (64) EL TEMP MIN = 23.636 Captured Min Value
- (65) MSG KEY NUMBER = STF128 Model Selection Guide Key Number
- (66) MSG METER BODY = A1A Model Selection Guide Meter Body Number
- (67) MSG FLANGE = 011D012 Model Selection Guide Flange Type
- (68) MSG OPTIONS 1 = Model Selection Guide Options Selection
- (69) MSG OPTIONS 2 = Model Selection Guide Options Selection

Continued on next page

XD-4000636 (STTB):

Block tagname (Transducer block)
(Index) Parameter mnemonic = Value

- (0) BLOCK_INFO =
 BLOCK_TAG = XD-4000636
 DD_MEMBER = 0x00000000
 DD_ITEM = 0x00020000
 DD_REVIS = 0x0001
 PROFILE = 0x0000
 PROFILE_REVISION = 0x0103
 EXECUTION_TIME = 0x00000000
 EXECUTION_PERIOD = 0x00007d00
 NUM_OF_PARAMS = 0x001d
 NEXT_FB_TO_EXECUTE = 0x0000
 VIEWS_INDEX = 0x01f1
 NUMBER_VIEW_3 = 0x01
 NUMBER_VIEW_4 = 0x01
- (1) ST_REV = 0x0000
- (2) TAG_DESC =
- (3) STRATEGY = 0x0000
- (4) ALERT_KEY = 0x00
- (5) MODE_BLK =
 TARGET = Auto
 ACTUAL = Auto
 PERMITTED = Auto | OOS
 NORMAL = Auto
- (6) BLOCK_ERR = 0x0000
- (7) UPDATE_EVT =
 UNACKNOWLEDGED = Uninitialized
 UPDATE_STATE = Uninitialized
 TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 STATIC_REVISION = 0x0000
 RELATIVE_INDEX = 0x0000
- (8) ALARM_SUM =
 CURRENT = 0x0000
 UNACKNOWLEDGED = Block Alm Unack
 UNREPORTED = Block Alm Unrep
 DISABLED = 0x0000
- (9) BLOCK_ALM =
 UNACKNOWLEDGED = Unacknowledged
 ALARM_STATE = Clear-Not Reported
 TIME_STAMP = 08/05/98 15:39:19 (MM/DD/YY HH:MM:SS)
 SUB_CODE = OutOfService
 VALUE = 0x00
- (10) PRIMARY_VALUE =
 STATUS = Good_NonCascade::UnacknowledgedBlockAlarm:NotLimited
 VALUE = 58.3553
- (11) CALC_VAL =
 STATUS = Bad::NonSpecific:NotLimited
 VALUE = 0
- (12) SENSOR_TEMP = 20.2925

(Index) Parameter mnemonic = Value

- (13) SENSOR_TEMP_UNIT = °C
- (14) LEVEL_COEFF =
 - LEVEL_COEFF = 0
 - LEVEL_COEFF = 0
 - LEVEL_COEFF = 0
 - LEVEL_COEFF = 0
 - LEVEL_COEFF = 0
 - LEVEL_COEFF = 0
- (15) PRIMARY_VALUE_RANGE =
 - EU_100 = 400
 - EU_0 = 0
 - UNITS_INDEX = inH2O (4°C)
 - DECIMAL = 0x00
- (16) CAL_CMD = NONE
- (17) CAL_POINT_HI = 400
- (18) CAL_POINT_LO = 0
- (19) CAL_STATUS = Success
- (20) CAL_SOURCE = Factory
- (21) CAL_UNIT = inH2O (4°C)
- (22) XD_DIAG_DETAIL = 0x0000
- (23) SENSOR_RANGE =
 - EU_100_R = 400
 - EU_0_R = 0
 - UNITS_INDEX_R = inH2O (4°C)
 - DECIMAL_R = 0x00
- (24) SENSOR_SN = 0x40006363
- (25) SENSOR_MAX_SP = 3000 *
- (26) SENSOR_MAX_OVP = 3000 *
- (27) TANK_RANGE =
 - EU_100 = 400
 - EU_0 = 0
 - UNITS_INDEX = inH2O (4°C)
 - DECIMAL = 0x00
- (28) BLOCK_TEST =
 - BLOCK_TEST = 0xaf
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
- (29) PV OVER RNG CTR = 0 Count of Occurrence
- (30) PV OVER RNG DATE = 01/01/72 00:00:00 Captured Date of Occurrence
- (31) PV UNDER RNG CTR = 0 Count of Occurrence
- (32) PV UNDER RNG DATE = 01/01/72 00:00:00 Captured Date of Occurrence
- (33) TEMP OVER RNG CTR = 0 Count of Occurrence
- (34) TEMP OVER RNG DATE = 01/01/72 00:00:00 Captured Date of Occurrence
- (35) TEMP UNDER RNG CTR = 0 Count of Occurrence
- (36) TEMP UNDER RNG DATE = 01/01/72 00:00:00 Captured Date of Occurrence
- (37) TEMP MAX = 22.9830 Captured Max Value

Constantly increases

(38) TEMP MIN = 18.4551	Captured Min Value
(39) ST PR = 23.3601	Present Value
(40) ST PR MAX = 25.8348	Max Value
(41) ST PR OVER RNG CTR = 0	Count of Occurrence
(42) ST PR OVER RNG DATE = 01/01/72 00:00:00	Captured Date of Occurrence
(43) STRESS MONITOR = 0	
(44) SERVICE LIFE =	Constantly Increases
(45) CALIB DATE LAST 2PT = 01/01/72 00:00:00	Captured Date of Occurrence
(46) CALIB DATE PREV 2PT = 01/01/72 00:00:00	Captured Date of Occurrence
(47) CALIB DATE RESTORE = 01/01/72 00:00:00	Captured Date of Occurrence
(48) CALIB DATE CLEAR = 01/01/72 00:00:00	Captured Date of Occurrence
(49) CALIB DATE ZERO = 01/01/72 00:00:00	Captured Date of Occurrence

* Please read CAUTION about these parameters on page 88.

Continued on next page

AI-4000636 (AI):

Block tagname (Analog Input block)
(Index) Parameter mnemonic = Value

(0) BLOCK_INFO =

BLOCK_TAG = AI-4000636
 DD_MEMBER = 0x00000000
 DD_ITEM = 0x800201d0
 DD_REVIS = 0x0001
 PROFILE = 0x0101
 PROFILE_REVISION = 0x0103
 EXECUTION_TIME = 0x000002e0
 EXECUTION_PERIOD = 0x00007d00
 NUM_OF_PARAMS = 0x0027
 NEXT_FB_TO_EXECUTE = 0x0000
 VIEWS_INDEX = 0x01e5
 NUMBER_VIEW_3 = 0x01
 NUMBER_VIEW_4 = 0x01

(1) ST_REV = 0x0003

(2) TAG_DESC =

(3) STRATEGY = 0x0000

(4) ALERT_KEY = 0x01

Initialized value = zero, Must be set to non-zero value

(5) MODE_BLK =

TARGET = Auto
 ACTUAL = Auto
 PERMITTED = Auto | Man | OOS
 NORMAL = Auto

(6) BLOCK_ERR = 0x0000

(7) PV =

STATUS = Good_NonCascade::UnacknowledgedBlockAlarm:NotLimited
 VALUE = 61.4117

(8) OUT =

STATUS = Good_NonCascade::UnacknowledgedBlockAlarm:NotLimited
 VALUE = 61.4117

(9) SIMULATE =

SIMULATE_STATUS = Good_NonCascade::UnacknowledgedBlockAlarm:NotLimited
 SIMULATE_VALUE = 61.4117
 TRANSDUCER_STATUS = Good_NonCascade::UnacknowledgedBlockAlarm:NotLimited
 TRANSDUCER_VALUE = 61.4117
 ENABLE_DISABLE = Disabled

(10) XD_SCALE =

EU_100 = 100
 EU_0 = 0
 UNITS_INDEX = inH2O (4°C)
 DECIMAL = 0x00

(11) OUT_SCALE =

EU_100 = 100
 EU_0 = 0
 UNITS_INDEX = inH2O (4°C)
 DECIMAL = 0x00

Continued on next page

		(Index) Parameter mnemonic = Value
(12)	GRANT_DENY =	
	GRANT = 0x00	
	DENY = 0x00	
(13)	IO_OPTS = 0x0000	
(14)	STATUS_OPTS = 0x0000	
(15)	CHANNEL = 0x0001	Initialized value = zero, Must be set to non-zero value
(16)	L_TYPE = Direct	Initialized value = Uninitialized , Must be set to a valid value
(17)	LOW_CUT = 0	
(18)	PV_FTIME = 0Sec	
(19)	FIELD_VAL =	
	STATUS = Good_NonCascade::UnacknowledgedBlockAlarm:NotLimited	
	VALUE = 61.4117%	
(20)	UPDATE_EVT =	
	UNACKNOWLEDGED = Unacknowledged	
	UPDATE_STATE = Not Reported	
	TIME_STAMP = 08/05/98 15:39:45 (MM/DD/YY HH:MM:SS)	
	STATIC_REVISION = 0x0003	
	RELATIVE_INDEX = 0x0010	
(21)	BLOCK_ALM =	
	UNACKNOWLEDGED = Unacknowledged	
	ALARM_STATE = Clear-Not Reported	
	TIME_STAMP = 08/05/98 15:39:45 (MM/DD/YY HH:MM:SS)	
	SUB_CODE = OutOfService	
	VALUE = 0x00	
(22)	ALARM_SUM =	
	CURRENT = 0x0000	
	UNACKNOWLEDGED = Block Alm Unack	
	UNREPORTED = Block Alm Unrep	
	DISABLED = 0x0000	
(23)	ACK_OPTION = 0x0000	
(24)	ALARM_HYS = 0.5%	
(25)	HI_HI_PRI = 0x00	
(26)	HI_HI_LIM = 1.#INF	
(27)	HI_PRI = 0x00	
(28)	HI_LIM = 1.#INF	
(29)	LO_PRI = 0x00	
(30)	LO_LIM = -1.#INF	
(31)	LO_LO_PRI = 0x00	
(32)	LO_LO_LIM = -1.#INF	
(33)	HI_HI_ALM =	
	UNACKNOWLEDGED = Uninitialized	
	ALARM_STATE = Uninitialized	
	TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)	
	SUB_CODE = Other	
	VALUE = 0	

Continued on next page

(Index) Parameter mnemonic = Value

- (34) HI_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (35) LO_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (36) LO_LO_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (37) AUX_VAR1 = 20.2925
- (38) BLOCK_TEST =
 - BLOCK_TEST = 0xed
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
- (39) MAXIMUM PV = Captured Max Value
- (40) MAXIMUM PV = Captured Min value

Constantly increases

Continued on next page

PID-4000636 (PID):

Block tagname (PID Control block)
(Index) Parameter mnemonic = Value

- (0) BLOCK_INFO =
 BLOCK_TAG = PID-4000636
 DD_MEMBER = 0x00000000
 DD_ITEM = 0x800202b0
 DD_REVIS = 0x0001
 PROFILE = 0x0108
 PROFILE_REVISION = 0x0103
 EXECUTION_TIME = 0x00000920
 EXECUTION_PERIOD = 0x00007d00
 NUM_OF_PARAMS = 0x004b
 NEXT_FB_TO_EXECUTE = 0x0000
 VIEWS_INDEX = 0x01e9
 NUMBER_VIEW_3 = 0x01
 NUMBER_VIEW_4 = 0x01
- (1) ST_REV = 0x0004
- (2) TAG_DESC =
- (3) STRATEGY = 0x0000
- (4) ALERT_KEY = 0x00
- (5) MODE_BLK =
 TARGET = Auto
 ACTUAL = Auto
 PERMITTED = ROut | RCas | Cas | Auto | Man | OOS
 NORMAL = Auto
- (6) BLOCK_ERR = 0x0000
- (7) PV =
 STATUS = Good_NonCascade::NonSpecific:NotLimited
 VALUE = 61.0979
- (8) SP =
 STATUS = Good_Cascade::NonSpecific:NotLimited
 VALUE = 46
- (9) OUT =
 STATUS = Good_Cascade::NonSpecific:LowLimited
 VALUE = 0
- (10) PV_SCALE =
 EU_100 = 100
 EU_0 = 0
 UNITS_INDEX = 0x0000
 DECIMAL = 0x00
- (11) OUT_SCALE =
 EU_100 = 100
 EU_0 = 0
 UNITS_INDEX = 0x0000
 DECIMAL = 0x00
- (12) GRANT_DENY =
 GRANT = 0x00
 DENY = 0x00
- (13) CONTROL_OPTS = 0x0000
- (14) STATUS_OPTS = 0x0000

PID Control Block, Continued

- (15) IN = **(Index) Parameter mnemonic = Value**
 STATUS = Good_NonCascade::UnacknowledgedBlockAlarm:NotLimited
 VALUE = 61.0979
- (16) PV_FTIME = 0Sec
- (17) BYPASS = Off **Initialized value = Uninitialized , Must be set to a valid value**
- (18) CAS_IN =
 STATUS = Bad::OutOfService:NotLimited
 VALUE = 0
- (19) SP_RATE_DN = 1.#INFPV/Sec
- (20) SP_RATE_UP = 1.#INFPV/Sec
- (21) SP_HI_LIM = 100
- (22) SP_LO_LIM = 0
- (23) GAIN = 1
- (24) RESET = 50Sec
- (25) BAL_TIME = 0Sec
- (26) RATE = 0Sec
- (27) BKCAL_IN =
 STATUS = Good_Cascade::NonSpecific:NotLimited
 VALUE = 0
- (28) OUT_HI_LIM = 100
- (29) OUT_LO_LIM = 0
- (30) BKCAL_HYS = 0.5%
- (31) BKCAL_OUT =
 STATUS = Good_Cascade::NotInvited:LowLimited
 VALUE = 46
- (32) RCAS_IN =
 STATUS = Bad::OutOfService:NotLimited
 VALUE = 0
- (33) ROUT_IN =
 STATUS = Bad::OutOfService:NotLimited
 VALUE = 0
- (34) SHED_OPT = NormalShed_NormalReturn **Initialized value = Uninitialized , Must be set to a valid value**
- (35) RCAS_OUT =
 STATUS = Good_Cascade::NotInvited:LowLimited
 VALUE = 46
- (36) ROUT_OUT =
 STATUS = Good_Cascade::NotInvited:NotLimited
 VALUE = 0
- (37) TRK_SCALE =
 EU_100 = 100
 UNITS_INDEX = 0x0000
 DECIMAL = 0x00
- (38) TRK_IN_D =
 STATUS = Bad::OutOfService:NotLimited
 VALUE = Discrete state 0
- (39) TRK_VAL =
 STATUS = Bad::OutOfService:NotLimited
 VALUE = 0
-

Continued on next page

(Index) Parameter mnemonic = Value

- (40) FF_VAL =
 STATUS = Bad::OutOfService:NotLimited
 VALUE = 0
- (41) FF_SCALE =
 EU_100 = 100
 EU_0 = 0
 UNITS_INDEX = 0x0000
 DECIMAL = 0x00
- (42) FF_GAIN = 0
- (43) UPDATE_EVT =
 UNACKNOWLEDGED = Unacknowledged
 UPDATE_STATE = Not Reported
 TIME_STAMP = 08/05/98 14:45:59 (MM/DD/YY HH:MM:SS)
 STATIC_REVISION = 0x0004
 RELATIVE_INDEX = 0x0018
- (44) BLOCK_ALM =
 UNACKNOWLEDGED = Uninitialized
 ALARM_STATE = Uninitialized
 TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 SUB_CODE = Other
 VALUE = 0x00
- (45) ALARM_SUM =
 CURRENT = 0x0000
 UNACKNOWLEDGED = 0x0000
 UNREPORTED = 0x0000
 DISABLED = 0x0000
- (46) ACK_OPTION = 0x0000
- (47) ALARM_HYS = 0.5%
- (48) HI_HI_PRI = 0x00
- (49) HI_HI_LIM = 1.#INF
- (50) HI_PRI = 0x00
- (51) HI_LIM = 1.#INF
- (52) LO_PRI = 0x00
- (53) LO_LIM = -1.#INF
- (54) LO_LO_PRI = 0x00
- (55) LO_LO_LIM = -1.#INF
- (56) DV_HI_PRI = 0x00
- (57) DV_HI_LIM = 1.#INF
- (58) DV_LO_PRI = 0x00
- (59) DV_LO_LIM = -1.#INF
- (60) HI_HI_ALM =
 UNACKNOWLEDGED = Uninitialized
 ALARM_STATE = Uninitialized
 TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 SUB_CODE = Other
 VALUE = 0

Continued on next page

(Index) Parameter mnemonic = Value

- (61) HI_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (62) LO_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (63) LO_LO_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (64) DV_HI_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (65) DV_LO_ALM =
 - UNACKNOWLEDGED = Uninitialized
 - ALARM_STATE = Uninitialized
 - TIME_STAMP = 01/01/72 00:00:00 (MM/DD/YY HH:MM:SS)
 - SUB_CODE = Other
 - VALUE = 0
- (66) PID_FORM = IDEAL PID
- (67) ALGO_TYPE = PID Type A
- (68) OUT_LAG = 0
- (69) GAIN_NLIN = 0
- (70) GAIN_COMP = 1
- (71) ERROR_ABS = 14.5165
- (72) WSP =
 - STATUS = Good_Cascade::NonSpecific:NotLimited
 - VALUE = 46
- (73) BLOCK_TEST =
 - BLOCK_TEST = 0xb3
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x00
 - BLOCK_TEST = 0x22
 - BLOCK_TEST = 0x57

Constantly increases

Appendix C – Freeze Protection of Transmitters

C.1 Possible Solutions/Methods

Problem

When water is present in the process fluid and ambient temperatures can fall below the freezing point (32°F/0°C), pressure transmitters and their piping require freeze protection. Transmitters may also require continuous heating, if the process fluid is tar, wax, or other medium that will solidify at normal ambient. However, uncontrolled steam or electric heating, in addition to wasting energy, can cause errors and accidentally destroy the transmitter.

Solution

These two basic solutions are possible:

- Eliminate the need for heating the transmitter by keeping the freezable process fluid out of direct contact with transmitter.
- Control the steam or electric heat to prevent overheating on warm days while protecting against freeze-ups under the coldest conditions.

The other paragraphs in this section review a number of methods for implementing both solutions.

Sealing liquid method

The simplest and least costly method is to use a sealing liquid in the transmitter meter body and its impulse piping to the process. The small contact (interface) area between the sealing liquid and the process fluid reduces the mixing of the two fluids.

You should select a sealing liquid that has a greater specific gravity than the process fluid to inhibit mixing. It also must have freezing and boiling temperatures compatible with the range of temperatures existing at the site, including the heated interface.



WARNING — The user must verify the compatibility of any sealing liquid with their process fluid.

A reliable sealing liquid is a 50/50 percent (by volume) solution of ethylene-glycol and water. This solution has a specific gravity of 1.070 at 60°F (15°C), a freezing temperature of –34°F (–36°C), and a boiling temperature of +225°F (+106°C) at atmospheric pressure. Conventional antifreeze liquids for automobile coolant systems such as Prestone and

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C.1 Possible Solutions/Methods, Continued

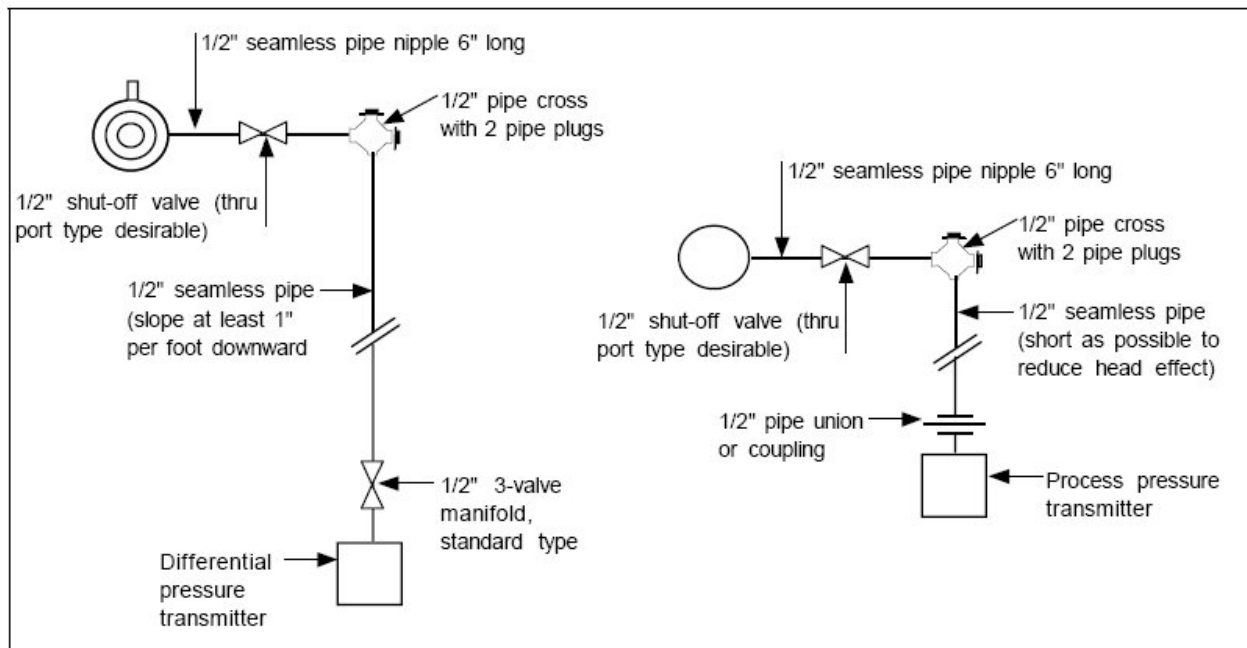
Sealing liquid method, continued

Zerex are solutions of ethylene-glycol with some rust inhibitors and possibly leak sealants added; they may be used in place of pure ethylene-glycol.

Another sealing liquid, used in many chemical plants, is dibutylphthalate an oily-type liquid with a specific gravity of 1.045 at 70°F (21°C). It has a boiling point 645°F (340°C) and does not freeze so it can be used down to about -20°F (-30°C).

Figures C-1 and C-2 show typical piping installations for this method. The process fluid must be heated above its freezing point. This is frequently done by lagging in (insulating) the connecting nipple, shut-off valve and "T" connector with the process piping. Where the process piping itself requires heating, a steam or electric trace is run around their components with consideration given to the boiling point of the sealing liquid.

Figure C-1 Piping Installation for Sealing Liquid With Specific Gravity Heavier Than Process Fluid.

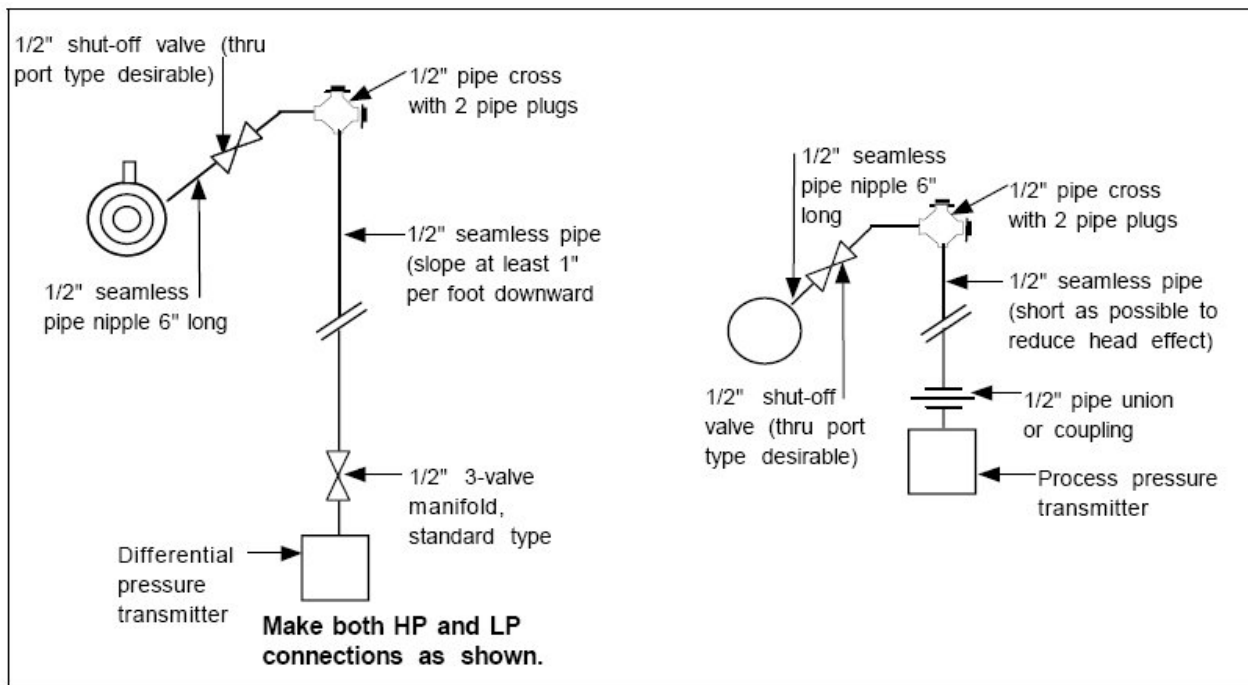


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C.1 Possible Solutions/Methods, Continued

Sealing liquid method, continued

Figure C-2 Piping Installation for Sealing Liquid with Specific Gravity Lighter Than Process Fluid.



The installation should be checked every 6 to 12 months to verify that the sealing liquid is at its required specific gravity.

Purging

Purging air or water purges are commonly used to prevent viscous materials from clogging the impulse lines to pressure, level, or flow transmitters. The bubbler system, using a constant-air flow regulator, is particularly common on open tank liquid level applications. No heating of impulse lines or transmitter is required, but normal precautions are required to keep water out of the air supply system.

Gas applications

We must not overlook the possibility of condensate freezing in impulse lines to transmitters measuring gas flow or pressure. Although these components could be heated similar to water and steam applications, the simplest and best approach is to install transmitters so that they are self draining. This means that the impulse lines are connected to the lowest

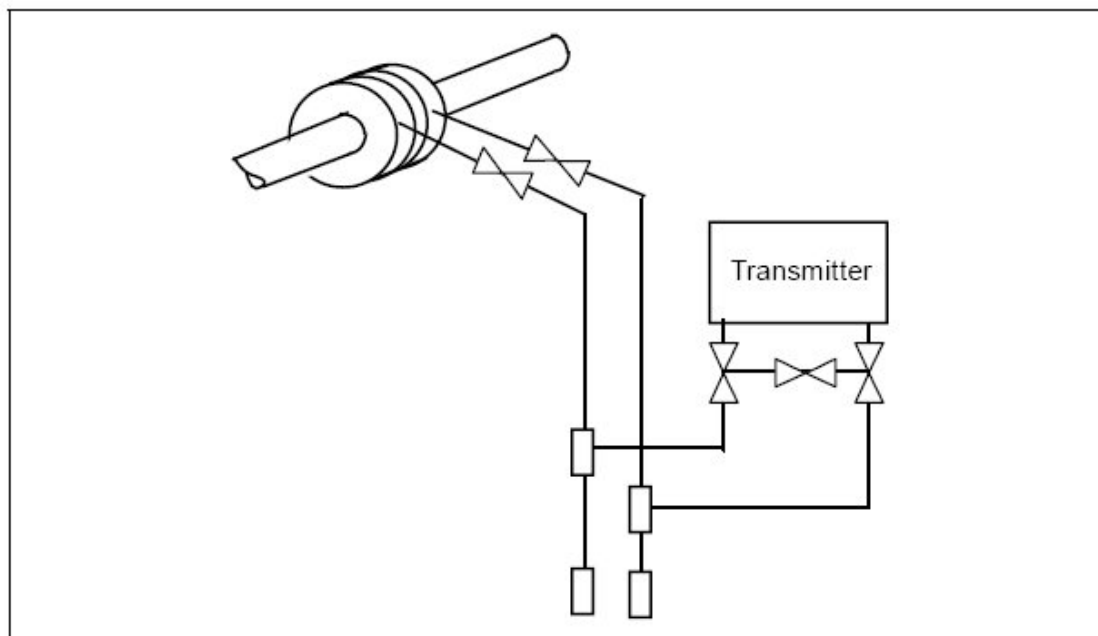
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C.1 Possible Solutions/Methods, Continued

Gas applications, continued

point in the transmitter meter body and the piping is sloped downward at least one inch per foot. (Side-connected transmitters with vent-drains at a lower point in the meter body must be regularly checked to assure condensate removal.) If the transmitter is located below the process taps (not recommended), piping must still run downward from the transmitter to the drain point and then up to the process as shown in Figure C-3. Steam or electric heating of the drain point will prevent pipe rupture due to freezing.

Figure C-3 Piping Installation for Gas Flow.



Mechanical (diaphragm) seals

Diaphragm seals on the impulse lines provide the most expensive, yet broadest application of all the methods. Similar in principle to the liquid seals, diaphragm seals eliminate the possibility of seal liquid carry-over into the process fluid. This eliminates the need for periodic maintenance checks to assure full and equal liquid seal legs. Welded diaphragm seals with special fills permit temperatures from -34° to 600°F (-36° to 315°C) at the process interface which can therefore be steam or electrically heated to assure viscosity of tars and similar high-freezing point fluids under the coldest conditions.

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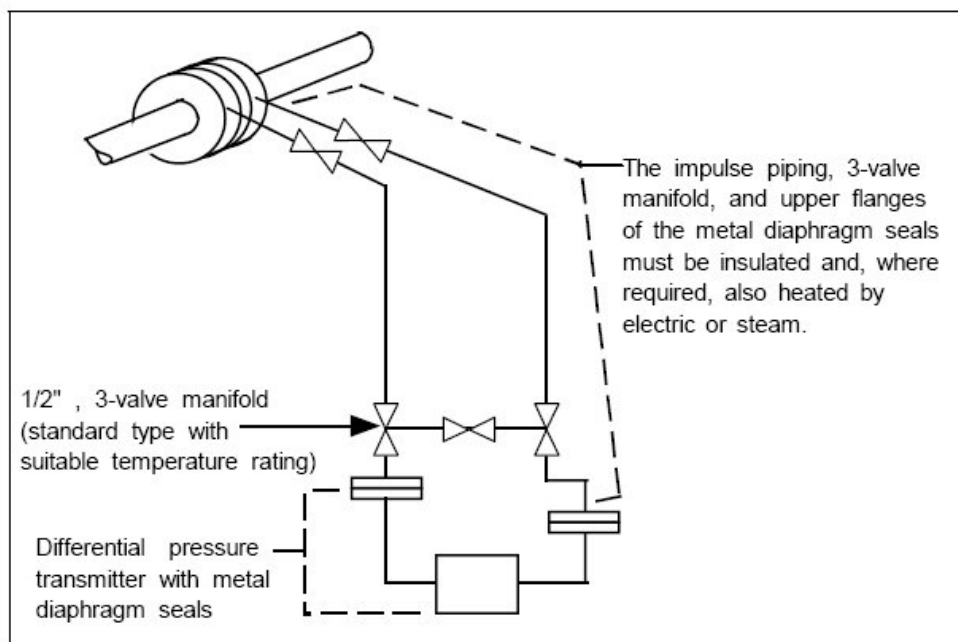
C.1 Possible Solutions/Methods, Continued

Mechanical (diaphragm) seals, continued

You must be careful to specify large enough diaphragms to accommodate expansion and contraction of the fill fluid under varying temperatures without overextending the diaphragm into its stiff area. In general, conventional diaphragm seals are satisfactory for pressure ranges above approximately 75 psig with special large diameter elements required for low pressure or differential pressure measurements.

You can lag (insulate) impulse lines and diaphragm seals with the process piping, but this practice is only common with liquid level applications involving highly viscous materials unsuitable for 1/2-inch impulse lines. Use a tank-mounted flanged seal in such installations. Otherwise, it is more desirable to keep the capillary lengths short, the transmitter accessible for maintenance, and (for flow applications) the normal 3-valve manifold assembly close to the transmitter for normal service checks. Thus, the impulse lines, valving and diaphragm seals with 1/2-inch connections would be electrically or steam traced, with high temperature steam permitted without damage to the transmitter. See Figures C-4 and C-5 for typical piping layouts.

Figure C-4 Piping Installation for Differential Pressure Transmitter with Metal Diaphragm Seals.

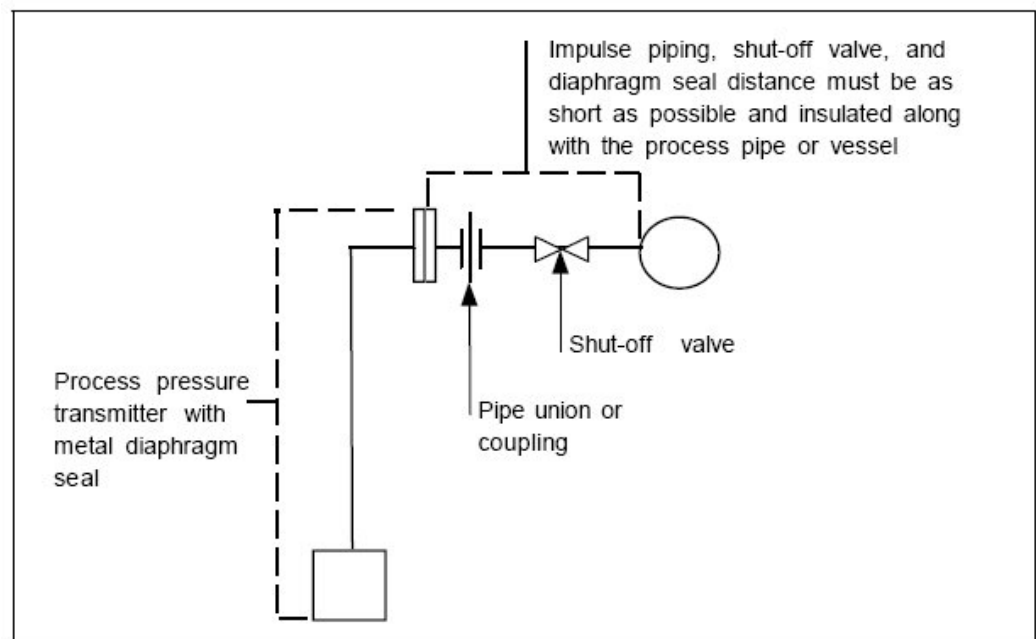


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C.1 Possible Solutions/Methods, Continued

Mechanical (diaphragm) seals, continued

Figure C-5 Piping Installation for Process Pressure Transmitter with Metal Diaphragm Seal.



Electric heating

Most transmitters will withstand higher temperatures at their process interfaces (bodies) than at their electronics. Normally, it is impractical to heat transmitter bodies above 225 to 250°F (107 to 121°C) without radiant and conducted heat exceeding the rating at the electronics (normally 200°F/93°C). Prefabricated insulated enclosures with integral heating coils and thermostats set at 200°F (93°C) can assure viscosity of fluids which freeze below 180°F (82°C) while assuring safe transmitter operation. For water or similar lower-temperature mediums, the control can be set at 50°F (10°C) to save energy and call for heat only when temperature and wind conditions require.

Systems can be engineered for uncontrolled, continuous electric heating to prevent water freezing at 0°F (−18°C) and 20 mph wind velocity, while not exceeding 225°F (107°C) at the transmitter body at 90°F (32°C) ambient and zero wind velocity. The operating costs in energy for these systems usually exceed the high initial cost of the thermostat systems. Never attempt to maintain freeze points above 100°F (38°C) without thermostat controls since the Btu required to prevent freezing will normally exceed the body temperature rating under opposite extremes.

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C.1 Possible Solutions/Methods, Continued

Electric heating, continued

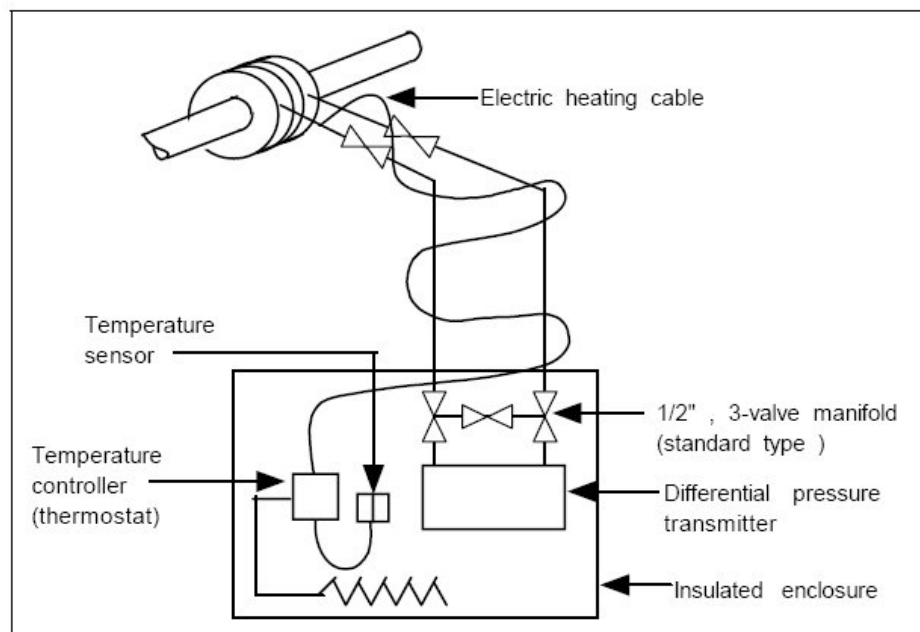
Although systems are available with hollow bolts replacing the normal transmitter body bolts and containing electrical heating elements and thermostats, certain precautions are required with such arrangements. Some transmitter meter body bolts are too small to accept the available thermostats. Also thermostat settings should not approach the body temperature limit because the heat gradient across the meter body can be such that limits are exceeded adjacent to the heating elements even when the thermostat setting is lower.

Electrical heating systems are available in explosionproof ratings for Class I, Group D, Division I and II installations.

The possibility of electric supply failure must be considered. For this reason, we recommend using alarm devices with manual acknowledgment and reset.

See Figures C-6 and C-7 for typical piping installations.

Figure C-6 Piping Installation for Differential Pressure Transmitter and Impulse Piping with Electric Heating and Control.

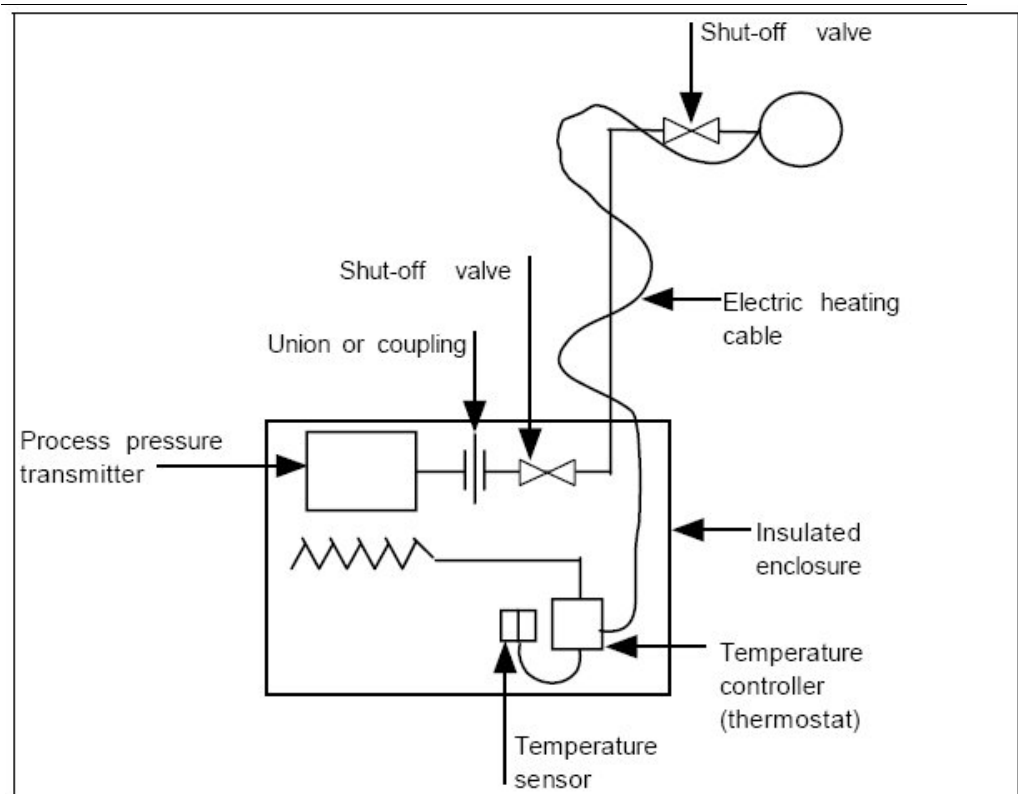


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C.1 Possible Solutions/Methods, Continued

Electric heating, continued

Figure C-7 Piping Installation for Process Pressure Transmitter and Impulse Piping with Electric Heating Control.



Steam heating

Steam heating is perhaps the most common, yet potentially the most damaging method of protecting transmitters from freeze-ups. Since steam is generated for use in the overall process operation, it is considered an available by-product. The most important point to remember when steam heating transmitter meter bodies is the temperature of the steam that will be used and its pressure. We recommend that you review the next paragraph Superheated steam considerations to get a better understanding of the temperature problem with steam heating. In brief, do not assume that 30 psig steam is 274°F (134°C) and cannot damage a transmitter rated for 250°F (121°C). With steam heating, as with electrical, you should use insulated transmitter body housing, impulse piping and valves.

Continued on next page

C.1 Possible Solutions/Methods, Continued

Steam heating, continued

It is common practice to use conventional steam traps on all steam heating systems. They permit live, superheated steam to enter the heating coils and piping down to the trap. You should also use conventional steam traps with lower pressure desuperheated steam which cannot overheat the transmitter under warm-day conditions. If the heating pipes are not carefully installed to eliminate low spots and trapped condensate in the piping, they could freeze at low temperatures.

All steam traps require a periodic maintenance program. Dirt, scale, and water softeners will cause traps to stick or jam which result in their either blowing steam continuously or not blowing steam, allowing condensate freeze-up in cold weather. When steam traps are used for cold-weather freeze protection of water lines, a thermostat controlled steam supply valve, which will shut off the steam at ambient temperatures higher than 50°F (10°C), will save steam and prevent overheating.

A more general solution is offered by a specialized type of trap that throttles condensate flow based on its temperature. This backs up hot water in the radiator within the insulated transmitter enclosure, assuring temperatures no higher than the saturated steam at the reduced pressure. Models are available to set the condensate temperature from about 70° to 200°F (21° to 93°C). They must be located within 6 to 12 inches (15 to 30 cm) of the transmitter body and, like all steam traps, they also require periodic maintenance. The engineering of this type system is more complex than electric systems since the amount of heat loss upstream of the CTV valve under varying conditions will determine the location of the steam/water interface. It could occur within the heater coil or further up the steam line, thus affecting the heating efficiency within the insulated enclosure. Therefore, steam control of materials which freeze or become too viscous above 100°F (38°C) should probably not be attempted without some experimenting with the specific piping layout used.

Uncontrolled steam heating, even with the best pressure regulation and desuperheating of steam, should not be used to maintain transmitter temperatures above 100°F (38°C), since this type of fixed Btu input must either over or under-heat under normal ambient swings.

As with electric heating, there are many types of commercial steam heating units available such as radiant heaters, hollow meter body studs or just tubing lagged to the impulse piping and transmitter body. The same precaution applies to the use of hollow studs as on the electrical versions.

Continued on next page

C.1 Possible Solutions/Methods, Continued

Steam heating, continued

See Figure C-8 and C-9 for typical piping installations. Table C-1 summarizes the temperature ranges for the various freeze protection systems.

Table C-1 Temperature Range of Freeze Protection Systems

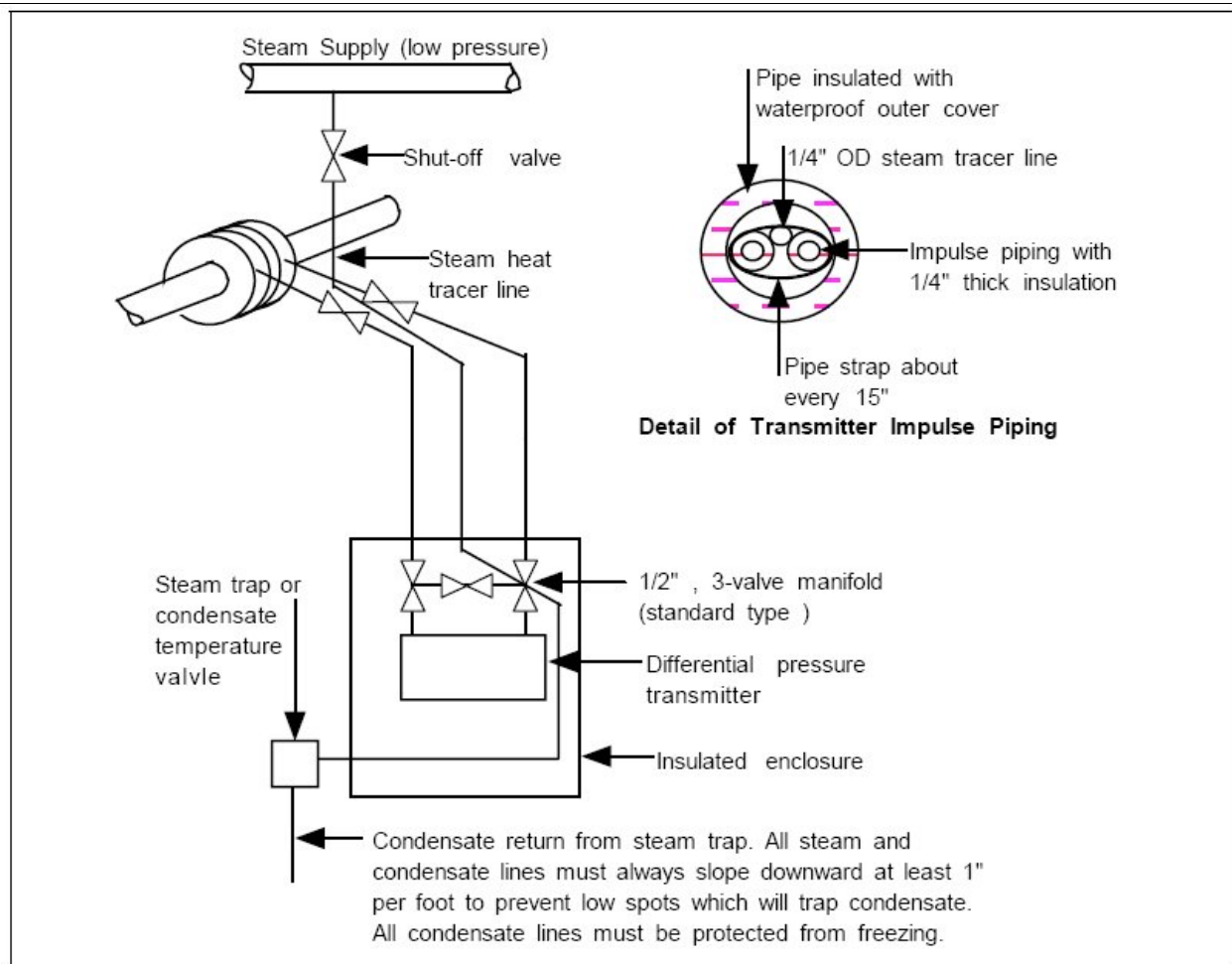
Operating Temperature Range		Liquid Seals		Diaphragm Seals	Steam Heating		Electric Heat	
		Ethylene Glycol	Dibutyl-Phthalate		No Seals		No Control	Thermo-stated
					Trap	CTV Valve		
° F	°C							
-34	-36	↕		↕	↕	↕	↕	↕
-20	-30				↕	↕	↕	↕
50	10				↓	↓	↓	↓
100	38				↓	↓	↓	↓
200	93	↓		↕		↓		↓
225	106		↓			↓		↓
325	163			↕				↓
600	315			↕				

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C.1 Possible Solutions/Methods, Continued

Steam heating, continued

Figure C-8 Piping Installation for Differential Pressure Transmitter and Impulse Piping with Steam Heating.

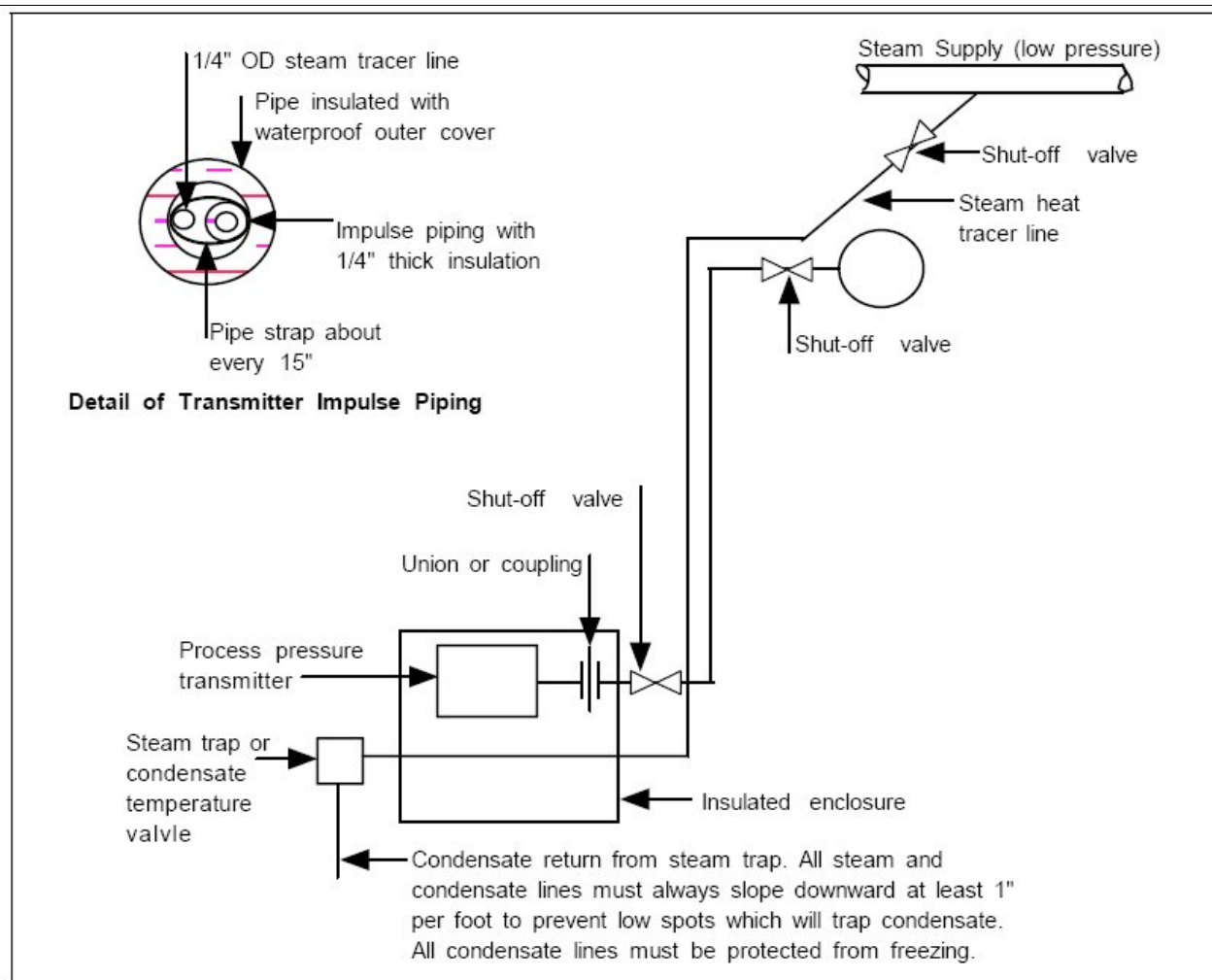


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C.1 Possible Solutions/Methods, Continued

Steam heating, continued

Figure C-9 Piping Installation for Process Pressure Transmitter and Impulse Piping with Steam Heating.



Superheated steam considerations

We must remember that the temperature of steam is 212°F (100°C) only at the normal atmospheric pressure of about 14.7 pounds per square inch absolute (psia). If the pressure of steam is increased above 14.7 psia, the temperature of the steam is also increased. For example, if we have steam at 30 pounds per square inch gage (psig), the steam temperature is 274°F (134°C).

Continued on next page

C.1 Possible Solutions/Methods, Continued

Superheated steam considerations, continued

On industrial flow and pressure measurement applications, we may be required to use steam to heat the impulse piping to the flow or pressure transmitter, as well as the transmitter itself. For these applications, we must verify the temperature of the heating steam used. As an example, assume that steam at 100 psig saturated (338°F/170°C) is to be reduced to 30 psig pressure for the heating system. Too frequently, it is assumed that this pressure reduction will result in steam at 274°F (134°C), the temperature of saturated steam at 30 psig. Wrong! A reduction of the steam pressure will not appreciably decrease the initial steam temperature.

In our example, we were talking about saturated steam in the main header from the boiler. But modern industrial boilers cannot afford to let waste heat go up the stack. After reaching the boiling point in the drum, the steam flows through a series of pipes in the second pass of the flue gas exit, extracting additional heat energy and being raised to a temperature higher than the saturation temperature at the same pressure. This is superheat and, depending on boiler design, it may amount to 50 to 300°F (10 to 149°C) above the saturated steam temperature. It also permits packing more heat energy in a given size pipe for transmission from the process. Thus, in the typical application, the problem of steam heating is compounded by the additional superheat in the main header.

Specifically, when steam is reduced in pressure, it retains about the same latent heat or the same Btu's/pound at the reduced pressure. Therefore, in our example, steam at 100 psig and 338°F (170°C) when reduced to 30 psig steam will have a temperature of 306°F (152°C) or a loss of only 32°F (18°C).

This steam temperature can only be reduced by using a desuperheater. This device mixes cold water with the superheated steam to reduce its temperature by removing Btu's per pound of water (steam). It is also possible to use temperature controlled steam traps, which actually allow the steam to condense to water and therefore reduce its temperature to a pre-set value.

Continued on next page

C.1 Possible Solutions/Methods, Continued

Superheated steam considerations, continued

Table C-2 lists the various values of steam pressure, saturated steam temperatures at these pressures, degrees of superheat added to the saturated steam and finally the actual temperature of each when it is reduced to 30 psig steam.

Table C-2 Steam Pressure Versus Steam Temperature Values

Pressure (1)	Saturated Temperature (2)		Superheat Added (3)		Final Steam Temperature (2) + (3)		Actual Temperature of Steam When Reduced From (1)* to 30 psig	
psig	°F	°C	°F	°C	°F	°C	°F	°C
50	298	147	None	None	298	147	290	143
100	338	170	100	55	438	225	420	215
150	366	185	120	66	486	251	460	234
200	387	198	150	83	537	281	500	260
400	448	231	200	111	648	342	600	316
600	489	254	250	139	739	393	660	349

*(1) equals pressure in column one with superheat added.

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